Pindari Dam Bubble Plume Destratification System

Review of Environmental Factors

Prepared by ASSETREADY for
WaterNSW

March 2025



ASSETREADY
A WSP & SMEC Joint Venture

Document control

Project name	Pindari Dam Bubble Plume Destratification System
Document title	Review of Environmental Factors
Prepared for	WaterNSW
Service Order number	PS122845-ENV-PAA-REF-Pindari_Rev2

Revision history

Rev	Date	Details
0	29 October 2024	Draft Review of Environmental Factors
1	4 December 2024	Draft Review of Environmental Factors
2	28 January 2025	Final Review of Environmental Factors
3	6 February 2025	Final Review of Environmental Factors
4	4 March 2025	Final Review of Environmental Factors

	Name	Date	Signature
Prepared by:	[redacted]	17 January 2025	[redacted]
Reviewed by:	[redacted]	22 January 2025	
Approved by:	[redacted]	4 March 2025	

Asset Ready Contact	Nick Taylor
Address	Level 27, 680 George Street, Sydney NSW
Telephone	+61 2 9272 5034
Email	nick.taylor@wsp.com

Declaration

This Review of Environmental Factors (REF) assesses the potential environmental impacts of the proposed Pindari Dam Bubble Plume Destratification System and was prepared under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). WaterNSW is the proponent and determining authority.

The State Environmental Planning Policy (Transport and Infrastructure) 2021 (TISEPP) allows the proposal to be carried out without development consent. The proposal has been assessed against the matters listed in Clause 171 of the Environmental Planning and Assessment Regulation 2021.

By adopting the safeguards and measures identified in this REF, the proposal is not expected to have a significant environmental impact and an Environmental Impact Statement (EIS) is not required for the proposal. Approval is not required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Name: Mark Maund

Position: Technical Executive, Planning and Approvals

Signed: [redacted]

Date: 6 February 2025

Table of contents

Declaration iii

Abbreviations vii

Executive summary x

1 Introduction 1

1.1 Proposal overview 1

1.2 Background 2

1.3 The Proponent 2

1.4 Location 3

1.5 Purpose and structure of the report 9

2 Need and options considered 10

2.1 Need for the proposal 10

2.2 Proposal objectives 11

2.3 Options and alternatives considered 11

2.3.1 Do nothing 11
2.3.2 Multi-level offtakes: selective withdrawal 11
2.3.3 Artificial destratification: surface mixer 12
2.3.4 Installation of bubble plume destratification system using an air compressor – preferred option 12

3 Description of the proposal 13

3.1 Scope of works 13

3.2 Construction 14

3.2.1 Method 14
3.2.2 Site compound 17
3.2.3 Plant and equipment 18
3.2.4 Traffic and access 18
3.2.5 Public utilities 18
3.2.6 Construction hours and duration 19
3.2.7 Property acquisition and access 19

3.3 Operation 19

4 Statutory and planning framework 20

4.1 Environmental Planning and Assessment Act 1979 20

4.2 Water NSW Act 2014 21

4.2.1 Commonwealth legislation 21

4.3 State environmental planning policies 22

4.3.1 State Environmental Planning Policy (Transport and Infrastructure) 2021 22

CONTENTS (Continued)

4.3.2 Other relevant NSW legislation 23
4.3.3 Local environmental plans 27

4.4 Confirmation of statutory position 27

5 Stakeholder and community consultation 28

5.1 Agency consultation 28

5.1.1 TISEPP consultation 28
5.1.2 Outcome of consultation 29

5.2 Community consultation 35

5.3 Aboriginal community involvement 36

6 Environmental assessment 37

6.1 Terrestrial biodiversity 37

6.1.1 Method 37
6.1.2 Existing environment 40
6.1.3 Potential impacts – construction 45
6.1.4 Potential impacts – indirect and operational 46
6.1.5 Assessment of impact significance 47
6.1.6 Safeguards and mitigation measures 48

6.2 Aquatic biodiversity 50

6.2.1 Method 50
6.2.2 Existing environment 53
6.2.3 Potential impacts – construction 60
6.2.4 Potential impacts – operation 62
6.2.5 Safeguards and mitigation measures 64

6.3 Aboriginal heritage 69

6.3.1 Method 69
6.3.2 Existing environment 69
6.3.3 Potential impacts – construction 74
6.3.4 Potential impacts – operation 74
6.3.5 Safeguards and mitigation measures 74

6.4 Surface water, groundwater and flooding 76

6.4.1 Method 76
6.4.2 Existing environment 76
6.4.3 Potential impacts – construction 76
6.4.4 Potential impacts – operation 77
6.4.5 Safeguards and mitigation measures 78

6.5 Geology, soils and contamination 79

6.5.1 Method 79
6.5.2 Existing environment 79
6.5.3 Potential impacts – construction 79
6.5.4 Potential Impacts – operation 80
6.5.5 Safeguards and mitigation measures 80

CONTENTS (Continued)

6.6 Non-Aboriginal heritage 81
6.6.1 Method 81
6.6.2 Existing environment 81
6.6.3 Potential impacts – construction and operation 82
6.6.4 Safeguards and mitigation measures 82
6.7 Noise and vibration 83
6.7.1 Method 83
6.7.2 Existing environment 84
6.7.3 Potential impacts – construction 86
6.7.4 Potential impacts – operation 87
6.7.5 Safeguards and mitigation measures 88
6.8 Traffic, transport and access 90
6.8.1 Method 90
6.8.2 Existing environment 90
6.8.3 Potential impacts – construction 90
6.8.4 Potential impacts – operation 91
6.8.5 Safeguards and mitigation measures 91
6.9 Air quality 92
6.9.1 Method 92
6.9.2 Existing environment 92
6.9.3 Potential impacts – construction 93
6.9.4 Potential impacts – operation 93
6.9.5 Safeguards and mitigation measures 94
6.10 Visual amenity 95
6.10.1 Method 95
6.10.2 Existing environment 95
6.10.3 Potential impacts – construction 95
6.10.4 Potential impacts – operation 95
6.10.5 Safeguards and mitigation measures 96
6.11 Property and land use 97
6.11.1 Method 97
6.11.2 Existing environment 97
6.11.3 Potential impacts – construction 99
6.11.4 Potential Impacts – operation 99
6.11.5 Safeguards and mitigation measures 99
6.12 Waste management 100
6.12.1 Method 100
6.12.2 Existing environment 100
6.12.3 Potential impact – construction 100
6.12.4 Potential impacts – operation 101
6.12.5 Safeguards and mitigation measures 102
6.13 Socio-economic 103
6.13.1 Method 103
6.13.2 Existing environment 103
6.13.3 Potential impacts – construction 103
6.13.4 Potential impacts – operation 103

CONTENTS (Continued)

6.13.5 Safeguards and mitigation measures 103

6.14 Cumulative impacts 104

6.14.1 Methodology 104
6.14.2 Existing environment 104
6.14.3 Potential impacts – construction 104
6.14.4 Potential impacts – operation 104
6.14.5 Safeguards and mitigation measures 104

6.15 Principles of ecologically sustainable development 105

7 Environmental management 106

7.1 Construction environmental management plan (CEMP) 106

7.2 Licencing and approvals 106

7.3 Summary of safeguards and mitigation measures 106

8 Conclusion and justification 123

9 References 124

List of tables

Table 1.1 Proposal site Lot and DP 3
Table 3.1 Proposed construction activities 14
Table 4.1 Other SEPPs relevant to the proposal 22
Table 4.2 Other relevant legislation to the proposal 23
Table 5.1 TISEPP consultation requirements 28
Table 5.2 Assessment requirements from NSW Office of Environment and Heritage 29
Table 5.3 Assessment requirements from NSW Department of Primary Industries and Regional Development Fisheries 34
Table 6.1 Landscape context 40
Table 6.2 Dominant plant species within areas mapped as PCT 4151 41
Table 6.3 Dominant flora species likely to occur within areas mapped as PCT 3518 41
Table 6.4 Potential impacts to native vegetation 45
Table 6.5 Biodiversity safeguards and mitigation measures 48
Table 6.6 Potential impacts to aquatic ecology from construction of the proposal 60
Table 6.7 Potential impacts on aquatic ecology during operation of the proposal 62
Table 6.8 Aquatic ecology safeguards and mitigation measures 64
Table 6.9 Summary of previously recorded AHIMS sites 70
Table 6.10 Aboriginal heritage safeguards and mitigation measures 74
Table 6.11 Surface water, groundwater and flooding safeguards and mitigation measures 78
Table 6.12 Geology, soil and contamination safeguards and mitigation measures 80
Table 6.13 Non-Aboriginal heritage mitigation measures 82
Table 6.14 Noise and vibration sensitive receivers 84
Table 6.15 Predicted noise impacts for residential sensitive receivers 86
Table 6.16 Predicted noise impacts for non-residential receivers during the day (standard working hours) 86
Table 6.17 Predicted noise impacts for non-residential receivers during the evening 87
Table 6.18 Noise and vibration safeguards and mitigation measures 88
Table 6.19 Traffic, transport and access safeguards and mitigation measures 91
Table 6.20 Air quality sensitive receivers 93
Table 6.21 Air quality noise and vibration mitigation measures 94
Table 6.22 Visual amenity mitigation measures 96
Table 6.23 Property and land use mitigation measures 99
Table 6.24 Indicative waste generation and management 101
Table 6.25 Waste safeguards and mitigation measures 102
Table 6.26 Principles of ESD applied to the proposal 105
Table 7.1 Safeguards and mitigation measures proposed 106

List of figures

Figure 1.1 Locality plan 4
Figure 1.2 Pindari Dam existing infrastructure 5
Figure 1.3 Impact area 6
Figure 1.4 Cross section of the bubble plume system infrastructure within Lake Pindari 7
Figure 1.5 Holding down systems 8
Figure 6.1 Survey locations and results 39
Figure 6.2 Aquatic ecology study area 52
Figure 6.3 Key fish habitat type and class at the proposal site 59
Figure 6.4 Locations of AHIMS sites nearby the proposal site 71
Figure 6.5 Noise and vibration sensitive receivers 85
Figure 6.6 Land zoning at the proposal site 98

List of appendices

Appendix A Environmental Assessment Clause 171 Environmental Factors Checklist
Appendix B Biodiversity Assessment Report
Appendix C NSW DPIRD Fisheries Consultation
Appendix D Aquatic Ecology Assessment
Appendix E Aboriginal Objects Due Diligence Assessment
Appendix F Statement of Heritage Impact
Appendix G WaterNSW Unexpected Aboriginal Objects Procedure
Appendix H Transport for NSW Construction and Maintenance Noise Estimator Tool
Appendix I Operational Noise Impact Assessment
Appendix J Issue for Tender design drawings
Appendix K NSW Office of Environment and Heritage (DCCEEW) Consultation
Appendix L Communications and Stakeholder Engagement Plan

Abbreviations

Term	Definition
ABS	Australian Bureau of Statistics
AEA	Aquatic Ecology Assessment
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AQMS	Air Quality Monitoring Station
ASS	Acid Sulfate Soils
BAR	Biodiversity Assessment Report
BC Act	*Biodiversity Conservation Act 2016*
BOM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EMP	Ecological Monitoring Program
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPI's	Environmental Planning Instruments
EPT	Ephemeroptera, Plecopteran and Trichopteran
ESD	Ecologically Sustainable Development
FAD	Free air delivery
FM Act	*Fisheries Management Act 1994*
GPS	Global Positioning System
HDPE	High-density polyethylene
Heritage Act	*Heritage Act 1977*
HV	High voltage
IAQM	Institute of Air Quality Management
ICNG	Interim Construction Noise Guideline
ICOMOS	The International Council on Monuments and Sites

Term	Definition
Inverell Shire LEP	Inverell Shire Local Environmental Plan 2012
KFH	Key Fish Habitat
LEP	Local Environmental Plan
LGA	Local Government Area
LV	Low voltage
MER	Monitoring, Evaluation and Reporting
MNES	Matters of National Environmental Significance
NML	Noise Management Levels
NPI	National Pollutant Inventory
NPW Act	*National Parks and Wildlife Act 1974*
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NSW DCCEEW	NSW Government Department of Climate Change, Energy, the Environment and Water
NSW DECCW	Former NSW Government Department of Environment, Climate Change and Water
NSW DPE	Former NSW Government Department of Planning and Environment
NSW DPHI	NSW Government Department of Planning, Housing and Infrastructure
NSW DPIE	Former NSW Government Department of Planning, Industry and Environment
NSW DPIRD	NSW Government Department of Primary Industries and Regional Development
NSW EPA	NSW Environment Protection Authority
NSW OEH	NSW Office of Environment and Heritage
PLC	Power Line Communication
PMST	Protected Matters Search Tool
POEO Act	*Protection of the Environment Operations Act 1997*
PVC-U	Poly Vinyl Chloride – Unplasticised
QA	Quality Assurance
REF	Review of Environmental Factors
ROV	Remotely Operated Vehicle
SCADA	Supervisory Control and Data Acquisition
SCUBA	Self Contained Underwater Breathing Apparatus
SoHI	Statement of Heritage Impact

Term	Definition
SSD	State Significant Development
TEC	Threatened Ecological Community
TISEPP	State Environmental Planning Policy (Transport and Infrastructure) 2021
Transport	Transport for NSW
UNSW	University of New South Wales
VPS	Vertical profile system
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
WM Act	*Water Management Act 2000*
WMP	Waste Management Plan
WRL	Water Research Laboratory

Executive summary

The proposal

WaterNSW, together with the New South Wales (NSW) Government Department of Primary Industries and Regional Development (NSW DPIRD), is proposing to establish a bubble plume destratification system at Pindari Dam as a trial mitigation measure to disrupt thermal stratification within Lake Pindari and reduce potential for cold water pollution to affect downstream fish stocks (the proposal).

Pindari Dam is situated in Pindaroi on the Severn River, about 22 kilometres upstream of Ashford and 58 kilometres north-east of Inverell near the NSW-Queensland border and falls within the Inverell Shire Local Government Area (LGA) (see Figure 1.1 and Figure 1.2). Specifically, the construction and operation of the proposal is located in Lake Pindari, an impounded reservoir behind Pindari Dam.

The proposal would involve the construction and operation of a bubble plume destratification system to reduce potential downstream cold water pollution from thermal stratification within the reservoir. Once operational, the proposal would pump compressed air through a pipe network to diffusers, located in the deepest parts of the dam (noting that depths of the diffusers can be varied). Marker buoys and vertical profile system (VPS) monitoring would be located on the surface of Lake Pindari to indicate the alignment of the bubble plume destratification system and monitor water quality parameters such as temperature profiles and turbidity within the reservoir (see Figure 1.3). A boom would also be installed on the surface of Lake Pindari adjacent to the spillway as a safety measure to demarcate the bubble plume destratification system (see Figure 1.3). The proposal is expected to operate during the summer season (September to April), typically commencing in spring if stratification is detected. If successful, bubble plumes will be used as a framework for remediating stratified reservoirs across the State.

The proposal would include the following key features, also shown in Figure 1.3:

- site establishment for location of two oil-free compressors located at the base of the dam embankment
- electrical and mechanical construction works to power the compressors
- assembly and installation of aeration pipework including:
  - installation of an 855 metres buoyancy pipe along reservoir batter and within the water
  - drilling holes (air ports) on the air diffuser pipe
  - installation of a 500 metre air diffuser pipe
- installation of a 500 metre boom adjacent to the spillway
- commissioning of compressors and air diffuser pipe
- demobilisation and site restoration.

Access to the proposal site (see Section 1.1 for further definitions), will be via public roads in accordance with any restrictions, such as vehicle weights, speed, widths and heights. The proposal site will be fenced at the limit of the impact area to restrict public access during construction. Existing access roads will be utilised throughout the works with extension of access tracks between the construction compound site and staging point (the spillway and boat ramp) (see Figure 1.3). A permanent aquatic exclusion area will also be established around the area of the aeration pipework to avoid impacts during construction and operation where no public vessels will be permitted access.

Key objectives of the proposal are to:

- establish a trial cold water destratification system in Lake Pindari using bubble plume principles, to reduce the potential for cold water pollution to impact downstream fish stocks. Demonstrating the effectiveness of a bubble plume destratification system at a large, deep dam such as Pindari will strengthen the case to develop and deploy this technology at other high priority cold water pollution dams in the Murray-Darling Basin
- increase water temperature by 10 degrees Celsius and improve water quality outcomes in downstream receiving waterways, for native fish stocks and primary production (NSW DPIRD, 2024). Research has shown bubble plume destratification has been effective in achieving these outcomes in smaller dams (Chaaya and Miller, 2022)
- reduce evaporation: destratification reduces water surface temperatures that in turn reduces surface evaporation rates (Chaaya and Miller, 2023)
- improve water quality parameters via reservoir destratification (e.g., increase benthic dissolved oxygen levels, reduce soluble metal and nutrient release from anoxic sediments, and decrease frequency and severity of cyanobacteria blooms; Chaaya and Miller, 2022).

Need for the proposal

Cold water pollution is caused when the bottom cold layer of water from large dams is released downstream resulting in an artificial reduction in river water temperatures. This release of cold water during the warmer months causes pervasive ecological, social, and cultural impacts to over 2,000 kilometres of mainstream rivers in NSW. As such, cold water pollution is listed as a Key Threatening Process under the *NSW Fisheries Management Act 1994* (FM Act).

In response to the problems caused by cold water pollution, NSW DPIRD developed the NSW Cold Water Pollution Strategy (NSW DPI, 2012) that provides for an incremental program of investigation; on ground works; improved operating practices; and associated monitoring, evaluation, and reporting (MER). A key deliverable of Phase 1 of the NSW Cold Water Pollution Strategy is to verify the effectiveness of bubble plume destratification to mitigate cold water pollution at a large dam (Pindari).

Pindari Dam was selected as the preferred demonstration site due to the following reasons:

- Pindari reservoir has the smallest capacity of the eight high priority dams in NSW, thereby increasing the chances of project success while keeping costs to a minimum due to smaller compressor sizing and reduced power consumption
- Pindari reservoir is strongly stratified in summer, being the most northerly of the NSW high priority dams, thereby ensuring cold water pollution impacts
- a multi-level offtake tower is already present which affords increased trial flexibility to optimise bubble plume operation
- multiple bubble plume modelling assessments and reviews have been completed at Pindari that will facilitate quick assessment between theoretical and actual outcomes (Prentice et al., 2021; Chaaya and Miller, 2022).

Demonstrating the effectiveness of a bubble plume destratification system at a large, deep dam such as Pindari will strengthen the case to develop and deploy this cost-effective technology at the remaining high priority cold water pollution dams in the Murray-Darling Basin.

Strategic and statutory planning framework

WaterNSW is both the proponent and determining authority under Part 5 Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Section 5.5 of the EP&A Act imposes a duty on determining authorities to consider 'to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'. Should WaterNSW find that the proposal will likely have a significant impact on the environment, Section 5.7 of the EP&A Act requires an Environmental Impact Statement (EIS) be prepared. The proposal is permitted without consent under Clause 2.159(2A) of the State Environmental Planning Policy (Transport and Infrastructure) 2021 (TISEPP) as development for the purpose of maintenance of an existing water storage facility.

Community and stakeholder consultation

WaterNSW has consulted with the Office of Environment and Heritage, Transport for NSW, NSW DPIRD Fisheries, Crown Lands and NSW Rural Fire Service (RFS) under the requirements of the TISEPP. Section 5.1.2.1 provides further details on consultation, matters raised and where these are addressed in this REF.

A Communication and Stakeholder Engagement Plan (CESP) (Appendix L) was prepared for the proposal to provide proactive communication and engagement activities that empower stakeholders through clear and consistent, values-based communications that will be key to building social capital with the target audience.

The CESP identifies key consultation and proposal delivery stakeholders as well as key proposal implementation partners. The CESP outlines proposed consultation activities to be completed prior, during and after construction of the proposal. Additionally, the CESP details proposed engagement activities for First Nations communities. Further detail regarding objectives of the CESP and the approach and tools proposed to be used for community consultation are provided in Section 3 of the CESP (Appendix L).

Environmental impacts

A number of technical specialist assessments were undertaken to assess potential impacts of the proposal on the environment and identify measures to avoid, minimise and mitigate the potential impacts. An overview of the key environmental impacts of the proposal is provided below.

Significant environmental impacts are not expected as a result of the proposal, however, some impacts may occur during the construction and operation of the proposal. These impacts will be avoided where practicable through the implementation of safeguards and mitigation measures during construction and operation of the proposal as detailed in in Section 7 of this REF.

Terrestrial biodiversity

A Biodiversity Assessment Report (BAR) was prepared by WSP (refer to Appendix B and Section 6.1) to identify the impacts on the terrestrial ecology from the construction and operation of the proposal. The BAR assessed a broader ecological study area investigated during May 2024 field surveys, to inform the report's environmental and impact assessments, and identified the following key impacts:

- potential impacts to habitat, predominantly foraging habitat, for seven threatened flora and twelve fauna species that have the potential to occur within the broader ecological study area

- direct removal of approximately 0.63 hectares of native vegetation during construction, which will likely impact limited areas of potential foraging habitat for the assessed species within the broader ecological study area
- potential spread of weed species as the area contains significant weed growth
- potential for dispersal or importation of pathogens from earthworks, movement of soil, and attachment of plant matter to vehicles and machinery.

Given the implementation of recommended safeguards and mitigation measures, significant adverse impacts to terrestrial biodiversity are considered unlikely as a result of the proposal.

Aquatic biodiversity

The Aquatic Ecology Assessment (AEA) prepared by H2O Consulting Group (refer to Appendix D and Section 6.2) identified the following potential impacts on aquatic ecology in Lake Pindari and the Severn River from construction and operation of the proposal:

- modification to Key Fish Habitat (KFH) and disturbance to the dam floor and shoreline aquatic habitats during construction
- short-term disturbances of fauna at lower trophic levels, such as invertebrates of the Darling River Endangered Ecological Community (EEC), as they adapt to modifications to existing environmental conditions
- operation of the bubble plume destratification system has potential to cause nutrient enrichment, contributing to surrounding environmental conditions that could lead to algal blooms, particularly in warmer months
- localised indirect disturbances such as short-term reductions in water quality from mobilisation of sediments and use of the laydown area during construction resulting in increased sedimentation and turbidity
- increased success of recruitment and survival of threatened fish species both within the dam and the Seven River downstream, through increased likelihood of normal temperature cues, increased number of suitable spawning days, increased growth and metabolic rates and increased fitness
- improved water quality parameters (temperature and dissolved oxygen) of Lake Pindari waters in vicinity of the plume from mixing of anoxic and cold bottom waters with oxygenated, warmer surface waters.

The proposal is unlikely to have a significant negative impact on threatened aquatic species or populations in Pindari Dam and the Severn River downstream of the dam, with a net positive impact expected. Appropriate safeguards and mitigation measures will be implemented to mitigate potential impacts to aquatic ecology and water quality as well as ecological monitoring during operation of the proposal.

Aboriginal heritage

The Aboriginal Objects Due Diligence Assessment (Due Diligence Assessment) (refer to Appendix E) found there is low potential for Aboriginal objects to remain in the area and no Aboriginal objects will be impacted by the proposal. The Due Diligence Assessment made recommendations to ensure construction workers are aware of the history of Aboriginal sites nearby to Pindari Dam. Additionally, recommendations require appropriate procedures to be in place in case of unexpected finds of Aboriginal objects or Aboriginal Ancestral remains.

Surface water, groundwater and flooding

Potential water quality impacts are primarily associated with construction activities on the water including mobilisation of a barge, placement of mooring blocks, connection of the aeration pipework to the mooring blocks and use of remotely operated vehicles to assess operation of the bubble plume destratification system. Risks to water quality are

also associated with the use of plant and equipment along the banks and around the dam from and potential for accidental spills from refuelling.

Safeguards and mitigation measures will be implemented to reduce potential water quality impacts, including appropriate erosion and sediment control of exposed surfaces, ongoing weather monitoring and proper storage and handling of chemicals and fuels on-site.

Impacts to flooding and groundwater are not anticipated during operation of the proposal.

Geology, soils and contamination

Potential soil and contamination impacts will primarily be associated with accidental spills and leaks and management of materials, spoil and waste. The construction activities with highest potential for contamination include:

- movement of construction vehicles
- storage and handling of dangerous goods on-site (e.g. chemicals and fuel)
- refuelling of plant and equipment
- stockpiling of materials
- unloading and loading of materials and waste.

The proposed works are not expected to disturb potential acid sulfate soil, saline soils or any areas of known contamination. Safeguards and mitigation measures will be implemented to reduce potential impacts of refuelling of plant and equipment and storage and handling of construction materials, waste and dangerous goods. Operation of the proposal is not expected to adversely impact on geology, soils or contamination.

An Unexpected Finds Procedure will be prepared as a part of the Construction Environmental Management Plan (CEMP) prior to construction, to address any unforeseen interaction with contamination.

Non-Aboriginal heritage

Pindari Dam is listed on the WaterNSW Section 170 Heritage and Conservation Register (item number 4550170). According to the listing, Pindari Dam was established on land used as an early pastoral run, one of which was named Pindari, meaning ‘high rock’. Records indicate that the area was used as pastoral and grazing lands until the dam was built in the mid to late 1960s.

The Statement of Heritage Impact (SoHI) (refer to Appendix F) identified the following potential impacts of the proposal:

- may partially impact associated roads and has potential to result in localised impacts to landscape features directly associated with the dam wall from removal and trimming of extant vegetation
- will not impact any existing structures, including the dam and power generating facilities
- aside from the dam itself, the remaining structures do not appear to have historical, social, aesthetic, or scientific values, although they do support the function and maintenance of the dam
- there is low potential for archaeological features or deposits relating to any former structures.

Overall, the proposal will not alter the dam itself or harm the heritage value of the identified heritage item.

Noise and vibration

Assessment of potential noise impacts during construction identified that residential receivers within 700 metres over land and 1,310 metres over water will be affected by construction noise of the proposal. Non-residential (passive recreation) receivers within 155 metres over land and 230 metres over water will experience noise impacts during construction. Non-residential (office) receivers within 60 metres over land and 80 metres over water will be noise affected during construction.

Noise generating activities will be scheduled during standard construction hours where practicable. However, if noise generating construction activities occur outside of standard hours and would require out of hours work, residential receivers within 1,010 metres over land and 1,900 metres over water will be affected by construction noise. Non-residential sensitive receiver R07 will be noise affected, with noise levels 5-15 dBA above the noise management level (NML). Non-residential sensitive receiver R09 is located within the impact area and will likely be highly noise affected.

Noise generating activities during construction of the proposal will be intermittent and within standard construction hours as far as practicable. As WaterNSW assets, the potential noise impacts during construction to receivers R02, R03 and R09 are acceptable given their temporary and intermittent nature. Nearby sensitive receivers will be notified prior to the commencement of works in line with mitigation measures recommended in the Transport for NSW Construction and Maintenance Noise Estimator Tool (Transport, 2024).

Specialist assessment of vibration impacts will be considered if use of vibratory plant and equipment is required within 100 metres of sensitive receivers, including the heritage listed dam.

The Operational Noise Impact Assessment (Appendix I), which included modelling under various meteorological conditions, confirms that the proposed compressor location will remain within the permissible noise limits across all time periods (day, evening, and night). Therefore, no additional noise mitigation measures are necessary, with minimal noise impact on the surrounding community and environment.

Vibration impacts during operation of the proposal are expected to be negligible.

Traffic, transport and access

The proposal site will be fenced at the limit of the impact area, and public access to the dam will be restricted during construction. Access to private properties surrounding the proposal site will not be impacted during construction. Existing access roads will be utilised throughout the works. Extension of access tracks at the base of the dam wall and between the construction compound and the staging point are proposed for construction of the proposal (Figure 1.3). The dam wall crest road (Coulton Walk) will also be used for construction access. Access tracks will be closed during inclement weather and for a duration after wet weather until the access road is deemed satisfactory to gain access.

Access to the site will be through the public roads network in accordance with any restrictions, such as vehicle weights, widths and heights. The proposed access route will be via:

- Ashford Road, Bakkulla Road and Pindari Dam Road (via Ashford Village)
- Ashford Road, The Pocket Road (including an unsealed section of this road), and Pindari Dam Road.

There are no load limit signs posted on any of these roads.

The proposal will temporarily increase traffic along the access routes due to construction vehicle movements and traffic comprising small vehicles, trucks and plant associated with workers entering and leaving the site, importation of materials and disposal of spoil. However, traffic is not expected to be impacted to more than a minor extent during construction. Pindari Dam Road will remain open for public use during construction.

Operation of the proposal is not expected to result in permanent changes to traffic flow following the completion of works. The proposal involves a permanent aquatic exclusion area around the bubble plume destratification system within Lake Pindari. Public access will be restricted from the aquatic exclusion area during construction and operation around the area bubble plume destratification system to avoid impacts to the aeration pipework .

Air quality

Land use within and surrounding the proposal site is associated with water storage, recreation and conservation in the Severn River Nature Reserve. Air quality at the proposal site is characterised by vehicle movements and natural events including bushfires, dust storms and strong winds.

Air quality impacts during construction of the proposal are expected to be associated with dust generation and vehicle emissions from the following construction activities:

- excavation, trenching, and earthworks
- fibre-reinforced polymer slab construction
- stockpiling of materials
- movement of construction vehicles
- refuelling of plant and equipment
- loading and transfer of materials and/or spoil
- vehicular access along unsealed road surfaces.

A qualitative risk assessment using *Guidance on the assessment of dust from demolition and construction guidelines* (IAQM 2024) found the commercial office (WaterNSW asset) at the base of the dam wall and three residences on Pindari Dam Road were assessed to have a medium sensitivity to dust soiling and low sensitivity to human health impacts. The Pindari Boat Camp Recreation Area was assessed to have a low sensitivity to dust soiling and human health impacts. The remaining sensitive receivers are not anticipated to experience any air quality impacts from construction of the proposal as they are located greater than 250 metres from the proposal site. Implementation of safeguards and mitigation measures are expected to appropriately mitigate potential impacts of dust and vehicle exhaust emission from construction of the proposal. Operation of the proposal is not expected to result in permanent changes to air quality following the completion of works.

Visual amenity

Visual impacts from the presence of heavy machinery, plant and work within and around Pindari Dam are anticipated to be experienced by residential and recreational sensitive receivers during construction. However, visual amenity impacts are anticipated to be minor as the proposal is located within a heavily modified landscape and use of plant and equipment will be limited to the construction period. Operation of the proposal will result in minor impacts to visual amenity for sensitive receivers visiting Pindari Dam due to the bubble plume destratification system infrastructure, permanent exclusion area and maintenance operations. The aquatic exclusion area will permanently restrict public access to the area around the bubble plume destratification system. Overall, the proposal is considered to be in keeping with the existing character of the site.

Property and land use

Construction of the proposal will be consistent with the existing land use at the site (RU1 – Primary Production), and significant long-term impacts to land use at the proposal site are not expected. During construction and operation, public

use of Lake Pindari within the aquatic exclusion area will be restricted for recreational activities such as fishing and water sports. The Pindari Boat Camp Recreation Area and Pindari Dam Camping Ground will remain accessible during construction. However, during construction these camping locations will experience minor noise and vibration, air quality, and visual amenity impacts (refer to Sections 6.7, 6.9 and 6.10). Overall, operational property and land use impacts are considered minor and consistent with existing maintenance access requirements for Pindari Dam and will be managed by WaterNSW.

Waste management

Construction of the proposal is expected to generate the following waste streams:

- general and domestic waste from workers and on-site facilities
- general construction waste such as packaging and surplus construction materials including remnant pipework
- waste residual chemicals
- green waste from vegetation clearing activities
- 1,500 cubic metres of rock strata during excavation.

Waste generated will either be reused on-site or disposed off-site as general solid waste (depending on its type). Options for reuse on-site will be assessed at the time of excavation depending on the suitability of excavated material. Where waste materials generated by the proposal cannot be reused on-site, disposal will be required.

Operation of the proposal is not expected to result in additional generation of waste, however any waste generated during operation will be disposed of in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014).

Socio-economic

Socio-economic impacts will be primarily associated with disturbances to recreational activities nearby and within the aquatic exclusion area (see Figure 1.3) and impacts related to accommodation of construction personnel. The aquatic exclusion area will limit the area available to the public for water sports and fishing. Pindari Dam Road will remain open for public use during construction, however access to the dam wall crest road (Coulton Walk) will be restricted during construction. Socio-economic impacts during construction will be temporary and minor.

The estimated maximum number of construction personnel required during construction is 20. Local accommodation in Inverell including housing, AirBNB, hotels/motels, and/or campgrounds are likely to accommodate construction personnel. Accommodation of construction personnel is not anticipated to result in any adverse socio-economic impacts.

Minor operational socio-economic impacts associated with the proposal are expected from the permanent aquatic exclusion area around the diffuser pipe. However, there is potential for a positive impact through reduction of thermal stratification that will improve the water quality, ecosystem health and recreation value of Lake Pindari.

Cumulative impacts

In accordance with a search of the Major Projects Application Tracker for State Significant Developments and the Inverell Shire Council development application tracker on 30 September 2024, there are no current projects within five kilometres of the proposal site.

It is understood that WaterNSW is proposing work on the spillway at Pindari Dam; however, no information was available during preparation of this REF. Future environmental assessment of the spillway will consider potential cumulative impact of both projects.

As no existing or future projects within or in proximity to the proposal were identified at the time of preparing this REF, cumulative impacts during construction and operation of the proposal are not expected.

Justification and conclusion

Pindari Dam is a sport and recreation destination in northern NSW situated on the Severn River about 22 kilometres upstream of Ashford and 58 kilometres north-east of Inverell near the NSW-Queensland border. Pindari Dam operates with Queensland's Glenlyon Dam to meet irrigation, stock and household needs in the Border Rivers valley (WaterNSW, 2024).

Of the eight high priority dams in the Murray-Darling Basin, Pindari Dam has been recognised during stage one of the NSW Cold Water Pollution Strategy to be most appropriate to conduct trial mitigation works involving artificial destratification through application of bubble plumes by the UNSW Water research laboratory (WRL) (Chaaya and Miller, 2023; NSW DPI, 2012). Demonstrating the effectiveness of a bubble plume destratification system at a large, deep dam such as Pindari will strengthen the case to develop and deploy this cost-effective technology at the remaining high priority cold water pollution dams in the Murray-Darling Basin.

Installation of the bubble plume destratification system aims to increase the water temperature and improve water quality parameters in Lake Pindari, as well as reduce evaporation rates. Additionally, as a trial the proposal will inform artificial destratification systems that can be utilised in future destratification projects for dams across NSW.

The REF has been assessed under Part 5 Division 5.1 of the EP&A Act and has considered *'to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'*.

By adopting the safeguards and measures identified in the REF, the proposal is unlikely to have a significant environmental impact and an EIS is not required for the proposal. Approval is not required under the *Environment Protection and Biodiversity Conservation Act 1999*.

1 Introduction

1.1 Proposal overview

WaterNSW, together with the NSW Government Department of Primary Industries and Regional Development (NSW DPIRD), is proposing to establish a bubble plume destratification system at Pindari Dam as a trial mitigation measure to disrupt thermal stratification and reduce potential for cold water pollution to affect downstream fish stocks (the proposal). If successful, bubble plumes will be used as a framework for remediating stratified reservoirs across the state.

The proposal involves the construction and operation of a bubble plume destratification system within the impounded reservoir of Lake Pindari to reduce potential downstream cold water pollution from thermal destratification. This system involves pumping compressed air through a pipe network to diffusers generally located in the deepest part of a dam; however, the depth of the diffusers can be varied. Marker buoys and vertical profile system (VPS) monitoring will be located on the surface of Lake Pindari to indicate the alignment of the bubble plume destratification system and monitor water quality parameters such as temperature profiles and turbidity within the reservoir (see Figure 1.3). A boom will also be installed on the surface of Lake Pindari adjacent to the spillway as a safety measure to demarcate the bubble plume destratification system (see Figure 1.3).

The proposal is expected to operate during the summer season (September to April), typically commencing in spring if stratification is detected. Stratification will be identified through temperature profiling of the reservoir water column, which involves measuring temperatures at various depths from the water surface to the bottom. The trigger for action will be the need to mix the warmer upper layers with the colder lower layers.

Key features of the proposal include:

- site establishment for location of two oil-free compressors located at the base of the dam embankment including:
  - concrete foundations
  - shade structure
  - security fencing
  - pavement for the placement of associated equipment
- electrical and mechanical construction works (to power the compressors) including:
  - extension of the HV electrical power supply from the Essential Energy grid (refer to Figure 1.3)
  - installation of 1000 kVA pad mounted transformer and low voltage switchboard
- assembly and installation of aeration pipework including:
  - barge mobilisation from the dam spillway and boat ramp
  - installation of the buoyancy pipe (855 metres) along reservoir batter and within the water
  - drilling holes (air ports) on the air diffuser pipe
  - installation of air diffuser pipe (500 metres)
- installation of a 500 metre boom adjacent to the spillway
- commissioning of compressors and air diffuser pipe
- demobilisation and site restoration.

For the purpose of this report the following definitions apply:

- **proposal –** proposed installation of a bubble plume destratification system at Pindari Dam
- **proposal site –** the location, inclusive of the impact area, where the proposal will occur
- **impact area –** defined area where proposed works will be conducted during construction and operation, including temporary and permanent infrastructure (Figure 1.3)
- **study area –** defined investigation area for desktop searches (generally one kilometre buffer)
- **locality –** 10 kilometre area buffering the study area and extent of some database searches (Figure 1.1)
- **Pindari Dam –** physical dam structure including dam wall (Figure 1.2)
- **Lake Pindari –** the impounded reservoir or water storage behind (upstream) of Pindari Dam and area in which the bubble plume destratification system including the diffuser and buoyancy pipe will be constructed and operated.

This Review of Environmental Factors (REF) has been prepared by AssetReady on behalf of WaterNSW to consider potential environmental impacts of the proposal and propose appropriate safeguards and mitigation measures.

1.2 Background

The Severn River receives flow downstream of Pindari Dam from the high- and low-level outlets, on the south-eastern and north-western ends of the dam wall respectively, and from the full supply level spillway at the north-western end of the dam wall. Additional flow enters the Severn River at the confluence of Scrub Hut Creek, approximately 275 metres downstream of the dam wall. The high-level flows from Pindari Dam and a number of seepage weirs discharge into the most downstream section of Scrub Hut Creek just before its confluence with Severn River.

Pindari Dam, in northern NSW, has been identified as a lake with thermal stratification with high potential for its dam release water to cause cold water pollution. The cold water released downstream from the low-level outlet, can cause cold water pollution or 'thermal' impacts on the natural temperature regimes of the Severn River system which in turn can affect ecosystem health and native fish populations.

While Pindari Dam has a high-level outlet which could be used to selectively withdraw warmer water from near the surface of Lake Pindari, research by Chaaya and Miller (2023) notes dams with a multi-level offtake have demonstrated an ineffectiveness to mitigate cold water pollution due to conflicting algae management protocols.

Pindari Dam is one of eight high priority dams identified during stage one of the NSW Cold Water Pollution Strategy (NSW DPI, 2012). Pindari Dam was deemed most appropriate to conduct trial mitigation works involving artificial destratification through application of bubble plumes by UNSW WRL (Chaaya and Miller, 2023). Successful destratification at Lake Pindari and reduction of downstream cold water pollution will be used as a framework for remediating stratified reservoirs across the state.

1.3 The Proponent

WaterNSW is a public authority as defined in the *Environmental Planning and Assessment Act 1979* (EP&A Act). Under the EP&A Act a public authority includes a statutory State Owned Corporation (SOC) (and its subsidiaries) within the meaning of the *State Owned Corporations Act 1989* (SOC Act). Schedule 5 of the SOC Act lists WaterNSW as a statutory SOC.

WaterNSW is a SOC established under the *Water NSW Act 2014* and operates under an Operating Licence issued and monitored by the Independent Pricing and Regulatory Tribunal (IPART). WaterNSW operates the states rivers and water supply systems in accordance with the rules set out by regulators.

With more than 40 dams across the state, WaterNSW supply two-thirds of water used in NSW to regional towns, irrigators, Sydney Water Corporation and local water utilities. WaterNSW are responsible for the protection of water quality and management of bulk water supply, including management of Pindari Dam.

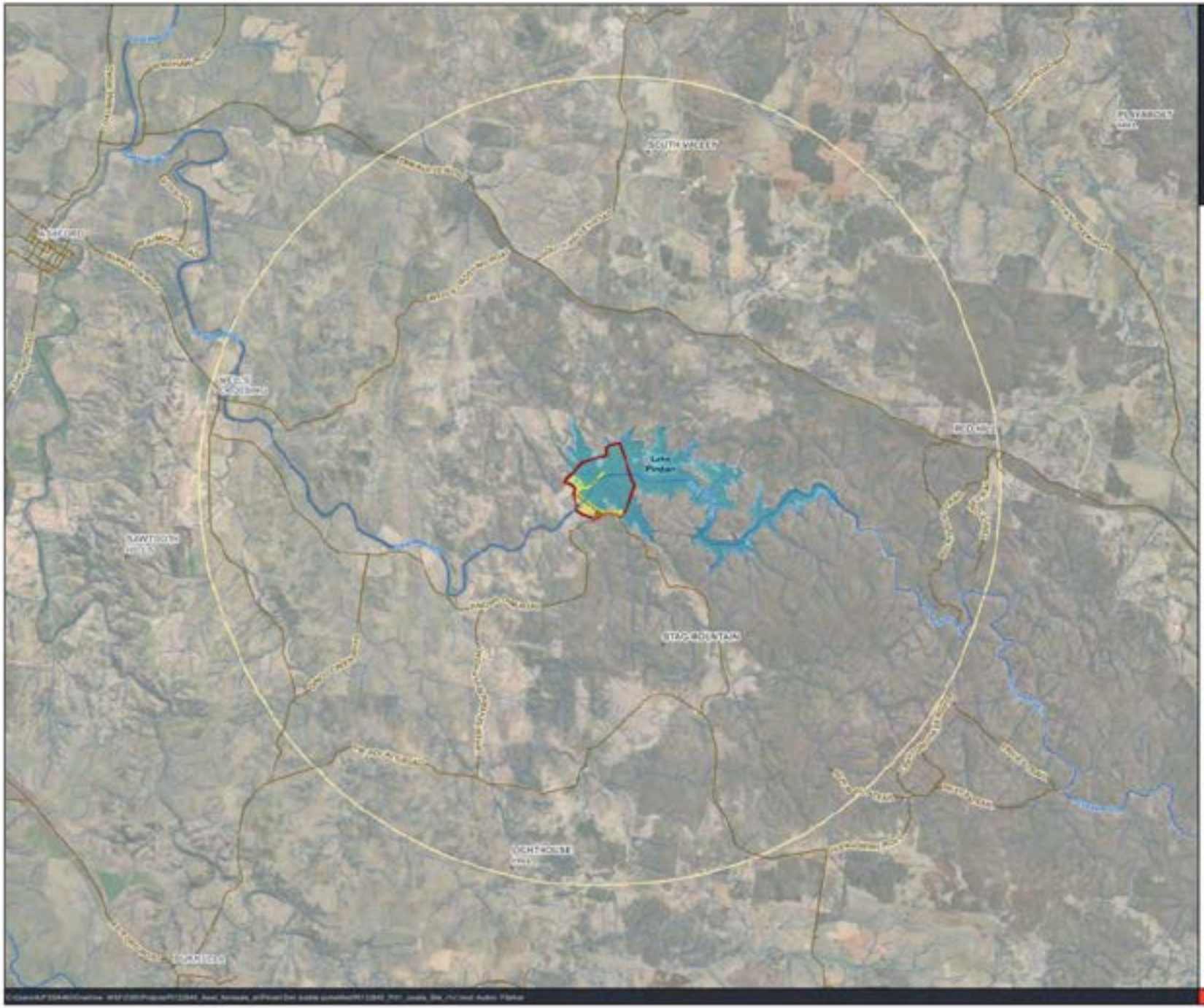
1.4 Location

Pindari Dam is located at 1627 Pindari Dam Road, Pindaroi (Lot 31 DP 914703), within the Inverell Shire Local Government Area (LGA) on the Severn River about 22 kilometres upstream of Ashford and 58 kilometres north-east of Inverell near the NSW-Queensland border (see Figure 1.1). The proposal site is located within land zoned as RU1 – Primary production. Refer to Table 1.1 and Figure 1.1 for the location of the proposal site. Refer to Figure 1.2 for the existing infrastructure at Pindari Dam and Figure 1.3 for features of the proposal.

Pindari Dam operates in conjunction with Queensland's Glenlyon Dam to meet irrigation, stock and household water needs in the Border Rivers region (WaterNSW, 2024). Lake Pindari is also a recreation destination utilised by the public for activities including water sports, fishing and camping.

Table 1.1 Proposal site Lot and DP

Lot	DP	Land zoning	Land owner
31	914703	RU1 – Primary production	WaterNSW
1	232186	RU1 – Primary production	WaterNSW
1	535248	RU1 – Primary production	WaterNSW
1	810544	RU1 – Primary production	WaterNSW
4	5352248	RU1 – Primary production	WaterNSW
7	869840	RU1 – Primary production	Crown lands
6	869840	RU1 – Primary production	WaterNSW
5	869840	RU1 – Primary production	WaterNSW
4	869840	RU1 – Primary production	WaterNSW
1	1175290	RU1 – Primary production	Appears to be Crown lands
2	534966	RU1 – Primary production	WaterNSW



wsp

PS122845
Pindari Dam bubble plume

Figure 1.1
Locality Plan

Legend

- Places
- Watercourse
- Road
- Impact Area
- Lake Pindari
- Project Study Area
- 10km Buffer from Study Area



Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:150,000 Date: 29/10/2024

GDA 2020

Data source: DEC/DPI, Geoscience Australia

© WSP Australia Pty Ltd ("WSP"). Copyright in the drawings, information and data recorded (the "Information") is the property of WSP. This document and the Information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that for which it was supplied by WSP. WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the Information. No part of this document may be reproduced without the prior written permission of WSP Australia Pty Ltd.

www.wsp.com



wsp

PS122845
Pindari Dam bubble plume

Figure 1.2
Pindari Dam existing infrastructure

Legend

- Spillway Boom
- Watercourse
- Boat Ramp
- High level outlet
- Low level outlet
- Operational aquatic exclusion area
- Construction aquatic exclusion area
- Dam crest road (Coulton Walk)
- Spillway
- Staging area
- Existing Access Bridge
- Impact Area
- Study Area



Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:8,000 Date: 23/01/2025

GDA 2020

Data source: ©NSW Spatial Services

© WSP Australia Pty Ltd ("WSP") Copyright in the drawings, information and data recorded (the "information") is the property of WSP. This information and these drawings are made available solely for the purpose for which it was originally supplied to WSP. WSP does not accept responsibility for any use of the information for other purposes or by other persons, and shall be indemnified against any claims or liability arising from any such use. Unauthorised use of this information is prohibited. WSP Limited (Quality System no ABZ 284) is certified to ISO 9001:2015 and ISO 14001:2015 by Lloyd's Register Quality Assurance Limited.



wsp

PS122345
Pindari Dam bubble plume

Figure 1.3
Impact Area

Legend

- VPS monitoring locations
- Boat Ramp
- Marker buoys
- Anchor Block 'A'
- Anchor Block 'B'
- High level outlet
- Low level outlet
- Spillway Boom
- Access tracks
- Compressors Site Location
- Construction compound and site facilities including accommodation
- Construction aquatic exclusion area
- Operational aquatic exclusion area
- Existing Access Bridge
- Spillway
- Staging area
- Impact Area
- Study Area

Current Design Features

- Air distribution pipe
- Compressors and pipework
- Compressors site
- Air diffuser and buoyancy pipe



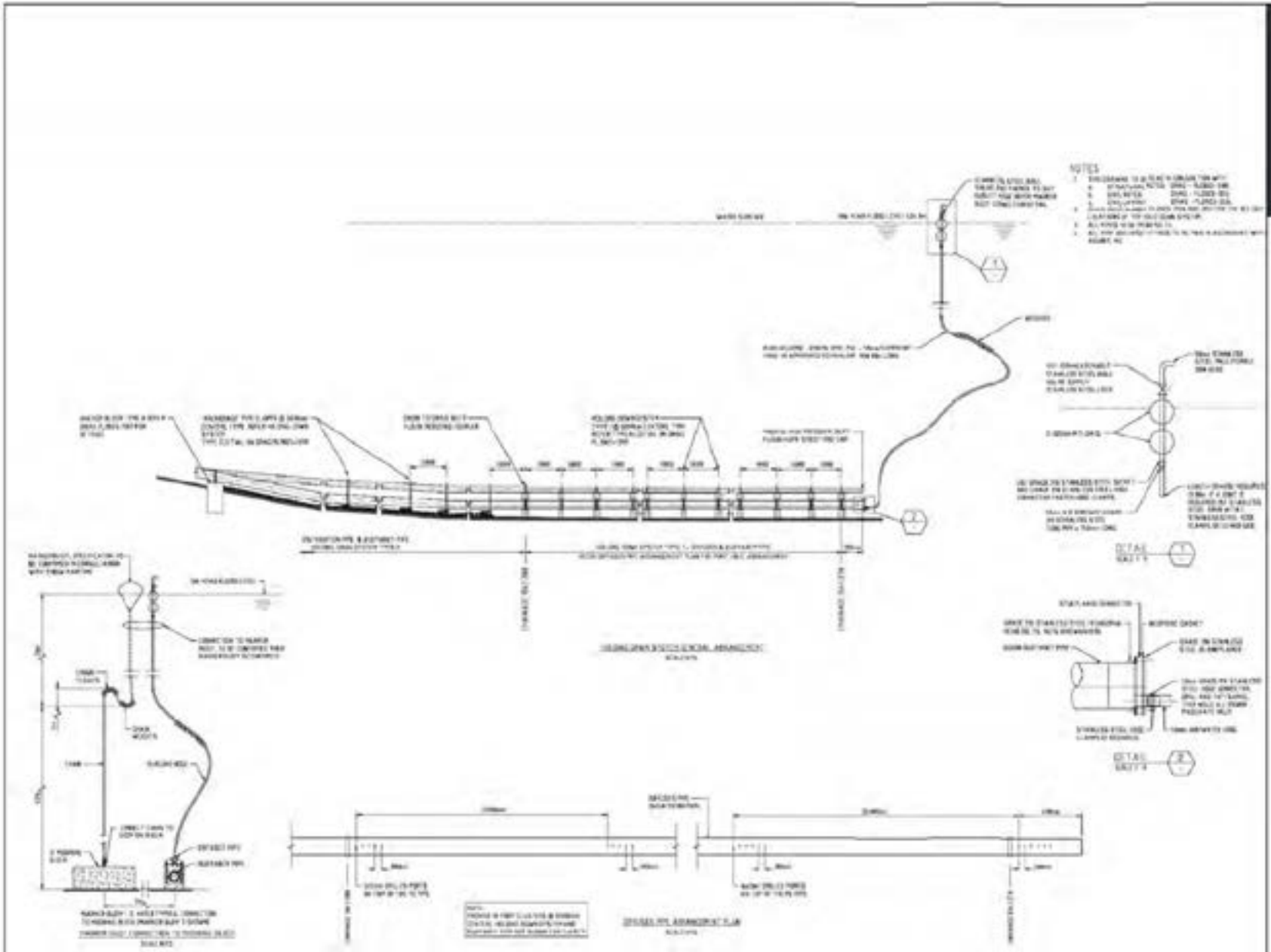
Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:10,000 Date: 23/01/2025

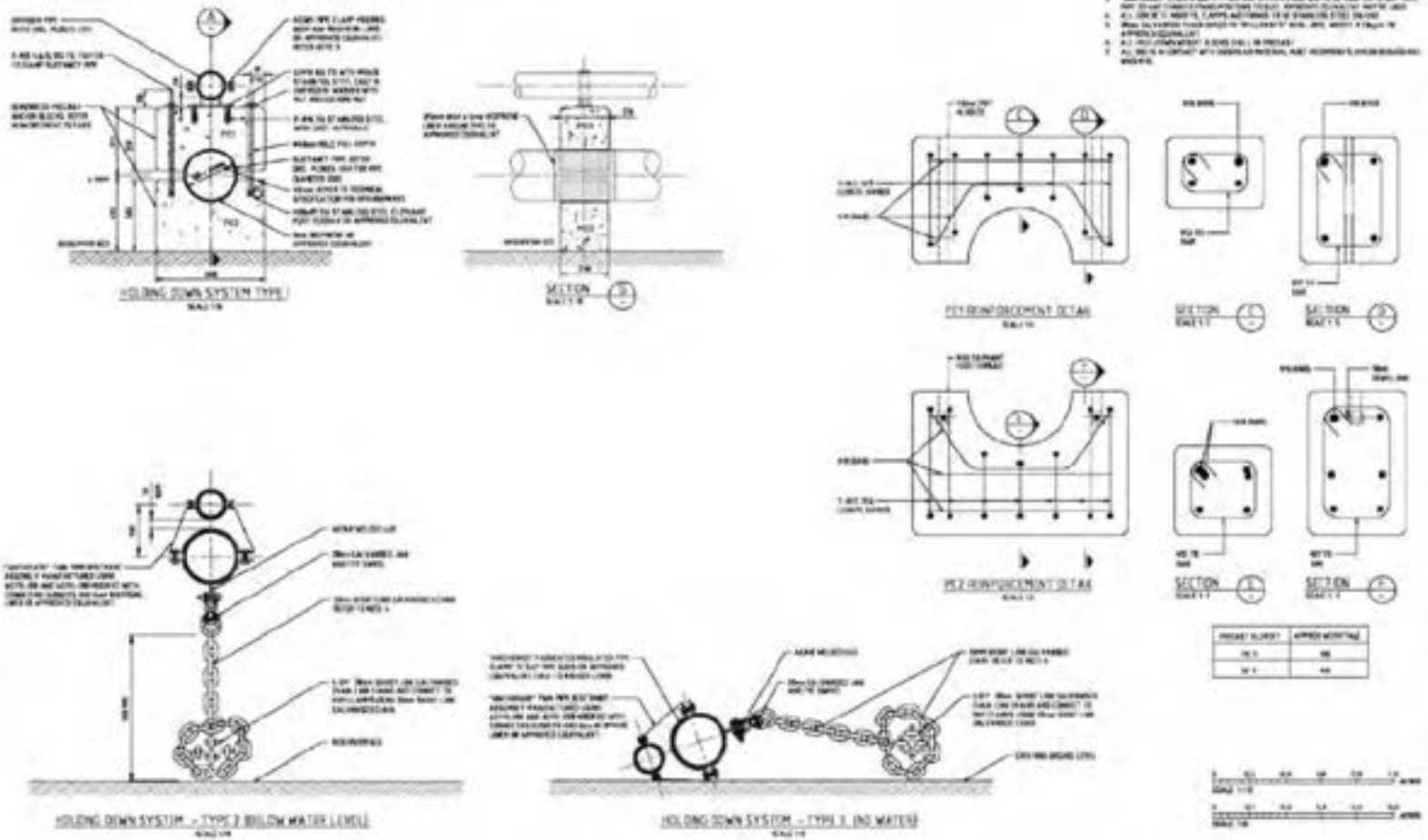
GDA 2020

© WSP Australia Pty Ltd (WSP) Copyright in the drawings, information and data recorded (the information) is the property of WSP. This document is provided on the terms of the WSP Australia Pty Ltd Terms of Use and is not to be used, copied or reproduced in whole or part or adapted, stored, published, communicated or disclosed to any other party without the prior written permission of WSP. Use of the information by any party for any purpose other than that for which it was prepared is prohibited. WSP does not accept responsibility for any loss or damage suffered by any party howsoever arising from unauthorised use of the information. WSP Australia Pty Ltd ABN 80 078 004 798



PS122845
Pindari Dam bubble plume

Figure 1.4
Cross section of the bubble plume system infrastructure within Lake Pindari



wsp

PS122845
Pindari Dam bubble plume

Figure 1.5
Holding down systems

1.5 Purpose and structure of the report

This REF has been prepared by AssetReady on behalf of WaterNSW. WaterNSW is both the proponent and the determining authority under Division 5.1 of the EP&A Act for the proposal.

The purpose of this REF is to describe the proposal, document potential and likely impacts on the environment, and identify appropriate safeguards and mitigation measures to minimise those impacts.

Description of the proposed works and associated environmental impacts have been prepared in the context of Clause 171 of the NSW Environmental Planning and Assessment Regulation 2021 (EP&A Regulation) (factors to be taken into account concerning the impact of an activity on the environment), the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In doing so, the REF fulfils the requirements of Division 5.1, Section 5.5 of the EP&A Act that the proponent and determining authority (WaterNSW) examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

To assess environmental impacts, the report includes the following sections:

- Section 1 – Introduction
- Section 2 – Need and options considered
- Section 3 – Description of the proposal
- Section 4 – Statutory and planning framework
- Section 5 – Stakeholder and community consultation
- Section 6 – Environmental assessment
- Section 7 – Environmental management
- Section 8 – Conclusion and justification
- Section 9 – References.

The findings of the REF will be considered when assessing:

- whether the proposal is likely to have a significant impact on the environment and therefore whether an Environmental Impact Statement (EIS) is required to be prepared and approval sought from the Minister for Planning and Public Spaces under Division 5.1 Section 5.7 of the EP&A Act
- whether the proposal is likely to have a significant impact on any threatened species or ecological communities as defined by the BC Act or *Fisheries Management Act 1994* (FM Act); and therefore, the requirement for a Species Impact Statement or Biodiversity Development Assessment Report (BDAR)
- potential for the proposal to significantly impact on Matters of National Environmental Significance (MNES) and the need to make a referral to the Commonwealth Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the EPBC Act.

2 Need and options considered

2.1 Need for the proposal

Pindari Dam, in northern NSW, has been identified as a reservoir with thermal stratification with a high potential for its dam release water to cause cold water pollution. Cold water pollution is caused when the bottom cold layer of water from large dams is released downstream resulting in an artificial reduction in river water temperatures. This release of cold water during the warmer months causes pervasive ecological, social, and cultural impacts to over 2,000 kilometres of mainstem rivers in NSW. As such, cold water pollution is listed as a Key Threatening Process under the FM Act.

The cold water released downstream from the low-level outlet, can cause cold water pollution or 'thermal' impacts on the natural temperature regimes of the Severn River system which in turn can affect ecosystem health and native fish populations. Whilst Pindari Dam has a high-level outlet which could be used to selectively withdraw warmer water from near the surface, research by Chaaya and Miller (2023) notes dams with a multi-level offtake have demonstrated an ineffectiveness to mitigate cold water pollution due to conflicting algae management protocols.

In response to the problems caused by cold water pollution, NSW developed the NSW Cold Water Pollution Strategy (NSW DPI, 2012) that provides for an incremental program of investigation; on ground works; improved operating practices; and associated monitoring, evaluation, and reporting (MER). A key deliverable of Phase 1 of the NSW Cold Water Pollution Strategy is to verify the effectiveness of bubble plume destratification to mitigate cold water pollution at a large dam (Pindari). Pindari Dam is one of eight high priority dams identified during stage one of the NSW Cold Water Pollution Strategy (NSW DPI, 2012).

Pindari Dam was selected as the preferred demonstration site due to the following reasons:

- Pindari reservoir has the smallest capacity of the eight high priority dams in NSW, thereby increasing the chances of project success while keeping costs to a minimum due to smaller compressor sizing and reduced power consumption.
- Pindari is strongly stratified in summer, being the most northerly of the NSW high priority dams, thereby ensuring cold water pollution impacts.
- A multi-level offtake tower is already present that affords increased trial flexibility to optimise bubble plume operation.
- Multiple bubble plume modelling assessments and reviews have been completed at Pindari that will facilitate quick assessment between theoretical and actual outcomes (Prentice et al., 2021; Chaaya and Miller, 2022).

The proposal will involve construction and operation of a bubble plume destratification system within Lake Pindari to pump compressed air through a pipe network to diffusers typically located in the deepest part of a dam; however depth of the diffusers can be varied.

Operation of the proposal is expected to break down thermal stratification that persists in the dam, thus homogenising the water quality conditions in the lower dam in the vicinity of the offtake. Subsequently, the temperature of dam releases is expected to increase, reducing the temperature differential between releases and the ambient temperature of the Severn River. Through reducing potential for cold water pollution, the proposal aims to increase the success of recruitment and survival of threatened fish species including Golden Perch (*Macquaria ambigua*), Silver Perch (*Bidyanus bidyanus*), Murray Cod (*Maccullochella peelii*) and the Eel-tailed catfish (*Tandanus tandanus*) (NSW Department of Primary Industries (DPI), 2012).

If destratification at Lake Pindari and reduction of downstream cold water pollution is successful, it will be used as a framework for remediating stratified reservoirs across the state.

2.2 Proposal objectives

Key objectives of the proposal are to:

- Establish a trial cold water destratification system in Lake Pindari using bubble plume principles, to reduce the potential for cold water pollution to impact downstream fish stocks. Demonstrating the effectiveness of a bubble plume destratification system at a large, deep dam such as Pindari will strengthen the case to develop and deploy this technology at other high priority cold water pollution dams in the Murray-Darling Basin.
- Increase water temperature by 10 degrees Celsius and improve water quality outcomes in downstream receiving waterways, for native fish stocks and primary production (NSW DPIRD, 2024). Research has shown bubble plume destratification has been effective in achieving these outcomes in smaller dams (Chaaya and Miller, 2022).
- Reduce evaporation: destratification reduces water surface temperatures that in turn reduces surface evaporation rates (Chaaya and Miller, 2023).
- Improve water quality parameters via reservoir destratification (e.g., increase benthic dissolved oxygen levels, reduce soluble metal and nutrient release from anoxic sediments, and decrease frequency and severity of cyanobacteria blooms; Chaaya and Miller, 2022).

2.3 Options and alternatives considered

2.3.1 Do nothing

The 'do nothing' option involves not installing a bubble plume destratification system at Pindari Dam. This option will result in no additional environmental impact and costs for WaterNSW in the short-term. However, this option will lead to continued thermal stratification in Lake Pindari and potential cold water pollution impacts downstream in the Severn River. Further, current surface evaporation rates and water quality parameters such as anoxic conditions within Lake Pindari would remain unchanged. Additionally, the ‘do nothing’ option does not provide the opportunity to trial the effectiveness of a bubble plume destratification system for other deep water dams in NSW to mitigate cause cold water pollution.

The 'do nothing' option was not considered as a viable option as it will not achieve the proposal objectives outlined in Section 2.2.

2.3.2 Multi-level offtakes: selective withdrawal

This option would enable selective withdrawal from different depths in Lake Pindari to improve the quality of the release water and mitigate potential downstream environmental impacts of thermal stratification (Chaaya and Miller, 2022). Selective withdrawal would be used to avoid cold, poor quality hypolimnion (deepest) waters by withdrawing from above the thermocline (transition layer between warmer mixed water at the surface and cooler deep water below), and similarly undesirable discharge of toxic cyanobacteria by withdrawing from below the surface (Chaaya and Miller, 2022). This option is generally considered feasible for dams with existing multi-level offtakes as retrofitting these structures may be of considerable cost (Chaaya and Miller, 2022).

This option was not preferred as multi-level offtakes are generally downstream focused management solutions and provide little benefit for the reservoir itself. Further, this option would likely be the most expensive option.

2.3.3 Artificial destratification: surface mixer

This option would involve mounting mixers near the surface of Lake Pindari. These systems generally use a raft-mounted impellor located just below the surface of Lake Pindari to either jet water down or draw-up water (Chaaya and Miller, 2022). The system would be a draft tube that extends below the raft to direct the jet to a desired depth. The water entrained from the mixers responds to the water density variations and rises or sinks to a depth of neutral buoyancy, creating a mixing effect and destratifying thermal gradients in the vicinity of the mixing system (Chaaya and Miller, 2022).

Whilst this option is considered a cost-efficient method for artificial destratification, it was not preferred due to the lack of studies on the benefits and applications of surface mixers when compared to bubble plumes.

2.3.4 Installation of bubble plume destratification system using an air compressor – preferred option

This preferred option will involve pumping compressed air through a pipe network to diffusers typically located in the deepest part of a reservoir. The air is diffused into plumes of buoyant bubbles which rise through the water column to the surface. As the plumes rise through the water column to the surface, they entrain cold, dense waters from the hypolimnion (deepest) to the warmer surface layers. Cold water detrains from the rising plume at the surface, and due to the water density variation, sinks back through the density field to a depth of neutral buoyancy and propagates away from the centre of the plume. This causes local mixing in the vicinity of the bubble plume, dismantling the density structure and breaking thermal stratification (Chaaya and Miller, 2022).

This option was preferred as bubble plume destratification systems have been used in many reservoirs globally to mitigate cold water pollution, prevent cyanobacteria blooms, and remediate other water quality issues caused by thermal stratification. Bubble plume destratification is also commonly considered to be one of the most cost-effective options for mitigating the impacts of thermal stratification (Chaaya and Miller, 2022).

This option will result in short-term environmental impacts and costs for WaterNSW. However, in the long-term it is anticipated that this option will achieve the objectives of the proposal by establishing a trial cold water destratification system within Lake Pindari and reducing the potential for cold water pollution downstream in the Severn River. There is also potential for the proposal to exacerbate conditions that lead to algal blooms. Careful management will be required to reduce the potential for algal blooms. The short-term environmental impacts and costs are considered minor and justified by the long-term benefits of the proposal.

3 Description of the proposal

3.1 Scope of works

The proposal will involve the following scope of works:

- site establishment and mobilisation
- civil construction works for the location of two oil-free compressors at the base of the dam including:
  - concrete foundations
  - erosion and sediment control
  - separate car-port style shade structure for the compressors
  - perimeter security fencing of compressor site
  - underground drainage pipes (Poly Vinyl Chloride – Unplasticised (PVC-U))
  - asphalt access road and vehicle pavement suitable for a standard 7.8 metres long non-articulated vehicle and concrete pavement for the associated mechanical and electrical equipment
- electrical and mechanical construction works (to power the compressors)
  - high voltage (HV) electrical power supply from the Essential Energy grid by an extension from an existing pole at the base of the pad mounted 1,000 kilovolt amps (kVA) transformer
  - HV conduit and cables from transformer to switchboard low-voltage (LV) Switchboard
  - other instruments required including pressure transmitter and flowmeter
  - other electrical works include:
    - LV conduits, pits and cabling from switchboard to dam existing workshop
    - LV conduits, pits and cabling from switchboard to dam low level outlet
    - Communications cables in existing conduits from switchboard to office
- aeration pipework assembly – 680 metre air distribution pipe for compressors delivering nominal maximum 1,000 litres per second free air delivery (FAD)
  - above ground pipework, valves, and fittings and associated metal pipe supports within compressors site
  - bifurcation of air distribution pipe into air diffuser pipe and buoyancy with isolating valves
  - survey using multi-beam echo sound and sediment sampling of thalweg (line of curve at lowest elevation) to gather accurate data for location of the air diffuser pipe
  - barge mobilisation from the boat ramp, located south of the dam wall
  - installation of the buoyancy pipe (855 metres) along reservoir batter and within water
- installation of air diffuser pipe (500 metres) with air ports clustered on top of the air diffuser pipe at 25 metre spacing over the pipe length in the thalweg (line of curve at lowest elevation) of the reservoir
  - drilling holes (air ports) on the obvert (highest interior level) of air diffuser pipe
  - scuba to inspect the location and alignment of the air diffuser pipe and anchor blocks– this will only be viable if the water depth at the time of construction is less than 30 metres
  - purging hose and valve at the downstream end of the buoyancy pipe
- installation of a 500 metre boom adjacent to the spillway
- commissioning of compressors and air diffuser pipe
  - testing and commissioning will need to occur to ensure all interfaces are operating as intended.

- installation of marker buoys and two VPS monitoring systems on the water surface
- demobilisation and site restoration.

3.2 Construction

3.2.1 *Method*

Construction of the proposal will occur in several stages. The key construction activities are outlined in Table 3.1.

Table 3.1 Proposed construction activities

Construction stage	Activities	Estimated duration
Site establishment and mobilisation	— establishment of environmental controls — installation of temporary boundary fencing and site amenities — installation of temporary power generators — establishment of concrete washout bays for construction works, locations for stockpiling earth fill, concrete or other recycle materials — survey of existing structures, abutment, surrounds, and relevant underground infrastructure — relocation of infrastructure which may interfere with undertaking works — installation of traffic controls — vegetation removal.	2 weeks
Civil construction: New concrete foundations and awning structures for compressors and electrical switchboard prior to on-site fusion welding of the air diffuser pipe strings	— erosion and sediment control — earthworks cut and fill — slab drainage and electrical pits/conduits — reinforced concrete slab construction and compressor plinths — installation of stormwater drainage — asphalt surface — security fencing — earthworks will involve removal and replacement of approximately 500 m^3 of soil using conventional earthmoving equipment such as 30 tonne excavators, dump trucks, water cart and a 12 tonne excavator — stockpile of materials on-site.	17 weeks
Electrical and mechanical construction	— connection of low voltage switchboard and pipework to one 1000 kilovolt amps (kVA) transformer — unloading of the two oil-free compressors from the delivery truck and installation on the concrete pads — supply, installation and termination of all conduits and cables to power supply and control systems as necessary — configuration of the communication (PLC)/supervisory control and data acquisition (SCADA) network to communicate with the compressor to provide monitoring on the SCADA — testing, including system acceptance test and commissioning of each compressor to meet the design, installation and functional requirements.	9 weeks

Construction stage	Activities	Estimated duration
Aeration pipe assembly	Air distribution pipe: — trenching adjacent the existing asphalt access track (to the existing workshop at the base of the dam) using conventional trenching open cut method — restoration of asphalt surfaces will be necessary at road crossings — trenching will be below ground for about 100 metres from the compressor site and will cross the existing outlet channel bridge by an anchorage system to existing access bridge structure (see Figure 1.3) — pipe will continue above ground along the bottom edge of the dam embankment where the slope of the existing ground increases from 10 per cent grade (1V:10H) to 40 per cent grade (1V:2.5H) to the northern crest — high-density polyethylene (HDPE) pipe for the section running along the edge of the dam wall will be strung out at the base of the dam and pulled up the base of the embankment using a small dozer or excavator — the section of pipe to run up beside the embankment will be welded together at the crest and then welded to the pipe work at the compressor site — the air diffuser pipe section will be welded and strung out across the spillway (see Figure 1.3) — the above ground section in the steep batter to the reservoir will be subject to variable water levels and be exposed to solar radiation when water levels are low — the pipe will be white to mitigate thermal effects and is PN25 pressure rated to accommodate pressure de-rating due to exposure to high solar radiation. Distribution and air diffuser pipe: — the pipe size selected minimises pressure losses to ensure uniform flow distribution through the holes along the diffuser, without oversizing the diffuser, which minimises the size of hold down anchors required — the distribution and air diffuser pipe will be welded and strung out in approximate 500 metre strings — the delivered pipe sections will be stored and welded on the dam spillway, with likely two pipe strings pulled along and stored on the side of crest road — the pipe strings will not block access along the dam crest wall but may impact access — the precast concrete anchor blocks will be stockpiled at the dam spillway and fitted progressively as the pipe is constructed.	5 weeks

Construction stage	Activities	Estimated duration
Aeration pipework – in dam installation	Barge mobilisation: — mobilisation of a 9 by 12 metre barge for marine operations sized to accommodate a suitable sized crane for lifting and positioning mooring anchors (5 tonnes) and permanent anchor blocks (4 tonnes) — three road transportable barge modules (each 12 x 2.7 metres) will be lifted and assembled on the water using a 100 tonne mobile crane — a marine architect will set out the barge assembly at the boat ramp to meet the load requirements — the loading of the barge crane will be done using ramps — boats will be used to move the barge and materials around the dam — the five tonne mooring blocks will be positioned along the pipeline alignment to help secure the floating pipe against wind and wave action — the barge will be used to fit the anchor blocks progressively along the pipeline to provide the hold down support for the security/protection of the pipe from environmental factors such as wind and waves during assembly. Air diffuser pipe installation: — the air diffuser pipe will be anchored to resist buoyancy. The pipe size has been optimised to minimise the anchor block size to facilitate installation — anchorage is based on 200 kilogram concrete anchor blocks at five metre spacing along the air diffuser pipe — a separate buoyancy pipe is clamped into the anchor blocks with the diffuser pipe. The buoyancy pipe allows the two-pipe and anchor system to float on the water surface when the buoyancy pipe is filled with air and sink when water is introduced to the buoyancy pipe. When the buoyancy pipe is completely filled with water the pipes will lay on the bed of the reservoir — five tonne mooring blocks will be positioned along the final alignment to help locate the pipe and anchor blocks against wind and wave action during its assembly. Permanent marker buoys are provided at the beginning midpoint and end of the diffuser pipe and these buoys will be directly attached to the mooring blocks with anchor chain or approved equivalent cable to minimise the potential for entanglement of the chain around the diffuser pipe — a global positioning system (GPS) will be used to position the mooring blocks, as the guide to ensure the pipe is along the correct alignment — for installation the anchor blocks will be progressively attached to the pipe string as the string is pulled into the water using a workboat and barge	6 weeks

Construction stage	Activities	Estimated duration
	— the air diffuser pipe will be sunk from the shoreline out along the alignment of the mooring blocks to maintain correct positioning. SCUBA: — a dive crew will be on-site during preparations and process of the aeration pipe and concrete blocks to assist when required — during the preparation works the concrete blocks will be released from the pipe allowing it to hang below the connecting cable, the divers will ensure that these cables hang free below the pipe and are not entangled before sinking.	
Commissioning	— commissioning of the system will occur in stages with the construction exclusion zones maintained until after system operation has been proven — factory acceptance testing of equipment will occur off-site throughout the manufacturing process for different operating safeguards for the compressors, transformers and electrical equipment — once all the equipment is assembled on-site, testing and commissioning will occur to ensure all interfaces are operating as intended — after it has been established that power, control and the air system functions correctly, load will be added, air will at this point be pumped through the delivery pipeline to the air diffuser pipe on the reservoir floor — underwater remotely operated vehicles (ROV's) will be operated around the air diffuser pipe delivering recorded live video feed back to the surface as confirmation of the bubble plumes rising from the pipe suspended at the correct height above the anchor blocks.	8 weeks
Demobilisation and restoration	— removal of plant and equipment from site — removal of environmental controls — site clean-up and remove temporary fencing — reinstate any fencing or gates — remediation of proposal site — carry out any final inspections and handover of the work site.	1 week

3.2.2 *Site compound*

The proposed site compound will be located at the base of the dam wall on previously cleared land in close proximity to the existing WaterNSW office (refer to Figure 1.3). The proposed site compound will be fenced and include site facilities, power and water supplied from the WaterNSW office. Typically, the site compound will include a site office, male and female ablutions, storage units and a lunchroom with hot and cold drinking water facilities and means to heat food.

3.2.3 Plant and equipment

An indicative list of plant and equipment required for construction of the proposal is as follows:

- 9 by 12 metre barge
- 20 tonne barge crane
- 100 tonne mobile crane
- six metre motorised work boats (approximately three will be required)
- light vehicles
- 30 tonne excavator with rock hammer attachment
- dump truck
- water truck
- 12 tonne excavator
- remotely operated vehicles (ROVs)
- concrete saw
- delivery rigid trucks (heavy vehicle)
- three-tonne trucks
- pole truck
- positrack loader
- concrete mixer truck
- concrete pumping truck
- grader
- roller
- concrete agitator
- paver
- road planer
- Ramex trench compactor.

3.2.4 Traffic and access

The site will be accessed from Inverell via the following public roads in accordance with any restrictions, such as vehicle weights, speed, widths and heights. The proposed access route will be:

- Ashford Road, Bakkulla Road and Pindari Dam Road (via Ashford Village).
- Ashford Road, The Pocket Road (including an unsealed section of this road), and Pindari Dam Road.

There are no load limit signs posted on any of these roads.

The proposal site will be fenced at the limit of the impact area, with access to the public restricted during construction. Access to private properties surrounding the proposal site will not be restricted during construction. Existing dam access roads will be utilised throughout the works. Extension of access tracks at the base of the dam wall and between the construction compound and the spillway for on water activities (along the west side of the dam embankment, adjacent to the pipe) are proposed for construction of the proposal (refer Figure 1.3). The dam wall (Coulton Walk) will also be used for construction access and will be closed to the public during construction. Closure of the walk would be short-term and temporary, resulting in minimal impacts on public access and use. The impacts are further discussed in Section 6.8 and Section 6.13. During wet weather and for a duration after, access tracks will be closed until they are deemed satisfactory for use by vehicles, plant and equipment. Public access to the boat ramp will be maintained and will not be impacted during construction of the proposal.

3.2.5 Public utilities

The works will be carried out on WaterNSW and NSW Crown Land. The proposal will involve connection to the existing Essential Energy grid for electrical power supply by an extension from an existing pole at the base of the pad mounted transformer. There are no additional public utilities that will be affected by the proposal.

3.2.6 Construction hours and duration

The proposed construction hours for the proposal are 6.30am – 6.30pm Monday to Sunday (including public holidays).

Noise generating activities will be scheduled during standard construction hours (see below) where practicable. In addition, management and mitigation measures detailed within the Construction Environmental Management Plan (CEMP) will be implemented as required to further mitigate any construction impacts. This includes the development of an out-of-hours work protocol which will govern the management of work outside standard work hours.

Noise generating activities will generally be undertaken during standard construction hours as follows:

- 7:00 am to 6:00 pm Monday to Friday
- 8:00 am to 1:00 pm Saturday
- no work on Sundays or public holidays.

Construction is expected to commence April 2025 with a construction period of about 40 weeks.

3.2.7 Property acquisition and access

No property acquisition is required. Access through private property to access the proposal site is not required.

3.3 Operation

Upon completion of the works, the repaired and rehabilitated site will provide for the safe operation of the bubble plume destratification system during the spring and summer season. The proposal is expected to operate September to April, typically commencing in spring if stratification is detected. Ongoing maintenance activities will include:

- using vessels for operating the drain valve mounted at the end of buoyancy pipe during raising the air diffuser pipe to the reservoir surface for any replacement/repair works
- purging water into the buoyancy pipe to sink the air diffuser pipe into reservoir
- purging air into buoyancy and air diffuser pipes to raise the system in case of repair/replacement.

Water required for sinking the air diffuser pipe will be sourced from Pindari Dam by direct pumping or from a tanker. The tanker will temporarily store water from the dam for use in raising and sinking the buoyancy pipe. The tanker will be located on the existing dirt track at the west end of the dam wall. Water purged from the buoyancy pipe will be released into Pindari Dam. Operational maintenance activities at the dam will continue to be completed in accordance with existing WaterNSW procedures. The aquatic exclusion area around the bubble plume destratification system within Lake Pindari is permanent and will remain in place during operation. The aquatic exclusion area is required to protect the bubble plume destratification system, predominantly from public use of Lake Pindari. Marker buoys will be located on the surface of Lake Pindari to indicate the alignment of the bubble plume destratification system (see Figure 1.3). Access to the boat ramp will not be impacted during operation of the proposal.

4 Statutory and planning framework

4.1 Environmental Planning and Assessment Act 1979

The *Environment Planning and Assessment Act 1979* (EP&A Act) is the principal Act relating to development in NSW. The proposal is subject to environmental impact assessment and planning approval requirements of Division 5.1 of the EP&A Act.

The relevant planning approval process for development is set out in Environmental Planning Instruments (EPIs); State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs). Under the provisions of State Environmental Planning Policy (Transport and Infrastructure) 2021 (TISEPP) (refer to Section 4.3.1), the proposal is permissible without consent.

WaterNSW is both the proponent and determining authority under Part 5 Division 5.1 of the EP&A Act. Section 5.5 of the EP&A Act imposes a duty on determining authorities to consider 'to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity' (this REF). Should WaterNSW find that the proposal will likely have a significant impact on the environment, Section 5.7 of the EP&A Act requires an EIS to be prepared.

Under Clause 171 (4) of the EP&A Regulation, the REF must be published on the determining authority's website or the NSW planning portal if:

a the activity has a capital investment value of more than $5 million, or

b the activity requires an approval or permit as referred to in any of the following provisions before it may be carried out:

- **i** *Fisheries Management Act 1994* (FM Act), Sections 144, 200, 205 or 219
- **ii** *Heritage Act 1977* (Heritage Act) Section 57
- **iii** *National Parks and Wildlife Act 1974* (NPW Act), Section 90
- **iv** *Protection of the Environment Operations Act 1997* (POEO Act), Sections 47–49 or 122, or

c the determining authority considers that it is in the public interest to publish the review.

As the proposal is expected to have a capital investment value of more than $5 million, WaterNSW is required to publish this REF on their website, either:

a before the activity commences, or

b if publishing the review before the activity commences is not practicable, as soon as practicable, and no later than 1 month, after the activity commences.

4.2 Water NSW Act 2014

The *Water NSW Act 2014* establishes WaterNSW as a public authority that is responsible for water supply services. This REF has been prepared having regard to, but not limited to, the specific objectives of WaterNSW within Division 2 Section 6 (1) of the *Water NSW Act 2014*:

a to capture, store and release water in an efficient, effective, safe and financially responsible manner, and
b to supply water in compliance with appropriate standards of quality, and
c to ensure that declared catchment areas and water management works in such areas are managed and protected so as to promote water quality, the protection of public health and public safety, and the protection of the environment, and
d to provide for the planning, design, modelling and construction of water storages and other water management works, and
e to maintain and operate the works of WaterNSW efficiently and economically and in accordance with sound commercial principles.

The proposal involves the installation of a bubble plume destratification system as a trial measure to reduce thermal stratification in Lake Pindari and the potential for cold water pollution downstream in the Severn River. In doing so, the proposal aims to promote water quality and protection of the environment within and downstream of Pindari Dam.

4.2.1 Commonwealth legislation

4.2.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act provides a national framework for environmental protection and management of nationally and internationally important flora, fauna, ecological communities and heritage places. Part 3 of the Act lists nine Matters of National Environmental Significance (MNES) that may require approval from the Commonwealth Minister for the Environment and Water.

Furthermore, an action taken by any person on Commonwealth land that is likely to have a significant impact on the environment (Section 26(1)) or an action taken by any person outside of Commonwealth land that is likely to have a significant impact on MNES (Section 26(2)) may require approval from the Commonwealth Minister for the Environment and Water. Refer to Appendix A for consideration of MNES and Commonwealth land with regard to the proposal.

Assessment of the proposal concluded it is unlikely to have a significant impact on any MNES and referral under the EPBC Act is not required.

4.2.1.2 *Native Title Act 1993*

The *Native Title Act 1993* (Native Title Act) recognises that Aboriginal people have rights and interests to land and water which comes from their traditional laws and customs.

The proposal site falls within the boundary of the Native Title Claim by the Gomeroi people (NC2011/006). The claim was entered on the register on 20 January 2012. Engagement activities for First Nations communities include, but are not limited to education sessions, Pindari Dam MER program updates and involvement during site surveys. Further detail regarding engagement activities for First Nation communities are provided in Section 6.3 and Appendix E of this REF.

4.3 State environmental planning policies

The following State Environmental Planning Policies are relevant to the proposal.

4.3.1 *State Environmental Planning Policy (Transport and Infrastructure) 2021*

The TISEPP seeks to provide a consistent planning regime for infrastructure and provision of services across NSW that aims to improve regulatory certainty and efficiency. The TISEPP prevails over most other Environmental Planning Instruments (EPIs) to the extent of any inconsistency including LEPs.

Clause 2.159 (2A) of TISEPP states 'development for the purpose of the maintenance or repair of existing water storage facilities may be carried out by or on behalf of a public authority without consent on any land'.

The proposal is environmental management works to reduce thermal stratification within an existing water storage system at Pindari Dam as well as the potential for downstream cold water pollution. The works will be carried out on behalf of WaterNSW, a public authority.

Under Clause 2.158 a water storage facility is defined in the Standard Instrument – Principal Local Environmental Plan as:

- water storage facility means a dam, weir or reservoir for the collection and storage of water, and includes associated monitoring or gauging equipment.

As such, the works fall within the above definition under the TISEPP as maintenance of a water storage facility and the proposal is considered development permitted without consent.

There are certain instances where the provisions of another SEPP could prevail over TISEPP, as identified in Chapter 2 Clause 2.7 of TISEPP. These provisions do not apply to the proposal.

Other SEPPs apply to the proposal and are discussed in Table 4.1.

Table 4.1 Other SEPPs relevant to the proposal

SEPP	Relevance	Section where addressed
State Environmental Planning Policy (Resilience and Hazards) 2021	The SEPP (Resilience and Hazards) 2021 aims to promote an integrated and coordinated approach to land use planning. The SEPP (Resilience and Hazards) includes consideration of development within the coastal zone, hazardous and offensive development, and remediation of land.	The proposal is not mapped within a coastal environment area (NSW Department of Planning, Housing and Infrastructure (NSW DPHI), 2024) and is not considered hazardous or offensive development. A search of the contaminated land records (NSW Environment Protection Authority (NSW EPA), 2024) on 1 October 2024 identified no contaminated sites within five kilometres of the proposal site. Contamination is further discussed in Section 6.5.

SEPP	Relevance	Section where addressed
State Environmental Planning Policy (Biodiversity and Conservation) 2021	Chapter 3 of the SEPP (Biodiversity and Conservation) 2021 aims to encourage the proper conservation and management of areas of natural vegetation. The SEPP includes consideration of development in relation to habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.	Inverell Shire LGA is listed under Schedule 2 of the SEPP (Biodiversity and Conservation). The area is not subject to a Koala Plan of Management. Biodiversity is further discussed in Section 6.1.

4.3.2 *Other relevant NSW legislation*

Other legislative and approval requirements relevant to the proposal are outlined in Table 4.2.

Table 4.2 Other relevant legislation to the proposal

Legislation	Purpose	Relevance to the proposal and approval requirements
Biodiversity Conservation Act 2016	The BC Act aims to maintain a healthy, productive and resilient environment for the wellbeing of the community. Part 7 of the BC Act requires that the significance of impacts to threatened species, populations and endangered ecological communities listed under the BC Act or FM Act are assessed using a Test of Significance. Where a significant impact is likely to occur, a Species Impact Statement (SIS) or BDAR must be prepared.	A detailed assessment of significance for the assessed threatened terrestrial flora and fauna species listed under the BC Act has been completed as part of the Biodiversity Assessment Report (BAR) (Refer to Appendix C and D respectively of Appendix B). This assessment of significance for threatened terrestrial flora and fauna has concluded that a significant impact as a result of the proposal is considered unlikely.
Biosecurity Act 2015	The primary object of the *Biosecurity Act 2015* is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, including pests, diseases and contaminants.	Under the *Biosecurity Act 2015*, land managers are required to follow the regional and non-regional duties that have been allocated to each Priority Weed. Weeds are present within the proposal site. Appropriate mitigation measures associated with preventing the spread of weeds and pathogens are included in Section 6.1.
Contaminated Land Management Act 1997	The *Contaminated Land Management Act 1997* establishes a process for investigating and remediating land that the NSW EPA considers to be contaminated significantly enough to require regulation under Part 3 Division 2 of the Act.	A search of the contaminated land record of notices (NSW EPA, 2024) on 1 October 2024 identified no contaminated sites within five kilometres of the proposal site. Potential discovery of contaminated soil will be managed in accordance with an unexpected finds procedure, to be prepared as a part of the CEMP prior to construction. Contamination is further discussed in Section 6.5.

Legislation	Purpose	Relevance to the proposal and approval requirements
Crown Land Management Act 2016	The *Crown Land Management Act 2016* manages the ownership, use and management of Crown Land in NSW including environmental, social, cultural heritage and economic considerations of decisions regarding and actions on Crown Land.	The proposal involves work within a Crown Lands waterway (Severn River) within Lake Pindari as well as within Lot 7 DP869840 and Lot 1 DP1175290. Consultation with Crown Lands is detailed in Section 5.1.2.4.
Fisheries Management Act 1994	The FM Act applies if works involve dredging or reclamation, fish passage obstruction, harm to marine vegetation, or use of explosives or electrical devices. Under Part 7 of the FM Act the following activities require a Part 7 Permit: — activities involving dredging and reclamation work — activities temporarily or permanently obstructing fish passage — activities harming marine vegetation.	The proposal is located at Pindari Dam located on the Severn River. Lake Pindari and the Severn River are mapped as Key Fish Habitat (KFH) (NSW DPIRD, 2024). Nearby waterways including Scrub Hut Creek, Spring Creek, Ironbark Creek and associated tributaries are also mapped as KFH. The proposal will involve works within Lake Pindari, including barge mobilisation, air diffuser pipe installation, civil works and aeration pipe alignment and SCUBA work. Under Section 199 (1) of the FM Act, a public authority must, before it carries out or authorises the carrying out of dredging or reclamation work: **a** give the minister written notice of the proposed work **b** consider any matters concerning the proposed work that are raised by the Minister within 21 days after the giving of the notice (or such other period as is agreed between the Minister and the public authority). Consultation with NSW DPIRD Fisheries has been conducted, as detailed in Section 5.1.2.3 and Appendix C. Aquatic biodiversity is further discussed in Section 6.2.

Legislation	Purpose	Relevance to the proposal and approval requirements
Heritage Act 1977	The *Heritage Act 1977* (the Heritage Act) established the Heritage Council of NSW (the Heritage Council). The Heritage Council's role is to advise the government on the protection of heritage assets, make listing recommendations to the Minister in relation to the State Heritage Register, and assess/approve/decline proposals involving modification to heritage items or places listed on the State Heritage Register. Most proposals involving modification are assessed under Section 60 of the Heritage Act. Automatic protection is afforded to 'items' of state or local significance, where items mean a place, building, work, relic, moveable object, or precinct. 'Relics' are defined as 'any deposit or material evidence relating to the settlement of the area that comprised New South Wales, not being Aboriginal settlement, and which holds state or local significance'. Excavation of land on which it is known or where there is reasonable cause to suspect that 'items' will be exposed, moved, destroyed, discovered, or damaged is prohibited unless approved under an excavation permit.	Pindari Dam is item number 4550170 of the Water NSW Section 170 Heritage and Conservation Register (Section 170 Register). The Section 170 Register records heritage assets of NSW state government agencies and was established under the Heritage Act. NSW state government agencies have a responsibility to ensure that items listed on their Section 170 Registers are 'maintained with due diligence'. Government agencies are required to give 14-days' notice to the Heritage Council under Section 170A(1) before removing an item from the Register, transferring ownership of an item, or demolishing an item. The Statement of Heritage Impact prepared by OzArk Environment and Heritage (Appendix F) concluded that the project will have no negative impacts on the heritage significance of Pindari Dam. Non-Aboriginal heritage impacts are further discussed in Section 6.6.
National Parks and Wildlife Act 1974	The *National Parks and Wildlife Act 1974* (NPW Act) aims to conserve nature and objects, places or features of cultural value. An Aboriginal Heritage Impact Permit (AHIP) is required for any activities likely to have an impact on Aboriginal objects or places or cause land to be disturbed for the purposes of discovering an Aboriginal object.	The proposal involves work within Lot 7 DP869840 adjacent the Severn River Nature Reserve (Lot 3 DP834078). The Severn River Nature Reserve is reserved under the NPW Act. Refer to Section 5.1.2.1 for details of consultation with NSW OEH regarding construction adjacent to the Severn River Nature Reserve. A Biodiversity Assessment Report (BAR) (refer to Appendix C and D respectively of Appendix B) was completed to assess potential impacts to terrestrial ecology which found the proposal will result in the direct removal of approximately 0.63 hectares of native vegetation, including 0.6007 hectares of plant community type (PCT) 4151 - North White pine Silver-leaved Ironbark Forest and 0.0246 hectares of PCT 3518 - Northwest Pine-ironbark grassy woodland. A detailed assessment of significance for the assessed threatened terrestrial flora and fauna species listed under the BC Act and / or EPBC

Legislation	Purpose	Relevance to the proposal and approval requirements
		Act was prepared and concluded that a significant impact is considered unlikely. Additionally, an Aquatic Ecology Assessment (AEA) was completed to assess potential impacts to aquatic ecology and water quality in Lake Pindari and the Severn River. The AEA found the proposal is unlikely to have a significant impact on any state or commonwealth listed threatened aquatic biodiversity. Biodiversity and aquatic ecology impacts are discussed in Section 6.1 and 6.2 respectively. An Aboriginal Objects Due Diligence Assessment (Due Diligence Assessment) was completed on 21 August 2024 (refer Appendix E) The Due Diligence Assessment found the proposal is not expected to impact any Aboriginal objects in the Aboriginal heritage study area during construction or operation. Aboriginal heritage is discussed in Section 6.3.
Protection of the Environment Operations Act 1997	The *Protection of the Environment Operations Act 1997* (POEO Act) provides for issuing licences regarding environmentally hazardous activities, issuing offence notices, establishing environmental protection policies, instituting proceedings, investigating breaches and auditing activities. It primarily regulates pollution control and waste disposal in NSW.	Maintenance of water storage facilities is not a scheduled activity under Schedule 1 of the POEO Act, and as such a separate Environment Protection Licence (EPL) will not be required for the proposal. The proposal has potential to result in waste and water quality impacts, if not adequately managed. Part 5 of the POEO Act provides a 'Duty to Notify' the NSW EPA in the event of a pollution incident occurring. Erosion and sediment control measures, and procedures to manage pollution events will be outlined in the CEMP to be prepared prior to construction commencing. The CEMP will include the WaterNSW Environmental Incident Management Protocol.
Waste Avoidance and Resource Recovery Act 2001	Objects of the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) include encouraging efficient use of resources and reducing environmental harm in accordance with the principals of Ecologically Sustainable Development (ESD). The Act establishes the waste hierarchy of avoidance, resource recovery and disposal.	Waste will be generated by the proposal, including general construction, domestic waste, waste residual chemicals, green waste and excavated rock strata. Waste will be managed through the CEMP and disposed of or recycled in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014). Waste management is further discussed in Section 6.12.

Legislation	Purpose	Relevance to the proposal and approval requirements
Water Management Act 2000	The *Water Management Act 2000* (WM Act) aims to provide for the sustainable and integrated management of water sources of the state for the benefit of both present and future generations. Works within 40 metres of a waterway generally require a Controlled Activity Approval (Section 91 of the Act); however, an exemption is provided for public authorities under Clause 41 of the Water Management (General) Regulation 2018.	The proposal will involve work within Lake Pindari. The overall objective will be to reduce thermal stratification in the reservoir and reduce the potential for cold water pollution downstream. Potential impacts of the proposal on watercourses and water quality have been considered in Section 6.4 and 6.5.

4.3.3 *Local environmental plans*

4.3.3.1 Inverell Local Environmental Plan 2012

The Inverell Local Environmental Plan 2012 (Inverell LEP) provides a framework for land use management within Inverell Shire LGA. Under Clause 5.12 of the Inverell Shire LEP, the plan 'does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development' under TISEPP. As the proposal is permitted without consent under TISEPP, consent requirements of the LEP are not applicable.

Pindari Dam is located within land zoned as RU1 (Primary Production) under Inverell LEP. Objectives of RU1 land zone are as follows:

- to encourage sustainable primary industry production by maintaining and enhancing the natural resource base
- to encourage diversity in primary industry enterprises and systems appropriate for the area
- to minimise the fragmentation and alienation of resource lands
- to minimise conflict between land uses within this zone and land uses within adjoining zones.

The proposal aims to reduce thermal stratification in Pindari Dam and the potential for cold water pollution downstream. The proposal aligns with the objectives of RU1 zoned land by maintaining and enhancing the water resource for irrigation and primary production.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of the maintenance or repair of existing water storage facilities and is being carried out by or on behalf of a public authority. Under clause 2.159 (2A) of the TISEPP the proposal is permissible without consent.

The proposal can be assessed under Division 5.1 of the EP&A Act. WaterNSW is the determining authority for the proposal. This REF fulfils WaterNSW's obligation under Section 5.5 of the EP&A Act including to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

5 Stakeholder and community consultation

5.1 Agency consultation

5.1.1 *TISEPP consultation*

In preparation of this REF, AssetReady has considered requirements for notification of the proposal under the TISEPP. Chapter 2 of the TISEPP provides consultation requirements with Councils and other public authorities before commencing certain types of development. The consultation requirements of the proposal are considered in Table 5.1.

Table 5.1 TISEPP consultation requirements

TISEPP Clause	Requirement	Relevance
2.10	Consultation with councils—development with impacts on council-related infrastructure or services	Consultation with Council is not required under this Clause as the proposal will not: — have a substantial impact on stormwater management services provided by a Council — generate traffic to an extent that will strain the capacity of the road system in the LGA — involve connection to, and a substantial impact on the capacity of, any part of a sewerage system or water supply system owned by Council — involve the installation of a temporary structure on, or the enclosing of, a public place that is under Council management — involve excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for which a council is the roads authority.
2.11	Consultation with councils—development with impacts on local heritage	Consultation with Council is not required under this Clause as the proposal will not impact a local heritage item listed on the Inverell Shire LEP or heritage conservation area.
2.12	Consultation with councils—development with impacts on flood liable land	Consultation with Council is not required under this Clause as the proposal is not mapped within flood liable land (NSW DPHI, 2024).
2.13	Consultation with State Emergency Service (SES) — development with impacts on flood liable land	Consultation with the SES is not required under this Clause as the proposal is not mapped within flood liable land (NSW DPHI, 2024).

TISEPP Clause	Requirement	Relevance
2.14	Consultation with councils — development with impacts on certain land within the coastal zone	The proposal is not mapped within a coastal environment area, under SEPP (Resilience and Hazards) 2021 (NSW DPHI, 2024). Consultation with Council is not required under this Clause.
2.15	Consultation with public authorities other than councils	Consultation with the Office of Environment and Heritage is required as the proposal involves work within Lot 7 DP869840 adjacent the Severn River Nature Reserve (Lot 3 DP834078) which is reserved under the NPW Act. Consultation has occurred with Transport for NSW (Transport) as the proposal will involve 'a fixed or floating structure in or over navigable waters'. A maritime notice will be developed for the proposal prior to construction and operation in consultation with Transport – Maritime North.
2.16	Consideration of planning for bushfire protection	The proposal is mapped within bushfire prone land, classified as Category 1, and Category 2 and part of the vegetation buffer (NSW DPHI, 2024). However, consultation with other public authorities is not required under this Clause, as it is not development for a health services facility, correctional centre or group home, or for residential purposes and does not involve subdivision of land. NSW Rural Fire Service (RFS) were consulted regarding potential impacts to use of Pindari Dam as a water source for aerial firefighting. Consultation with NSW RFS would continue throughout the duration of the proposal.

5.1.2 Outcome of consultation

5.1.2.1 NSW Office of Environment and Heritage

A consultation letter was sent to NSW OEH on 15 October 2024. A response was received on 11 November that outlined their requirements to be addressed in the REF (refer to Appendix K). Refer to Table 5.2 for a summary of the assessment requirements.

Table 5.2 Assessment requirements from NSW Office of Environment and Heritage

Requirement	Where addressed in this REF
The proposed activity	
The REF should fully and clearly describe the proposed activity, including any environmental impact mitigation measures, and identify all the processes and activities intended for the site during the life of the proposed activity.	See Section 1.4 and Section 6.11 for the location of the proposal and, land use and land ownership at the proposal site. See Section 1.1 and Section 3 for details of the proposal including: — the proposed layout — equipment — staging and timing. See Section 6 for the anticipated environmental impacts of the proposal including:

Requirement	Where addressed in this REF
	— Section 6.1 and 6.2 for details of threatened flora and fauna at the proposal site — Section 6.1.3 for detail of proposed vegetation clearing — Section 6.5 for management of chemicals and fuelling during construction of the proposal — Section 6.12 for management of waste streams from the proposal — Section 6.14 for assessment of potential cumulative impacts of the proposal. See Section 7 for details of environmental management and proposed mitigation measures.
Environmental impacts of the proposed activity	
Impacts related to Biodiversity, National Parks and Wildlife Services (NPWS) Estate, Acid Sulfate Soils, Flooding, Coastal Processes and Associated Hazards, and Cumulative Impacts, should be assessed, quantified, and reported on in the REF, as required.	See Section 6 for the anticipated environmental impacts of the proposal.
The REF should address the specific requirements outlined under each heading below (Refer to Section B in Appendix K), where necessary, and assess impacts in accordance with the relevant guidelines mentioned.	See Section 6 for assessment of potential impacts during construction and operation of the proposal.
Biodiversity	
The REF must demonstrate whether the proposed activity is to be carried out in a declared area of outstanding biodiversity value.	Table 6.1 states there are no areas of outstanding biodiversity value in the ecology study area.
If the proposed activity is not carried out in a declared area of outstanding biodiversity value, then the REF must document the test for determining whether proposed development or activity is likely to significantly affect threatened species or ecological communities as outlined in Section 7.3 of the BC Act by preparing an ecological assessment. The ecological assessment should include the requirements listed in Section C of Appendix K.	Section 6.1 for assessment of potential impacts to terrestrial ecology. Assessments of significance, in accordance with Section 7.3 of the BC Act, have been completed for threatened flora and fauna that may be impacted by the proposal. Section 7.3 BC Act assessments of significance are provided in Appendix C of the BAR (Appendix B).
If the REF determines under the proposed activity is likely to significantly affect threatened species, then in accordance with Section 7.8 of the BC Act, an EIS must be prepared that is accompanied by a Species Impact Statement prepared in accordance with Part 7, Division 5 of the BC Act, or, if the proponent so elects, a BDAR	Assessment of significance provided in Appendix C of the BAR (Appendix B) determined the proposal is unlikely to significantly impact threatened species.

Requirement	Where addressed in this REF
prepared in accordance with Part 6, Division 3 of the BC Act.	
If the REF determines the proposed activity is unlikely to significantly affect threatened species, then the proposed activity should: — be designed to avoid and minimise impacts on biodiversity values to the fullest extent possible, and — include a biodiversity offset package to offset remaining direct and indirect impacts on biodiversity values, prepared in accordance with the Department's 13 offsetting principles.	Section 6.1 details potential impacts of construction and operation of the proposal on terrestrial ecology. The proposal involves removal of approximately 0.63 hectares of native vegetation. Offsets are not required as no work is occurring in the Severn River Nature Reserve and vegetation in the reserve will not be impacted.
NPWS Estate	
Where appropriate, likely impacts (both direct and indirect) of the proposed development on any adjoining and/or nearby NPWS estate reserved under the NPW Act should be considered, with reference to the Developments adjacent to National Parks and Wildlife Service lands Guidelines for consent and planning authorities.	Refer to Section 6 for consideration of the potential impacts of the proposal during construction and operation. In particular, see Section 6.1 and 6.2 for potential impacts to terrestrial and aquatic ecology.
The NPWS has clear guidelines for assessing the environmental impact of developments and activities proposed within NPWS managed lands. These include guidelines for the preparation of a REF for activities proposed on land reserved under the NPW Act, including national parks and nature reserves. The Guidelines for preparing a Review of Environmental Factors provides information on how to determine whether certain activities are permissible, as well as specific information on matters for consideration during the preparation of an REF.	N/A. The proposal site is not located within NPWS land.
For those proposals within NPWS managed areas that seek a lease or licence under Section 151 of the NPW Act, in addition to an REF, applications must also be accompanied by a sustainability assessment. The assessment must address the criteria adopted by the Chief Executive of the former OEH.	N/A. The proposal site is not located within NPWS land.

Requirement	Where addressed in this REF
Flooding, coastal processes, and associated hazards	
The REF should include an assessment of the following referring to the relevant guidelines in Attachment 2 of Appendix K: — the potential effect of coastal processes and coastal hazards including potential impacts of sea level rise on the proposed activity arising from the proposed activity — whether the proposed activity is consistent with any coastal zone management plans or floodplain risk management plans — whether the proposed activity is compatible with the flood hazard of the land — whether the proposed activity will significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other proposals or properties — whether the proposed activity will significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses — whether the proposed activity incorporates appropriate measures to manage risk to life from flood — whether the proposed activity is likely to result in unsustainable social and economic costs to the community as a consequence of flooding.	The proposal is not mapped within a coastal environment area (NSW DPHI, 2024), and as such is not expected to impact on coastal processes and coastal hazards. The proposal site is not mapped within flood liable land (NSW DPHI, 2024) and the proposal is not anticipated to affect flood behaviour. See Section 6.1 and 6.2 for assessment of potential impacts to riparian vegetation and section 6.4 and 6.5 for details of potential impacts from erosion and sedimentation.
The implications of flooding over the full range of potential flooding, including the probable maximum flood, should be considered as set out in the NSW Government Floodplain Development Manual and should include: — full details of the flood assessment and modelling undertaken in determining any design flood levels (if applicable), including the 1 in 100 year flood levels — sensitivity assessment of the potential impacts of an increase in rainfall intensity and runoff (10 per cent, 20 per cent and 30 per cent) and sea level rise on the flood behaviour for the 1 in 100 year design flood if applicable.	The proposal site is not mapped within flood liable land (NSW DPHI, 2024) and the proposal is not anticipated to affect flood behaviour.

Requirement	Where addressed in this REF
All site drainage, stormwater quality devices and erosion / sedimentation control measures should be identified and the onsite treatment of stormwater and effluent runoff and predicted stormwater discharge quality from the proposed activity should be detailed.	See Section 6.2.5 and 6.4.5 for management of erosion and sedimentation and mitigation measures for impacts to water quality.
Cumulative impacts	
The cumulative impacts, including both construction and operational impacts, from all clearing activities and operations, associated edge effects and other indirect impacts on cultural heritage, biodiversity and NPWS Estate in accordance with the EP&A Act.	See Section 6.1 for assessment of potential edge effects and indirect impacts on terrestrial ecology. See Section 6.14 for assessment of potential cumulative impacts of the proposal.
The cumulative impacts, including both construction and operational impacts, of the proponent's existing proposals and other proposals and associated infrastructure (such as access tracks etc.), as well as the cumulative impact of the proposed activity in the context of other proposals located in the vicinity.	See Section 6.14 for assessment of potential cumulative impacts of the proposal.

5.1.2.2 Transport for NSW

A consultation letter was sent to Transport on 10 October 2024. Transport – Maritime North provided a response on 26 November 2024 requesting a meeting to discuss aspects of the proposal with regard to approval requirements and impacts to the recreational use of Lake Pindari. A meeting was held on 29 November 2024, with representatives from Transport – Maritime North, WaterNSW and AssetReady. The meeting confirmed a maritime notice will be required for construction and operation of the proposal under Section 12 of the *Maritime Safety Act 1998* to give safety advice about potential hazards, special events and closures such as the aquatic exclusion zone. A maritime notice will be developed for the proposal prior to construction and operation in consultation with Transport – Maritime North.

5.1.2.3 NSW DPIRD Fisheries consultation

A consultation letter was sent to NSW DPIRD Fisheries on 10 October 2024. A response letter was received from NSW DPIRD Fisheries on 14 October 2024 (refer to Appendix C) (that outlined assessment requirements for potential impacts of the proposal to aquatic ecology from Chapter 3 of the *Policy and Guidelines for Fish Habitat Conservation and Management* (Fairfull, 2013)). Refer Table 5.3 for the aquatic ecology assessment requirements required by NSW DPIRD Fisheries and where they are addressed in this REF.

Table 5.3 Assessment requirements from NSW Department of Primary Industries and Regional Development Fisheries

Requirement	Where addressed in this REF
Recent aerial photograph (preferably colour), map or GIS of the locality which details the Key Fish Habitat of the development site, all habitats impacted by the development, and waterway classification (CLASS) as defined in Tables 1 and 2 of the *Policy and Guidelines for Fish Habitat Conservation and Management (2013).*	Refer Figure 6.3 in Section 6.2 for a map of the proposal impact area with KFH, habitats impacted by the development and waterway classification.
Location details of all temporary and permanent infrastructure and construction activities, such as pipelines, access tracks, mooring blocks, anchorages etc.	Refer Figure 1.3 for the impact area and features of the proposal including temporary and permanent, infrastructure, pipelines, access tracks, mooring blocks and anchorages. See Figure 1.4 and Figure 1.5 for an indicative cross section and holding down systems of the bubble plume destratification system in Lake Pindari.
Details of the location of all waterway structures and a timetable for construction of the proposal with details of various phases of construction.	See Figure 1.3 for the location of waterway structures. Refer to Table 3.1 details the staging of the construction phase of the proposal.
Mapping of the full aerial extent of Key Fish Habitat that will be impacted either directly or indirectly by the development and subsequent operation of the project, with impacted habitats clearly identified on recent aerial photographs, maps or GIS.	See Figure 6.3 in Section 6.2 for a map of the proposal impact area within KFH, habitats impacted by the development and waterway classification.
Description, quantification, and mapping of all aquatic and riparian vegetation communities potentially impacted by the development. This should include an assessment of the extent and condition of aquatic and riparian vegetation and the presence of significant habitat features (e.g. gravel beds, cobble beds, large woody debris, reed beds, rock bars, etc) within the dam. NSW DPIRD Fisheries requests information on the chosen pipeline alignment underwater, and the impacts of the pipeline, the 5 tonne mooring blocks and 200kg anchor blocks on any such habitat features.	Refer to Section 6.2.2 for a description of the existing environment within Lake Pindari. Refer to Section 6.2.3 and 6.2.4 for potential impacts of construction and operation of the proposal on aquatic ecology. See Figure 1.4 and Figure 1.5 for an indicative cross section and holding down systems of the bubble plume destratification system within Lake Pindari. Refer to Appendix J for the Issue for Tender design drawings.
Predicted impacts on water quality within and downstream of the dam as a result of the proposed development.	Refer to Section 6.2 and 6.4 for potential impacts of construction and operation of the proposal on water quality.

Requirement	Where addressed in this REF
Addressing the threatened species provisions of the *Fisheries Management Act 1994* for species, populations or communities listed under schedules 4 and 5 whose historical geographical distribution extends to the area of works.	Refer to Section 6.2 for provisions for threatened species under schedules 4 and 5 of the FM Act.
Development of mitigation measures during construction (e.g. Environmental Management Plans) and operation (e.g. Operational Management Plan) including monitoring of proposed mitigation measures and plans to confirm their effectiveness. Erosion and sediment mitigation devices are to be erected in a manner consistent with currently accepted Best Management Practice (i.e. Managing Urban Stormwater: Soils and Construction 4th Edition Landcom, 2004) to prevent the entry of sediment into the waterway.	Refer to Section 6.2.5 for safeguards and mitigation measures for potential impacts to aquatic ecology during construction and operation of the proposal. Refer to Section 6.4.5 for erosion and sediment control measures.

5.1.2.4 Crown Lands NSW

The proposal involves works within a Crown Lands waterway within Lake Pindari as well as Crown land. A notification letter was sent to Crown Lands NSW on 11 October 2024. Crown Lands requested further information regarding the proposal on 22 October 2024. After provision of further details, Crown Lands, confirmed the proposal does not require a licence to complete the works via email on 31 October 2024.

5.2 Community consultation

A Communication and Stakeholder Engagement Plan (CESP) (Appendix L) was prepared for the proposal by WaterNSW on 10 November 2024 to provide proactive communication and engagement activities that empower stakeholders through clear and consistent, values-based communications. The CESP identified key consultation stakeholders for the proposal including:

- recreational fishers
- NSW Task Force on Fish Passage
- Cold Water Pollution Interagency Working Group
- water customers/irrigators /agricultural corporations
- riparian landholders
- general public
- recreational fishing and boating groups
- NSW RFS
- Commonwealth Environment Water Office (CEWO)
- Murray Darling Basin Authority (MDBA).

Further stakeholders including key proposal implementation partners, and key proposal delivery stakeholders are detailed in the CESP (Appendix L).

Consultation activities proposed in the CESP include preparation of a website, factsheet, frequently asked questions (FAQs), media releases and announcements, social media posts, site signage and stakeholders briefings and notifications prior to construction. Proposed consultation activities during construction and operation include media releases, smoking ceremony and cultural heritage inductions, news informing on-going project updates, school tours for educational outcomes and a commissioning ceremony.

Aboriginal nations and communities in the Border Rivers region include the Kamilaroi/Gomeroi, Kambuwal, Githabul, Bigambul, Kwiambul and Ngarabal groups. Engagement activities for First Nations communities include, but are not limited to, the following:

- Education sessions – presentation of Fish Community Condition Assessments for each nation group including an overview of the impact of cold water pollution and the potential for mitigation and associated responses for water management and water quality.
- Pindari Dam MER Program – consult with First Nations groups to develop criteria to assess health of Totemic Species.
- Program updates – information sessions post cold water pollution implementation to detail changes in water quality and fish communities within respective regions and river reaches.

Further detail regarding objectives of the CESP and the approach and tools proposed to be used for community consultation are provided in Section 3 of the CESP (Appendix L).

5.3 Aboriginal community involvement

An Aboriginal Objects Due Diligence Assessment (Due Diligence Assessment) which followed the requirements set out by the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (Due Diligence Code) (NSW Department of Environment, Climate Change and Water (NSW DECCW), 2010) was completed by WaterNSW and Dharawal Environment and Heritage on 21 August 2024 (Appendix E). A field assessment was conducted on 19 July 2024 and was attended by representatives of WaterNSW and the Gomeroi People. The Aboriginal heritage study area (refer to Figure 2 and Plate 1 in Appendix E) lies within the Ashford Local Aboriginal Land Council (LALC) footprint and is under the Gomeroi Peoples Native Title land claim area.

No Aboriginal Heritage sites were identified during the field assessment in the Aboriginal Heritage study area. Due to the extensive historical disturbance associated with the construction of the dam wall and associated infrastructure, and considering previous archaeological investigations, there is low potential for Aboriginal Objects to remain in the Aboriginal Heritage study area.

6 Environmental assessment

6.1 Terrestrial biodiversity

This section summarises potential impacts on terrestrial biodiversity likely to occur during construction and operation of the proposal.

6.1.1 Method

A BAR was prepared by AssetReady on 15 January 2025 (refer to Appendix B) and is summarised in this section. Preparation of the BAR involved a desktop assessment using relevant databases and historical records, as well as a field survey assessment to verify biodiversity values.

6.1.1.1 Desktop assessment

The following databases and resources were searched or viewed:

- BioNet Atlas of NSW Wildlife – NSW Department of Planning and Environment (with a 10 kilometre buffer around the subject site) (July 2024)
- Commonwealth Protected Matters Search Tool – Department of Climate Change, Energy, the Environment and Water (with a 10 kilometre buffer around the subject site) (July 2024)
- review of broad-scale regional vegetation mapping projects (Oct 2024)
- NSW Flora Online (PlantNet) – The Royal Botanic Gardens and Domain Trust (Oct 2024)
- existing broad-scale vegetation maps of the local area (Oct 2024)
- Commonwealth Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE)
- Department of Primary Industries (Fisheries) – threatened species list (Oct 2024)
- areas of outstanding biodiversity value and critical habitat search (Oct 2024)
- Biodiversity Values Map (Oct 2024)
- NSW Environment, Energy and Science vegetation classification database (Oct 2024)
- NSW Environment, Energy and Science Threatened Biodiversity Data Collection (Oct 2024)
- NSW Sharing and Enabling Environmental Data portal including NSW Wetland Mapping (Oct 2024)
- preliminary and provisional determinations of threatened species and ecological communities listed under the BC Act were viewed from the NSW Threatened Species Scientific Committee web resources (Oct 2024)
- Annual Final Priority Assessment List of nominated species and ecological communities that have been approved for assessment by the Minister responsible for the EPBC Act (Oct 2024).

6.1.1.2 Likelihood of occurrence assessment

A likelihood of occurrence assessment, including habitat assessment, was undertaken on the identified list of threatened flora and fauna species known or predicted to occur within the locality.

The habitat assessment compared the preferred habitat features for threatened species with the type and quality of the habitats identified in the ecology study area. This habitat assessment was completed to assess the likelihood of the species being present in the ecology study area. The habitat assessment formed the basis for targeted surveys. Refer to Table 3.2 in Appendix B for the criteria used in the habitat assessment and Appendix A in Appendix B for the results of the habitat assessment.

6.1.1.3 Field survey

A field survey was carried out within the ecology study area as displayed in Figure 6.1 on 21 May 2024, by one WSP Ecologist and one Environmental Scientist. The survey sought to:

- assess the extent and condition of vegetation and fauna habitat at and immediately surrounding each site, especially for the threatened flora and fauna species
- identify biodiversity of concern (threatened species) to avoid and/or minimise impacts to biodiversity where practicable during the works and for ongoing maintenance into the future
- identify plant communities with potential to be consistent with threatened ecological communities listed under the NSW BC Act or Commonwealth EPBC Act.

The survey involved traversing the ecology study area on foot and recording the biodiversity values including recording flora species present for determining plant community types (PCTs) and any opportunistic sightings of threatened species or their habitat. Specifically, the survey included:

- mapping of PCTs and their condition during Random Meander and Rapid Data Point survey methods (refer to a definition of these methods below in Section 3.4.2 and 3.4.3 of the BAR)
- completing one BAM plot in a good condition area in accordance with the techniques outlined in the Biodiversity Assessment Method (BAM) (NSW Department of Planning, Industry and Environment (DPIE), 2020)
- determining the nature and condition of vegetation within the ecology study area
- random meanders throughout the ecology study area to identify and/or assess the likelihood of threatened species to occur in the ecology study area
- opportunistic observations of animals and signs of animal activity (e.g. feeding signs, scats) to verify the ecological values of the proposal site and facilitate habitat condition assessments
- fauna habitat assessments to record threatened species habitat features such as hollow bearing trees, nest trees within the ecology study area
- recording the GPS location of significant habitat features or threatened biodiversity identified.

Refer to Section 3.4 in the BAR (Appendix B) for detailed information of field survey methods and assessments.



wsp

PS122845
Pindari Dam bubble plume

Figure 6.1
Survey locations and results

Legend

- BAM Plot Location
- Construction compound and site facilities including accommodation
- Ecology Study Area - field verified
- Construction aquatic exclusion area
- Operational aquatic exclusion area
- Impact Area
- Study Area

Vegetation

- PCT 4151: Northwest White Pine-Silver-leaved Ironbark Forest
- PCT 3518: Northwest Pine-Ironbark Grassy Woodland
- Miscellaneous Ecosystem
- Area not to be Impacted



Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:8,000 Date: 19/12/2024

GDA 2020

© WSP Australia Pty Ltd (WSP) Copyright in the drawings, information and data recorded (The information) is the property of WSP. This document and the information are made by WSP solely for the use of the Authorised Recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that which it was prepared by WSP. WSP makes no representations, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording or by any information storage and retrieval system without the written permission of WSP Australia Pty Ltd.

6.1.2 Existing environment

The landscape context of the ecology study area is described in Table 6.1.

Table 6.1 Landscape context

Landscape context	Landscape features
Local Government Area	Inverell Shire Council
IBRA (Interim Biogeographic Regionalisation for Australia) bioregion	New England Tablelands
IBRA subregion	Severn River Volcanics
Local Land Service Region	Northern Tablelands
Mitchell Landscapes	Inverell Plateau Granites
Catchment	Border Rivers (NSW)
Rivers, streams and estuaries	The ecology study area encompasses the Severn River (including the Severn River dammed within Pindari Dam). Severn River intersects the study area latitudinally flowing from the east to the west, regulated by the Pindari Dam wall and spillway. Nearby waterways which flow into Pindari Dam include Scrub Hut Creek, Spring Creek, Ironbark Creek and numerous tributaries.
Important and local wetlands	No mapped important or local wetlands are present in the ecology study area.
Connectivity features	Lake Pindari is surrounded by a mixture of partially cleared and fragmented lands to the west and south-west and larger areas of remnant vegetation to east, forming Severn River Nature Reserve. Pindari Dam is bordered by fragmented areas of remnant vegetation to the north, east and south. In the locality of the ecology study area, remnant vegetation is dissected by cleared areas along Severn River and below (to the south-east of) the Pindari Dam wall, as well as within an overflow are to the north-west of the dam wall.
Areas of geological significance and soil hazard features	No areas of geological significance occur in the ecology study area. Soil reports nearby the study area did not report salting 'salinity' as present (NSW DPIE, 2024).
Geology and Soils	The ecology study area is mapped as being located within the rudosol soil classification (according to the Australian Soil Classification) (NSW DPIE, 2024).
Areas of outstanding biodiversity value	Areas of Outstanding Biodiversity Value are special areas with irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally which are declared by the Minister under the BC Act. Theare no Areas of Outstanding Biodiversity Value within the ecology study area.

6.1.2.1 Plant community types

The ecology study area consisted of patches of native woodland vegetation and exotic grassland around the margins of Lake Pindari. The narrow areas of native vegetation varied in condition from poor to moderate, with lower condition areas of woodland a result of previous disturbance and ongoing land use associated with Pindari Dam. Field validation surveys for PCTs were completed in the ecology study area.

Two PCTs were recorded within the ecology study area. These include:

- PCT 4151: Northwest White Pine-Silver-leaved Ironbark Forest
- PCT 3518: Northwest Pine-Ironbark Grassy Woodland

A map of PCTs observed within the ecology study area during the field survey is provided in Figure 6.1.

PCT 4151 – NORTHWEST WHITE PINE-SILVER-LEAVED IRONBARK FOREST

PCT 4151 is located in areas both to the northwest and south of the dam wall. The description of this PCT is based on one BAM plot undertaken on the western side of the dam wall (Refer to Figure 6.1). The dominant species within this PCT are provided in Table 6.2. Areas of PCT 4151 are considered to be in poor to moderate condition. The areas of this PCT contained within the proposed impact area are positioned along the edge of the dam construction, fringed by exotic grasslands (mapped as miscellaneous ecosystem). Previous clearing associated with the dam construction and the resulting long-term edge effects from the proximity of PCT 4151 to the dam construction have resulted in a reduced vegetation condition. Trees present include predominantly young trees, with some larger trees located south of the dam wall.

Table 6.2 Dominant plant species within areas mapped as PCT 4151

Layer	Dominant species
Upper-stratum (Trees)	*Eucalyptus dealbata, Eucalyptus crebra*
Lower stratum	*Olearia elliptica subsp. elliptica, Gaudium brevipes, Cassinia uncata*
Ground stratum	*Aristida ramosa, Aristida jerichoensis, Pimelea neo-anglica, Cheilanthes lasiophylla, Dichondra repens, Glycine clandestina, Oxalis perennans, Phyllanthus carpentariae, Geranium solanderi, Cyperus gracilis, Desmodium rhytidophyllum, Lagenophora stipitata, Melichrus urceolatus, Lomandra multiflora subsp. multiflora, Xanthorrhoea johnsonii*
Exotic species	*Hyparrhenia hirta, Eragrostis curvula*

PCT 3518 – NORTHWEST PINE-IRONBARK GRASSY WOODLAND

PCT 3518 is located in a very small area at the western end of the dam wall (Refer to Figure 6.1). The description of this PCT is based on the PCT profile from BioNet vegetation classification and observations during the field visit. No BAM plot was undertaken in this PCT. The dominant species within this PCT are provided in Table 6.3. No large trees are present within this PCT. Areas of PCT 3518 are considered to be in poor condition, with the canopy, mid-storey and shrub layer being mostly absent, and a very sparse groundcover containing a mixture of native and exotic species.

Table 6.3 Dominant flora species likely to occur within areas mapped as PCT 3518

Layer	Dominant species
Upper-stratum (Trees)	*Eucalyptus dealbata, Eucalyptus crebra*
Ground stratum	*Melichrus urceolatus, Leucopogon muticus, Aristida ramosa, Aristida jerichoensis, Cassinia laevis*
Exotic species	*Hyparrhenia hirta, Eragrostis curvula*

6.1.2.2 Threatened ecological communities

A BioNet search of the Inverell LGA identified 27 TECs, including eight EPBC Act listed and 19 BC Act listed TECs. The PMST search undertaken found four EPBC Act listed ecological communities that are known to occur in the locality. No EPBC Act listed ecological communities were recorded in the study area. The PCTs identified within the study area are not consistent with any TECs known to occur within Inverell LGA.

None of the dominant canopy species were present within the study area, which is associated to the TEC White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions. Therefore, the vegetation communities identified within the study area are no considered to be consistent with this TEC.

Regarding the Howell Shrublands TEC in the New England Tableland and Nandewar Bioregions, this community is associated with granitic outcrops and specific geological formations. The study area's geology is mapped as Emmaville Volcanics (Pfwe), which is not associated with granitic outcrops. Additionally, the characteristic shrub species *Homoranthus prolixus* and *Babingtonia densifolia* were not recorded. Although Eucalyptus dealbata, which can occur in a modified version of this TEC, was identified, the absence of granitic outcrops and characteristic shrub species indicates that the vegetation within the study area is not consistent with this TEC.

6.1.2.3 Threatened flora species

Database searches for records of threatened flora species were undertaken for an area of approximately 10 kilometres radius centred over the ecology study area. The database searches results identified 38 threatened flora species records from a BioNet search and PlantNet area search and, 23 EPBC Act listed threatened flora species from a PMST search.

The following threatened flora species (the assessed species) are considered to have at least a moderate or greater likelihood of occurring within the ecology study area (with BC Act and EPBC Act listing category provided in brackets):

- *Acacia acrionastes* (Pindari Wattle) (E/-)
- *Acacia macnuttiana* (MacNutt's Wattle) (V/V)
- *Astrotricha roddii* (Rodd's Star Hair) (E/E)
- *Callistemon pungens* (-/V)
- *Indigofera baileyi* (Bailey's Indigo) (E/-)
- *Polygala linariifolia* (Native Milkwort) (E/-)
- *Thesium australe* (Austral Toadflax) (V/V).

These threatened flora species are known to occur within the Glenn Innes, Inverell and Tarrington Station Conservation Areas and the generally region of the ecology study area, some of which including recorded individuals closer to Pindari Dam. The closest of these is the Pindari Wattle found within the Severn River Nature Reserve and also along the peninsula of Pindari Dam approximately 600 metres from the study area. No threatened flora species were observed in the ecology study area during surveys conducted as part of the field survey.

This survey was undertaken outside of the optimal and / or recommended survey period (provided in brackets) for the following threatened flora species:

- *Acacia acrionastes* (July to September)
- *Acacia macnuttiana* (August to September)
- *Callistemon pungens* (September to February)
- *Indigofera baileyi,* (November to February)
- *Thesium australe* (November to February).

Despite the surveys being undertaken outside of their recommended survey periods, no specimens from any of the above genus were observed within the study area. Given that no specimens were observed and the small size of the proposed impact area, it is considered that any individuals present within the impact area are likely to be in low numbers.

A detailed assessment of significance for the assessed threatened flora species under both the BC Act and EPBC Act is provided in Appendix C and D respectively of the BAR (Appendix B). An assessment of the likelihood of occurrence of threatened species is provided in Appendix A of the BAR (Appendix B).

6.1.2.4 Threatened fauna species

Database searches for records of threatened fauna species were undertaken for an area of approximately 10 kilometres radius centred over the ecology study area. The database searches results identified 18 threatened fauna species records from a BioNet search and 34 EPBC Act listed threatened fauna species from a PMST search.

The following threatened fauna species are considered to have at least a moderate or greater likelihood of occurring within the ecology study area (with BC Act and EPBC Act listing category provided in brackets):

- *Anthochaera phrygia* (Regent Honeyeater) (CE/CE) – July to January
- *Artamus cyanopterus cyanopterus* (Dusky Woodswallow) (V/-) - Spring
- *Chthonicola sagittata* (Speckled Warbler) (V/-) – August to January
- *Climacteris picumnus victoriae* (Brown Treecreeper) (V/V) – July to February
- *Daphoenositta chrysoptera* (Varied Sittella) (V/-) – anytime but mostly May to June
- *Geophaps scripta scripta* (Squatter Pigeon (southern sub-species) (CE/V)
- *Glossopsitta pusilla* (Little Lorikeet) (V/-)
- *Haliaeetus leucogaster* (White-bellied Sea-eagle) (V/-)
- *Hieraaetus morphnoides* (Little Eagle) (V/-)
- *Melanodryas cucullata cucullata* (South-eastern Hooded Robin) (E/E)
- *Neophema pulchella* (Turquoise Parrot) (V/-)
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler – eastern subspecies) (V/-)
- *Stagonopleura guttata* (Diamond Firetail) (V/V)
- *Dasyurus maculatus* (Spotted-tailed Quoll) (V/E)
- *Phascolarctos cinereus* (Koala) (E/E).

An assessment of potential habitats for threatened fauna species was undertaken during the field survey, however no detailed targeted surveys were undertaken. These fauna species are known to occur in the locality, with BioNet records of all of the above species, with the exception of Squatter Pigeon, occurring within close proximity to Lake Pindari. No threatened fauna species were recorded during surveys. A list of common fauna species recorded is available in Appendix E of the BAR (Appendix B).

Habitats within the ecology study area consist of predominantly younger trees with limited shrub or ground cover habitats, a moderate cover of surface rocks and limited litter cover or fallen logs. Flowering trees provide limited foraging habitat for woodland birds while the ground habitats are likely to provide suitable habitat for common reptile species.

No stick nests, smaller nests or tree hollows were observed during surveys and given the sparse densities of shrubs and ground covers observed and the absence of larger trees around the dam edge, it is considered that the ecology study area provides predominantly foraging habitats and is unlikely to provide potential nesting opportunities.

Despite the absence of nests and potential nesting hollows, the site visit was undertaken in May, prior to the majority of the woodland bird breeding activity, which generally starts from June (with the exception of Little Lorikeet and Squatter Pigeon) and continues through to February for some species. A list of the assessed bird species and their breeding seasons is as follows:

- *Anthochaera phrygia* (Regent Honeyeater) – July to January
- *Artamus cyanopterus cyanopterus* (Dusky Woodswallow) - September
- *Chthonicola sagittata* (Speckled Warbler) – August to January
- *Climacteris picumnus victoriae* (Brown Treecreeper) – July to February
- *Daphoenositta chrysoptera* (Varied Sittella) – June to April
- *Geophaps scripta scripta* (Squatter Pigeon (southern sub-species) - anytime but mostly May to June
- *Glossopsitta pusilla* (Little Lorikeet) – May to September
- *Haliaeetus leucogaster* (White-bellied Sea-eagle) – June to September
- *Hieraaetus morphnoides* (Little Eagle) - September
- *Melanodryas cucullata cucullata* (South-eastern Hooded Robin) – July to November
- *Neophema pulchella* (Turquoise Parrot) – August to December
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler – eastern subspecies) – July to February
- *Stagonopleura guttata* (Diamond Firetail) – August to January.

The specific microhabitats required by other threatened fauna species are either absent from the ecology study area itself, or the microhabitats within the ecology study area are degraded to the point that the species is unlikely to occur in the ecology study area. This indicates the habitat is significantly altered and degraded to a point where there are no resources that would sustain a resident population and nor would any of the species rely upon this habitat for survival. Some threatened species may visit the ecology study area on rare occasion during dispersal, or as vagrants, but the likelihood of occurrence of most threatened fauna species in the ecology study area is low.

A detailed assessment of significance for the assessed threatened fauna species under both the BC Act and EPBC Act is provided in Appendix C and D respectively of the BAR (Appendix B). An assessment of the likelihood of occurrence of threatened species is provided in Appendix A of the BAR (Appendix B).

MIGRATORY SPECIES

The results of the PMST indicate that 11 listed migratory species may occur in the locality. These species include a number of migratory wetland birds that do not have any habitat within or near the ecology study area so have been excluded from the assessment. It is considered that dam habitats are unlikely to provide suitable habitat for migratory birds due to the steep slopes at the fringes of the dam and resulting absence of shallow and / or wading and foraging areas.

While some migratory species of bird could potentially use the ecology study area and locality, the ecology study area would not be classed as an 'important habitat'. A nationally significant proportion of a population of migratory birds would not be supported by the habitats in the ecology study area. The proposal will not substantially modify, destroy, or isolate an area of important habitat for the migratory species, and it will not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds.

6.1.2.5 Weeds

Two exotic plant species, *Hyparrhenia hirta* (Coolatai Grass) and *Eragrostis curvula* (African lovegrass) were present throughout within the ecology study area. These species are not listed under the *Biosecurity Act 2015* as priority weeds (NSW DPI, 2024) or as Weeds of National Significance (WONS) (Weeds Australia, 2024). Both species have a General Biosecurity Duty for all of NSW to prevent, eliminate or minimise any biosecurity risk so far as reasonably practical.

6.1.2.6 Riparian areas and key fish habitat.

Riparian areas occur outside the ecology study area, downstream of the dam. These areas are outside of the scope of this report but were assessed as part of the Aquatic Ecology Assessment (AEA) undertaken by H20 Consulting Group. A detailed assessment of riparian habitats located along the downstream sections of Severn River are provided in Section 3.3 of the AEA.

Investigations were conducted by H20 Consulting Group as part of the AEA to verify KFH across the aquatic ecology study area, resulting in the identification of Type 1 and Type 2 KFH within both Severn River and Scrub Hut Creek. A summary of KFH is provided in Section 3.3.4 of the AEA.

An assessment of significance for threatened fish listed under the FM Act and EPBC Act has been completed as part of the AEA. Refer to Section 4.7.1 and Appendix 4 of the AEA

6.1.3 Potential impacts – construction

Potential impacts to terrestrial ecology from construction of the proposal are summarised in the following section. The proposal will result in direct removal of approximately 0.63 hectares of native vegetation which will likely to impact upon only limited areas of potential foraging habitat for the assessed species.

6.1.3.1 Impacts on native vegetation

The proposal will result in the direct removal of approximately 0.63 hectares of native vegetation. A summary of predicted impacts to native vegetation is provided in Table 6.4. Broad condition classes provided below are based on visual estimates of vegetation condition with guidance from BAM plot data.

Table 6.4 Potential impacts to native vegetation

PCT ID No.	PCT name	Broad condition class	Direct vegetation removal (hectares)
4151	North White pine-silver-leaved Ironbark Forest	Poor to moderate	0.6007
3518	Northwest Pine-ironbark grassy woodland	Poor	0.0246
Total native vegetation impacts			**0.6253**

6.1.3.2 Threatened ecological communities

No threatened ecological communities were identified within the ecology study area.

6.1.3.3 Threatened species

The ecology study area is considered to provide potential habitat for seven threatened flora species and 15 threatened fauna species.

A total area of 0.63 hectares of native vegetation is proposed to be impacted, including 0.6 hectares of PCT 4151 and 0.02 hectares of PCT3518. These areas of habitat within the ecology study area consist of predominantly younger trees with limited shrub or ground cover habitats, a moderate cover of surface rocks and limited litter cover or fallen logs. No stick nests, smaller nests or tree hollows were observed during surveys and given the sparse densities of shrubs and ground covers observed and the absence of larger trees around the dam edge, it is considered that the ecology study area provides predominantly foraging habitats and is unlikely to provide potential nesting opportunities. Therefore, the proposal is likely to impact upon only limited areas of potential foraging habitat for the assessed species.

An assessment of the likelihood of occurrence of threatened species is provided in Appendix A of the BAR (Appendix B). A detailed assessment of significance for the assessed threatened fauna species under both the BC Act and EPBC Act is provided in Appendix C and D of the BAR (Appendix B) respectively.

6.1.3.4 Injury and mortality of fauna

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing will occur. The extent of this impact will be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground dwelling reptiles and frogs), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microchiropteran bat species), may find it difficult to rapidly move away from the clearing when disturbed.

Wildlife may also become trapped in or may choose to shelter in machinery that is stored in the ecology study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use. Detailed safeguards and mitigation measures are provided in Table 6.5.

6.1.4 Potential impacts – indirect and operational

Potential indirect and operational impacts to terrestrial ecology from the proposal are summarised in the following section and below:

- potential spread of weed species as the ecology study area contains significant weed growth, and no undisturbed weed free habitat exists
- potential for dispersal or importation of pathogens from earthworks, movement of soil, and attachment of plant matter to vehicles machinery.

6.1.4.1 Wildlife connectivity and habitat fragmentation

Habitat fragmentation relates to the physical dividing up of once continuous habitats into separate smaller fragments. Lake Pindari is surrounded by a mixture of partially cleared and fragmented lands to the west and south-west and larger areas of remnant vegetation to east, forming the Severn River Nature Reserve. In the locality of the ecology study area, remnant vegetation is dissected by cleared areas along the Severn River and below (to the south-east of) the Pindari Dam wall, as well as within an overflow are to the north-west of the dam wall.

The proposal will impact approximately 0.63 hectares of native vegetation predominantly along the edges of the existing dam wall and banks and will not dissect any large patches of native vegetation. Therefore, the proposal is unlikely to impact upon local vegetation connectivity or potential movement corridors. This impact will be of low magnitude and mitigation measures are not deemed necessary.

6.1.4.2 Edge effects on adjacent native vegetation and habitat

The proposal will impact approximately 0.63 hectares of poor to moderate condition native vegetation along a linear area positioned mostly at the edges of the existing dam wall, dam banks and exotic grassland with the exception of a small section to the north which dissects a small area of poor to moderate condition PCT 4151.

Linear infrastructure, such as that proposed, is known to cause disturbance in terms of reducing habitat quality in adjacent areas. This is due to the greater potential for edge effects and habitat fragmentation and barrier effects due to the high perimeter to area ratio of linear developments. The proposal is a linear development however given the position of the proposal being mostly adjacent to existing disturbed areas, with existing edge effects, it is considered that the proposal is unlikely to result in any significant increase in edge effects on adjacent native vegetation and habitats.

This impact will be of low magnitude and mitigation measures are not deemed necessary.

6.1.4.3 Invasion and spread of weeds

Proliferation of weeds is an indirect impact that is likely to occur during construction and operation of the proposal, although impacts will be greatest because of vegetation clearing during the construction phase. The most likely causes of weed dispersal and importation include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery.

The ecology study area contains significant weed growth, and no undisturbed weed free habitat exists. As such, weeds must be managed during construction. The presence of some high threat weeds may require careful management to ensure spread of these species is limited.

6.1.4.4 Invasion and spread of pathogens and disease

Three pathogens known from NSW are listed as a key threatening process under either the EPBC Act and/or BC Act including:

- dieback caused by Phytophthora (Root Rot; EPBC Act and BC Act)
- infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and BC Act)
- introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (BC Act).

The potential for pathogens to occur should be treated as a risk during construction. The most likely causes of pathogen dispersal and importation include earthworks, movement of soil, and attachment of plant matter to vehicles and machinery during construction and operation.

6.1.5 Assessment of impact significance

An Assessment of Significance has been conducted for threatened species that are considered to have at least a moderate or greater likelihood of occurrence within the ecology study area (Refer to Section 6 of the BAR (Appendix B). The proposed works will be assessed under Part 5 of the EP&A Act. Assessments of significance, in accordance with Section 7.3 of the BC Act, have been completed for threatened flora and fauna that may be impacted by the proposal. Section 7.3 BC Act assessments of significance are provided in Appendix C of the BAR (Appendix B).

For threatened biodiversity listed under the EPBC Act (Refer to Section 6 of the BAR (Appendix B), significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (NSW Department of the Environment, 2013).

The EPBC Act assessments of significance are provided in Appendix C and Appendix D of the BAR (Appendix B).

Given the implementation of recommended safeguards and mitigation measures (Refer to Table 6.5), it is considered that a significant impact is unlikely.

6.1.6 Safeguards and mitigation measures

Table 6.5 summarises recommended safeguards and mitigation measures that will be implemented to reduce impacts on biodiversity during construction and operation of the proposal.

Table 6.5 Biodiversity safeguards and mitigation measures

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Biodiversity	Pre-clearing checks for fauna and nests are to be undertaken immediately prior to the clearing of vegetation. Any fauna or nests observed are to be managed in consultation with the project ecologist.	Project manager/ project ecologist	Pre-construction
Biodiversity	An appropriate Erosion and Sediment Control Plan (ESCP) is to be prepared with consideration for the following: — on-site water management to reduce erosion and sedimentation and potential pollution of adjoining areas of native vegetation, watercourses and management of stormwater and dam water during periods of high rainfall — run-off or unplanned overflows from construction must be retained in water quality basins or an appropriate alternative Diverting run-on water from disturbance works occurring on upslope land, using non-erosive methods — installing protective measures to prevent sheet erosion where large portions of soil will be exposed. Construction of sediment filters or sediment retention traps where appropriate, particularly below fill batters near waterways.	Project manager/ contractor	Pre-construction
Biodiversity	Trees will be protected in accordance with the requirements of the Australian Standard 4970-2009 for the Protection of Trees on Development Sites.	Project manager/ contractor	Pre-construction
Biodiversity	Accurately and clearly mark out the limits of the work zone, areas for parking and turning of vehicles and plant equipment prior to commencement of works. These areas shall be located so that vegetation disturbance is minimised, and the drip-line of trees avoided.	Project manager/ contractor	Pre-construction
Biodiversity	Materials, plant, equipment, work vehicles and stockpiles will be placed to avoid damage to surrounding vegetation and will be outside tree drip-lines.	Contractor	Construction
Biodiversity	Machinery is to be inspected for fauna prior to starting each day. Wildlife may become trapped in or may choose to shelter in machinery that is stored in the ecology study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.	Contractor	Construction
Biodiversity	If any damage occurs to vegetation outside of the nominated work area (as shown in the CEMP), the Environmental Representative will be notified so that appropriate remediation strategies, such as revegetation, can be developed.	Contractor	Construction

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Biodiversity	Erosion and sediment controls will remain in place until all soil stabilisation has been completed.	Contractor	Construction
Biodiversity	Construction crews will be made aware that any native fauna species encountered must be allowed to leave site without being harassed and WIRES must be called for assistance where necessary.	Contractor	Construction
Biodiversity	If any threatened or native species (flora or fauna) are discovered during the works, all work will stop immediately, and the Environmental Representative will be notified. Work will only recommence once the impact on the species has been assessed and appropriate control measures provided. A Construction Site Plan will be prepared as part of the CEMP to show the: — no go areas and boundaries of the work area/disturbance corridor — locations of parking, lay-down and storage areas for materials, plant and stockpiles. — location and full extent of any lopping, trimming, clearing or other vegetation disturbance required for the works.	Contractor	Construction
Biodiversity	All vehicles driving to and from site should follow a protocol to prevent the spread or introduction of pathogens such as phytophthora and chytrid, namely vehicles should be clean, including the tyres and any equipment.	Contractor	Construction
Biodiversity	Weed control will be undertaken by suitably qualified and/or experienced, licenced sub-contractors in accordance with contemporary bush regeneration practices. This may include: — manual weed removal in preference to herbicides — replacing non-target species removed/killed as a result of weed control activities — protecting Non-target species from spray drift — using only herbicides registered for use within or near waterways for the specific target weed — applying herbicides during drier times when the waterway level is below the high-water mark — not applying herbicide if it is raining or if rain is expected — mixing and loading herbicides and cleaning equipment away from waterways and drains.	Project manager	Construction and operation
Biodiversity	Manage priority weeds in accordance with the requirements of the *Biosecurity Act 2015*, if found, including disposal off-site in sealed bags to a licenced waste disposal facility.	Project manager	Construction and operation
Biodiversity	All weeds, propagules, other plant parts and/or excavated topsoil material that is likely to be infested with weed propagules that are likely to regenerate will be bagged, removed from site and disposed of at a licenced waste disposal facility.	Project manager	Construction and operation

6.2 Aquatic biodiversity

This section summarises the potential impacts to aquatic biodiversity likely to occur during construction and operation of the proposal.

6.2.1 Method

An Aquatic Ecology Assessment (AEA) was prepared by H2O Consulting Group (refer to Appendix D). The AEA involved a desktop review as well as a site investigation. The aquatic ecology study area included the first two kilometres of the Severn River downstream of Pindari Dam wall and outlets, including lower Scrub Hut Creek and associated riverbanks. Refer Figure 6.2 for the aquatic ecology study area.

6.2.1.1 Desktop review

The desktop review involved searches of the following databases and mapping tools:

- BioNet, Atlas of NSW Wildlife (last 20 years)
- EPBC Act Protected Matters Search Tool (PMST)
- NSW DPIRD Fisheries Threatened Species Lists (NSW DPIRD, 2024)
- Atlas of Living Australia (ALA) (FM Act listings only)
- NSW DPIRD Fisheries Spatial Data Portal (Key Fish Habitat, Freshwater Fish Community Status, and Threatened Freshwater Fish Species) (NSW DPIRD Fisheries, 2024)
- Sharing and Enabling Environmental Data in NSW Map (SEED Map) (Mapping of freshwater wetlands) (NSW Government and NSW DCCEEW 2010)
- aerial imagery from 2023 and 2024 (Nearmap, 2024).

An approximate 10 kilometre radius around the aquatic ecology study area was used for searches to identify threatened biodiversity, migratory species and MNES that may potentially occur at the locality. Existing ecological research conducted at Lake Pindari was also reviewed in the desktop assessment including the following studies:

- summary data to date from the Pindari Dam MER program (NSW DPIRD, 2024a), specifically:
  - water quality and algal assessment within Pindari Dam – by University of New South Wales (UNSW) Water Research Laboratory (WRL) and University of Technology Sydney (UTS)
  - riverine temperature, water quality and algae assessment – by UTS
  - riverine fish population and physiological monitoring – by NSW DPI Fisheries
- Pindari dam fish monitoring project (Wilson and Ellison, 2010) – prepared for the NSW Office of Water.

6.2.1.2 Site investigation

A site investigation was conducted of the first two kilometres of the Severn River downstream of Pindari Dam wall. The site investigation included an inspection and description of the general habitat, creek bank flora and fauna, and subtidal flora and fauna that was visible from the banks within and adjacent to the aquatic ecology study area.

Targeted surveys were conducted at three sites along the Severn River at 500 metres (Site 1), one kilometre (Site 2) and two kilometres (Site 3) downstream of Pindari Dam wall (refer Figure 6.2). A visual assessment of the riparian zone was undertaken at each site along a 50 metre stretch of the river bank. The riparian assessment is derived from the AUSRIVAS riparian protocols (Parsons et al., 2001), including physical characteristics of the stream, site observations, substrate description, stream features, disturbances, riparian characteristics and composition and observable macrophytes.

A qualitative water quality assessment was undertaken at each site along a 50 metre stretch of the river bank. The assessment comprised of characterisation of stream size, water level, visual water quality, presence of algae and surface films and description of any aquatic macrophytes.

6.2.1.3 Threatened species assessment

The threatened species assessment was undertaken through a desktop review of 'sightings', assessment of the habitat in the aquatic ecology study area, and determination of the likelihood of occurrence of each species using the criteria outlined in Table 2 of the AEA (Appendix D). Species with a moderate or higher likelihood of occurrence with potential of being impacted were assessed further through the 5 / 7 Part Test and/ or Impact Assessment criteria processes.

6.2.1.4 Limitations

Limitations for assessment of aquatic ecology in the AEA (see Section 2.5 in Appendix D) include:

- threatened species sightings searches, with the exception of fish, were limited to sightings data within BioNet (from the last 20 years)
- more current sightings data may be available for some species, following threatened species searches undertaken in July 2024
- fauna surveys (unless otherwise specified) were limited to the assessment of habitat values and other opportunistic observations
- numerous threatened species of fauna are seasonal in geographical distribution and/or may be transient in nature
- site investigations were limited to visual and qualitative observations within the aquatic ecology study area, as a representative portion of the larger expected impact area in Severn River downstream of Pindari Dam
- quantitative and detailed studies conducted to June 2024 as part of the Pindari Dam MER Program (NSW DPIRD, 2024a) were considered sufficient to inform the existing ecological and environmental conditions in the Severn River and Pindari Dam for this assessment.



wsp

PS122845
Pindari Dam bubble plume

Figure 6.2
Aquatic ecology study area

6.2.2 Existing environment

6.2.2.1 Existing ecological mapping

Mapping of freshwater fish communities indicates that the Severn River, both upstream and downstream of Pindari Dam, has a 'fair' freshwater fish community status. However, Lake Pindari itself has a 'poor' status, due to the barrier in fish passage (NSW DPIRD, 2024a). Additionally, three threatened freshwater fish species have indicative distribution mapping that passes through the aquatic ecology study area along the Severn River, including the Silver Perch (Bidyanus bidyanus), Southern Purple Spotted Gudgeon (Mogurnda adspersa) and Eel Tailed Catfish (Tandanus tandanus) (NSW DPIRD, 2024a).

6.2.2.2 Threatened biodiversity and Protected Matters

The desktop review of BioNet, the FM Act List of Threatened Species and the EPBC Act PMST identified the following aquatic ecological matters which were considered threatened and required further consideration:

- one freshwater turtle
- three freshwater fish
- two freshwater Endangered Populations
- one Endangered Ecological Community (EEC).

Refer to Table 3 in the AEA (Appendix D) for a summary of all threatened species considered, along with their likelihood of occurrence within the aquatic ecology study area and potential to be impacted.

6.2.2.3 Review of existing research

The following information is a review of the existing data collected to date as part of the Pindari Dam MER Program (NSW DPIRD, 2024a).

STRATIFICATION DYNMIACS – PINDARI DAM

Pindari Dam exhibited strong thermal stratification between October 2023 and April 2024, with the most pronounced temperature differentials (up to 20 degrees Celsius) occurring during summer. Oxygen stratification was identified to occur within the dam. Dissolved oxygen levels were near saturation at the surface, while anoxic conditions were present in the hypolimnion (lower, cooler layer of water at the bottom of the lake) for the entire study period between October 2023 and May 2024.

COLD WATER POLLUTION – SEVERN RIVER

Water temperatures downstream of Pindari Dam were colder than upstream reaches during spring, summer, and autumn, evidencing the presence of cold water pollution in the Severn River. The mean daily water temperatures downstream of the dam were approximately 10 degrees Celsius colder than upstream. The magnitude of cold water pollution was found to be greater during the day than at night. The downstream recovery distance (the distance at which the modelled mean daily temperature reached that which was recorded upstream of the dam) occurred 82 kilometres downstream, noting that the upstream reference site is 438 metres higher in altitude.

ALGAL BLOOM FORMATION, POSITION IN WATER COLUMN AND TRANSPORT

The concentration of chlorophyll a was variable, but typically higher in warmer months. Increased concentrations were recorded in surface waters compared to bottom waters. Cyanobacteria dominated surface water communities, maintaining its position in the water column throughout the study period. Another potentially toxic cyanobacteria species, *Dolichospermum crassum* was only present in April and May of 2023.

Cell concentrations of cyanobacteria in the water column were generally followed a gradient corresponding to the typical thermocline (the transition layer located between the warm water above and cool water below) of the dam.

In the cooler months, the concentration of chlorophyll a downstream was generally similar to that upstream of the dam. However, between December 2023 and April 2024, chlorophyll a concentrations were over two times greater downstream of the dam. While concentrations of cyanobacteria were generally low downstream of the dam, in October and November of 2023, *D. circinale and M. aeruginosa* were detected at high concentrations. This finding suggests that cyanobacteria are entraining into the hypolimnion, or the depth of the outlet is approaching the epilimnion (upper, warmer layer of water near the surface of the lake) or thermocline.

NUTRIENT AND METAL RELEASE AND TRANSPORT

Within the dam, concentrations of oxidised nitrogen were variable but remained below 120 micrograms per litre throughout the study. These concentrations are substantially above the ANZECC guideline for reservoirs of 10 micrograms per litre. Ammonia concentration exhibited a trend of increasing concentration in bottom waters over the sampling period, with significantly higher concentrations recorded in bottom waters compared to surface waters indicating nutrient release from sediments on the dam floor.

Phosphorous concentrations were also higher in bottom waters (approximately 75-100 micrograms per litre) compared to surface waters (less than 70 micrograms per litre), exceeding the ANZECC guideline of five micrograms per litre. These results suggest that phosphorous is released from sediments during periods of thermal stratification, potentially as a result of anoxic reduction processes at the sediment-water interface on the dam floor.

Analysis of metal concentrations in the dam found a general trend of increasing Manganese concentration in bottom waters over time and higher concentrations of manganese and iron in bottom hypolimnion waters than surface waters, reflecting anoxic and reducing processes.

Downstream of the dam, NOx (nitrogen dioxide, nitrous acid and nitric acid) concentrations were, on average, greater than levels recorded in the hypolimnion of the dam, and much greater than concentrations recorded upstream of the dam. Ammonia concentrations downstream were lower than those recorded in the hypolimnion, and similar to that of the upstream site.

The concentration of phosphorous at the site downstream of the dam resembled that in the hypolimnion of the dam at around 100 micrograms per litre but was notably higher than the upstream site (20 micrograms per litre). Likely reflecting the uptake of nutrients by microorganisms, a trend of decreasing nutrient concentrations with distance downstream from the dam was observed.

Compared to sites upstream, manganese and iron concentrations were higher downstream of the dam but were lower than concentrations recorded in the hypolimnion. The concentration of these metals decreased with distance from the dam downstream, potentially as a result of uptake, chemical change, sedimentation, dilution and/or flushing.

COLD WATER POLLUTION IMPACTS ON PRIMARY PRODUCTION (SEVERN RIVER)

The concentration of planktonic chlorophyll a in Severn River exhibited considerable temporal variation and was not significantly different from the reference rivers. A trend of increasing chlorophyll a with distance downstream was observed, likely due to increasing phytoplankton growth downstream. Benthic chlorophyll a was also variable but was generally similar to reference rivers. Water temperature also influences the nutrient cycle, including both primary production and the decomposition of organic matter, with warmer temperatures typically supporting higher rates of metabolic activity and photosynthesis (Bonacina et al, 2023)(H20, 2024).

COLD WATER POLLUTION IMPACTS ON INVERTEBRATE PRODUCTION AND COMMUNITY COMPOSITION (SEVERN RIVER)

Overall, zooplankton abundance was lower in Severn River compared to the reference sites. The lowest abundance was observed 38 kilometres downstream from the dam in December of 2023, with an average of 8.3 individuals per cubic metre. The zooplankton community in the Severn River was dominated by Cladocera taxa (mainly *Chydorus spp*. and *Bosmina spp.*) with the general absence of copepods noted, except during March and May 2024 when water temperatures exceeded 20 degrees Celsius.

Macroinvertebrate community assemblage in the Severn River was found to differ significantly from the Mole River, which was considered a reference river in the study. The taxa contributing to the biggest differences included mayfly taxa (*Leptophlebiidae, Baetidae, and Caenidae*), diptera taxa (*Chironomidae and Simuliidae*), and tricopteran taxa (*Hydropsychidae*). In other systems, cold water pollution has been associated with declines in macroinvertebrate abundance. However, there is currently insufficient data to determine the influence of temperature on macroinvertebrate communities in this system.

FISH COMMUNITIES

Fish communities were assessed using electrofishing boat surveys conducted in 2023 and 2024. Nine fish species were captured in the Severn River, compared to 14 at the reference sites (see Table 4 in the AEA in Appendix D), despite double the sampling effort within the Severn River. However, catch rates of certain large-bodied native fish were higher from the Severn River, including Eel-tailed Catfish and Silver Perch, although several species including Bony Herring were not observed during surveys within the Severn River. The abundance and richness of small-bodied fish were limited in Severn River, with Carp Gudgeon being the only species recorded, compared to a diverse assemblage of small-bodied fish present at the reference sites. The Olive Perchlet, Southern Purple-spotted Gudgeon, and Un-specked Hardyhead exhibited considerably higher catch rates at the reference sites (in the Mole River and Severn River upstream of Pindari Dam), demonstrating a potential sensitivity to cold water pollution.

The water temperatures in the Severn River did not consistently meet the requirements of local fish communities for spawning and reproduction during the 2022/2023 breeding season. Temperatures were suitable for several species in the beginning of the breeding season. However, in January, a cold shock event led to a decrease in temperature from 23 degrees Celsius to 15 degrees Celsius, which was sustained until late March. This event had the potential to cause mortality of new recruits of some species. Suitable temperatures for spawning were not met for the Eel-tailed Catfish or Un-specked Hardyhead at any point in the breeding season upstream of and at this site (four kilometres downstream of Pindari Dam). The 2023/2024 breeding season was marked by significant temperature fluctuations of up to eight degrees Celsius. Compared to reference sites, the number of suitable spawning days in the Severn River was considerably lower, with up to 75 per cent less suitable days for some species. This trend was consistent for small and large-bodied native fish.

Young of Year (fish born within the past year) native and introduced fish were detected in small numbers in the Severn River during targeted surveys in March of 2024. No Silver Perch or Golden Perch Young of Year were identified during surveys, suggesting a potential lack of successful recruitment for these species during the prior breeding period. In the 2024 surveys, only mature Eel-tailed Catfish were recorded, providing no evidence for recent recruitment. The Murray Cod, however, displayed a diverse size structure across all locations. Some Young of Year Murray Cod were also observed in the Spring 2023 sampling event, suggesting shifts in the species reproductive timing, with the spawning window typically from September to December. This trend indicates delayed growth rates or late spawning outside the expected window, however, may also reflect the regular stocking of Murray Cod in the study zone, which is likely to confound the use of this index.

Refer to Section 3.2 of the AEA (Appendix D) for further information on existing research from the Pindari Dam MER Program.

6.2.2.4 Description of habitat and biota

The Severn River downstream of Pindari Dam receives flow from the high- and low-level outlets, on the south-eastern and north-western ends of the dam wall respectively, and from the full supply level spillway at the north-western end of the dam wall. Additional flow enters the Severn River at the confluence of Scrub Hut Creek, approximately 275 metres downstream of the dam wall. Scrub Hut Creek drains from the south-east, with its headwaters in the Severn River National Park stretching over 13 kilometres (straight line distance) to the south-east and has an altitude up to 250 metres above the altitude at the confluence. The high-level flows from Pindari Dam and a number of seepage weirs discharge into the most downstream section of Scrub Hut Creek just before its confluence with Severn River (See Plate 1 in the AEA).

On the southern side of the Severn River, the adjoining habitat is arid, with a thin line of riparian vegetation close to the riverbank. On the northern bank of the river, land is moderately vegetated by canopy species between the riverbank and the bedrock spillway. The spillway is comprised of predominantly barren bedrock and rocky rubble and provides minimal stable aquatic habitat. The top of the spillway comprises a large, flat bedrock area and is largely unvegetated, with the exception of a small area of highly disturbed native vegetation directly adjacent to the northern end of the dam wall.

SITE 1

Located approximately 500 metres downstream of the confluence of Scrub Hut Creek with the Severn River, at the location where overspill flow will discharge into the river from the Pindari Dam spillway. The riverbanks at Site 1 are comprised of hard substrata, with the southern bank predominantly consisting of extensive bedrock and the northern bank consisting of a combination of bedrock, boulder, cobble and pebbles. Some instream large boulders exist just downstream of Site 1, creating some small riffle habitat. Stream width at the time of survey varied between approximately 12 to 30 metres, with an average width of approximately 25 metres (refer to Plate 2 in Appendix D).

SITE 2

Site 2 is located at the start of the first bend of the Severn River downstream of Pindari Dam. At this location, the river widened to about 100 metres and contained a number of small islets in the middle of the channel. The riverbanks were sediment dominated, comprising silts and sands, with a high coverage of vegetation along the banks and islets (refer to Plate 2 in Appendix D).

SITE 3

Located downstream of the first river bend, the riverbank and bed substrate at Site 2 was found to be more variable with greater habitat complexity than at Sites 1 and 2. Banks and bed consisted predominantly of bedrock, with areas of cobble, pebble and gravel deposits and some areas of soft sediment. Similarly to Site 2, the site possessed an islet with a number of smaller raised areas of the riverbed, resulting in multiple channels across the width of the river (See Plate 4 in Appendix D). At the time of survey, the stream width varied between approximately 10 to 45 metres, with an average width estimated at 35–40 metres.

AQUATIC FLORA

Aquatic flora observed in the aquatic ecology study area was typically limited to areas between Sites 2 and 3, where riverbed and banks were comprised of a lower percentage of bedrock. Macrophytes were present in low density along the riverbanks and along the edges of river islets, with all aquatic flora observed limited to shallow areas immediately adjacent to the banks and comprising of emergent species. Species observed were generally limited to the native Common Rush (*Juncus usitatus*), with occasional various sedges. Other vegetation was typically limited to riparian areas along the riverbanks, or higher areas of the islets that may only periodically be inundated during high releases.

AQUATIC FAUNA

Opportunistic fauna sightings in the aquatic ecology study area during site surveys identified the presence of Platypus (*Ornithorhynchus anatinus*). An individual Platypus was observed instream at Site 1, that appeared to be foraging with intermittent diving behaviour.

At Site 3 and along the northern shore of the Severn River between Sites 2 and 3 where banks were more sediment dominated, numerous shells of the freshwater Billabong Mussel (*Velesunio ambiguus*) were observed. Both the Billabong Mussel and the Southern River Mussel (*Alathyria jacksoni*) are known to occur in northern areas of the Murray-Darling Basin (Sheldon and McCasker, 2020) and have been recorded in the Severn and Macintyre River Catchments (Atlas of Living Australia (ALA), 2024).

Other aquatic fauna such as freshwater fish, eels and turtles were not opportunistically observed within the aquatic ecology study area during site surveys; however, it is likely that the aquatic ecology study area and downstream areas of the Severn River provide semi-permanent or permanent habitat for these species.

KEY FISH HABITAT

The entirety of aquatic habitat and adjacent riverbanks inside the aquatic ecology study area, as well as further downstream along the Severn River and upstream in Pindari Dam, are identified as KFH – Murray Darling Basin North (NSW DPIRD, 2024a). The KFH mapped on the NSW DPIRD Fisheries Spatial Data Portal within the aquatic ecology study area was verified in-situ during the site investigation.

Within the aquatic ecology study area, the Severn River is classified as Type 1 – Highly sensitive KFH due to the abundance of snags over 300 millimetres in diameter or three metres in length, large rock boulders over 500 millimetres in diameter and known protected and threatened species habitat under the FM Act (Fairfull, 2013). Downstream areas of Scrub Hut Creek (Site 3) were also identified to be Type 1 KFH due to the presence of large rocky boulders. Aquatic habitat in the Severn River and Scrub Hut Creek that is adjoining or directly adjacent to the dam wall or infrastructure was classified as Type 2 – Moderately sensitive KFH, as Pindari Dam would be classified as a dam up to full supply level where the weir or dam is across a natural waterway (Fairfull, 2013). The lower section of Pindari Dam within the impact area was classified as Type 1 – Highly sensitive KFH due to the expected presence of threatened species habitat under the FM Act. The entirety of the Severn River within the aquatic ecology study area was classified as a Class 1 Major KFH, given it is a permanently flowing or flooded freshwater waterway (Fairfull, 2013).

Refer Figure 6.3 for mapping of KFH type and class in Pindari Dam and downstream waterways as defined in Table 1 and 2 of the *Policy and Guidelines for Fish Habitat Conservation and Management* (Fairfull, 2013).

WATER QUALITY

The Severn River and habitat at Sites 1, 2 and 3 comprise pool, run and riffle habitat, with an average width of 20 metres at Site 1, 80 metres at Site 2 and 45 metres at Site 3. Depth was typically between 0.5 to 2.0 metres at each site; however, Site 1 possessed some deeper pool habitat with an estimated depth of 6.0 metres. At the time of survey, the water level was relatively low across all sites with a low to moderate flow observed. Water appeared turbid at Sites 1 and 2, while it was tannin coloured but relatively clear at Site 3. No surface films or noticeable odours were observed at any site. Refer to Section 3.2 of Appendix D for quantitative water quality parameters recorded as part of the Pindari Dam MER Program (NSW DPIRD, 2024a).

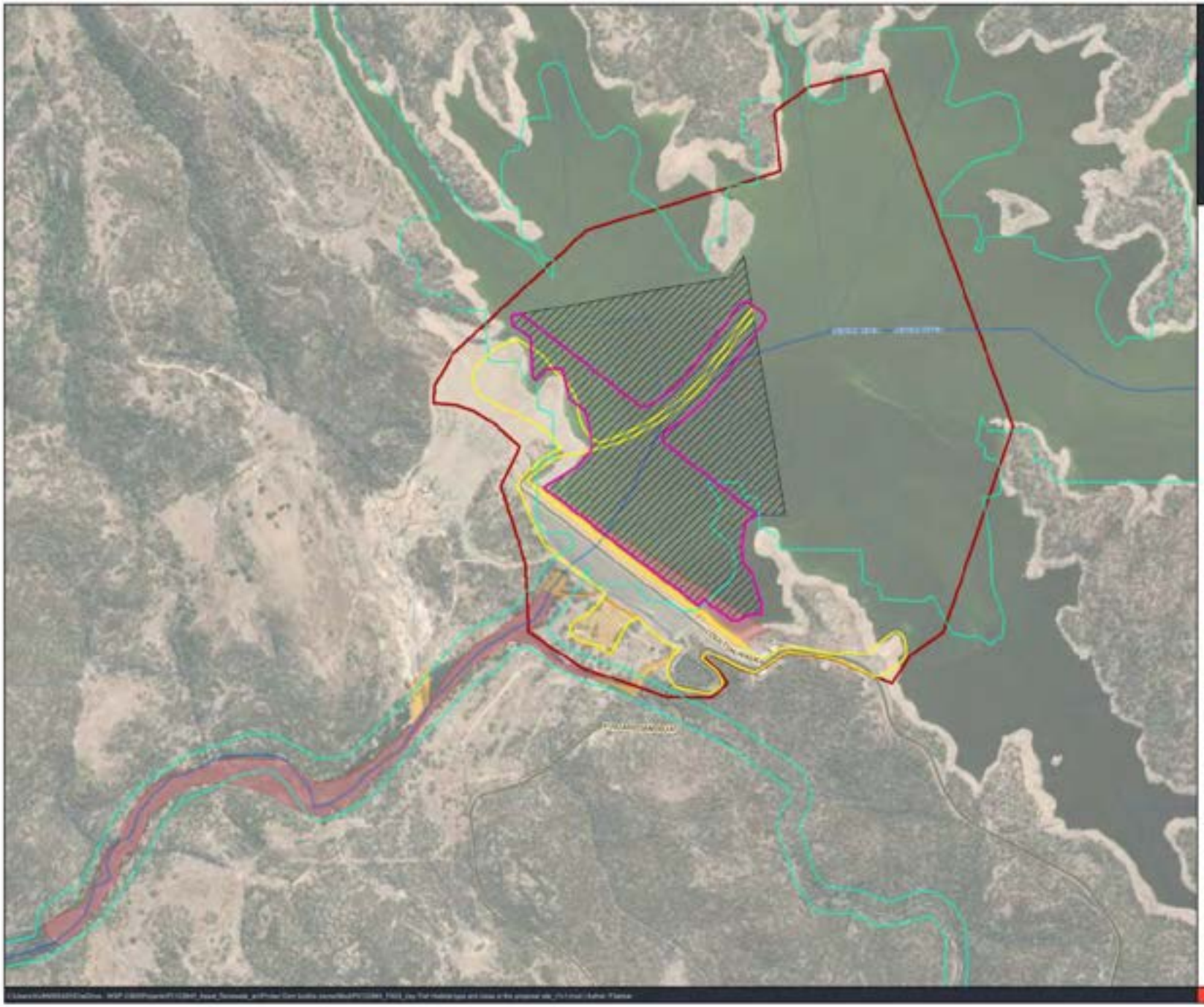
RIPARIAN ASSESSMENT

Riparian vegetation coverage differed across the aquatic ecology study area, associated with the geomorphology of the riverbank and adjoining land. Vegetation communities were relatively uniform throughout the aquatic ecology study area, with an even composition of native and exotic species that was characteristic of woodlands. Extensive areas of high and very high coverage of native woody riparian vegetation is known to occur in the western and eastern midlands of the NSW Border Rivers, including the Severn River below Pindari Dam (NSW Department of Planning and Environment (NSW DPE), 2019).

Riparian vegetation at Site 1 was higher in density on the northern bank and was regularly spaced, dominated by exotic pine trees with some occasional native grassy ground cover. On the southern bank, riparian vegetation within 20 metres of the water's edge was isolated, with the occasional small Wattle (*Acacia sp*.) and tussock grass.

At Site 2, riparian vegetation was more regularly spaced with a moderate density. Along the immediate riverbanks, vegetation was dominated by River She-oak (*Casuarina cunninghamiana)* and small stands of *Juncus usitatus* while areas 5 to 10 metres back from the bank were vegetated by a range of Eucalyptus species and some small wattles. The islets were typically dominated by large, established Willows (*Salix sp*.), *Casuarina cunninghamiana* and various rush and sedge species.

Riparian vegetation at Site 3 was semi-continuous with very low disturbance, high density and a higher native to exotic species ratio. *Casuarina cunninghamiana* and rush species dominated riverbanks bordered by various Eucalypts. Islets at Site 3 were largely vegetated by *Casuarina cunninghamiana* and rushes with occasional Willows and pines.



PS122845
Pindari Dam bubble plume

Figure 6.3
Key fish habitat type and class at the proposal site

Legend

- Watercourse
- Road
- Operational aquatic exclusion area
- Construction aquatic exclusion area
- Construction compound and site facilities including accommodation
- Impact Area
- Study Area
- Key Fish Habitat (Murray Darling Basin North)

Key Fish Habitat Type

- Type 1 KFH
- Type 2 KFH

Note: The entirety of the Severn River within the aquatic ecology study area is classified as a Class 1 Major KFH.



Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:12,000

Date: 19/12/2024

Data source: GEOAM Geoscience Australia

6.2.3 *Potential impacts – construction*

Potential impacts to aquatic ecology in Pindari Dam and the Severn River downstream of the dam wall during construction of the proposal are summarised in Table 6.6 and below:

- removal, disturbance or modification of KFH, aquatic vegetation or aquatic habitat including along the dam floor or shoreline
- physical disturbance or injury to aquatic fauna and flora
- nutirification and changes in water quality
- disturbance to a threatened aquatic species or their habitat
- invasion or spread of non-native or invasive species.

The boom adjacent to the spillway was determined to be required as a safety measure after preparation of the AEA. Installation of the boom has potential to impact aquatic ecology. Installation will follow a similar method to the installation of aeration pipework. As such, mitigation measures in Table 6.8 are anticipated to appropriately mitigate potential impacts to aquatic ecology.

For further detail on potential impacts of the proposal on aquatic ecology during construction refer to Section 4.1 of Appendix D.

Table 6.6 Potential impacts to aquatic ecology from construction of the proposal

Type	Impact	Likelihood
Physical	Removal or modification of KFH: The installation of the bubble plume destratification system comprising a distribution pipeline and pipeline diffuser in Pindari Dam will result in the modification of some Type 1 KFH. Modifications will include the placement of the bubble plume destratification infrastructure along the deepest section of the dam and will involve some construction disturbances to the KFH.	Known
Physical	Disturbance and/or modification to the dam floor and/or shoreline habitat: The installation of the air diffuser header pipeline and the associated anchor blocks will result in disturbance and modification of the shoreline and dam floor.	Known
Physical	Physical disturbance to aquatic fauna and flora: Construction works may result in some disturbances to aquatic fauna and flora in the epilimnion (uppermost and warmest part of Lake Pindari). Freshwater macrophytes along the riverbanks or in shallow areas near the shore may be disturbed as the pipeline and anchor blocks are laid. Additionally, macroinvertebrates utilising edge habitat associated with the dam shoreline, or benthic infauna inhabiting shallow sediments may be lost or smothered by the pipeline and supports. Impacts to benthic infauna will likely be restricted to infauna inhabiting sediments in the epilimnion and potentially metalimnion (middle layer in the thermally stratified Lake Pindari), whilst infauna in hypolimnion (part of Lake Pindari below the thermocline that is stagnant and generally uniform temperature) is considered to be unlikely and low under anoxic conditions. Considering the small footprint of works compared to the available habitat of Lake Pindari, this is not expected to be ecologically significant.	Likely

Type	Impact	Likelihood
Physical	Removal or loss of aquatic vegetation: Construction of the air distribution header pipe near Anchor Block 'A' (see Figure 1.3) will result in some shoreline disturbance. Some short-term disturbances are also expected for any freshwater macrophytes (e.g. rushes) that may be growing along the shoreline or shallow waters within the construction footprint at the time of construction. Installation of the air diffuser header pipe along the dam bed is not expected to result in the removal or loss of aquatic vegetation, as the pipe is to be laid at depths of greater than 40 metres in an anoxic area of the dam floor.	Possible
Physical	Disturbance to a threatened aquatic species or their habitat: Construction works associated with installation of the header pipes and anchor blocks including presence of work boats, construction barge and associated construction noise may result in disturbances to threatened aquatic species or their habitat. Considering the minor footprint of the construction area compared to the dam's total size, any expected disturbances to habitat from construction works are not expected to be of an ecologically significant scale.	Possible
Physical	Injury caused by ingestion of, or entanglement in, harmful marine debris: Materials used or rubbish generated during construction that are not contained or disposed of correctly have potential to find their way into the water and be ingested by marine fauna.	Possible
Physical	Removal or loss of a threatened ecological community or population.	Unlikely
Physical	Removal or loss of a threatened species.	Unlikely
Physical	Potential for increased risk of vessel strike for marine fauna.	Unlikely
Physical	Generation of noise resulting in injury.	Unlikely
Physical	Barriers to fish passage.	None
Chemical	Change in water quality: Construction activities may result in some short-term disturbances to the adjacent aquatic habitat in Lake Pindari as a result of increased turbidity and sedimentation from works on the top of the spillway. Sinking of the pipeline and anchor blocks may also result in a temporary sediment plume, which may disperse anoxic sediments and sediments with high concentrations of metals and nutrients.	Likely
Chemical	Nutrification: Waters in the hypolimnion were recorded to have elevated levels of soluble metals and nutrients (manganese, iron and phosphorus). The sinking of anchor blocks and the pipeline has potential to result in a small disturbance of sediment on the dam floor that may disperse these nutrients to the photic zone, which may be utilised by cyanobacteria.	Possible
Chemical	Unexpected spill of potential contaminants.	Unlikely

Type	Impact	Likelihood
Biological	Invasion or spread of non-native or invasive species: It is not expected that construction will facilitate the introduction or spread of aquatic pest species. However, given the existing frequency of algal blooms in Lake Pindari, machinery may facilitate the spread of algal species if not cleaned thoroughly between sites.	Possible
Biological	Introduction of disease or pathogens.	Unlikely
Behavioural	Generation of underwater noise with potential for behaviour affect.	Unlikely
Behavioural	Generation of construction noise with potential for ecological affect.	Unlikely

6.2.4 *Potential impacts – operation*

Potential impacts to aquatic ecology in Pindari Dam and the Severn River downstream of the dam wall during operation of the proposal are detailed in Table 6.7 and below:

- removal or modification of KFH
- nutrification and changes in water quality
- impact to a threatened aquatic species or their habitat
- removal or disturbance to aquatic fauna and flora
- invasion or spread of non-native or invasive species.

For further detail on potential impacts of the proposal on aquatic ecology during operation refer to Section 4.2 in Appendix D.

Table 6.7 Potential impacts on aquatic ecology during operation of the proposal

Type	Impact	Likelihood
Physical	Removal or modification of KFH: Operation of the bubble plume destratification system will result in modification of Type 1 KFH in Lake Pindari and the Severn River, as a result of changes in water quality parameters. Operation of the proposal is expected to: — increase temperatures and oxygen (DO) in dam release waters — cause mixing of epilimnion and hypolimnion waters in the vicinity of the plume within Lake Pindari — reduce effects of cold water pollution from the existing operation of Pindari Dam.	Known
Physical	Impact to a threatened aquatic species or their habitat: Impacts to aquatic habitat in Severn River downstream of Pindari Dam are expected to provide improved habitat for aquatic fauna including threatened fish species which currently face pressures from cold water pollution. Expected increases in temperatures of dam releases and a reduced temperature differential between releases and the river is expected to reduce the extent and magnitude of cold water pollution and cold shock events, with potential for positive impacts for reproduction cycles.	Likely

Type	Impact	Likelihood
Physical	Disturbance to aquatic fauna and flora: Some disturbances to aquatic fauna and flora are expected as a result of plume operation. Aquatic fauna have an optimal thermal range for metabolic and physiological functioning and changes in environmental conditions may impact on the capacity and function of different organisms. Particularly, changes in temperature dynamics may cause some shifts in invertebrate distribution, that may cause some minor shifts in prey habitat for upper trophic levels; however, this is not expected to occur at any ecologically significant levels.	Likely
Physical	Removal or loss of aquatic vegetation: Aquatic macrophytes were uncommon in the aquatic ecology study area and largely restricted to riverbanks in downstream areas of the Severn River. Temperature changes may increase productivity of these stands. Where aquatic macrophytes are present in shallow areas along the pipeline footprint, they may be disturbed during periods of low water levels where the pipeline and Type 3 (See Figure 1.5) holding down systems may lay or drag along the dam bed.	Possible
Physical	Removal or loss of a threatened ecological community or population.	Unlikely
Physical	Barriers to fish passage.	Unlikely
Physical	Potential for increased risk of vessel strike for marine fauna.	Unlikely
Physical	Generation of noise resulting in injury.	Unlikely
Physical	Injury caused by ingestion of, or entanglement in, harmful marine debris.	None
Chemical	Changes in water quality: The operation of the bubble plume destratification system will change water quality parameters of Lake Pindari waters in vicinity of the plume by mixing anoxic and cold bottom waters with oxygenated, warmer surface waters. This is expected to homogenise temperature and DO conditions within the lake. As a result, the temperature of dam releases is expected to increase, thus reducing the temperature differential between the ambient water temperature of the Severn River downstream of Pindari Dam and the water temperature of dam releases. There is some potential that operation of the bubble plume destratification system may circulate soluble metals and nutrients from the hypolimnion that could exacerbate conditions for potential algal blooms.	Known
Chemical	Nutrification: Operation of the bubble plume destratification system has potential to result in nutrification of Lake Pindari and the Severn River. Waters in the hypolimnion were recorded to have elevated levels of soluble metals and nutrients (manganese, iron and phosphorus). As these waters are entrained to the surface, cyanobacteria may utilise these nutrients to metabolise and create a feedback loop, resulting in potential algal blooms. Whilst the system may not solely cause an algal bloom, it may be exacerbated by surrounding environmental conditions in Lake Pindari, which is already susceptible to algal blooms.	Possible

Type	Impact	Likelihood
Chemical	Mobilisation of contaminants.	Unlikely
Biological	Invasion or spread of non-native or invasive species: Operation of the bubble plume destratification system has potential to exacerbate the spread of cyanobacteria into downstream areas of the Severn River. As mixing of waters may facilitate a higher proportion of algae to be drawn into release waters.	Possible
Biological	Introduction of disease or pathogens.	Unlikely
Behavioural	Generation of underwater noise with potential for behaviour affect.	Unlikely

6.2.5 *Safeguards and mitigation measures*

Table 6.8 summarises recommended safeguards and mitigation measures that will be implemented to reduce impacts on aquatic ecology during construction and operation of the proposal.

Table 6.8 Aquatic ecology safeguards and mitigation measures

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Aquatic Biodiversity	Further detailed water quality and ecological monitoring will be undertaken prior to the commencement of works, to establish baseline data and trends. This will be used following completion of works to measure changes in temperature, water quality and ecological communities in Pindari Dam and Severn River. This monitoring will include: — fish populations and Young of Year (fish born within the past year) — macroinvertebrate and zooplankton assemblages — algae concentrations and species, including within Pindari Dam and Severn River — water quality parameters including, but not limited to, temperature (stratification in Pindari Dam and longitudinally in Severn River compared to reference sites), dissolved oxygen, nutrients, metals and chlorophyll-a.	Project manager	Prior to construction
Aquatic Biodiversity	A pre-works inspection of the laydown area and habitats within 200 metres at the top of the spillway for fauna habitat, especially threatened turtles, and where required fauna clearance works, must be undertaken before any works in these areas commence.	Project manager	Prior to construction
Aquatic Biodiversity	The CEMP or equivalent document will include information to assist in identifying the threatened fish and turtle species that occurs or may occur within the locality.	Contractor	Prior to construction

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Erosion and sedimentation	An appropriate Erosion and Sediment Control Plan (ESCP) that adequately protects aquatic habitat during construction will be prepared before works commence. The ESCP will need to consider: — on-site water management to reduce sedimentation and potential pollution of watercourses and management of stormwater and dam water during periods of high rainfall — run-off or unplanned overflows from construction must be retained in water quality basins or an appropriate alternative — diverting run-on water from disturbance works occurring on upslope land, using non-erosive methods — installing protective measures to prevent sheet erosion where large portions of soil will be exposed — construction of sediment filters or sediment retention traps where appropriate, particularly below fill batters near waterways.	Contractor	Prior to construction
Aquatic biodiversity	If the threatened Western saw-shelled turtle are seen within 50 metres of any works, works must stop immediately until the turtle moves away. If the turtle remains in the area or continuously returns an aquatic ecologist should be notified. The aquatic ecologist and project team must consult with NSW DPIRD Fisheries to determine appropriate management actions to allow works to continue. Threatened fish in Lake Pindari are expected to be mobile enough to disperse from disturbances.	Contractor	Construction
Water quality	Storing of construction machinery, equipment, materials, vehicles and the pipeline string along the top of the spillway must be appropriately managed to avoid impacts on the adjacent waterway. This includes: — storing hydrocarbon-based products on any water sites within the impact area will be avoided and must be stored in a suitable bunded area within the construction compound — hydrocarbons will be stored in a bunded area with adequate spill kits available — all staff will be made aware of the location of the spill kit and trained in its use — all machinery will be routinely checked for leaks.	Contractor	Construction
Water quality	Hydrocarbon booms will be placed around all stationary machinery on the water and be on hand for deployment around vessels.	Contractor	Construction

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Water quality	Where practical, floating containment booms will be in place to control any unplanned spills of hydrocarbons around machinery operating on or over water.	Contractor	Construction
Algae management	All equipment brought to the impact area will be thoroughly cleaned and free of substrate to avoid introduction of species such as cyanobacteria. Given the potential for toxic cyanobacteria in nearby areas, equipment will be also thoroughly cleaned following completion of the project to prevent spread of the species to other areas.	Contractor	Construction
Algae management	If an algal bloom is present within Lake Pindari, it should be avoided and not disturbed to minimise further spread to other areas. Works will not be conducted while an algal bloom is present within Lake Pindari. If vessels or equipment are found to have been covered by algae during works, they will be thoroughly cleaned with fresh water, with all biota safely disposed of on land.	Contractor	Construction
Erosion and sedimentation	The sinking of the pipeline and anchor blocks must be conducted in a controlled and slow manner, to minimise the disturbance to the dam floor.	Contractor	Construction
Water quality	Visual monitoring of water quality monitoring during construction works will be undertaken daily. Monitoring of water quality parameters, including algal counts and limiting factors (nitrogen, phosphorus, manganese, iron) will also be conducted regularly during works.	Contractor	Construction
Erosion and sedimentation	Environmental controls such as sediment and erosion controls, and if necessary, the position of pipeline string, will be inspected weekly by an Environmental Scientist during construction.	Contractor	Construction
Waste management	Waste products and materials will be adequately managed and stored in designated areas on-site to prevent injury caused by ingestion or entanglement in debris. Designated litter bins will be provided.	Contractor	Construction
Waste management	All materials, machinery and rubbish will be removed from site.	Contractor	Post-construction
Post-construction review	An inspection of the site by an Environment Officer or Project Manager will be undertaken to review removal of waste and effectiveness of environmental controls prior to demobilisation from the site.	Environment officer/project manager	Post-construction
Fisheries Management Act 1994 requirements	Any notification requirements of the Section 199 or 205 permits must be filled and submitted.	Project manager	Post-construction

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Water quality monitoring	A Water Quality Monitoring Program (WQMP) will be established for operation of the Pindari Dam bubble plume destratification system. This WQMP may be incorporated into the existing monitoring conducted by WaterNSW, the Border Rivers monitoring program and the existing Pindari Dam MER Program (NSW DPIRD, 2024a) and will include: — Continuation of monthly monitoring within Lake Pindari and the Severn River catchment, including physical water quality parameters, cyanobacteria, rainfall, discharge and dam capacity. — At least two years of water quality monitoring at previously established sites under the Pindari Dam MER Program (NSW DPIRD, 2024a), including the existing daily riverine temperature monitoring in the Severn River and reference sites, and daily temperature and dissolved oxygen monitoring in Lake Pindari, using a thermistor chain. — Regular (monthly to quarterly) water quality monitoring (physical, chemical and biological parameters) within Lake Pindari and the Severn River for the first two years of operation of the bubble plume destratification system. This will include at least two sites in the Severn River upstream of the dam and at least eight sites downstream of the dam (across a distance of ~100 kilometres). It is recommended that this monitoring is continued for up to eight years following the commissioning of the system and then on a less regular basis, for the duration of operation of the bubble plume destratification system. — Water quality monitoring will be reviewed against existing baseline data for the Severn River. Emerging trends will be assessed, to review with changes in frequency of operation or pressure applied to the system at various times throughout the year.	Project manager	Operation

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Ecological monitoring	An Ecological Monitoring Program (EMP) will be established for operation of the bubble plume destratification system. The program will focus on those communities targeted by the existing Pindari Dam MER Program (NSW DPIRD, 2024a): — Fish: — annual spring and autumn fish community surveys in the Severn River and a reference river, for at least two years following commissioning — annual targeted Young of Year sampling at the end of summer or early autumn in Severn River, for at least two years following commissioning. — Invertebrates: — incorporate ecological health monitoring using AUSRIVAS methodology, including Ephemeroptera, Plecopteran and Trichopteran (EPT) taxa, abundance and species richness in both spring and autumn in the Severn River. Surveys will include at least one site upstream and at least three sites downstream of the dam for at least two years following commissioning. — Water quality, algae and food web: — continuation of the existing Pindari Dam MER Program (NSW DPIRD, 2024a) water quality, algae and food web monitoring. Monthly sampling between September and May sampling nutrients, metals, zooplankton, chlorophyll-a and phytoplankton. This will be conducted for at least two years following commencement of operation. — Periphyton: — incorporate monitoring of periphyton coverage and composition in the Severn River downstream of Pindari Dam. This may be incorporated into the above existing Pindari Dam MER Program (NSW DPIRD, 2024a) monthly monitoring, to be conducted for at least two years following commencement of operation.	Project manager	Operation

6.3 Aboriginal heritage

This section summarises potential impacts on Aboriginal heritage likely to occur during construction and operation of the proposal.

6.3.1 Method

An Aboriginal Objects Due Diligence Assessment (Due Diligence Assessment) was completed by WaterNSW on 21 August 2024 and is summarised in this section (Appendix E). The assessment follows the requirements of due diligence as set out by the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (Due Diligence Code) (NSW Department of Environment, Climate Change and Water (NSW DECCW), 2010). A field assessment was conducted on 19 July 2024 and was attended by representatives of WaterNSW and the Gomeroi Native Title Group. Refer to Figure 2 and Plate 1 in Appendix E for the Aboriginal heritage study area.

6.3.2 Existing environment

The Aboriginal heritage study area lies within the Ashford Local Aboriginal Land Council (LALC) footprint and is under the Gomeroi Peoples Native Title land claim area.

6.3.2.1 Aboriginal objects due diligence assessment

IS THE PROPOSED ACTIVITY A LOW IMPACT ACTIVITY AS DEFINED BY THE REGULATION?

No. The activity is not a low impact activity as defined under Section 58 of the National Parks and Wildlife Regulation 2019 NPW Regulation) because it involves earthworks within the Aboriginal heritage study area and it is not listed as a low impact activity as defined under Section 58.

WILL THE ACTIVITY DISTURB THE GROUND SURFACE OR ANY CULTURALLY MODIFIED TREES? (STEP 1)

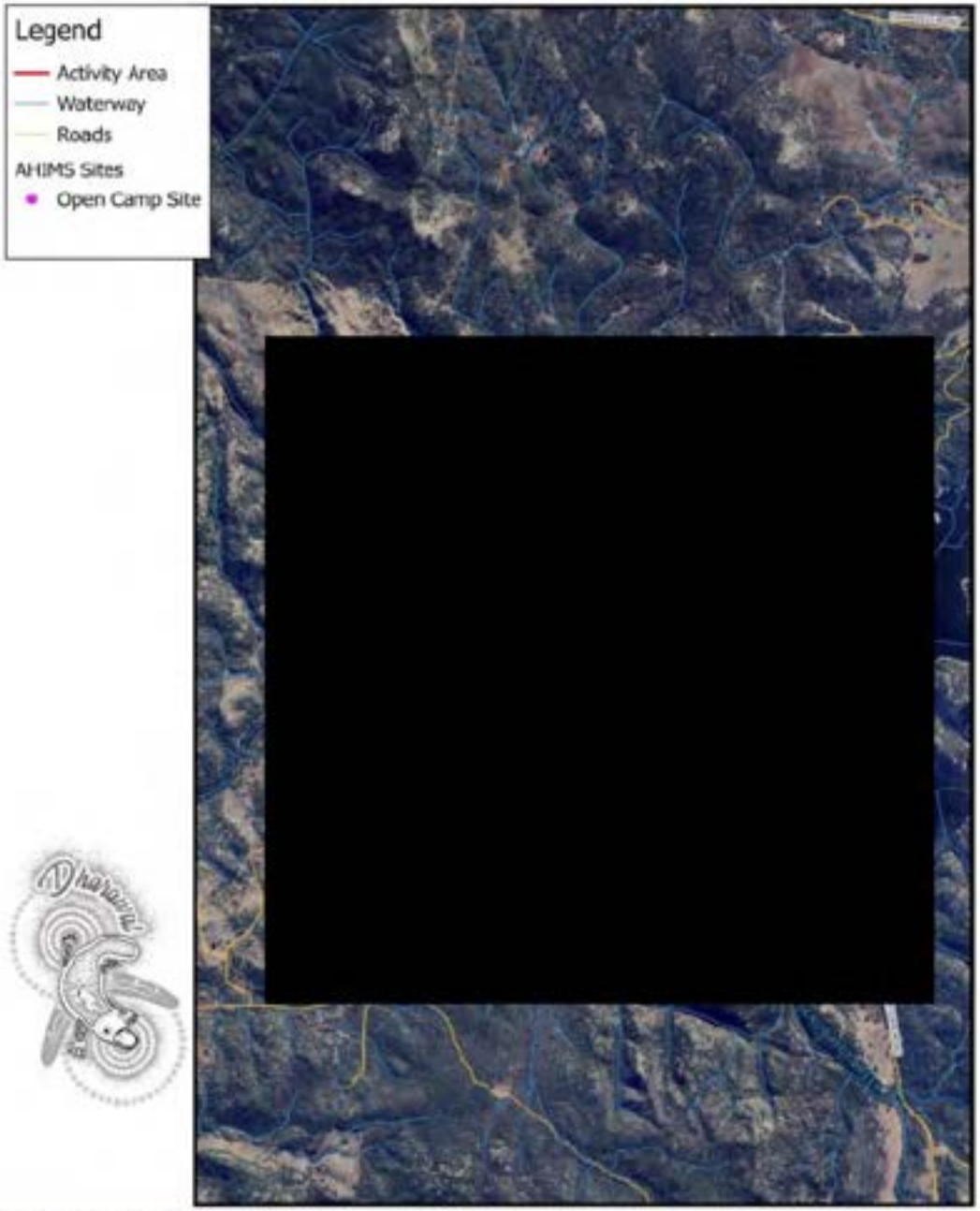
Yes. The proposal will disturb the ground surface. There are no culturally modified trees in the Aboriginal heritage study area. The proposal will not impact any culturally modified trees.

ARE THERE ANY RELEVANT CONFIRMED SITE RECORDS OR OTHER ASSOCIATED LANDSCAPE FEATURE INFORMATION ON AHIMS (OR OTHER HERITAGE REGISTERS)? (STEP 2A)

Yes. A basic and advanced search of the Aboriginal Heritage Information Management System (AHIMS) database was undertaken on the 31 July 2024. The search results of the AHIMS database identified nine registered Aboriginal sites, and no declared Aboriginal places in or near the Aboriginal heritage study area. See Table 6.9 and Figure 6.4 for the details and location of AHIMS sites. Refer to Section 2.3 in the Due Diligence Assessment for further details of the AHIMS sites listed in Table 6.9 and searches of Aboriginal Heritage Registers (Appendix E).

Table 6.9 Summary of previously recorded AHIMS sites

AHIMS ID#	AHIMS site name	Aboriginal site type	Located in the Aboriginal heritage study area	Site status as per AHIMS search	Site Status (as per data in interrogation)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]



wsp

PS122845
Pindari Dam bubble plume

Figure 6.4
Locations of AHIMS sites nearby the proposal site

NOT TO SCALE

ARE THERE ANY OTHER SOURCES OF INFORMATION OF WHICH A PERSON IS ALREADY AWARE? (STEP 2B)

Yes.

The region is on the traditional lands of the Kwiambal people of the Gamileroi Nation and within the Gomeroi Native Title Claim boundaries.

Traditionally, the Inverell districts fertile rivers and valleys was home to several Clans of the Gomeroi Nation, whose language and association gave rise to many place names in the area. Traditional lands extend as far as Moree to the Queensland border and into the Hunter River region, within the Ashford LALC Boundaries. The Gomeroi people are extremely resourceful, with a range of resource material utilisation recorded by Parker (1909) and Mitchell (1839).

Major water courses such as the Macintyre and Severn River as well as the many perennial creeks were a valuable source of plant and animal food and material resources. Resources as far as the Pilliga forests are used extensively in the technology of the central west region, heavily dependent on the wood and bark fibre for use in spears, clubs, shields and boomerangs (Parker 1909). Stone tool utilisation of the region included axes, and small unspecialised flakes, though it is noted that analysis of stone tool assemblages in the region is sparse (Piper, Hill and Mazlin 2019).

Aboriginal traditional lifestyles were disrupted by the spread of European settlement by the 1840s. Following on the explorer's steps, squatters moved into the district from about 1835, establishing large sheep and cattle stations. In June 1838 the Myall Creek massacre occurred 35 kilometres from present Inverell. This became famous in Australian history as it was the first-time white men were punished (hung) for the killing of Aboriginal people. Events, as such led to a rapid decline in traditional communities as people were gradually absorbed into the pastoral workforce or forced removal from traditional lands to missions or reserves, though a strong traditional link continues to remain to the area (Haglund, 1992).

In the region there has been several small Aboriginal reserves: one in the Nullamanna district in the 1850s, the Sevington Aboriginal Reserve at Pindari and Murroombah (or Ngoorumba, Aboriginal settlement near Tingha in the 1890s. Tingha was dismantled in 1914 and moved to Nucoorilma, which was abandoned by the 1920s. In 1938 the Toomelah Aboriginal Reserve was established, where the Aboriginal people from Ashford went to live, with most returning to Ashford over time (Haglund, 1992).

The lack of archaeological investigation in the area has limited the number of AHIMS recordings, though it is acknowledged that identification of Aboriginal heritage sites is growing in significance as the recognition and value of Aboriginal heritage is respectfully acknowledged. Haglund, acknowledges that longer term camping sites in the area, are most likely below the historical Pindari dam storage area, with the first stages of the dam being constructed prior to any archaeological assessments being undertaken.

Archaeological and Cultural Heritage studies in the region are limited but have presented valuable archaeological findings supported with tangible evidence of nomadic seasonal movements and continued occupation in the area (see Table 5 in Appendix D). The results indicate that, despite clearing associated with agricultural practices in the wider regional area, and the construction of the Pindari dam prior to any archaeological assessments, or Aboriginal heritage assessments, Aboriginal sites are still likely to be located on landforms next to permanent water sources (OzArk 2018a; OzArk 2018b), as well as other landforms identified by NSW NPWS (2002). See Table 5 in the Due Diligence Assessment (Appendix E) for a summary of previous heritage assessments of the proposal site. Refer to Section 2.4 in the Due Diligence Assessment (Appendix E) for further detail regarding sources of information on Aboriginal Cultural Heritage at Pindari Dam.

ARE THERE ANY LANDSCAPE FEATURES THAT ARE LIKELY TO INDICATE THE PRESENCE OF ABORIGINAL OBJECTS? (STEP 2C)

Yes. The following landscape features listed in the Due Diligence Code signify a high potential for the presence of Aboriginal objects:

- within 200 metres of waters, or
- located within a sand dune system, or
- located on a ridge top, ridge line or headland, or
- located within 200 metres below or above a cliff face, or
- within 20 metres of or in a cave, rock shelter, or a cave mouth.

The Aboriginal heritage study area is within 200 metres of waters and lies on Severn River directly below the historically established Pindari Dam wall. The present dam water storage covers up to 30 metres of the original landform, as discussed by Haglund (1992) will cover most of the landforms used for traditional occupation and resource gathering.

The underlying geological formations of the Aboriginal heritage study area and surrounds are dominated by Permian intrusive and extrusive porphyries and porphyrites. Undifferentiated granites, mudstones, lithic sandstones, hornfels, pebbly conglomerate and ash flow tuff, tertiary basalt and dolerite all occur in the area (Haglund, 1992). Several of these geological rock formations were commonly used by people for stone tool manufacturing.

The Rudosols soil landscape is associated with the Aboriginal heritage study area. The landscape according to Haglund (1992) contains rocky outcrops, with lithosols common on steep slopes and rocky crests. Downslopes the soils are dominated by hard setting loamy materials, with mottled yellow clayey subsoils. Erosion from grazing and clearing activities has occurred in the local area, which in turn has effect on the ability for archaeological evidence to retain traditional context.

The archaeological characteristics and potential of an area are additionally defined through a range of factors, including the availability of past resources, stability of the soil matrix, underlying geology and land use history. The potential for in-situ Aboriginal objects is lower on land that has been disturbed by more recent European land use. The Aboriginal heritage study area has been modified during historical and recent times, as demonstrated through historical aerial imagery (refer to Figure 5 in Appendix E) and confirmed during the field assessment.

Considering the extensive historical disturbance associated with construction of the dam wall, and the previous Aboriginal Cultural Heritage Assessments and associated AHIPs and salvage excavations, there is low archaeological potential in the Aboriginal heritage study area.

CAN THE HARM OR THE ACTIVITY BE AVOIDED? (STEP)

Not applicable. There is no harm to any Aboriginal objects associated with the proposed works in the Aboriginal heritage study area.

DOES A DESKTOP ASSESSMENT AND SITE INSPECTION CONFIRM THAT THERE ARE ABORIGINAL OBJECTS OR THAT THEY ARE LIKELY? (STEP 4)

No. The desktop assessment, using available information such as AHIMS search results, relevant archaeological reports and landscape features identified the requirement to undertake a visual site assessment to determine the archaeological potential for Aboriginal objects to occur, and confirm the location of previously recorded AHIMS sites associated with the Aboriginal heritage study area. A site assessment of the Aboriginal heritage study area was undertaken on 19 July 2024, and was inclusive of all areas of ground disturbance within the Aboriginal heritage study area. Details and results of the site inspection are presented in Section 3 of the Due Diligence Assessment (Refer to Appendix E).

FURTHER INVESTIGATIONS AND IMPACT ASSESSMENT (STEP 5)

No. On the basis of the Due Diligence Assessment, it has been determined that no further archaeological assessment is required for the proposed works in the Aboriginal heritage study area, due to significant historical ground disturbance during construction of the dam wall and associated infrastructure.

6.3.3 Potential impacts – construction

Due to the extensive historical disturbance associated with construction of the dam wall and associated infrastructure, and considering previous archaeological investigations, there is low potential for Aboriginal Objects to remain in the Aboriginal heritage study area. No Aboriginal Heritage sites were identified during the field assessment and no Aboriginal objects are expected to be impacted by the proposal in the Aboriginal heritage study area.

6.3.4 Potential impacts – operation

Aboriginal heritage impacts associated with operation of the proposal are not expected.

6.3.5 Safeguards and mitigation measures

Table 6.10 summarises recommended safeguards and mitigation measures that will be implemented to reduce impacts on Aboriginal heritage during construction and operation of the proposal.

Table 6.10 Aboriginal heritage safeguards and mitigation measures

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Aboriginal heritage	Aboriginal community representatives, including Gomeroi Native Title Group representatives, will be onsite during any construction activities requiring ground disturbance.	Project manager/ contractor	Prior to construction
Aboriginal heritage	Prior to initiation of works in the Aboriginal heritage study area, all site workers will undertake a site awareness training, inclusive of the history of AHIMS sites associated with the Pindari Dam wall infrastructure.	Project manager/ contractor	Prior to construction
Aboriginal heritage	All Aboriginal objects and Places are protected under the *National Parks and Wildlife Act 1974* (NPW Act). It is an offence to knowingly disturb an Aboriginal object or Place without consent permit issued by the Department of Climate Change, Energy, Environment and Water (DCCEEW) under the NPW Act. Should any Aboriginal objects be encountered during works associated with this assessment proposal, works will cease immediately, and the find will not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object, the archaeologist will provide further recommendations. These may include notifying the DCCEEW and Aboriginal Stakeholders.	Project manager/ contractor	Prior to construction

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Aboriginal heritage	Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity, you must: 1 immediately cease all work at that location, and avoid further movement or disturbance of the remains and establish a buffer of at least 20 metres, to avoid harm 2 refer to and follow the Water NSW unexpected finds procedure (Appendix G) 3 notify the NSW Police and DCCEEW Environmental line on 131555, as soon as practicable and provide details of the remains and their location 4 not recommence work at that location unless authorised by DCCEEW and WaterNSW.	Project manager/ contractor	Prior to construction
Aboriginal heritage	[redacted]	WaterNSW	Post-Construction
Aboriginal heritage	[redacted]	WaterNSW	Post-Construction

6.4 Surface water, groundwater and flooding

This section summarises impacts on surface water, groundwater and water quality likely to occur during construction and operation of the proposal.

6.4.1 Method

Surface water, groundwater and flooding at Pindari Dam were investigated through a desktop assessment. The desktop assessment reviewed publicly available data from the following sources:

- NSW Planning Portal Planning Spatial Viewer (Flood Planning Map) (NSW DPHI, 2024)
- NSW Planning Portal Planning Spatial Viewer (Natural Resource – Groundwater Vulnerability Map) (NSW DPHI, 2024)
- Groundwater Dependant Ecosystems Atlas (Bureau of Meteorology (BOM), 2024)
- Sharing and Enabling Environmental Data in NSW Map (SEED Map) (Groundwater Dependent Ecosystem (GDE) Probability) (DCCEEW, 2012)

6.4.2 Existing environment

6.4.2.1 Surface water, groundwater and flooding

The proposal site is located at Pindari Dam within the Border Rivers Catchment. The Severn River intersects the proposal site latitudinally flowing from the east to the west. Nearby waterways that flow into Pindari Dam include Scrub Hut Creek, Spring Creek, Ironbark Creek and numerous tributaries. The proposal site is not mapped as flood prone land or groundwater vulnerable (NSW DPHI, 2024).

A review of the GDEs Atlas identified moderate potential for an aquatic GDE (by national assessment) and low to high potential for a terrestrial GDE (by regional assessment) within the study area (BOM, 2024). Similarly, Severn River within the study area is mapped as having high GDE probability and Lake Pindari is mapped as having low GDE probability (DCCEW, 2012).

6.4.2.2 Topography

Topography surrounding Pindari Dam is generally hilly with the broader landscape characterised by gently undulating terrain rises on Emmaville volcanics (NSW Department of Planning, Industry and Environment (NSW DPIE), 2024). The locality contains rocky outcrops with lithosols common on steep slopes and rocky crests (Haglund, 1992)

6.4.3 Potential impacts – construction

6.4.3.1 Surface water

Potential impacts to water quality in Lake Pindari and the Severn River will primarily be from erosion, mobilisation of sediment into watercourses and accidental spills. Construction activities with the highest risk to result in adverse water quality impacts include:

- vegetation clearing
- excavation and earthworks

- on water construction activities including:
  - use of work boats
  - mobilisation of a barge using a crane for marine operations
  - placement of mooring blocks, using GPS for correct alignment
  - connection of the bubble plume pipe to the mooring blocks
  - use of remotely operated vehicles to assess operation of the bubble plume destratification system during commissioning phase
- refuelling of plant and equipment
- accidental spills
- stockpiling of materials.

Construction activities on the water from the boat ramp and, earthworks and excavations adjacent to watercourses present the highest risk of impact to surface water. Vegetation clearing and excavation increase the potential for soil erosion and sediment run-off into watercourses, resulting in increased turbidity that can adversely affect water quality. Sedimentation impacts may occur as a result of increased sediment loads entering drainage systems and/or local runoff from stockpiled materials and bulk earthworks on-site. Construction vehicle movements over exposed soil and earthworks are also likely to result in accelerated erosion. However, potential risk is expected to be limited to periods of heavy rainfall.

Appropriate safeguards and mitigation measures will be implemented to reduce potential water quality impacts, including appropriate erosion and sediment control of exposed surfaces, ongoing weather monitoring and proper storage and handling of fuels and chemicals on-site.

6.4.3.2 Groundwater

Groundwater impacts are not expected during construction of the proposal. If groundwater seepage is encountered during construction, the WaterNSW Dewatering and Discharge Activities – Environmental Standard Operating Procedure (ESOP) CD2021/54 will be enacted.

6.4.4 Potential impacts – operation

Potential operational impacts associated with surface water, groundwater and flooding will include:

- minor short-term adverse environmental impacts to surface water from activities such as excavation, refuelling of plant and equipment, accidental spills, and on water activities
- destratification of water within Lake Pindari leading to improved water quality
- potential to exacerbate conditions that lead to algal blooms
- reduced potential for cold water pollution downstream of Pindari Dam
- negative adverse impacts to groundwater and flooding are not anticipated during operation of the proposal.

6.4.5 Safeguards and mitigation measures

Table 6.11 summarises recommended safeguards and mitigation measures that will be implemented to reduce impacts on surface water and groundwater during construction and operation of the proposal.

Table 6.11 Surface water, groundwater and flooding safeguards and mitigation measures

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Erosion and sedimentation	A site-specific Erosion and Sediment Control Plan (ESCP) will be prepared and implemented during construction of the proposal.	Project manager/ contractor	Prior to construction
Erosion and sedimentation	Weather monitoring will occur on-site to allow adequate time for chemicals, material stockpiles, plant and equipment to be moved prior to heavy rainfall.	Contractor	Construction
Erosion and sedimentation	The CEMP will consider prevailing wind direction, wind speeds and where practicable, timing of works to minimise periods of heavy rainfall.	Contractor	Construction
Water quality	The following control measures will be included in the ESCP and be implemented to minimise impacts to surface water quality: — detailed information on erosion and surface water management — appropriate flow diversions, sediment and erosion control measures — stockpiles to be located at least 40 metres away from watercourses — plastic tray to be placed under plant and machinery when re-fuelling to capture any accidental spills — no equipment, machinery or work vehicles will be washed on-site — an appropriate water quality monitoring program — stockpiles will be covered by tarps and/or sediment fencing will be installed around stockpiles — disturbed areas will be stabilised as soon as practicable, following disturbance — planning and staging of works will be undertaken to reduce exposure of stockpiles and open excavations — access to work sites and work areas will be planned and managed to reduce disturbance — access and egress points will be stabilised and mud and soil removed from the wheels and bodies of vehicles and equipment before entering public roads — erosion and sediment control measures will be routinely inspected and maintained, including before expected heavy rainfall and after heavy rainfall — vehicle and machinery movements will be minimised during and immediately following wet weather to avoid or minimise disturbance to ground cover — erosion and sediment control measures will not be removed until the works are complete and areas are stabilised.	Contractor	Construction
Groundwater	If groundwater seepage is encountered in excavations, the WaterNSW Dewatering and Discharge Activities – Environmental Standard Operating Procedure (ESOP) CD2021/54 will be enacted.	Contractor	Construction

6.5 Geology, soils and contamination

This section summarises potential impacts on soils and geology likely to occur during construction and operation of the proposal.

6.5.1 Method

Geology, soils and contamination at Pindari Dam were investigated through desktop assessment. The desktop assessment reviewed publicly available data on the following platforms:

- NSW Planning Portal ePlanning Spatial Viewer (Acid Sulfate Soils (ASS) Map) (NSW DPHI, 2024)
- NSW Planning Portal ePlanning Spatial Viewer (Salinity Map) (NSW DPHI, 2024)
- Sharing and Enabling Environmental Data in NSW Map (SEED Map) (Australian Soil Classification (ASC) Soil Map of NSW) (DCCEW, 2012)
- NSW eSpade NSW Soil and Land Information (GA 1:1m simplified surface geology map) (NSW DPIE, 2024)
- Contaminated Land Record of Notices (NSW EPA, 2024).

6.5.2 Existing environment

6.5.2.1 Geology and soils

The primary surface geology of the study area is comprised of Emmaville Volcanics (felsic igneous rock) (NSW DPIE, 2024). The primary soil type at the proposal site is Rudosol (DCCEW, 2012). Rudosols typically have little pedological organisation and little texture or colour change with depth (Isbell, 2021).

6.5.2.2 Acid Sulfate Soils

The proposal site is not mapped as having potential for ASS (NSW DPHI, 2024).

6.5.2.3 Salinity

The proposal site is not mapped as a known salinity hazard (NSW DPHI, 2024).

6.5.2.4 Contamination

A Contaminated Land Record of Notices search (NSW EPA, 2024) on 1 October 2024 identified no known registered contaminated sites within five kilometres of the proposal site.

6.5.3 Potential impacts – construction

Potential soil and contamination impacts will primarily be associated with vegetation clearing, earthworks, accidental spills and leaks and management of materials/spoil and waste. Construction activities with the highest risk include:

- movement of construction vehicles
- storage and handling of dangerous goods on-site (e.g. chemicals and fuel)
- refuelling of plant and equipment
- stockpiling of materials
- unloading and loading of materials and waste.

The proposed works are not expected to disturb potential ASS, saline soils or areas of known contamination. The proposal site is also not mapped as an area for naturally occurring asbestos. Safeguards and mitigation measures in Table 6.12 will be implemented to mitigate potential impacts of refuelling of plant and equipment and storage and handling of construction materials, waste and dangerous goods.

Although there is no indication of contamination, there is potential for unexpected contaminated material to be uncovered during construction due to previous land use activities including construction of Pindari Dam. An unexpected finds procedure will be prepared prior to construction and implemented in the event unknown contamination is uncovered during construction of the proposal as a part of the CEMP.

6.5.4 Potential Impacts – operation

Operation of the proposal is not expected to adversely impact on geology, soils and contamination.

6.5.5 Safeguards and mitigation measures

Table 6.12 summarises recommended safeguards and mitigation measures that will be implemented to reduce impacts on geology, soils and contamination during construction and operation of the proposal.

Table 6.12 Geology, soil and contamination safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Contamination	If potentially contaminated material is uncovered works will cease in that location, the WaterNSW Project Manager will be contacted, and advice will be sought from a contamination specialist as required.	Contractor	Construction
Contamination	An unexpected finds procedure will be prepared prior to construction and implemented in the event unknown contamination is uncovered during construction of the proposal as a part of the CEMP.	Project manager/ contractor	Pre-construction
Waste management	All excavated soil, fill and liquid waste material requiring off-site disposal will be classified in accordance with the NSW EPA *Waste Classification Guidelines* (NSW EPA, 2014) and disposed at an appropriately licensed facility.	Contractor	Construction
Contamination	Chemicals stored on-site will be stored within a bunded area with a holding capacity of 110 per cent of all containers.	Contractor	Construction
Contamination	An emergency spill kit will be kept on-site at all times and will include marine spill equipment. The spill kit will be appropriately sized for the volume of substances at the work site. All staff will be made aware of the location of the spill kit and trained in its use.	Contractor	Construction
Incident management	Environmental incidents will be notified in accordance with the WaterNSW Environmental Incident Management Protocol and the *Protection of the Environment Operations Act 1997*.	Contractor	Construction and operation

6.6 Non-Aboriginal heritage

This section summarises potential impacts to non-Aboriginal heritage, likely to occur during construction and operation of the proposal.

6.6.1 Method

A Statement of Heritage Impact (SoHI) was prepared by OzArk Environment and Heritage (OzArk) (refer to Appendix F). The SoHI was prepared in accordance with the following guidelines:

- *Guidelines for preparing a statement of heritage impact* (SoHI Guidelines) (NSW DPE, 2023)
- *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (Burra Charter) (The International Council on Monuments and Sites (ICOMOS), 2013)
- *Assessing heritage significance: Guidelines for assessing places and objects against the Heritage Council of NSW criteria* (NSW DPE, 2023)

The non-Aboriginal heritage study area comprised of approximately 3.1 hectares of undulating terrain adjacent to Pindari Dam wall at Lot 1 DP232186 and Lot 31 DP914703 (refer to Figure 1-2 in Appendix F).

6.6.2 Existing environment

Pindari Dam is listed (item number 4550170) on the WaterNSW Section 170 Heritage and Conservation Register (Section 170 Register). According to the listing, Pindari Dam was established on land used as an early pastoral run, one of which was named Pindari, meaning ‘high rock’. Records indicate that the area was used as pastoral/grazing lands until the dam was built in the mid to late 1960s.

6.6.2.1 Significance assessment:

Pindari Dam has been assessed as significant due to its contribution to the community of Inverell in the following forms:

- providing employment opportunity
- its social and recreational uses
- for revitalising the local economy
- supplying the agricultural industry with a reliable water source
- for its connection to a select group of farmers who were involved in partially funding past expansion works.

The dam’s seamless concrete facing to minimise leakage was an innovative design unique to the Pindari Dam’s construction, and as such was attributed some research significance from a design perspective. It is noted that the dam was recommended for removal from the Section 170 Register. The dam has minor significance at a local level.

The statement of significance completed for Pindari Dam identifies the architectural merits, aesthetic values, and economic and social contribution as the significant heritage elements of the heritage item, as well as the historic association with a small selection of un-named local farmers. The dam also has contributary value as a major water storage and supply facility for both NSW and south-east Queensland.

6.6.3 Potential impacts – construction and operation

The proposal is located on landforms adjacent to the existing dam wall at Pindari Dam, Ashford NSW (See Figure 1-2 in Appendix F). The proposal will not impact any existing structures, including the dam and power generating facilities; however, may partially impact associated roads. Aside from the dam itself, the remaining structures do not appear to have historical, social, aesthetic, or scientific values, although they do support the function and maintenance of the dam.

There is no evidence to suggest the existence of a previous substantial structure within the non-Aboriginal heritage study area. Therefore, there is low potential for archaeological features or deposits relating to any former structures.

Potential impacts to non-Aboriginal heritage from the proposal based on matters for consideration outlined in the SoHI Guidelines (NSW DPE, 2023) include localised impacts to landscape features directly associated with the dam wall from removal and trimming of extant vegetation.

As the works are unlikely to adversely affect the heritage significance of the item, Council consent is not required. The State Environmental Planning Policy (Transport and Infrastructure) 2021 (Section 2.11) also removes the obligation to consult with the Inverell Shire Council.

6.6.3.1 Consideration for specific works – works adjacent to a heritage item

The proposal will improve the function of the dam and as a result add to its perceived value. This suggests that the proposed works are compliant with Article 22 of the Burra Charter (ICOMOS 2013).

The proposal will likely be visible from the publicly accessible side of the dam wall (the east) and will be viewed in association with the structure. Currently, from the east bank a road and spillway are visible where the project will be situated. As such, the proposed works are not likely to detract from, or contribute to, the current visual landscape.

6.6.4 Safeguards and mitigation measures

Table 6.13 summarises recommended safeguards and mitigation measures that will be implemented to reduce impacts to non-Aboriginal heritage during construction and operation of the proposal.

Table 6.13 Non-Aboriginal heritage mitigation measures

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Non-Aboriginal heritage	A non-Aboriginal Heritage Unanticipated Finds Protocol will be developed as part of the CEMP in consultation with WaterNSW, prior to construction.	Contractor	Pre-construction

6.7 Noise and vibration

This section summarises impacts on noise and vibration likely to occur during construction and operation of the proposal.

6.7.1 Method

Potential noise and vibration impacts of construction of the proposal at Lake Pindari was investigated via desktop assessment. The desktop assessment reviewed publicly available data on the following platforms:

- NSW Planning Portal Planning Spatial Viewer (NSW DPHI, 2024)
- Transport for NSW Construction and Maintenance Noise Estimator Tool (Transport, 2024).

Assessment of potential noise and vibration impacts were assessed for construction during the following hours:

- 6.30am – 6.30pm Monday to Sunday (including public holidays).

Noise generating activities will be scheduled during standard construction hours (see below) where practicable. In addition, management and mitigation measures detailed within the CEMP will be implemented as required to further mitigate any construction impacts. This includes development of an out-of-hours work protocol which will govern the management of work outside standard work hours.

Noise generating activities will generally be undertaken during standard construction hours as follows:

- 7:00 am to 6:00 pm Monday to Friday
- 8:00 am to 1:00 pm Saturday
- no work on Sundays or public holidays.

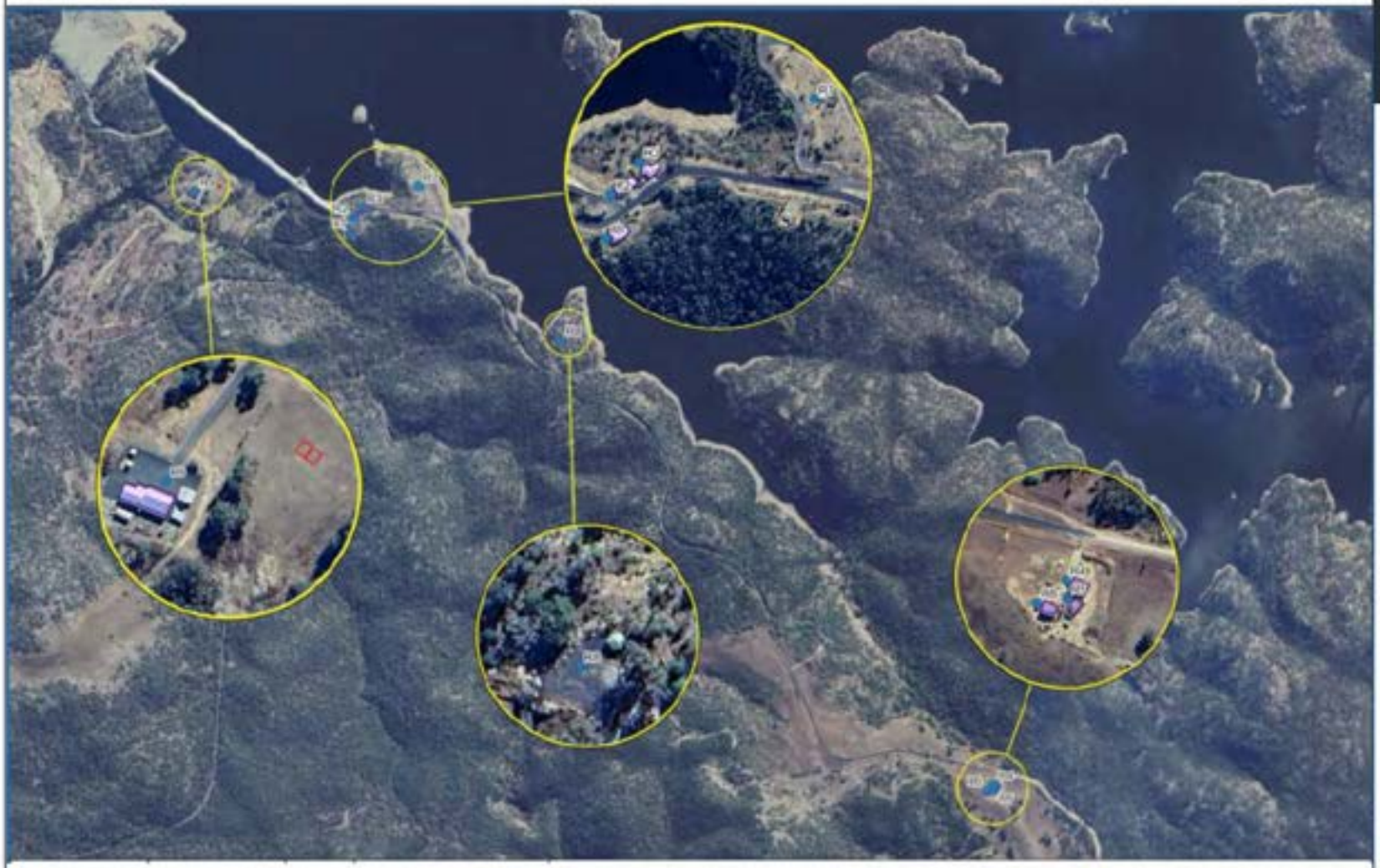
An Operational Noise Impact Assessment was prepared by AssetReady to assess the potential noise impacts of simultaneous operation of the two compressors during operation (Appendix I). The Operational Noise Impact Assessment involved testing potential operational noise during standard conditions and noise enhancing night time conditions in a 3D computer noise model (see Table 3.6 in Appendix I for details of standard noise enhancing night time conditions). The assessment also considered meteorological conditions and the dam's water height for a range of potential scenarios. Key parameters used in establishment across all noise model predictions are summarised in Table 4.2 of the Operational Noise Impact Assessment (Appendix I). The Operational Noise Impact Assessment was based on the conservative assumption that the compressors will operate at 100 per cent capacity at all times (24-hour operation). As such, the proposal will need to demonstrate that it is able to comply with the most stringent criteria (night time).

6.7.2 Existing environment

Lake Pindari is located in a rural area of northern NSW. A primary aerial identification of noise sensitive receivers within two kilometres of the proposal site has been carried out finding three residential receiver locations and three non-residential receiver locations, see Table 6.14 and Figure 6.5.

Table 6.14 Noise and vibration sensitive receivers

ID	Receiver type	Noise sensitive	Address	Distance and direction to impact area
R01	Residential	Yes	1626 Pindari Dam Rd, Pindaroi NSW 2361	10 metres south-east
R02	Residential/Office	Yes	1627 Pindari Dam Rd, Pindaroi NSW 2361	10 metres north
R03	Residential/Office	Yes	1629 Pindari Dam Rd, Pindaroi NSW 2361	10 metres north
R04	Residential	Yes	1986 Pindari Dam Rd, Pindaroi NSW 2361	2.7 kilometres south-east
R05	Shed	No	1986 Pindari Dam Rd, Pindaroi NSW 2361	2.7 kilometres south-east
R06	Shed	No	1986 Pindari Dam Rd, Pindaroi NSW 2361	2.7 kilometres south-east
R07	Passive recreation	Yes	Pindari Boat Camp Recreation Area	100 metres north
R08	Passive recreation	Yes	Pindari Dam Camping Ground, Pindaroi NSW 2361	500 metres east
R09	Commercial	Yes	Pindari Dam Rd, Pindaroi	within impact area

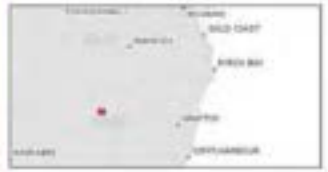


PS122845
Pindari Dam Bubble Plume

Figure 6.5
Noise and vibration sensitive receivers

Legend

- Receivers
- Buildings
- Compressors



Coordinate system:
Scale ratio correct when printed on A3
1:12500
Date: 4/03/2025

6.7.3 *Potential impacts – construction*

Construction of the proposal will include noise-generating activities, due to operation of plant and/or equipment outlined in Section 3.2.3.

The Transport for NSW Construction and Maintenance Noise Estimator Tool (Transport, 2024) was utilised to predict Noise Management Levels (NMLs) as a result of the proposal (refer to Appendix H). The establishment of NMLs is in accordance with the *Draft Construction Noise Guideline* (NSW EPA, 2020). A distance based (scenario) assessment was conducted based on a rock crushing scenario. The rock crushing scenario was chosen to conservatively assess potential noise impacts during construction and involves use of the following plant:

- rock crusher
- bulldozer D9
- excavator (tracked) 35 tonne
- dump truck.

The noise environment considered at the proposal site is R0 with a line of sight to the receiver, resulting in a NML of 40 dBA for standard working hours and 35 dBA for out of hours work (OOHW). Refer to Table 6.15 and Table 6.16 for the predicted noise impacts for residential and non-residential sensitive receivers.

Table 6.15 Predicted noise impacts for residential sensitive receivers

Receiver landscape	Working hours	Maximum affected distance (m)	Clearly audible (m)	Moderately intrusive (m)	Highly intrusive (m)
Undeveloped green fields, rural areas with isolated dwellings	Standard working hours	700	N/A	335	155
	OOHW	1010	700	335	155
Propagation across a valley/over water	Standard working hours	1310	N/A	575	230
	OOHW	1900	1310	575	230

Table 6.16 Predicted noise impacts for non-residential receivers during the day (standard working hours)

Receiver landscape	Receiver type	Maximum affected distance (m)	Clearly audible (m)
Undeveloped green fields, rural areas with isolated dwellings	Passive recreation	155	60
	Offices	60	N/A
Propagation across a valley/over water	Passive recreation	230	70
	Offices	80	N/A

The assessment identified that during standard construction hours residential sensitive receivers within 700 metres over land and 1,310 metres over water will be affected by construction noise of the proposal (see Table 6.16). As such, residential sensitive receivers R01, R02 and R03 located 10–20 metres from the proposal site will likely experience highly intrusive noise impacts. Non-residential sensitive receiver R07 (Pindari Boat Camp Recreation Area) is within 155 metres over land and 230 metres over water and will experience highly intrusive noise impacts during construction (see Table 6.17). Non-residential sensitive receiver R09 is within 60 metres over land and 80 metres over water and will also be impacted by noise during construction (see Table 6.17).

Table 6.17 Predicted noise impacts for non-residential receivers during the evening

Receiver landscape	Receiver type	Maximum affected distance (m)	5 to 15 dBA above NML within distance (m)	15 to 25 dBA above NML within distance (m)	>25 dBA above NML within distance (m)
Undeveloped green fields, rural areas with isolated dwellings	Passive recreation	155	105	30	9
	Offices	60	30	9	3
Propagation across a valley/over water	Passive recreation	230	135	35	11
	Offices	80	35	11	4

Noise generating activities will be scheduled during standard construction hours where practicable. However, if noise generating construction activities occur during out of hours work (OOHW) residential receivers within 1,010 metres over land and 1,900 metres over water will be affected by construction noise of the proposal (see Table 6.15). Residential sensitive receivers R01, R02 and R03 will likely experience highly intrusive noise impacts. Non-residential sensitive receiver R07 will be noise affected, with noise levels 5-15 dBA above the NML (see Table 6.17). Non-residential sensitive receiver R09 is located within the impact area and will likely be highly noise affected (see Table 6.17).

Sensitive receivers R04, R05, R06 and R08 are unlikely to experience noise impacts during standard hours or OOHW for construction of the proposal due to their distance from the proposal site.

Noise generating activities during construction of the proposal will be intermittent and within standard construction hours as far as practicable. As WaterNSW assets, the potential noise impacts during construction to receivers R02, R03 and R09 are acceptable given their temporary and intermittent nature. Nearby sensitive receivers will be notified prior to the commencement of works in line with mitigation measures recommended in the Transport for NSW Construction and Maintenance Noise Estimator Tool (Transport, 2024).

During construction, use of an excavator will be required in some areas as the depth of rock will vary from shallow to well below the proposed excavation levels. The majority of the works are either on-ground, built up above ground, or in the reservoir. Some excavation in rock is likely to be required in discrete locations. For the purposes of excavation, an excavator with hammer attachment will be the preferred method, so the use of such plant will be required but limited to only where needed. Typically, an excavator up to 16-20 tonnes with hammer attachment is expected to be sufficient. As Pindari Dam is a heritage listed item (item number 4550170), a specialist assessment will be required where the excavator is to be used. Additionally, for the use of vibratory plant and equipment, such as a 20 tonne excavator with hammer attachment and 12 tonne excavator, within 100 metres of sensitive receivers, including the heritage listed dam, consideration of specialist assessment is recommended.

6.7.4 *Potential impacts – operation*

The Operational Noise Impact Assessment for the proposed compressor units at Pindari Dam has demonstrated that the proposed compressor location is a viable option for installation, with no significant noise impacts on the surrounding environment. The assessment showed that noise levels at all sensitive receivers, including residential areas, recreational sites, and offices, are predicted to comply with the established noise criteria under various operational scenarios. The predicted worst case external noise impacts from the proposal to R02 and R03 are predicted to be 15-17 dBA (A-weighted decibel), which is well below the external noise limit of 63dBA.

The Operational Noise Impact Assessment, which included modelling under various meteorological conditions, confirms that the proposed compressor location will remain within the permissible noise limits across all time periods

(day, evening, and night). Therefore, no additional noise mitigation measures are necessary, with minimal noise impact on the surrounding community and environment.

Vibration impacts during operation of the proposal are expected to be negligible.

6.7.5 Safeguards and mitigation measures

Table 6.18 summarises recommended safeguards and mitigation measures to be implemented to reduce potential noise impacts during construction and operation of the proposal.

Table 6.18 Noise and vibration safeguards and mitigation measures

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
Noise management	An out-of-hours work protocol will be developed prior to construction to govern the management of work outside standard work hours.	Contractor	Pre-construction
Noise management	Work will occur in accordance with the WaterNSW Noise Management Procedure.	Contractor	Construction
Noise management	Where practicable, noise generating construction activities will be restricted to standard construction hours: — 7:00 am to 6:00 pm Monday to Friday — 8:00 am to 1:00 pm Saturday — no work on Sundays or public holidays.	Contractor	Construction
Noise management	Out of hours work will require additional assessment, including: — potentially affected residents to be provided at least seven days' notice prior to conducting night works — night works will be planned with consideration to respite periods for high noise generating activities and the number of consecutive nights worked.	Project manager	Construction
Noise management	All construction staff will complete an environmental induction that will include awareness of noise impacts and the need to limit noise where practicable. Staff will be instructed not to leave plant idling unnecessarily and avoid dropping materials from height.	Contractor	Construction
Noise management	Plant will be properly maintained in order to reduce noise levels.	Contractor	Construction
Noise management	The following additional principles and proactive noise management measures will be considered for implementation: — sensitive receivers will be notified about the proposal, work activities, time periods over which these will occur, impacts and mitigation measures a minimum of five working days prior to the commencement of construction — where practical, simultaneous operation of dominant noise generating plant will be managed to reduce noise impacts, such	Contractor	Construction

Impact	Environmental safeguards and mitigation measures	Responsibility	Timing
	as operating at different times or increasing distance between the plant — where practicable and in compliance with work health and safety standards, reversing beepers on trucks will be replaced with low pitch non-tonal beepers (quackers). Alternatives to reversing beepers include the use of spotters and designing the site to reduce the need for reversing may assist in minimising the use of reversing beepers — a summary of appropriate construction noise and vibration management practices will be provided to all staff and contractors and be included during site inductions and daily tool-box talks. The tool-box talks will include as a minimum, permitted hours of construction work, work site locations, site ingress/egress and the required noise management measures for each construction phase.		
Vibration	Specialist assessment of vibration impacts will be considered if use of vibratory plant and equipment is required within 100 metres of sensitive receivers, including the heritage listed dam.	Project manager/ contractor	Construction

6.8 Traffic, transport and access

This section summarises potential traffic, transport and access impacts likely to occur during construction and operation of the proposal.

6.8.1 Method

AssetReady prepared a desktop assessment to investigate potential impacts associated with traffic, transport and access at the proposal site. The assessment reviewed publicly available information on the following platforms:

- NSW Planning Portal Planning Spatial Viewer (NSW DPHI, 2024).

6.8.2 Existing environment

The site will be accessed from Inverell via the following public roads in accordance with any restrictions, such as vehicle weights, speed, widths and heights. The proposed access route will be:

- Ashford Road, Bakkulla Road and and Pindari Dam Road (via Ashford Village)
- Ashford Road, The Pocket Road (including an unsealed section of this road), and Pindari Dam Road.

There are no load limit signs posted on any of these roads.

The proposal site will be fenced at the limit of the impact area, and access to the public will be restricted during construction. Existing dam access roads will be utilised throughout the works. Extension of access tracks at the base of the dam wall and between the construction compound and the staging point are proposed for construction of the proposal. The dam wall will also be used for construction access. Access tracks will be closed during inclement weather and for a period following wet weather until deemed satisfactory to gain access.

6.8.3 Potential impacts – construction

Construction of the proposal is expected to result in traffic, transport and access impacts due to movement of construction vehicles.

Vehicles required for the proposal include:

- six light vehicles
- four delivery rigid trucks
- two three-tonne trucks
- one pole truck
- two transformer delivery vehicles
- 7.8 metres long vehicle.

The proposal will generate increased vehicle movements and traffic comprising small vehicles, trucks and plant associated with workers entering and leaving the site, importation of materials and disposal of spoil. As a result, traffic flow is expected to temporarily increase along the access routes; however, traffic is not expected to be impacted to more than a minor extent.

Access to the proposal site will be restricted and fenced off for public safety during construction. All vehicles accessing the proposal site will be subject to WaterNSW protocols regarding vehicle movements, in addition to NSW Road Rules.

The proposal will include a permanent aquatic exclusion area around the bubble plume destratification system (see Figure 1.3). Public access to this area will be restricted to protect the bubble plume destratification system infrastructure during construction.

6.8.4 Potential impacts – operation

Operation of the proposal is not expected to result in permanent changes to traffic flow or access following the completion of works. Vehicles will require maintenance access during operation of the proposal; however, this will have a negligible impact on traffic on the road surrounding Pindari Dam. Public access to the aquatic exclusion area during operation will continue to be restricted to protect the bubble plume destratification system infrastructure.

6.8.5 Safeguards and mitigation measures

Table 6.19 summarises recommended safeguards and mitigation measures to be implemented to reduce impacts on traffic, transport and access during construction and operation of the proposal.

Table 6.19 Traffic, transport and access safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Traffic	A Traffic Management Plan (TMP) will be prepared and implemented to allow for the safe movement and access within the road network. The TMP will include: — confirmation of haulage routes — measures to maintain access to local roads and properties — site-specific traffic control measures (including signage) to manage and regulate traffic movement — requirements and methods to consult and inform the local community of impacts to the local road network — access to construction sites including designated entry and exit locations and measures to prevent construction vehicles queuing on public roads — a response plan for construction traffic incidents.	Project manager/ Contractor	Prior to construction/ Construction
Access	Appropriate exclusion barriers, signage and site supervision will be employed at all times to ensure that the work site is controlled and that unauthorised vehicles and pedestrians are excluded from the works area.	Contractor	Construction
Access	Construction traffic will use only existing access points and tracks to the pipeline corridor, as detailed in this REF.	Project manager/ Contractor	Construction
Access	Consider preparing a dilapidation survey of roads to document any damage during construction to be reinstated to pre-construction condition.	Contractor	Construction

6.9 Air quality

This section summarises potential impacts to air quality likely to occur during construction and operation of the proposal.

6.9.1 Method

AssetReady prepared a desktop assessment to investigate potential impacts associated with air quality at the proposal site. The assessment considered sensitive receivers within two kilometres of the proposal site and reviewed information and guidelines from the following publicly available sources:

- Air quality data at Armidale (Air quality NSW, 2024)
- National Pollutant Inventory (NPI) (DCCEEW, 2024)
- *Guidance on the assessment of dust from demolition and construction* (Institute of Air Quality Management (IAQM), 2024)

6.9.2 Existing environment

Land use within and surrounding the proposal site is predominantly associated with water storage, recreation and conservation in the Severn River Nature Reserve. Factors that impact the air quality at the proposal site are related to the following:

- natural events including bushfires, dust storms and strong winds
- vehicle movements to and from rural properties and for recreational and conservation purposes.

The closest Air Quality Monitoring Station (AQMS) is located in Armidale about 130 kilometres south-west of the proposal site. A review of air quality concentration data for Armidale on 30 September 2024 identified air quality as 'good' based on Particles ($PM_{2.5}$) (Air Quality NSW, 2024). $PM_{2.5}$ particles are fine particles in the air with a diameter of 2.5 micrometres or less. These particles can penetrate the lungs and be absorbed into the bloodstream, resulting in breathing difficulties, worsening of asthma, chronic bronchitis symptoms, and/or irritation of the eyes, nose and throat. The same station noted PM_{10} concentration as good. PM_{10} are particles in air with a diameter of 10 micrometres or less. These particles can also pass into the lungs with short-term impacts including difficulty breathing and worsening of asthma or chronic bronchitis symptoms. They can also cause irritation of eyes, nose and throat.

The closest facility listed on the NPI is Gunnee Feedlot Pty Ltd – in Delungra, NSW. The facility is a beef cattle feedlot. The facility is about 40 kilometres south-west of the proposal site. The NPI indicates that the facility generated around 95,000 kilograms of PM_{10} for financial year 2022/2023. Considering the distance of the feedlot from the proposal, it is unlikely to affect the air quality at the proposal site.

A primary aerial identification of air quality sensitive receivers within two kilometres of the proposal site located three residential receivers and three non-residential receivers, as detailed in Table 6.20.

Table 6.20 Air quality sensitive receivers

ID	Receiver type	Address	Distance and direction to proposal site
R01	Residential	1626 Pindari Dam Rd, Pindaroi NSW 2361	10 metres south-east
R02	Residential/Office	1627 Pindari Dam Rd, Pindaroi NSW 2361	10 metres north
R03	Residential/Office	1629 Pindari Dam Rd, Pindaroi NSW 2361	10 metres north
R04	Residential	1986 Pindari Dam Rd, Pindaroi NSW 2361	2.7 kilometres south-east
R05	Shed	1986 Pindari Dam Rd, Pindaroi NSW 2361	2.7 kilometres south-east
R06	Shed	1986 Pindari Dam Rd, Pindaroi NSW 2361	2.7 kilometres south-east
R07	Passive recreation	Pindari Boat Camp Recreation Area	100 metres north
R08	Passive recreation	Pindari Dam Camping Ground, Pindaroi NSW 2361	500 metres east
R09	Commercial	Pindari Dam Rd, Pindaroi	within impact area

6.9.3 Potential impacts – construction

Air quality impacts associated with dust generation and vehicle emissions are expected during construction of the proposal, due to the following construction activities:

- excavation, trenching, and earthworks
- fibre-reinforced polymer slab construction
- stockpiling of materials
- movement of construction vehicles
- refuelling of plant and equipment
- loading and transfer of materials and/or spoil
- vehicular access along unsealed road surfaces (trackout).

A qualitative risk assessment using *Guidance on the assessment of dust from demolition and construction guidelines* (IAQM 2024) found R01, R02, R03 and R09 were assessed to have a medium sensitivity to dust soiling and low sensitivity to human health impacts. R07 was assessed to have a low sensitivity to dust and human health impacts. R04, R05, R06 and R08 are not anticipated to experience any air quality impacts from construction of the proposal as they are located greater than 250 metres from the proposal site. Based on the sensitivity of receivers in Table 6.20 to air quality impacts and extent of construction, earthworks and trackout expected during construction, the proposal is anticipated to pose a low risk of dust soiling and negligible risk to human health. Implementation of environmental safeguards are expected to appropriately mitigate potential impacts of dust and vehicle exhaust emissions from construction of the proposal.

6.9.4 Potential impacts – operation

Monitoring and maintenance activities will continue in accordance with WaterNSW protocols. The proposed works are not expected to result in increased emissions and/or air quality impacts to the surrounding environment. Therefore, operation of the proposal is not expected to result in permanent changes to air quality following the completion of works.

6.9.5 Safeguards and mitigation measures

Table 6.21 summarises recommended safeguards and mitigation measures that will be implemented to reduce impacts on air quality during construction and operation of the proposal.

Table 6.21 Air quality noise and vibration mitigation measures

Impact	Environmental Safeguards	Responsibility	Timing
Air quality	The CEMP will be prepared and implemented during construction with measures to minimise air quality impacts, including where practicable: — a progressive rehabilitation strategy will be prepared for exposed surfaces — all vehicles and machinery will be maintained in good working condition in accordance with the manufacturer standards — all site vehicles and machinery will be switched off when not in use to eliminate generation of any unnecessary emissions — all vehicles transporting material to and from sites will be covered immediately after loading to prevent fugitive emissions and spillages — stockpiles will be located away from sensitive receivers, where practicable — appropriate dust control measures, such as water cart rotations and misting systems, will be applied as required to minimise dust dispersion beyond construction areas — emissions will comply with the *Protection of the Environment Operations Act 1997*.	Project manager/ contractor	Construction

6.10 Visual amenity

This section summarises potential visual amenity impacts likely to occur during construction and operation of the proposal.

6.10.1 Method

AssetReady prepared a desktop assessment to investigate potential impacts associated with visual amenity at the proposal site. The assessment reviewed publicly available information on the following platforms:

- NSW Planning Portal Planning Spatial Viewer (NSW DPHI, 2024).

6.10.2 Existing environment

The proposal site is zoned as RU1 – Primary Production under the Inverell Shire LEP. The objectives of RU1 land are:

- to encourage sustainable primary industry production by maintaining and enhancing the natural resource base
- to encourage diversity in primary industry enterprises and systems appropriate for the area
- to minimise the fragmentation and alienation of resource lands
- to minimise conflict between land uses within this zone and land uses within adjoining zones.

Land immediately east of the study area is zoned as C3 – Environmental Management. Beyond this, around three kilometres east of the study area, the Severn River Nature Reserve is zoned as C1 – National Parks and Nature Reserves (see Figure 6.6).

Whilst Lake Pindari is not mapped within the Scenic Protection Land, it is a popular recreation destination offering year-round attractions for campers, fishing and water sports enthusiasts, bushwalkers and picnickers. The dam wall provides scenic views of the lake and valley (WaterNSW, 2024). Sensitive receivers for impacts to visual amenity include the commercial office (WaterNSW asset) located within the impact area at the base of the dam wall, three residences located 10 metres from the impact area on Pindari Dam Road (two of which are WaterNSW assets) and the Pindari Boat Camp Recreation Area and Pindari Dam Camping Ground located 100 metres and 500 metres from the impact area, respectively (refer to Table 6.14).

6.10.3 Potential impacts – construction

Minor visual impacts during construction of the proposal are anticipated to be experienced by nearby residential, commercial and recreational sensitive receivers due to the bubble plume destratification system infrastructure and presence of machinery and plant. However, visual amenity impacts are anticipated to be minor as the proposal is located within a heavily modified landscape and use of plant and equipment will be limited to the construction period (estimated to be around 40 weeks). Implementation of environmental safeguards in Table 6.22 will mitigate potential impacts to visual amenity during construction.

6.10.4 Potential impacts – operation

Operation of the proposal will result in minor impacts to visual amenity for nearby residential, commercial and recreational sensitive receivers due to the bubble plume destratification system infrastructure. Overall, the proposal is considered to be in keeping with the existing character of the site. Implementation of environmental safeguards in Table 6.22 will mitigate potential impacts to visual amenity during operation.

6.10.5 Safeguards and mitigation measures

Table 6.22 summarises recommended safeguards and mitigation measures to be implemented to reduce impacts on visual amenity during construction and operation of the proposal.

Table 6.22 Visual amenity mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Visual	The work site and equipment will be maintained in an orderly manner. Rubbish will be removed at the end of each work day. Site equipment will be stored entirely within designated laydown areas and secured when not in operation.	Contractor	Construction
Rehabilitation	Upon completion of the works, all vehicles, construction equipment, materials, and refuse relating to the works will be removed from the area and all areas will be restored to a level that matches the pre-work condition.	Contractor	Construction
Rehabilitation	All natural and built surfaces and property disturbed or damaged as a result of the works will be replaced, repaired, reinstated or otherwise restored to their pre-existing condition.	Contractor	Construction

6.11 Property and land use

This section summarises potential impacts to property and land use likely to occur during construction and operation of the proposal.

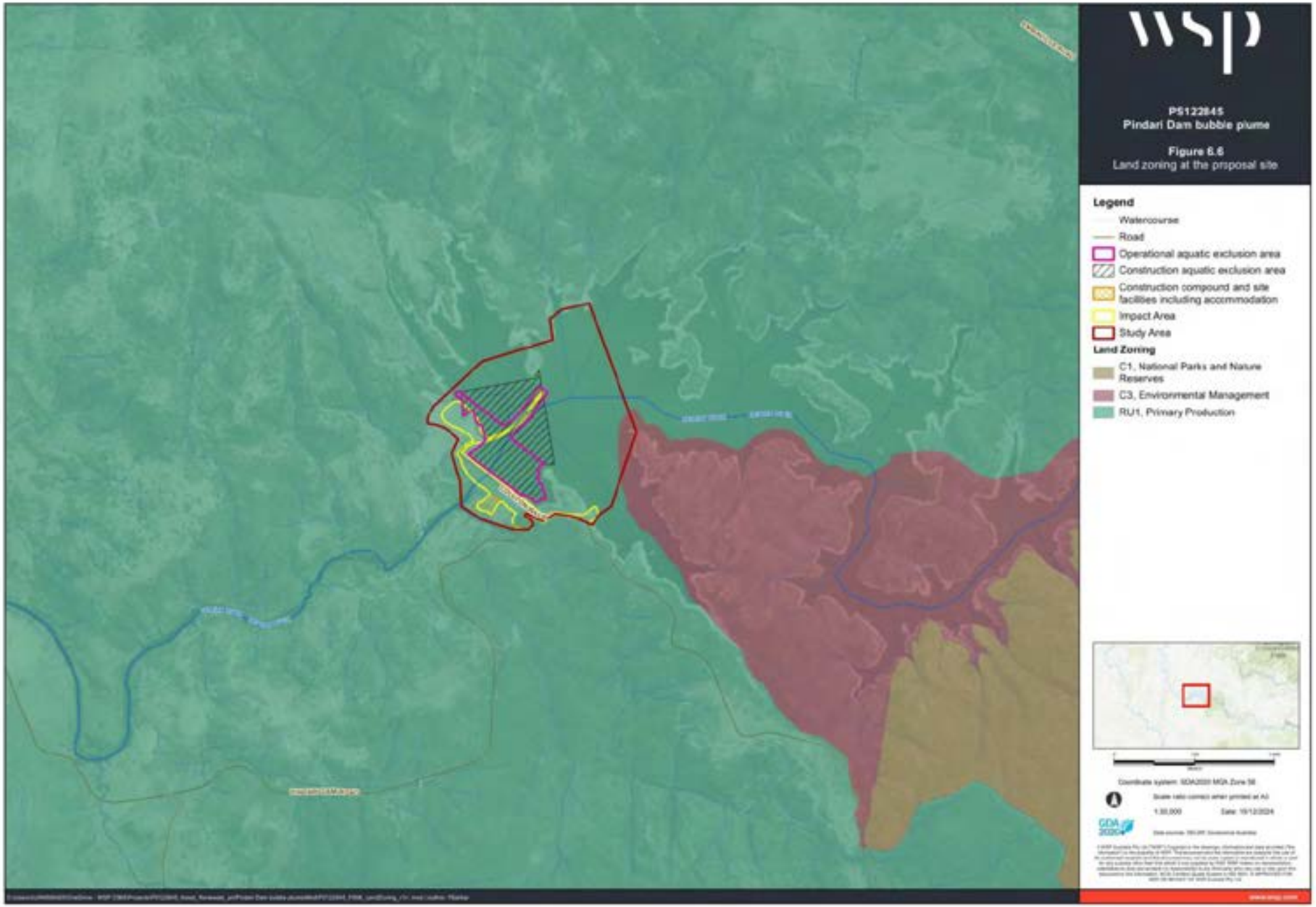
6.11.1 Method

AssetReady prepared a desktop assessment to investigate potential impacts associated with property and land use at the proposal site. The assessment reviewed publicly available information on the following platforms:

- NSW Planning Portal Planning Spatial Viewer (NSW DPHI, 2024).

6.11.2 Existing environment

The proposal site traverses land zoned RU1 – Primary Production. Land use within and surrounding the proposal site is primarily associated with water storage, grazing, agriculture and farming practices as well as recreational activities including camping, water sports and fishing (see Figure 6.6). Sensitive receivers to property and land use impacts include the commercial office (WaterNSW asset) located within the impact area at the base of the dam wall, three residences located 10 metres from the impact area on Pindari Dam Road (two of which are WaterNSW assets) and the Pindari Boat Camp Recreation Area and Pindari Dam Camping Ground located 100 metres and 500 metres from the impact area, respectively (refer to Table 6.14).


wsp
PS122845
Pindari Dam bubble plume
Figure 6.6
Land zoning at the proposal site
Legend
Watercourse
Road
Operational aquatic exclusion area
Construction aquatic exclusion area
Construction compound and site facilities including accommodation
Impact Area
Study Area
Land Zoning
C1, National Parks and Nature Reserves
C3, Environmental Management
RU1, Primary Production
Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3
1:30,000
Date: 10/12/2024
GDA 2020

6.11.3 Potential impacts – construction

During construction, recreation use of Lake Pindari and the associated camping grounds will be impacted. Public use of Lake Pindari within the aquatic exclusion area will be restricted for recreational activities such as fishing and water sports. The Pindari Boat Camp Recreation Area and Pindari Dam Camping Ground will remain accessible during construction. However, these camping locations will experience noise and vibration, air quality, and visual amenity impacts during construction (refer Sections 6.7, 6.9 and 6.10).

Overall, construction of the proposal is consistent with the existing land use at the site, and significant long-term impacts to land use in the area are not expected.

6.11.4 Potential Impacts – operation

During operation, public use of Lake Pindari within the aquatic exclusion area will be restricted for recreational activities such as fishing and water sports. The Pindari Boat Camp Recreation Area and Pindari Dam Camping Ground will experience negligible impacts to land use during operation such as noise and vibration, air quality and visual impacts (refer to Sections 6.7, 6.9 and 6.10 for assessment of impacts during operation of noise and vibration, air quality and visual amenity).

Overall, operational property and land use impacts are considered minor and consistent with existing maintenance access requirements for Pindari Dam and will be managed by WaterNSW.

6.11.5 Safeguards and mitigation measures

Table 6.23 summarises recommended safeguards and mitigation measures to be implemented to reduce impacts on property and land use during construction and operation of the proposal.

Table 6.23 Property and land use mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Consultation	Accurate public information signs will be displayed while construction work is in progress and maintained in a presentable manner. Notification of commencement of works through email, letter, newspaper and signage to all stakeholders would be completed two weeks prior to the start of construction.	Contractor	Construction
	A complaint handling procedure and register will be maintained throughout construction. A maritime notice will also be developed for the proposal prior to construction and operation in consultation with Transport – Maritime North.	Contractor	Construction Operation

6.12 Waste management

This section summarises potential waste management impacts likely to occur during construction and operation of the proposal.

6.12.1 Method

AssetReady prepared a desktop assessment to investigate potential impacts associated with waste management at the proposal site. The assessment reviewed publicly available information on the following platforms:

- *Waste Classification Guidelines* (NSW EPA, 2014).

6.12.2 Existing environment

Waste in NSW is regulated under the POEO Act and the WARR Act. The objective of these Acts is to prevent degradation of the environment, eliminate harmful wastes, reduce the amount of waste generated and establish priorities for waste reuse, recovery and recycling.

The WARR Act establishes a waste hierarchy, that comprises the following principles, in order of priority:

- avoidance of waste: minimising unnecessary resource consumption in construction, operations, maintenance and management
- resource recovery: re-using, recycling, reprocessing, and energy recovery of waste products during construction and operations to minimise the amount of waste for disposal
- disposal: where resources cannot be recovered, they will be appropriately managed and disposed of to minimise the potential adverse environmental impacts likely to be associated with their disposal.

In accordance with the resource management hierarchy principles detailed in the WARR Act, WaterNSW promotes responsible management of unavoidable waste and re-use where practicable. Adopting the waste hierarchy principles aims to efficiently use and reduce resources, reduce costs, and reduce environmental harm in accordance with the principles of ESD.

6.12.3 Potential impact – construction

Construction of the proposal is expected to generate the following waste streams:

- general and domestic waste from workers and on-site facilities
- general construction waste such as packaging and surplus construction material including remnant air diffuser pipework
- waste residual chemicals
- green waste from vegetation clearing activities
- 1,500 cubic metres of rock strata.

Waste generated will either be reused on-site or disposed off-site. Options for reuse on-site will be assessed at the time of excavation depending on the suitability of excavated material. Where waste materials generated by the proposal cannot be reused on-site, disposal will be required. Disposal of wastes will be in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014) with waste taken to a suitably licenced waste facility. Suspected contaminated waste, harmful materials or classifiable special wastes will be managed in accordance with an unexpected finds procedureto be prepared as a part of the CEMP.

Table 6.24 lists the indicative waste streams created from construction of the proposal and the preferred management and disposal. As identified below, there are several orders and exemptions that allow for resource recovery without NSW EPA approval.

Table 6.24 Indicative waste generation and management

Waste stream	Classification	Preferred management
Excavated natural material (spoil) notwithstanding potential for encountering contamination	General solid waste (non-putrescible)	Recovery under exemption for reuse off-site or on-site
Surplus building material (fencing, sediment, concrete, sandbags, excess metal)	General solid waste (non-putrescible)	Disposal to a licenced facility off-site
Packaging materials (pallets, crates, cartoons, plastics, wrapping materials)	General solid waste (non-putrescible)	Recovery under exemption for reuse off-site
Waste residual chemicals and oils (including packaging and containers) Asbestos containing materials	Hazardous waste	Disposal to a licenced facility off-site
Green waste	General solid waste (putrescible)	Recovery off-site (composting/mulching)
Domestic and food waste	General solid waste (putrescible)	Recovery off-site (composting)

6.12.4 *Potential impacts – operation*

Operation of the proposal is not expected to result in generation of significant volumes of waste. Any waste generated during operation will be disposed of in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014).

6.12.5 Safeguards and mitigation measures

Table 6.25 summarises recommended safeguards and mitigation measures that will be implemented to reduce impacts of waste generated during construction and operation of the proposal.

Table 6.25 Waste safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Waste management	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include, but not be limited to: — measures to avoid and minimise waste associated with the proposal — classification of wastes and management options (re-use, recycle, stockpile, disposal) — statutory approvals required for managing on-and-off-site waste, or application of any relevant resource recovery exemptions — procedures for storage, transport and disposal monitoring, record keeping and reporting.	Project manager/ Contractor	Prior to construction/ Construction
Waste management	All waste generated during the course of the works will be either re-used or removed from the work areas as soon as practicable and disposed of in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014). Options for reuse on-site will be assessed at the time of excavation depending on suitability of excavated material.	Contractor	Construction
Waste management	Construction compound areas will be maintained, kept free of weeds, debris and other rubbish and cleaned up at the end of each working day.	Contractor	Construction

6.13 Socio-economic

This section summarises potential socio-economic impacts likely to occur during construction and operation of the proposal.

6.13.1 Method

A desktop assessment was prepared to identify potential socio-economic impacts associated with the proposal. The assessment comprised a search of the following publicly available information and government databases:

- NSW Planning Portal ePlanning Spatial Viewer (NSW DPHI, 2024).

6.13.2 Existing environment

The proposal site is located within Pindari Dam on Pindari Dam Road (Lot 31 DP914703), in the Inverell Shire LGA. The proposal site is approximately 16 kilometres south-east of Ashford with a population of 659 and 34 kilometres west of Emmaville with a population of 505 (Australian Bureau of Statistics (ABS), 2021).

There are no sensitive receivers for socio-economic impacts within the impact area of the proposal. However, the Pindari Boat Camp Recreation Area and Pindari Dam Camping Ground are located 100 metres and 500 metres from the impact area, respectively (refer to Table 6.14). There are several other camping and recreation areas located within 10 kilometres of the proposal site including Pindari Adventures, Fernlee River camp ground and Severn River Water Park.

6.13.3 Potential impacts – construction

Socio-economic impacts will be primarily associated with disturbances to recreational activities nearby and within the aquatic exclusion area within Lake Pindari and impacts related to accommodation for construction personnel during construction.

The proposal will require an aquatic exclusion area within Pindari Dam during construction for the installation of aeration pipework (see Figure 1.3). This will limit the area available to the public for water sports, fishing and recreational activities. Pindari Dam Road will remain open for public use during construction, however access to the dam wall crest road (Coulton Walk) will be restricted during construction.

The estimated maximum number of construction personnel required during construction is 20. Local accommodation in Inverell including housing, AirBNB, hotels/motels, and/or campgrounds are likely to accommodate construction personnel. Accommodation of construction personnel is not anticipated to result in any adverse socio-economic impacts.

Overall, socio-economic impacts from construction are anticipated to be minor.

6.13.4 Potential impacts – operation

Minor operational socio-economic impacts associated with the proposal are expected from the permanent aquatic exclusion area around the bubble plume destratification system. However, there is potential for a positive impact through reduction of thermal stratification that will improve the water quality, ecosystem health and recreation value of Lake Pindari.

6.13.5 Safeguards and mitigation measures

No additional safeguards or mitigation measures are considered necessary.

6.14 Cumulative impacts

This section summarises potential cumulative impacts likely to occur during construction and operation of the proposal.

6.14.1 Methodology

AssetReady prepared a desktop assessment to investigate potential cumulative impacts associated with the proposal site. The assessment reviewed publicly available information on the following platforms:

- NSW Planning Portal Major Projects Application Tracker (NSW DPHI, 2024a)
- Inverell Shire Council Application Tracking (Inverell Shire Council, 2024).

6.14.2 Existing environment

In accordance with a search of the Major Projects Application Tracker for State Significant Development and the Inverell Shire Council development application tracker on 30 September 2024, there are no current projects within five kilometres of the proposal site.

6.14.3 Potential impacts – construction

It is understood that WaterNSW is proposed work on the spillway at Pindari Dam; however, no information was available during preparation of this REF. Future environmental assessment of the spillway will consider potential cumulative imapct of both projects.

As no existing or future projects within or in proximity to the proposal were identified at the time of preparing this REF, cumulative impacts during construction of the proposal are not expected.

6.14.4 Potential impacts – operation

As no existing or future projects within or in proximity to the proposal were identified at the time of preparing this REF, cumulative impacts during operation of the proposal are not expected.

6.14.5 Safeguards and mitigation measures

No additional safeguards or mitigation measures are considered necessary.

6.15 Principles of ecologically sustainable development

This section explains how the proposal considers the principles of ESD in accordance with Section 6(2) of the *Protection of the Environment Administration Act 1991*.

Principles of ESD are detailed and considered in Table 6.26.

Table 6.26 Principles of ESD applied to the proposal

ESD Principle	Application to the proposal
Precautionary principle	The proposal does not pose a risk of significant or irreversible environmental damage. The impacts associated with the proposal are generally known and avoided, where practicable. Adverse impacts associated with the proposal are considered minor. Mitigation measures to reduce adverse impacts as far as practicable have been identified within this REF. The proposal will result in mixing of thermally stratified water within Lake Pindari leading to reduced potential for cold water pollution and improved water quality. The proposal will be used as a trial to inform a framework for remediating stratified reservoirs across the state.
Inter-generational equity	Operation of the proposal aims to ensure the health, productivity and diversity of species and habitats within Lake Pindari and downstream in the Severn River are enhanced. Improving environmental conditions will benefit current and future generations.
Conservation of biological diversity and ecological integrity	The proposal will involve removal of approximately 0.63 hectares of native vegetation. Conservation of biological diversity and ecological integrity are expected to be improved by operation of the proposal which aims to achieve destratification of the water in Lake Pindari, mitigating the potential for cold water pollution downstream in the Severn River. This will support biological diversity through reducing the potential for negative impacts on the survival, growth and reproduction of native fish from cold water pollution.
Improved valuation, pricing and incentive mechanisms	WaterNSW recognises the value of environmental resources and aims to minimise impacts of its activities by ensuring that appropriate mitigation measures are implemented for all aspects of the proposal.

7 Environmental management

This chapter describes how the proposal will be managed to reduce potential environmental impacts throughout detailed design, construction and operation. The licence and/or approval requirements required prior to construction are also listed.

7.1 Construction environmental management plan (CEMP)

Safeguards and mitigation measures have been identified within this REF (refer to Table 7.1) to reduce the potential environmental impacts as a result of the proposal. Should the proposal proceed, these measures will be incorporated into the detailed design and applied during the construction and operation of the works. A CEMP will be prepared to describe mitigation and management measures identified in this REF. The CEMP will provide a framework for establishing how these measures will be implemented and persons responsible for their implementation. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements.

7.2 Licencing and approvals

The following approvals are required:

- Section 199 permit under the FM Act will be applied for and received prior to conducting dredging or reclamation in Pindari Dam.

7.3 Summary of safeguards and mitigation measures

Table 7.1 provides a summary of management measures to manage the potential environmental impacts associated with construction and operation of the proposal.

Table 7.1 Safeguards and mitigation measures proposed

ID	Safeguards and mitigation measures	Responsibility	Timing
Terrestrial biodiversity			
B1	Pre-clearing checks for fauna and nests are to be undertaken immediately prior to the clearing of vegetation. Any fauna or nests observed are to be managed in consultation with the project ecologist.	Project manager/ project ecologist	Pre-construction

ID	Safeguards and mitigation measures	Responsibility	Timing
B2	An appropriate Erosion and Sediment Control Plan (ESCP) is to be prepared with consideration for the following: — on-site water management to reduce erosion and sedimentation and potential pollution of adjoining areas of native vegetation, watercourses and management of stormwater and dam water during periods of high rainfall — run-off or unplanned overflows from construction must be retained in water quality basins or an appropriate alternative Diverting run-on water from disturbance works occurring on upslope land, using non-erosive methods — installing protective measures to prevent sheet erosion where large portions of soil will be exposed. Construction of sediment filters or sediment retention traps where appropriate, particularly below fill batters near waterways.	Project manager/ contractor	Pre-construction
B3	Trees will be protected in accordance with the requirements of the Australian Standard 4970-2009 for the Protection of Trees on Development Sites.	Project manager/ contractor	Pre-construction
B4	Accurately and clearly mark out the limits of the work zone, areas for parking and turning of vehicles and plant equipment prior to commencement of works. These areas shall be located so that vegetation disturbance is minimised, and the drip-line of trees avoided.	Project manager/ contractor	Pre-construction
B5	Materials, plant, equipment, work vehicles and stockpiles will be placed to avoid damage to surrounding vegetation and will be outside tree drip-lines.	Contractor	Construction
B6	Machinery is to be inspected for fauna prior to starting each day. Wildlife may become trapped in or may choose to shelter in machinery that is stored in the ecology study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.	Contractor	Construction

ID	Safeguards and mitigation measures	Responsibility	Timing
B7	If any damage occurs to vegetation outside of the nominated work area (as shown in the CEMP), the Environmental Representative will be notified so that appropriate remediation strategies, such as revegetation, can be developed.	Contractor	Construction
B8	Erosion and sediment controls will remain in place until all soil stabilisation has been completed.	Contractor	Construction
B9	Construction crews will be made aware that any native fauna species encountered must be allowed to leave site without being harassed and WIRES must be called for assistance where necessary.	Contractor	Construction
B10	If any threatened or native species (flora or fauna) are discovered during the works, all work will stop immediately, and the Environmental Representative will be notified. Work will only recommence once the impact on the species has been assessed and appropriate control measures provided. A Construction Site Plan as part of the CEMP will be prepared to show the: — no go areas and boundaries of the work area/disturbance corridor — locations of parking, lay-down and storage areas for materials, plant and stockpiles — location and full extent of any lopping, trimming, clearing or other vegetation disturbance required for the works.	Contractor	Construction
B11	All vehicles driving to and from site should follow a protocol to prevent the spread or introduction of pathogens such as phytophthora and chytrid, namely vehicles should be clean, including the tyres and any equipment.	Contractor	Construction

ID	Safeguards and mitigation measures	Responsibility	Timing
B12	Weed control will be undertaken by suitably qualified and/or experienced, licenced sub-contractors in accordance with contemporary bush regeneration practices. This may include: — manual weed removal in preference to herbicides — replacing non-target species removed/killed as a result of weed control activities — protecting Non-target species from spray drift — using only herbicides registered for use within or near waterways for the specific target weed — applying herbicides during drier times when the waterway level is below the high-water mark — not applying herbicide if it is raining or if rain is expected — mixing and loading herbicides and cleaning equipment away from waterways and drains.	Project manager	Construction and operation
B13	Manage priority weeds in accordance with the requirements of the *Biosecurity Act 2015*, if found, including disposal off-site in sealed bags to a licenced waste disposal facility.	Project manager	Construction and operation
B14	All weeds, propagules, other plant parts and/or excavated topsoil material that is likely to be infested with weed propagules that are likely to regenerate will be bagged, removed from site and disposed of at a licensed waste disposal facility.	Project manager	Construction and operation

ID	Safeguards and mitigation measures	Responsibility	Timing
Aquatic biodiversity			
A1	Further detailed water quality and ecological monitoring will be undertaken prior to the commencement of works, to establish baseline data and trends. This will be used following completion of works to measure changes in temperature, water quality and ecological communities in Pindari Dam and Severn River. This monitoring will include: — fish populations and Young of Year (fish born within the past year) — macroinvertebrate and zooplankton assemblages — algae concentrations and species, including within Pindari Dam and Severn River — water quality parameters including, but not limited to, temperature (stratification in Pindari Dam and longitudinally in Severn River compared to reference sites), dissolved oxygen, nutrients, metals and chlorophyll-a.	Project manager	Prior to construction
A2	A pre-works inspection of the laydown area and habitats within 200 metres at the top of the spillway for fauna habitat, especially threatened turtles, and where required fauna clearance works, must be undertaken before any works in these areas commence.	Project manager	Prior to construction
A3	The CEMP or equivalent document will include information to assist in identifying the threatened fish and turtle species that occurs or may occur within the locality.	Contractor	Prior to construction

ID	Safeguards and mitigation measures	Responsibility	Timing
A4	An appropriate Erosion and Sediment Control Plan (ESCP) that adequately protects aquatic habitat during construction will be prepared before works commence. The ESCP will need to consider: — on-site water management to reduce sedimentation and potential pollution of watercourses and management of stormwater and dam water during periods of high rainfall — run-off or unplanned overflows from construction must be retained in water quality basins or an appropriate alternative — diverting run-on water from disturbance works occurring on upslope land, using non-erosive methods — installing protective measures to prevent sheet erosion where large portions of soil will be exposed — construction of sediment filters or sediment retention traps where appropriate, particularly below fill batters near waterways.	Contractor	Prior to construction
A5	If the threatened Western saw-shelled turtle are seen within 50 metres of any works, works must stop immediately until the turtle moves away. If the turtle remains in the area or continuously returns an aquatic ecologist should be notified. The aquatic ecologist and project team must consult with NSW DPIRD Fisheries to determine appropriate management actions to allow works to continue. Threatened fish in Lake Pindari are expected to be mobile enough to disperse from disturbances.	Contractor	Construction
A6	Storing of construction machinery, equipment, materials, vehicles and the pipeline string along the top of the spillway must be appropriately managed to avoid impacts on the adjacent waterway. This includes: — storing hydrocarbon-based products on any water sites within the impact area will be avoided and must be stored in a suitable bunded area within the construction compound — hydrocarbons will be stored in a bunded area with adequate spill kits available — all staff will be made aware of the location of the spill kit and trained in its use — all machinery will be routinely checked for leaks.	Contractor	Construction

ID	Safeguards and mitigation measures	Responsibility	Timing
A7	Hydrocarbon booms will be placed around all stationary machinery on the water and be on hand for deployment around vessels.	Contractor	Construction
A8	Where practical, floating containment booms will be in place to control any unplanned spills of hydrocarbons around machinery operating on or over water.	Contractor	Construction
A9	All equipment brought to the impact area will be thoroughly cleaned and free of substrate to avoid introduction of species such as cyanobacteria. Given the potential for toxic cyanobacteria in nearby areas, equipment will be also thoroughly cleaned following completion of the project to prevent spread of the species to other areas.	Contractor	Construction
A10	If an algal bloom is present within Lake Pindari, it should be avoided and not disturbed to minimise further spread to other areas. Works will not be conducted while an algal bloom is present within Lake Pindari. If vessels or equipment are found to have been covered by algae during works, they will be thoroughly cleaned with fresh water, with all biota safely disposed of on land.	Contractor	Construction
A11	The sinking of the pipeline and anchor blocks must be conducted in a controlled and slow manner, to minimise the disturbance to the dam floor.	Contractor	Construction
A12	Visual monitoring of water quality monitoring during construction works will be undertaken daily. Monitoring of water quality parameters, including algal counts and limiting factors (nitrogen, phosphorus, manganese, iron) will also be conducted regularly during works.	Contractor	Construction
A13	Environmental controls such as sediment and erosion controls, and if necessary, the position of pipeline string, will be inspected weekly by an Environmental Scientist during construction.	Contractor	Construction
A14	Waste products and materials will be adequately managed and stored in designated areas on-site to prevent injury caused by ingestion or entanglement in debris. Designated litter bins will be provided.	Contractor	Construction
A15	All materials, machinery and rubbish will be removed from site.	Contractor	Post-construction

ID	Safeguards and mitigation measures	Responsibility	Timing
A16	An inspection of the site by an Environment Officer or Project Manager will be undertaken to review removal of waste and effectiveness of environmental controls prior to demobilisation from the site.	Environment officer/project manager	Post-construction
A17	Any notification requirements of the Section 199 or 205 permits must be filled and submitted.	Project manager	Post-construction
A18	A Water Quality Monitoring Program (WQMP) will be established for operation of the Pindari Dam bubble plume destratification system. This WQMP may be incorporated into the existing monitoring conducted by WaterNSW, the Border Rivers monitoring program and the existing Pindari Dam MER Program (NSW DPIRD, 2024a) and will include: — Continuation of monthly monitoring within Lake Pindari and Severn River catchment, including physical water quality parameters, cyanobacteria, rainfall, discharge and dam capacity. — At least two years of water quality monitoring at previously established sites under the Pindari Dam MER Program (NSW DPIRD, 2024a), including the existing daily riverine temperature monitoring in the Severn River and reference sites, and daily temperature and dissolved oxygen monitoring in Lake Pindari, using a thermistor chain. — Regular (monthly to quarterly) water quality monitoring (physical, chemical and biological parameters) within Lake Pindari and the Severn River for the first two years of operation of the bubble plume destratification system. This will include at least two sites in the Severn River upstream of the dam and at least eight sites downstream of the dam (across a distance of ~100 kilometres). It is recommended that this monitoring is continued for up to eight years following the commissioning of the system and then on a less regular basis, for the duration of operation of the bubble plume destratification system. — Water quality monitoring will be reviewed against existing baseline data for the Severn River. Emerging trends will be assessed, to review with changes in frequency of operation or pressure	Project manager	Operation

ID	Safeguards and mitigation measures	Responsibility	Timing
	applied to the system at various times throughout the year.		
A19	An Ecological Monitoring Program (EMP) will be established for operation of the bubble plume destratification system. The program will focus on those communities targeted by the existing Pindari Dam MER Program (NSW DPIRD, 2024a): — Fish: — annual spring and autumn fish community surveys in the Severn River and a reference river, for at least two years following commissioning — annual targeted Young of Year sampling at the end of summer or early autumn in Severn River, for at least two years following commissioning. — Invertebrates: — incorporate ecological health monitoring using AUSRIVAS methodology, including Ephemeroptera, Plecopteran and Trichopteran (EPT) taxa, abundance and species richness in both spring and autumn in the Severn River. Surveys will include at least one site upstream and at least three sites downstream of the dam for at least two years following commissioning. — Water quality, algae and food web: — continuation of the existing Pindari Dam MER Program (NSW DPIRD, 2024a) water quality, algae and food web monitoring. Monthly sampling between September and May sampling nutrients, metals, zooplankton, chlorophyll-a and phytoplankton. This will be conducted for at least two years following commencement of operation. — Periphyton: — incorporate monitoring of periphyton coverage and composition in Severn River downstream of Pindari Dam. This may be incorporated into the above existing Pindari Dam MER Program (NSW DPIRD, 2024a) monthly monitoring, to be conducted for at	Project manager	Operation

ID	Safeguards and mitigation measures	Responsibility	Timing
	least two years following commencement of operation.		
Aboriginal heritage			
AH1	Aboriginal community representatives, including Gomeroi Native Title Group representatives, will be onsite during any construction activities requiring ground disturbance.	Project manager/ contractor	Prior to construction
AH2	Prior to initiation of works in the Aboriginal heritage study area, all site workers will undertake a site awareness training, inclusive of the history of AHIMS sites associated with the Pindari Dam wall infrastructure.	Project manager/ contractor	Prior to construction
AH3	All Aboriginal objects and Places are protected under the *National Parks and Wildlife Act 1974* (NPW Act). It is an offence to knowingly disturb an Aboriginal object or Place without consent permit issued by the Department of Climate Change, Energy, Environment and Water (DCCEEW) under the NPW Act. Should any Aboriginal objects be encountered during works associated with this assessment proposal, works will cease immediately, and the find will not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object, the archaeologist will provide further recommendations. These may include notifying the DCCEEW and Aboriginal Stakeholders.	Project manager/contractor	Prior to construction
AH4	Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity, you must: 1 immediately cease all work at that location, and avoid further movement or disturbance of the remains and establish a buffer of at least 20 metres, to avoid harm 2 refer to and follow the Water NSW unexpected finds procedure (Appendix G) 3 notify the NSW Police and DCCEEW Environmental line on 131555, as soon as practicable and provide details of the remains and their location 4 not recommence work at that location unless authorised by DCCEEW and WaterNSW.	Project manager/ Contractor	Prior to construction

ID	Safeguards and mitigation measures	Responsibility	Timing
AH5	The following AHIMS site cards will be updated, within six months of the proposal's completion to reflect the current information available in Section 2.3 of the Aboriginal Objects Due Diligence Assessment (Appendix E): — 11-3-0018 Pindari Dam Lookout; P/s.3 — 11-3-0020 Pindari Dam; Spring Creek — 11-3-0017 Pindari Dam; P/s 2 — 11-3-0021 Pindara Dam/Spring Creek.	WaterNSW	Post-Construction
AH6	The following AHIMS site will be assessed to confirm that preservation and protection is being adhered to as per the recommendations noted in Section 2.3 of the Aboriginal Objects Due Diligence Assessment prepared by WaterNSW (21 August 2024) (Appendix E), and update the site card if necessary, within six months of the project's completion: — 11-3-0016 Pindari Dam; P/S 1.	WaterNSW	Post-Construction
Surface water, groundwater and flooding			
SW1	A site-specific Erosion and Sediment Control Plan (ESCP) will be prepared and implemented during construction of the proposal.	Project manager/ contractor	Prior to construction
SW2	Weather monitoring will occur on-site to allow adequate time for chemicals, material stockpiles, plant and equipment to be moved prior to heavy rainfall.	Contractor	Construction
SW3	The CEMP will consider prevailing wind direction, wind speeds and where practicable, timing of works to minimise periods of heavy rainfall.	Contractor	Construction
SW4	The following control measures will be included in the ESCP and be implemented to minimise impacts to surface water quality: — construction contractor will include detailed information on erosion and surface water management within the CEMP — appropriate flow diversions, sediment and erosion control measures will be included in the CEMP — stockpiles will be located at least 40 metres away from watercourses — any refuelling activities will be undertaken off-site as far as practicable — no equipment, machinery or work vehicles will be washed on-site	Contractor	Construction

ID	Safeguards and mitigation measures	Responsibility	Timing
	— an appropriate water quality monitoring program will be included in the CEMP — stockpiles will be covered by tarps and/or sediment fencing will be installed around stockpiles — disturbed areas will be stabilised as soon as practicable, following disturbance — planning and staging of works will be undertaken to reduce exposure of stockpiles and open excavations — access to work sites and work areas will be planned and managed to reduce disturbance — access and egress points will be stabilised and mud and soil removed from the wheels and bodies of vehicles and equipment before entering public roads — erosion and sediment control measures will be routinely inspected and maintained, including before expected heavy rainfall and after heavy rainfall — vehicle and machinery movements will be minimised during and immediately following wet weather to avoid or minimise disturbance to ground cover — erosion and sediment control measures will not be removed until the works are complete and areas are stabilised.		
SW5	If groundwater seepage is encountered in excavations, the WaterNSW Dewatering and Discharge Activities – Environmental Standard Operating Procedure (ESOP) CD2021/54 will be enacted.	Contractor	Construction
Geology, soils and contamination			
G1	If potentially contaminated material is uncovered works will cease in that location, the WaterNSW Project Manager will be contacted, and advice will be sought from a contamination specialist as required.	Contractor	Construction
G2	An unexpected finds procedure will be prepared prior to construction and implemented in the event unknown contamination is uncovered during construction of the proposal as a part of the CEMP.	Project manager/ contractor	Pre-construction
G3	All excavated soil, fill and liquid waste material requiring off-site disposal will be classified in accordance with the NSW EPA *Waste Classification*	Contractor	Construction

ID	Safeguards and mitigation measures	Responsibility	Timing
	Guidelines (NSW EPA, 2014) and disposed at an appropriately licensed facility.		
G4	Chemicals stored on-site will be stored within a bunded area with a holding capacity of 110 per cent of all containers.	Contractor	Construction
G5	An emergency spill kit will be kept on-site at all times and will include marine spill equipment. The spill kit will be appropriately sized for the volume of substances at the work site. All staff will be made aware of the location of the spill kit and trained in its use.	Contractor	Construction
G6	Environmental incidents will be notified in accordance with the WaterNSW Environmental Incident Management Protocol and the *Protection of the Environment Operations Act 1997*.	Contractor	Construction and operation
Non-Aboriginal heritage			
H1	A non-Aboriginal Heritage Unanticipated Finds Protocol will be developed as part of the CEMP in consultation with WaterNSW, prior to construction.	Contractor	Pre-construction
Noise and vibration			
N1	An out-of-hours work protocol will be developed prior to construction to govern the management of work outside standard work hours.	Contractor	Pre-construction
N2	Work will occur in accordance with the WaterNSW Noise Management Procedure.	Contractor	Construction
N3	Where practicable, noise generating construction activities will be restricted to standard construction hours: — 7:00 am to 6:00 pm Monday to Friday — 8:00 am to 1:00 pm Saturday — no work on Sundays or public holidays.	Contractor	Construction
N4	Out of hours work will require additional assessment, including: — potentially affected residents to be provided at least seven days' notice prior to conducting night works — night works will be planned with consideration to respite periods for high noise generating activities and the number of consecutive nights worked.	Project manager	Construction

ID	Safeguards and mitigation measures	Responsibility	Timing
N5	All construction staff will complete an environmental induction that will include awareness of noise impacts and the need to limit noise where practicable. Staff will be instructed not to leave plant idling unnecessarily and avoid dropping materials from height.	Contractor	Construction
N6	Plant will be properly maintained in order to reduce noise levels.	Contractor	Construction
N7	The following additional principles and proactive noise management measures will be considered for implementation: — sensitive receivers will be notified about the proposal, work activities, time periods over which these will occur, impacts and mitigation measures a minimum of five working days prior to the commencement of construction. — where practical, simultaneous operation of dominant noise generating plant will be managed to reduce noise impacts, such as operating at different times or increasing distance between the plant. — where practicable and in compliance with work health and safety standards, reversing beepers on trucks will be replaced with low pitch non-tonal beepers (quackers). Alternatives to reversing beepers include the use of spotters and designing the site to reduce the need for reversing may assist in minimising the use of reversing beepers. — a summary of appropriate construction noise and vibration management practices will be provided to all staff and contractors and be included during site inductions and daily tool-box talks. The tool-box talks will include as a minimum, permitted hours of construction work, work site locations, site ingress/egress and the required noise management measures for each construction phase.	Contractor	Construction
N8	Specialist assessment of vibration impacts will be considered if use of vibratory plant and equipment is required within 100 metres of sensitive receivers, including the heritage listed dam.	Project manager/ contractor	Construction

ID	Safeguards and mitigation measures	Responsibility	Timing
Traffic, transport and access			
T1	A Traffic Management Plan (TMP) will be prepared and implemented to allow for the safe movement and access within the road network. The TMP will include: — confirmation of haulage routes — measures to maintain access to local roads and properties — site-specific traffic control measures (including signage) to manage and regulate traffic movement — requirements and methods to consult and inform the local community of impacts to the local road network — access to construction sites including designated entry and exit locations and measures to prevent construction vehicles queuing on public roads — a response plan for construction traffic incident.	Project manager/ Contractor	Prior to construction/ Construction
T2	Appropriate exclusion barriers, signage and site supervision will be employed at all times to ensure that the work site is controlled and that unauthorised vehicles and pedestrians are excluded from the works area.	Contractor	Construction
T3	Construction traffic will use only existing access points and tracks to the pipeline corridor, as detailed in this REF.	Project manager/ Contractor	Construction
T4	Consider preparing a dilapidation survey of roads to document any damage during construction to be reinstated to pre-construction condition.	Contractor	Construction

ID	Safeguards and mitigation measures	Responsibility	Timing
Air quality			
AQ1	The CEMP will be prepared and implemented during construction with measures to minimise air quality impacts, including where practicable: — a progressive rehabilitation strategy will be prepared for exposed surfaces — all vehicles and machinery will be maintained in good working condition in accordance with the manufacturer standards — all site vehicles and machinery will be switched off when not in use to eliminate generation of any unnecessary emissions — all vehicles transporting material to and from sites will be covered immediately after loading to prevent fugitive emissions and spillages — stockpiles will be located away from sensitive receivers, where practicable — appropriate dust control measures, such as water cart rotations and misting systems, will be applied as required to minimise dust dispersion beyond construction areas — emissions will comply with the *Protection of the Environment Operations Act 1997*.	Project manager/ contractor	Construction
Visual amenity			
V1	The work site and equipment will be maintained in an orderly manner. Rubbish will be removed at the end of each work day. Site equipment will be stored entirely within designated laydown areas and secured when not in operation.	Contractor	Construction
V2	Upon completion of the works, all vehicles, construction equipment, materials, and refuse relating to the works will be removed from the area and all areas will be restored to a level that matches the pre-work condition.	Contractor	Construction
V3	All natural and built surfaces and property disturbed or damaged as a result of the works will be replaced, repaired, reinstated or otherwise restored to their pre-existing condition.	Contractor	Construction

ID	Safeguards and mitigation measures	Responsibility	Timing
Property and land use			
L1	Accurate public information signs will be displayed while construction work is in progress and maintained in a presentable manner. Notification of commencement of works through email, letter, newspaper and signage to all stakeholders would be completed two weeks prior to the start of construction.	Contractor	Construction
L2	A complaint handling procedure and register will be maintained throughout construction. A maritime notice will also be developed for the proposal prior to construction and operation in consultation with Transport – Maritime North	Contractor	Construction Operation
Waste Management			
W1	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include, but not be limited to: — measures to avoid and minimise waste associated with the proposal — classification of wastes and management options (re-use, recycle, stockpile, disposal) — statutory approvals required for managing on-and-off-site waste, or application of any relevant resource recovery exemptions — procedures for storage, transport and disposal monitoring, record keeping and reporting.	Project manager/ Contractor	Prior to construction/ Construction
W2	All waste generated during the course of the works will be either re-used or removed from the work areas as soon as practicable and disposed of in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014). Options for reuse on-site will be assessed at the time of excavation depending on suitability of excavated material.	Contractor	Construction
W3	Construction compound areas will be maintained, kept free of weeds, debris and other rubbish and cleaned up at the end of each working day.	Contractor	Construction

8 Conclusion and justification

Pindari Dam has been recognised out of eight high priority dams during stage one of the NSW Cold Water Pollution Strategy with potential to cause cold water pollution to be most appropriate to conduct trial mitigation works involving artificial destratification through application of bubble plumes by UNSW WRL due to its size and depth (Chaaya and Miller, 2023; NSW DPI, 2012). Successful destratification and reduction of cold water pollution at Lake Pindari will be used as a framework for remediating stratified reservoirs across the state.

Installation of the bubble plume destratification system aims to improve the water temperature and quality in Lake Pindari, as well as reduce evaporation rates and the potential for algal blooms. Additionally, the proposal will provide further information on how artificial destratification systems work that can be utilised in future destratification projects for dams across NSW.

The REF has been assessed under Part 5 Division 5.1 of the EP&A Act and has considered *'to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'*. Overall, the proposal is considered unlikely to have a significant impact on the environment.

By adopting the safeguards and measures identified in the REF, the proposal is unlikely to have a significant environmental impact and an Environmental Impact Statement is not required for the proposal. Approval is not considered required under the *Environment Protection and Biodiversity Conservation Act 1999*.

9 References

Air Quality NSW, 2024, *Current air quality in Armidale*, accessed from https://www.airquality.nsw.gov.au/northern-tablelands/armidale

Atlas of Living Australia, 2024, accessed from: https://www.ala.org.au/

Australian Bureau of Statistics (ABS), 2021*, Ashford (NSW),* accessed from: https://abs.gov.au/census/find-census-data/quickstats/2021/SAL10100

Australian and New Zealand Guidelines (ANZG), 2018, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*

Bureau of Meteorology (BOM), 2024, Groundwater Dependant Ecosystems Atlas

Chaaya F and Miller B, 2022, *A review of artificial destratification techniques for cold water pollution mitigation,* Prepared for NSW Department of Primary Industries – Fisheries. University of New South Wales Water Research Laboratory.

Chaaya F and Miller B, 2023, *Pindari Dam – mitigating cold water pollution through artificial destratification,* Prepared for NSW Department of Primary Industries – Fisheries. University of New South Wales Water Research Laboratory.

Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2024*, National Pollutant Inventory*, accessed from https://www.npi.gov.au/npidata/action/load/map-search;jsessionid=FAA08F18B1A2513BF688D7F9C181A47D

Fairfull S, 2013, *Policy and guidelines for fish habitat conservation and management*, NSW Department of Primary Industries (DPI) Fisheries, Woolongbar, NSW

Haglund L, 1992, *Pindari Dam: Proposed Extension*, Archaeological Investigations including salvage excavation of NPWS 11-3-17+PD2 NPWS 11-3-18+PD3 and some collection of 11-3-16+PD1, Balmain: Haglund and Associates for Water Resources Commission of NSW

Institute for Air Quality Management (IAQM), 2024, *Guidance on the assessment of dust from demolition and construction*

The International Council on Monuments and Sites (ICOMOS), 2013, *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (Burra Charter)

Inverell Shire Council, 2024, *Application tracking*, accessed from: https://inverell.nsw.gov.au/building-and-development/application-tracking/

Isbell, 2021, *The Australian Soil Classification, Third Edition,* CSIRO Publishing

Mitchell T, 1839, *Three Expeditions into the Interior of Eastern Australia*, London: T. and W. Boone

NearMap, 2024, *Aerial imagery of Lake Pindari, NSW*

NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) and NSW Government, 2010, *NSW Wetlands*, accessed from The Sharing and Enabling Environmental Data Portal [https://datasets.seed.nsw.gov.au/dataset/36c734bd-1c9c-40b9-966a-0ad0f7500a09], date accessed 2024-08-12

NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2012, *Sharing and Enabling Environmental Data in NSW Map (SEED Map) (Groundwater Dependent Ecosystem (GDE) Probability),* NSW Government

NSW Department of the Environment 2013, *Significant Impact Guidelines 1.1 - Matters of National Environmental,* Significance Canberra: Department of the Environment.

NSW Department of Environment, Climate Change and Water (NSW DECCW), 2010, *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales,* NSW Government

NSW Department of Planning and Environment (NSW DPE), 2019, *NSW Border Rivers Surface Water Resource Plan Area Resource Description* – Appendix A. INT17/228128

NSW Department of Planning and Environment (NSW DPE), 2023, *Assessing heritage significance: Guidelines for assessing places and objects against the Heritage Council of NSW criteria,* NSW Government

NSW Department of Planning and Environment (NSW DPE), 2023, *Guidelines for preparing a statement of heritage impact,* NSW Government

NSW Department of Planning, Housing and Infrastructure (NSW DPHI), 2024, *NSW Planning Spatial Viewer*

NSW Department of Planning, Housing and Infrastructure (NSW DPHI), 2024a, *NSW Planning Portal Major Projects Application Tracker*

NSW Department of Primary Industries (NSW DPI), 2012, *NSW Cold Water Pollution Strategy: Report of the implementation of stage one*, NSW Government

NSW Department of Primary Industries (NSW DPI), 2024, *Threatened Species Lists*, NSW Department of Primary Industries, accessed April 2024 from: https://www.dpi.nsw.gov.au/fishing/species-protection/what-current

NSW Department of Primary Industries (NSW DPI), 2024, *NSW Weedwise*, accessed from: https://weeds.dpi.nsw.gov.au/

NSW Department of Planning, Industry and Environment (NSW DPIE), 2024*, eSPADE Spatial Data Portal,* accessed from NSW Soil and Land Information: https://www.environment.nsw.gov.au/eSpade2Webapp/

NSW Department of Planning, Industry and Environment (NSW DPIE), 2020, *Biodiversity Assessment Method*

NSW Department of Primary Industries and Regional Development (NSW DPIRD), 2024a, *Pindari Dam Bubble Plume Destratification Project Monitoring, Evaluation and Reporting (MER) Program Interim Report June 2024*, Department of Primary Industries, Department of Regional NSW.

NSW Department of Primary Industries and Regional Development (NSW DPIRD), 2024, *Cold water pollution*, accessed from: https://www.dpi.nsw.gov.au/fishing/habitat/threats/cold-water-pollution

NSW Department of Primary Industries and Regional Development (NSW DPIRD), 2024, *Fisheries Spatial Data Portal*, accessed from https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal

NSW Environment Protection Authority (NSW EPA), 2014*, Waste Classification Guidelines*

NSW Environment Protection Authority (NSW EPA), 2017, *Noise Policy for Industry* (NPfI)

NSW Environment Protection Authority (NSW EPA), 2024, *Contaminated Land Record of Notices*

NSW National Parks and Wildlife Service (NPWS), 2002, *Aboriginal Cultural Heritage Assessment: Brigalow Belt South, Stage 2, NSW Western Regional Assessments,* Sydney: NSW National Parks and Wildlife Service, accessed from https://www.environment.nsw.gov.au/resources/forestagreements/wra18.pdf

OzArk, 2018a, *Newell Highway Heavy Duty Pavements, Narrabri to Moree: Aboriginal and historic archaeological survey report*, Roads and Maritime Services.

OzArk, 2018b, *Aboriginal Cultural Heritage Assessment Report: Yarrabee Solar Project,* Dubbo: OzArk for SLR Consulting Australia Pty Ltd.

Parker K, 1909, *The Euahlayi Tribe: A Study of Aboriginal Life in Australia*. Archibald Constable: London.

Parsons M, Thoms M and Norris R, 2001, *Australian River Assessment System: AusRivAS Physical Assessment Protocol*, Environment Australia

Piper A, Hill T and Mazlin R, 2019, Baiada *Poultry Pty Ltd 'Oakburn' Processing Facility Tamworth, NSW: Aboriginal Cultural Heritage Assessment*, Brisbane: Everick Heritage Pty Ltd unpublished report prepared for Baiada Poultry Pty Ltd.

Prentice M., Linke S and Hamilton D, 2021, *Cold Water Pollution (CWP) mitigation options assessment for Pindari and Copeton: artificial destratification and water mixers,* ARI Report No. 018 to New South Wales Department of Primary Industries - Fisheries (DPI Fisheries), Australian Rivers Institute, Griffith University, Brisbane

Sheldon F, and McCasker N, 2020, *Habitat and flow requirements of freshwater mussels in the northern Murray-Darling Basin*. Report to the Commonwealth Environmental Water Office. Australian Rivers Institute, Griffith University and Institute of Land, Water and Society, Chales Sturt University

Transport for NSW (Transport), 2024, *Transport for NSW Construction and Maintenance Noise Estimator Tool*

WaterNSW, 2024, *Pindari Dam*, accessed from: https://www.waternsw.com.au/nsw-dams/regional-nsw-dams/pindari-dam

Weeds Australia, 2024, *Weeds of National Significance*, accessed from: http://www.weeds.org.au/WoNS/

Wilson and Ellison, 2010, *Pindari dam fish monitoring project*

Appendix A

Environmental Assessment
Clause 171 Environmental Factors Checklist

The following factors, listed in Clause 171 of the Environmental Planning and Assessment Regulation 2021, have been considered to assess the likely impacts of the proposal on the natural and built environment.

Clause 171	REF finding(s)
Any environmental impact on a community	Overall, the proposal will improve water quality in Lake Pindari which is used as a source of drinking water for surrounding towns including Ashford.
A transformation of a locality	The proposal is not expected to result in any adverse transformation of locality. The proposal will improve the ecosystem health downstream of Pindari Dam in Severn River.
Any environmental impact on the ecosystem of the locality	The proposal will result in direct vegetation removal of approximately 0.63 hectares of native vegetation. However, the proposal is not expected to significantly impact any listed threatened species or ecological communities. The proposal will improve the water quality and ecosystem health in Lake Pindari Dam and Severn River by reducing thermal stratification and the potential for cold water pollution.
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality	The visual and recreational value of Lake Pindari Dam will be minorly impacted during construction due to the presence of machinery and plant. During construction and operation the proposal will require a permanent aquatic exclusion area around the bubble plume destratification system that will restrict public access. However, operation of the proposal will improve water quality in Lake Pindari and is expected to increase the recreational value during operation.
Any effect upon a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or any other special value for present or future generations	The proposal is not expected to effect upon a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or any other special value.

Clause 171	REF finding(s)
Any impact on the habitat of any protected animals (within the meaning of the Biodiversity Conservation Act 2016)	Given the implementation of mitigation measures in Table 6.5 to reduce the potential ecological impacts of the proposal, it is considered that the proposal is unlikely to have a significant impact upon any threatened entities listed under the FM Act, BC Act or EPBC Act or their habitats.
Any endangering of any species of animal or plant or other form of life, whether living on land, in water or in the air	No threatened species or communities are expected to be significantly impacted by the proposal (refer to the BAR in in Appendix C).
Any long-term effects on the environment	The proposal will result in direct vegetation removal of approximately 0.63 hectares of native vegetation. However, the proposal is not expected to significantly impact any listed threatened species or ecological communities. The proposal is expected to increase the water quality and ecosystem health in Lake Pindari and Severn River.
Any degradation of the quality of the environment	The proposal is not expected to result in any significant degradation of the quality of the environment.
Any risk to the safety of the environment	The safety of the environment will be temporarily impacted during construction; however, no long-term impacts to the safety of the environment is expected. Measures will be implemented to reduce safety risks during construction of the proposal.
Any reduction in the range of beneficial uses of the environment	The permanent aquatic exclusion area around the bubble plume destratification system will limit publicly accessible area within Lake Pindari. However, overall the proposal is not expected to result in any reduction in the range of beneficial uses of the environment.
Any pollution of the environment	The proposal is not expected to result in any pollution of the environment.
Any environmental problems associated with the disposal of waste	Disposal of wastes will be conducted in accordance with the *Waste Classification Guidelines* (NSW EPA, 2014) and disposed of at a suitably licensed waste facility.
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply	The proposal is not expected to increase any demands on resources (natural or otherwise).
Any cumulative environmental effect with other existing or likely future activities	The proposal is not expected to result in any cumulative impacts on the environment.
Any impact on coastal processes and coastal hazards, including those under projected climate change conditions	The proposal is not mapped within a coastal environment area, and as such is not expected to impact on coastal processes and coastal hazards.

Matters of National environmental significance

Under the environmental assessment provisions of the *Environment Protection and Biodiversity Conservation Act 1999*, the following Matters of National Environmental Significance (MNES) are required to be considered to assist in determining whether the proposal should be referred to Australian Government Department of the Environment.

Table A.1 MNES assessment

Factor	Impact
a Any impact on a World Heritage property? The proposal will not impact on any listed World Heritage property.	Nil
b Any impact on a National Heritage place? The proposal will not impact on a National Heritage place.	Nil
c Any impact on a wetland of international importance? The proposal will not impact on a wetland of international importance.	Nil
d Any impact on a listed threatened species or communities? The proposal will not significantly impact on any Commonwealth listed threatened species or communities protected under the EPBC Act.	Nil
e Any impacts on listed migratory species? There will not be any significant impact on Commonwealth listed migratory species or migratory species protected under international agreements by the proposal.	Nil
f Any impact on a Commonwealth marine area? The proposal is not located within or adjacent to a Commonwealth marine area.	Nil
g Does the proposal involve a nuclear action (including uranium mining)? No part of the proposal involves a nuclear action.	Nil
h Additionally, any impact (direct or indirect) on the environment of Commonwealth land? The proposal is located within a Crown land waterway (Severn River) as well as within Lot 7 DP869840. Minor short-term impacts are anticipated during construction, however operation of the proposal is expected to improve water quality and ecosystem health in Severn River.	Short-term negative, long-term positive

Appendix B

Biodiversity Assessment Report

Pindari Dam Bubble Plume Destratification System

Biodiversity Assessment Report

Prepared for
WaterNSW

January 2025



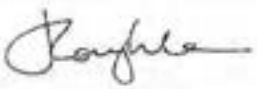
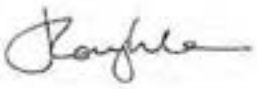
ASSETREADY
A WSP & SMEC Joint Venture

Document control

Project name	Pindari Dam Bubble Plume Destratification System
Document title	Biodiversity Assessment Report
Prepared for	WaterNSW
Service Order number	PS122845-ECO-BAR-Pindari_RevA

Revision history

Rev	Date	Details
A	15/01/2025	Final

	Name	Date	Signature
Prepared by:	Nicholas Everitt, Bernadette Quirk	15/01/2025	
Reviewed by:	Jacqui Coughlan	15/01/2025	
Approved by:	Jacqui Coughlan	15/01/2025	

Asset Ready Contact	
Address	
Telephone	
Email	

Table of Contents

Definitions and Abbreviations iv

1 Introduction 1

1.1 The proposal 1

1.1.1 Proposal site location and context 1

1.2 Objectives of the proposal 2

1.3 Purpose and scope of this report 2

1.4 Key terms used in this report 3

2 Legislative context 6

2.1 Commonwealth legislation 6

2.1.1 Environment Protection and Biodiversity Conservation Act 1999 6

2.2 State legislation 6

2.2.1 Biodiversity Conservation Act 2016 6

2.2.2 Fisheries Management Act 1994 7

2.2.3 Environment Planning and Assessment Act 1979 7

2.2.4 Biosecurity Act 2015 7

3 Methodology 8

3.1 Personnel 8

3.2 Background research and data sources 8

3.3 Likelihood of occurrence assessment 9

3.4 Field survey 10

3.4.1 Definition of native vegetation 10

3.4.2 Random meander survey 11

3.4.3 Rapid point assessment 11

3.4.4 Vegetation integrity plots 11

3.4.5 Condition of vegetation 12

3.4.6 Fauna habitat assessment 13

3.4.7 Condition of fauna habitats 13

3.4.8 Opportunistic sightings 14

3.4.9 Survey limitations 14

4 Existing environment 15

4.1 Study area landscape features 15

4.2 Plant community types 16

4.2.1 PCT 4151 – Northwest White pine-silver-leaved ironbark forest 16

4.2.2 PCT 3518 – Northwest Pine-ironbark grassy woodland 17

4.2.3 Miscellaneous ecosystem 18

4.3 Fauna species 18

Table of Contents (continued)

4.4 Threatened ecological communities 18
4.5 Threatened species 18
4.5.1 Threatened flora 18
4.5.2 Threatened fauna 19
4.5.3 Migratory species 21
4.6 Priority and high threat weeds 21
4.7 Aquatic habitat assessment 22
4.8 Riparian areas and key fish habitat 22
4.8.1 Riparian areas 22
4.8.2 Key fish habitat 22
4.8.3 Threatened entities listed under the FM Act and EPBC Act 22
5 Assessment of impacts 25
5.1 Direct construction impacts 25
5.1.1 Impacts on native vegetation 25
5.1.2 Impacts to threatened species 25
5.1.3 Impacts to aquatic habitats and threatened species 26
5.1.4 Injury and mortality of fauna 26
5.2 Indirect and operational impacts 26
5.2.1 Wildlife connectivity and habitat fragmentation 26
5.2.2 Edge effects on adjacent native vegetation and habitat 27
5.2.3 Invasion and spread of weeds 27
5.2.4 Invasion and spread of pathogens and disease 27
5.2.5 Noise and vibration 27
6 Assessment of impact significance 29
7 Safeguards and mitigation measures 31
7.1 Safeguards and mitigation measures for terrestrial biodiversity 31
8 Conclusion 34
9 Limitations 35
10 References 36

List of tables

Table 3.1 Personnel 8
Table 3.2 Likelihood of occurrence assessment 9
Table 3.3 Location of vegetation integrity plots and rapid data points 12
Table 3.4 Vegetation broad conditions states 13
Table 4.1 Landscape context 15
Table 4.2 Dominant plant species within areas mapped as PCT 4151 16
Table 4.3 Dominant flora species likely to occur within areas mapped as PCT 3518 17
Table 4.4 Priority weeds and WONS identified within the subject site 21
Table 5.1 Potential impacts to native vegetation 25
Table 7.1 Recommended safeguards and mitigation measures for terrestrial biodiversity 31

List of figures

Figure 1.1 Locality plan 4
Figure 1.2 Key features of the proposal 5
Figure 3.1 Vegetation integrity plot layout 11
Figure 4.1 Survey locations and results 24

List of appendices

Appendix A Likelihood of occurrence assessments for threatened species
Appendix B PMST Search result
Appendix C Assessments of significance – NSW BC ACT
Appendix D Assessments of significance – Commonwealth EPBC ACT
Appendix E Species list

Definitions and Abbreviations

Term	Definition
BC Act	*Biodiversity Conservation Act 2016*
Condition threshold	Some Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) ecological community listings specify 'condition classes' and/or 'condition thresholds' that determine which occurrences of a TEC are of highest conservation significance under the EPBC Act. Condition thresholds aim to prioritise habitat considered higher in function or quality and focus national legal protection on patches or occurrences of a TEC that are functional, relatively natural and in relatively good condition. There may be instances where the vegetation, or patches, are considered too degraded and do not meet the condition threshold of the EPBC Act listing and, therefore, will not require assessment or approval under the EPBC Act. Condition thresholds do not apply to threatened ecological communities listed under the *NSW Biodiversity Conservation Act 2016* (BC Act).
Direct impact	An impact on biodiversity values that is a direct result of vegetation clearance and loss of habitat. It is predictable, usually occurs at or near to the study area and can be readily identified during the planning, design, construction, and operational phases of a proposal.
Ecological community	An ecological community is a naturally occurring group of native plants, animals and other organisms living in a unique location. Ecological communities can be listed as threatened under the EPBC Act and/or BC Act.
EBPC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FM Act	*Fisheries Management Act 1994*
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population, or ecological community, including any biotic or abiotic component.
Impact area	The area of land that is directly impacted on by the proposal, including access roads, and areas used to store construction materials.
Indirect impact	An impact on biodiversity values that occurs when proposal activities affect threatened species, threatened species habitat, or ecological communities in a manner other than direct impact.
Local population	The population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area.
Locality	An approximately 10km radius surrounding the study area.
MNES	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the Commonwealth EPBC Act.
Mitchell landscape (NSW landscapes)	Landscapes with homogeneous geomorphology, soils, and broad vegetation types, mapped at a scale of 1: 250,000.

Term	Definition
Mitigation	Action to reduce the severity of an impact.
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
PCT	A NSW plant community type identified using the Plant community type classification system
Population	A group of organisms, all of the same species, occupying a particular area.
Ecology Study Area	The impact area and any other areas surveyed and assessed for biodiversity values as defined by shapefiles supplied by Water NSW in May 2024.
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.
Threatened Biodiversity Data Collection (TBDC)	Part of the BioNet database, accessible from the BioNet website at www.bionet.nsw.gov.au.
Threatened species	A species listed under the BC Act, FM Act, or EPBC Act.
TEC	Threatened Ecological Community. A community listed under the BC Act, FM Act or EPBC Act.

1 Introduction

1.1 The proposal

WaterNSW, together with the NSW Government Department of Primary Industries and Regional Development Fisheries (DPIRD Fisheries) are proposing to establish a bubble plume destratification system at Pindari Dam as a trial mitigation measure to disrupt thermal stratification and reduce potential for cold water pollution to affect downstream fish stocks ('the proposal'). The proposal is located in the Inverell Shire Local Government Area (LGA) (refer to Figure 1.1). If successful, bubble plumes will be used as a framework for remediating stratified reservoirs across the state.

The project would involve construction and operation of a diffuser system within Pindari Dam to reduce potential downstream cold water pollution from thermal destratification. This system involves pumping compressed air through a pipe network to diffusers typically located in the deepest part of a reservoir.

Key features of the proposal include:

- site establishment for location of two oil-free compressors located at the base of the dam embankment including:
  - concrete foundations
  - shade structure
  - security fencing
  - pavement for the placement of associated equipment
- electrical and mechanical construction works (to power the compressors) including:
  - extension of the HV electrical power supply from the Essential Energy grid
  - installation of 1000 kVA pad mounted transformer and low voltage switchboard
- assembly and installation of aeration pipework including:
  - barge mobilisation from the dam spillway and boat ramp
  - installation of the buoyancy pipe (855 metres) along reservoir batter and within the water
  - drilling holes (air ports) on the air diffuser pipe
  - installation of air diffuser pipe (500 metres)
  - commissioning of compressors and air diffuser pipe
- demobilisation and site restoration.

Access to the proposal site from Inverell will use Ashford Road, The Pocket Road, Upper Severn River Road and Pindari Dam Road. Existing access roads will be utilised throughout the works. Key operational features and the construction footprint associated with the proposal site is mapped in Figure 1.2.

1.1.1 Proposal site location and context

Pindari Dam is located at 1627 Pindari Dam Road, Pindaroi (Lot 31 DP914703), in the Inverell LGA. Pindari Dam is situated in Pindaroi on the Severn River about 22 kilometres upstream of Ashford and 58 kilometres north-east of Inverell near the NSW-Queensland border. The proposal will be carried out on WaterNSW and Crown land. The location of the proposal site in the broader locality (as defined in section 2.1) is mapped in Figure 1.1.

Pindari Dam is a sport and recreation destination situated on the Severn River and operates in conjunction with Queensland's Glenlyon Dam to meet irrigation, stock and household water needs in the Border Rivers region (WaterNSW, 2023).

Pindari Dam is one of eight high priority dams identified during stage one of the NSW Cold Water Pollution Strategy (NSW DPI, 2012). Pindari Dam was deemed most appropriate to conduct trial mitigation works involving artificial destratification through application of bubble plumes by UNSW WRL due to its depth (Chaaya and Miller, 2023).

If destratification at Lake Pindari and reduction of downstream cold water pollution is successful, it will be used as a framework for remediating stratified reservoirs across the state.

1.2 Objectives of the proposal

WaterNSW and the Department of Primary Industries and Regional Development (DPIRD) Fisheries propose to establish a trial cold water destratification system at Pindari Dam using bubble plume principles, to protect downstream fish stocks.

Key objectives of the proposal are to:

- Establish a trial cold water destratification system in Lake Pindari using bubble plume principles, to reduce the potential for cold water pollution to impact downstream fish stocks. Demonstrating the effectiveness of a bubble plume destratification system at a large, deep dam such as Pindari will strengthen the case to develop and deploy this technology at other high priority cold water pollution dams in the Murray-Darling Basin.
- Increase water temperature by 10 degrees Celsius and improve water quality outcomes in downstream receiving waterways, for native fish stocks and primary production (NSW DPIRD, 2024). Research has shown bubble plume destratification has been effective in achieving these outcomes in smaller dams (Chaaya and Miller, 2022).
- Reduce evaporation: destratification reduces water surface temperatures that in turn reduces surface evaporation rates (Chaaya and Miller, 2023).
- Improve water quality parameters via reservoir destratification (such as increase benthic dissolved oxygen levels, reduce soluble metal and nutrient release from anoxic sediments, and decrease frequency and severity of cyanobacteria blooms; Chaaya and Miller, 2022).

1.3 Purpose and scope of this report

This report details the methods and results of a biodiversity survey and assessment to identify the distribution and abundance of threatened species, populations, and ecological communities in the study area (as defined in section 2.1) to assess the extent and magnitude of ecological impacts associated with the proposal. The report addresses the requirements for assessment of significance under the NSW *Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Safeguards and mitigation measures to minimise and manage potential ecological impacts arising from the proposal are also provided.

The aims of the biodiversity assessment were to:

- describe the characteristics and ecological condition of the vegetation communities and habitats within the terrestrial (non-aquatic) parts of the study area for the proposal
- determine the occurrence, or likelihood of occurrence of threatened species, populations and communities listed under the BC Act, FM Act, and EPBC Act within the study area for the proposal
- describe the potential impacts on biodiversity within the study area and impact area as a result of the proposal

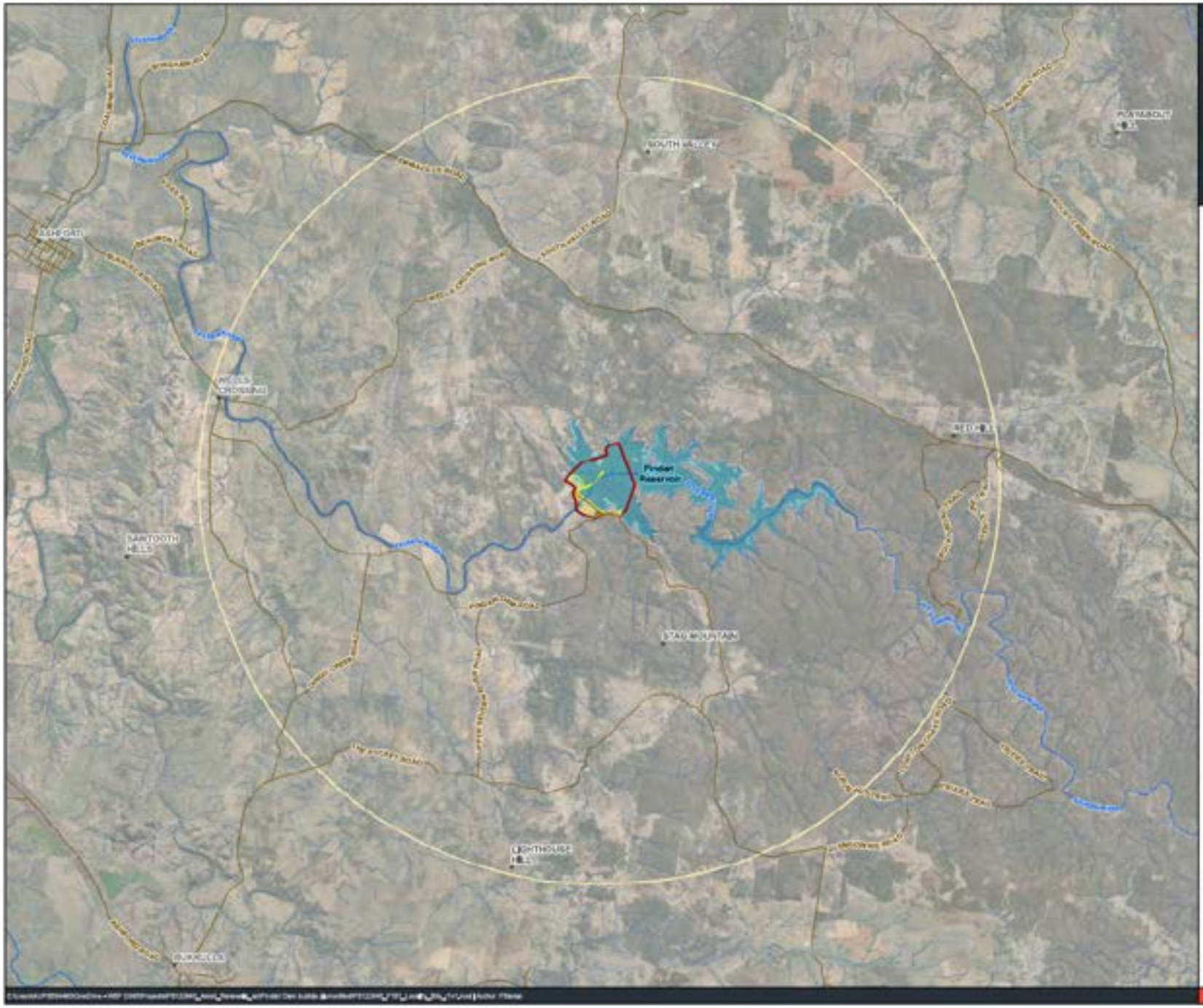
- undertake a test of significance for threatened species and communities that are confirmed or considered likely to occur within the study area for the proposal in accordance with section 7.3 of the BC Act to determine whether the proposal is likely to significantly affect threatened species listed under the BC Act
- undertake assessments in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment, 2013b) to consider impacts to nationally listed threatened species, ecological communities, and migratory species
- propose measures relating to the design, construction, and operation of the proposal to mitigate potential impacts on terrestrial biodiversity where practicable.

This Biodiversity Assessment Report (BAR) assesses the terrestrial (non-aquatic) sections of the proposed impact area as displayed in Figure 1.2. The aquatic impacts of the proposal are assessed by the Aquatic Ecological Assessment by H20 Consulting Group (Swanson, 2024). This BAR aims to document potential and likely impacts on biodiversity to support the Review of Environmental Factors (REF) being prepared for the proposal.

1.4 Key terms used in this report

The following areas are discussed throughout this technical report:

- Proposal – Installation and operation of the bubble plume system at Pindari Dam.
- Proposal site – The location, inclusive of the impact area, where the proposal would occur.
- Ecology study area – Refers to the area that was investigated during field surveys carried out in May 2024. Information collected during field surveys has been used to inform the existing environment (and subsequent impact assessment) of this report. Any use of the term ‘study area’ throughout this report is referring to the ‘ecology study area’ as defined here.
- Impact area – Defined area where proposed works will be conducted (encompassing the footprint of construction and operational activities, to consider construction and operational impacts)
- Project study area – Defined investigation area for desktop searches to consider potential construction and operational impacts within and surrounding the impact area (refer to Figure 1.2).
- Locality – 10 kilometre area buffering the study area for database searches and to describe the broader region.
- Pindari Dam (including the Pindari Dam wall) – Refers to the concrete faced, rockfill embankment dam structure and associated rock cut concrete sill spillway that is located across the Severn River.
- Pindari Reservoir – Refers to the Severn River and accumulated body of water upstream of the Pindari Dam wall, occurring as a result of (and regulated by) the Pindari Dam (including the Pindari Dam wall).
- Construction compound and site facilities including accommodation – Refers to the footprint of construction compound and site facilities (including accommodation) that would be required during construction of the proposal. Use of these areas would be temporary.
- Exclusion area – Refers to the permanent exclusion zone that has been nominated to exclude all marine craft (during construction and operation of the proposal) to prevent damage to the underwater element(s) of the proposal.



wsp

PS122845
Pindari Dam bubble plume

Figure 1.1
Locality Plan

Legend

- Places
- Watercourse
- Road
- Impact Area
- Pindari Reservoir
- Project Study Area
- 10km Buffer from Study Area

DRAFT



Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:100,000 Date: 21/10/2024

Data sources: GEOAF Geoscience Australia

© WSP Australia Pty Ltd (WSP) Copyright in the drawings, information and data recorded (the information) is the property of WSP. This document and the information are made available for the purpose of the authorised purpose for which this document has been prepared and is not to be used for any purpose other than that which it was specifically for WSP. Unless it has been otherwise agreed in writing by WSP, WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. All rights reserved. No part of WSP's information may be reproduced by any process without prior written permission from WSP Australia Pty Ltd.



wsp

PS122845
Pindari Dam bubble plume

Figure 1.2
Key features of the proposal

Legend

- Road
- Pindari Reservoir
- Exclusion Area
- Ecology Study Area - field verified
- Construction compound and site facilities including accommodation
- Area not to be Impacted
- Impact Area
- Project Study Area

DRAFT



Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:7,000 Date: 21/10/2024

GDA 2020

Data sources: DELWP, Geoscience Australia

© WSP Australia Pty Ltd (WSP). Copyright in the drawings, information and data recorded in this document is the property of WSP. This document and the information are made available for the purpose of the authorised purpose for this document and for no other purpose. No part of it may be copied or reproduced by any means, modified, made available to any other person or used for any other purpose without the prior written permission of WSP. To the extent permitted by law, WSP excludes all liability for any loss or damage arising out of or in connection with this document to any party other than the party who has entered into a contract with WSP for the purpose of preparing this document and accepts no responsibility for any use of or reliance on this document by any third party.

2 Legislative context

2.1 Commonwealth legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), any action that has, would have, or is likely to have a significant impact on a Matter of National Environmental Significance (MNES) or on Commonwealth land, triggers the Act and may require assessment and approval from the Commonwealth Minister for the Environment.

The nine Matters of National Environmental Significance (MNES) protected under the EPBC Act are:

- listed threatened species and ecological communities
- listed migratory species
- wetlands of international importance (listed under the Ramsar Convention)
- Commonwealth marine areas
- world heritage properties
- national heritage places
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mines)
- a water resource, in relation to coal seam gas development and large coal mining development.

2.2 State legislation

2.2.1 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of threatened species, populations, ecological communities of animals and plants, and Areas of Outstanding Biodiversity Value through specific objectives relating to the conservation of biodiversity and promoting ecologically sustainable development.

Part 7 of the BC Act requires that the significance of the impact on threatened species, populations and endangered ecological communities listed under the BC Act or FM Act, are assessed using a five-part test. Where a significant impact is likely to occur, a Species Impact Statement (SIS) or Biodiversity Development Assessment Report (BDAR) must be prepared.

The BC Act establishes a framework to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offsets Scheme (BOS). The BOS creates a transparent, consistent, and scientifically based approach to biodiversity assessment and offsetting for all types of development that are likely to have impacts on biodiversity values.

The Biodiversity Assessment Method (BAM) (Department of Planning Industry and Environment, 2020) was established under the BC Act as a standard method to implement the aims of the BOS and to address the loss of biodiversity and threatened species. The BOS creates a market framework for the conservation of biodiversity values and the offsetting of development impacts. It also provides the mechanisms to offset impacts of development, clearing or biodiversity certification such that there is no loss of biodiversity values.

2.2.2 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve, protect and manage fisheries, aquatic systems and habitats in NSW including conserving fish stocks and key fish habitats. The FM Act establishes mechanisms for the listing of threatened species, populations and ecological communities or key threatening processes, the declaration of critical habitat and the consideration and assessment of threatened species impacts in the development assessment process.

Part 7A Division 4 of the Act prohibits the carrying out, without a licence, of activities that damage habitats or harm threatened species, populations or ecological communities. In determining the significance of impacts, the determining authority must consider the matters listed in section 1.7 of the *Environment Planning and Assessment Act 1979*.

Threatened species, populations and ecological communities of fish and marine vegetation are protected under the FM Act. In addition, an object of the FM Act is to conserve key fish habitat. Pindari Dam and Severn River are mapped as Key Fish Habitat (KFH) (Department of Primary Industries, 2024a). Nearby waterways including Scrub Hut Creek, Spring Creek, Ironbark Creek and associated tributaries are also mapped as KFH.

Potential impacts of the proposal on aquatic systems, habitats and fish stocks are assessed within an Aquatic Ecology Assessment report, prepared by H2O Consulting to support the REF (Dated 10 October, 2024). Key findings of the Aquatic Ecology Assessment (H2O Consulting, 2024) are summarised in Section 5.1.3.

2.2.3 Environment Planning and Assessment Act 1979

The *Environment Planning and Assessment Act 1979* (EP&A Act) is the principal Act relating to development in NSW. The proposal is subject to the environmental impact assessment and planning approval requirements of Division 5.1 of the EP&A Act.

Under the provisions of State Environmental Planning Policy (Transport and Infrastructure) 2021 (TISEPP) the proposal is permissible without consent. WaterNSW is both the proponent and determining authority under Part 5 Division 5.1 of the EP&A Act.

A REF is being prepared to satisfy WaterNSW's duties under Section 5.5 EP&A Act to 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'. This Biodiversity Assessment Report (BAR) aims to inform the REF being prepared for the Pindari Dam Bubble Plume Destratification System proposal to assess potential biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Should WaterNSW find that the proposal is likely have a significant impact on the environment, a Species Impact Statement (SIS) or Biodiversity Development Assessment Report (BDAR) must be prepared.

2.2.4 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) provides a framework to manage biosecurity risks from animal and plant pests and diseases, weeds and contaminants and outlines the responsibilities of government, councils, private landholders and public authorities in the management of biosecurity matters. Under section 21 of the Biosecurity Act, any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised as is reasonably practicable.

The Biosecurity Act and Regulations provide specific legal requirements for high risk activities and State level priority weeds. The State level priority weeds and associated legal requirements relevant to the region are outlined in the Northern Tablelands Regional Strategic Weed Management Plan 2023-2027 (Local Land Services, 2022), together with the high risk priority weeds from the regional prioritisation process.

3 Methodology

The methodology used for this assessment included a combination of desktop searches of relevant databases and historical records, as well as a field survey assessment to verify biodiversity values.

All work was carried out under the appropriate licences, including scientific licence as required under Part 2 of the BC Act (License Number: SL100630).

3.1 Personnel

The contributors to the preparation of this report, their qualifications and roles are listed in Table 3.1.

Table 3.1 Personnel

Name	Qualifications	Position and role
Nicholas Everitt	B.Env.Sc	Principal Ecologist / field surveys and report preparation / report review
Bernadette Quirk	B.Env.Sc	Environmental Scientist / field surveys and report preparation
Terri-ann English	B.App.Sc (Env Sc)	Principal Ecologist / report preparation
Alicia Palmer	B.Sc: Resource and Env Mgt (Hons)	Ecologist / report preparation
Stella O'Dwyer	B.Env.Bio	Ecologist / report preparation
Sebastian Miller	B.Mar.Sc	Ecologist / report preparation
Charlotte Gurney-Read	M.Sc. B. Sc (Hons)	Graduate Ecologist / report preparation

3.2 Background research and data sources

Prior to the commencement of fieldwork, a desktop assessment was carried out to build a preliminary overview of the ecological values of the study area and to identify the existing environment within a nominal search area of 10 kilometres surrounding the study area (the locality).

The review focused on database searches, relevant ecological reports pertaining to the study area (where publicly available) and relevant GIS layers. The review was used to prepare a list of plant community types (PCTs), threatened species, populations, and communities as well as important habitat for migratory species with a likelihood of occurrence in the study area and locality. The searches were also carried out to identify if any Areas of Outstanding Biodiversity Value were present.

The following databases and resources were searched or viewed:

- BioNet Atlas of NSW Wildlife – NSW Department of Planning and Environment (with a 10 km buffer around the subject site) (July 2024)
- Commonwealth Protected Matters Search Tool – Department of Climate Change, Energy, the Environment and Water (with a 10 km buffer around the subject site) (July 2024)
- Review of broad-scale regional vegetation mapping projects (Oct 2024).
- NSW Flora Online (PlantNet) – The Royal Botanic Gardens and Domain Trust (Oct 2024).

- Existing broad-scale vegetation maps of the local area (Oct 2024).
- Commonwealth Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE).
- Department of Primary Industries (Fisheries) – threatened species list (Oct 2024).
- Areas of outstanding biodiversity value and critical habitat search (Oct 2024).
- Biodiversity Values Map (Oct 2024).
- NSW Environment, Energy and Science vegetation classification database (Oct 2024).
- NSW Environment, Energy and Science Threatened Biodiversity Data Collection (Oct 2024).
- NSW Sharing and Enabling Environmental Data portal including NSW Wetland Mapping (Oct 2024).
- Preliminary and provisional determinations of threatened species and ecological communities listed under the BC Act were viewed from the NSW Threatened Species Scientific Committee web resources (Oct 2024).
- Annual Final Priority Assessment List of nominated species and ecological communities that have been approved for assessment by the Minister responsible for the EPBC Act (Oct 2024).

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act were viewed from the NSW Threatened Species Scientific Committee web resources. At the time of writing, there were no preliminary or provisional listings of relevance to the project. The annual Final Priority Assessment List of nominated species and ecological communities that have been approved for assessment by the Minister responsible for the EPBC Act were also reviewed.

3.3 Likelihood of occurrence assessment

A likelihood of occurrence assessment, including habitat assessment, was undertaken on the identified list of threatened flora and fauna species known or predicted to occur within the locality (see Appendix A for the habitat assessment results).

The habitat assessment compared the preferred habitat features for threatened species with the type and quality of the habitats identified in the study area. This habitat assessment was completed to assess the likelihood of the species being present in the study area. The habitat assessment formed the basis for targeted surveys.

The criteria used in the habitat assessment are detailed in Table 3.2. The results of the habitat assessment are provided in Appendix A.

Table 3.2 Likelihood of occurrence assessment

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey or has been recorded from past surveys.
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded recently in the locality (10 km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however, may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (i.e. for breeding or important life cycle periods) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.

Likelihood	Criteria
Low	It is unlikely that the species inhabits the study area and it has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (i.e. for breeding or important life cycle periods) on available habitat. Specific habitat is not present in the study area or the species are non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.

3.4 Field survey

A field survey was carried out within the study area as displayed in Figure 1.2 on 21 May 2024, by one WSP Ecologist and one Environmental Scientist. The survey sought to:

- Assess the extent and condition of vegetation and fauna habitat at and immediately surrounding each site, especially for the threatened flora and fauna species.
- Identify biodiversity of concern (threatened species) to avoid and/or minimise impacts to biodiversity where possible during the works and for ongoing maintenance into the future.
- Identify plant communities with potential to be consistent with threatened ecological communities listed under the NSW BC Act or Commonwealth EPBC Act.

The survey involved traversing the study area on foot and recording the biodiversity values including recording flora species present for determining PCTs and any opportunistic sightings of threatened species or their habitat. Specifically, the survey included:

- Mapping of PCTs and their condition during Random Meander and Rapid Data Point survey methods (refer to a definition of these methods below in Section 3.4.2 and 3.4.3).
- Completing one BAM plot in a good condition area in accordance with the techniques outlined in the Biodiversity Assessment Method (BAM) (Department of Planning, Industry and Environment 2020).
- Determining the nature and condition of vegetation within the study area.
- Random meanders throughout the study area to identify and/or assess the likelihood of threatened species to occur in the study area.
- Opportunistic observations of animals and signs of animal activity (e.g. feeding signs, scats) to verify the ecological values of the proposal site and facilitate habitat condition assessments (refer to Appendix E).
- Fauna habitat assessments to record threatened species habitat features such as hollow bearing trees, nest trees etc. within the study area.
- Recording the GPS location of significant habitat features or threatened biodiversity identified.

3.4.1 Definition of native vegetation

For the purposes of this BAR, native vegetation is defined as in Section 1.6 of the BC Act which states that native vegetation and clearing native vegetation have the same meanings as in Part 5A of the *Local Land Services Act 2013* (LLS Act). Part 5A Section 60B of the LLS Act defines native vegetation as any of the following types of plants native to NSW:

- trees (including any sapling or shrub or any scrub).
- understorey plants.
- groundcover (being any type of herbaceous vegetation).
- plants occurring in a wetland.

A plant is native to NSW if it was established in NSW before European settlement.

3.4.2 Random meander survey

Random meander surveys are a variation of the transect type survey and were completed in accordance with the technique described by Cropper (1993) whereby the recorder walks in a random meander throughout the study area recording dominant and key plant species (e.g. threatened species, priority weeds), boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation community was proportional to the size of the community and its species richness (Cropper, 1993).

Random meander surveys were conducted to undertake flora and fauna habitat assessments, vegetation mapping and opportunistically search for threatened species within area of suitable habitat. This involved two ecologists walking throughout the study area, looking for threatened species.

3.4.3 Rapid point assessment

Rapid data point assessments (RDP) are used to validate and refine the mapped vegetation classification, being the State Vegetation Type Map (Department of Planning and Environment, 2022) to determine their associated PCT in accordance with the BioNet Vegetation Classification System (Environment., 2024).

RDPs recorded the following:

- dominant exotic and native plant species present
- percent cover of native groundcover
- photograph of each location
- threatened flora and/or fauna species identified
- significant fauna habitat resources (such as tree hollow, rock piles,and cracks and fissures present in wooden poles).

3.4.4 Vegetation integrity plots

One vegetation integrity plot (BAM plot), as described in the Biodiversity Assessment Method (BAM) (Department of Planning Industry and Environment, 2020) was completed in the most common vegetation type present throughout the study area. Vegetation integrity plots include a full floristic survey within a 20 m x 20 m quadrat, with function data collected using a 20 m x 50 m plot. A schematic diagram illustrating the layout of each Vegetation Integrity Plot is provided in Figure 3.1. The BAM plot was undertaken to sample the most common PCT. The use of the BAM survey methods were adopted as a standardised method for measuring vegetation integrity, however the survey effort (or number of BAM plots undertaken) is not intended to be completed in accordance with the BAM.

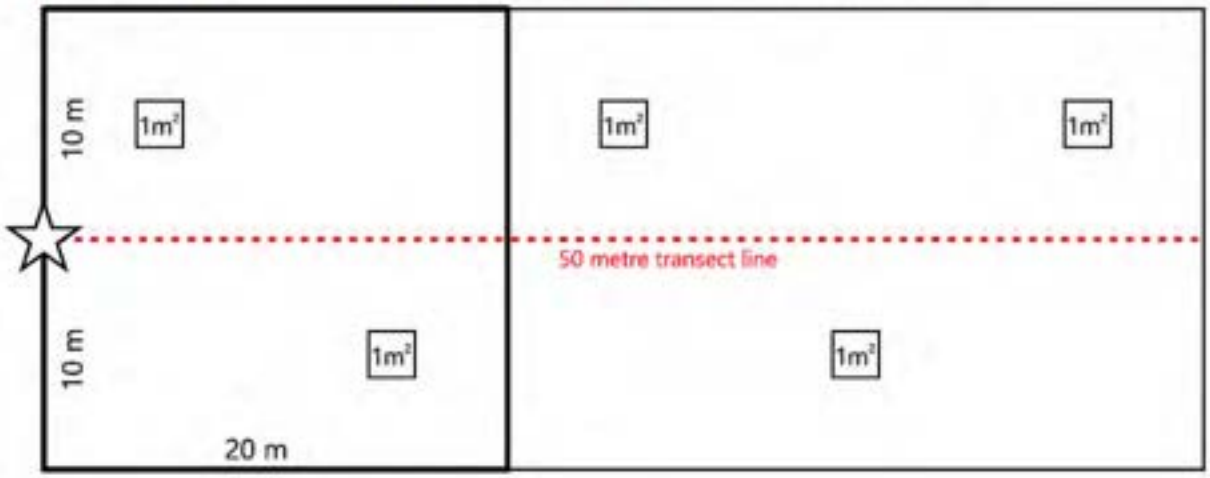


Figure 3.1 Vegetation integrity plot layout

The following site attributes were recorded within each vegetation integrity plot:

- Location: (easting – northing grid type MGA 94, Zone 56).
- Vegetation structure and dominant species and vegetation condition: Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer.
- Native and exotic species richness (within a 400 m^2quadrat): This consisted of recording all species by systematically walking through each 20 m x 20 m plot. The cover and abundance (percentage of area of quadrat covered) of each species was estimated. The growth form, stratum/layer and whether each species was native/exotic/high threat weed was also recorded.
- Number of trees with hollows (1,000 m squared quadrat): This was the frequency of hollows within living and dead trees within each 50 m x 20 m plot. A hollow was only recorded if (a) the entrance could be seen: (b) the estimated entrance width was at least 5 cm across: (c) the hollow appeared to have depth: (d) the hollow was at least 1m above the ground and the (e) the centre of the tree was located within the sampled quadrat.
- Number of large trees and stem size diversity (1,000 m^2 quadrat): tree stem size diversity was calculated by measuring the diameter at breast height (DBH) (i.e. 1.3 m from the ground) of all living trees (greater than 5 cm DBH) within each 50 m x 20 m plot. For multi-stemmed living trees, only the largest stem was included in the count. Number of large trees was determined by comparing living tree stem DBH against the PCTs benchmarks.
- Total length of fallen logs (1,000 m^2 quadrat): This was the cumulative total length of logs within each 50 m x 20 m plot with a diameter of at least 10 cm and a length of at least 0.5 m.
- Litter cover: This comprised estimating the average percentage groundcover of litter (i.e. leaves, seeds, twigs, branchlets and branches with a diameter less than 10 cm which is detached from a living plant) from within five 1 m x 1 m sub-plots spaced evenly either side of the 50 m central transect.
- Evaluation of regeneration: This was estimated as the presence/absence of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height less than or equal to 5 cm).

Table 3.3 Location of vegetation integrity plots and rapid data points

BAM Plot/Rapid Data Point	Easting	Northing	Orientation
Rapid data point	329551	6748074	Rapid data point
Rapid data point	329526	6748068	Rapid data point
Rapid data point	329440	6748025	Rapid data point
Rapid data point	329454	6747937	Rapid data point
Rapid data point	329578	6747755	Rapid data point
BAM Plot	329454	6747938	135

3.4.5 *Condition of vegetation*

Vegetation in the study area was firstly assigned to a PCT and then allocated to a vegetation zone, which is defined in the BAM as 'an area of native vegetation on the subject land that is the same PCT and has a similar broad condition state' (NSW and Department of Planning and Environment [DPE], 2020). A broad condition state infers that the vegetation has a similar tree cover, shrub cover, ground cover, weediness or combinations of these attributes which determine vegetation condition. Due to the consistency of condition across each of the two PCTs, no separate vegetation zones were defined.

The broad condition states applied to vegetation in the study area are summarised in Table 3.4.

Table 3.4 Vegetation broad conditions states

Condition Category	Description
Good	Vegetation structurally and floristically characteristic of assigned vegetation community. The vegetation is relatively undisturbed and appears to retain the structure and species composition typical of the PCT. Weeds are not common.
Moderate	Vegetation is still structurally and floristically characteristic of assigned vegetation community. The vegetation is however disturbed, and weeds are common.
Poor	The vegetation is considerably disturbed, and it lacks structural and floristic diversity. Weeds are dominant in the shrub layer and/or ground layer.

3.4.6 Fauna habitat assessment

The likelihood of threatened fauna species (those species known or predicted to occur within the locality from the literature and database review) occurring within the subject site was based on the assessment of available suitable fauna habitat on site. Fauna habitat characteristics assessed included:

- Structure and floristic diversity of the canopy, understorey and ground vegetation including significant flowering events, artificial habitat features and significant species for fauna (e.g. foraging species).
- Presence of hollow-bearing trees providing roosting and breeding habitat for arboreal mammals, birds and reptiles such as stags, hollow location, size and orientation and fire scars.
- Presence of ground habitats and potential to provide protection for ground-dwelling mammals, reptiles and amphibians including fallen timber, size of hollows in fallen timber (if any) and groundcover leaf litter.
- Evidence of fauna tracks/signs including scats, chew marks, scratches and/or worn areas on trees and potential large forest owl roost trees.
- Presence of waterways (ephemeral or permanent) including details on waterbody type, level of permanence, fringing composition, riparian vegetation and condition.

3.4.7 Condition of fauna habitats

For this study, suitable habitat for fauna was assessed based on vegetation mapping, ground-truthing, and local knowledge. Habitats were delineated by grouping vegetation communities according to the structure and floristics of the canopy, understorey and ground vegetation; the structure and composition of the litter layer; and other habitat attributes important for feeding, roosting and breeding. The location of habitat features such as hollow-bearing trees, aquatic habitat and rock outcrops were recorded using a hand held GPS.

The following criteria were used to evaluate the condition of habitat values:

- Good: A full range of fauna habitat components are usually present (for example, old-growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
- Moderate: Some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
- Poor: Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

3.4.8 Opportunistic sightings

Opportunistic sightings of animals were recorded during field surveys. Evidence of animal activity, such as scats, diggings, scratch marks, nests/dreys, burrows etc., was also noted. This provided indirect information on animal presence and activity.

3.4.9 Survey limitations

No sampling technique can eliminate the possibility that a species is present within a study area. For example, some species of plant may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present within the study area during surveys. The conclusions in this report are based upon data acquired for the proposal and the one-off field survey, therefore, they are merely indicative of the environmental condition of the study area at the time of preparing the report, including the presence or otherwise of species. It should be recognised that study area conditions, including the presence of threatened species, can change with time.

No targeted flora and fauna surveys have been conducted. The likelihood of occurrence of threatened species has been assessed on the basis of species' known habitat requirements and the availability of suitable habitat (type, condition and extent) on site. Given the disturbed nature of the site and the limited habitat available, the methodology is considered adequate and the conclusions justified.

4 Existing environment

This section describes the environmental context of the study area including abiotic and biotic features of the landscape area. The context of the study area assists in assessing likelihood of occurrence for threatened species and determining PCTs.

4.1 Study area landscape features

The landscape context of the study area is described in Table 4.1. The study area's location in the locality is mapped in Figure 1.1.

Table 4.1 Landscape context

Landscape Context	Landscape Features
Local Government Area	Inverell Shire Council
IBRA (Interim Biogeographic Regionalisation for Australia) bioregion	New England Tablelands
IBRA subregion	Severn River Volcanics
Local Land Service Region	Northern Tablelands
Mitchell Landscapes	Inverell Plateau Granites
Catchment	Border Rivers (NSW)
Rivers, streams and estuaries	The study area encompasses the Severn River (including the Severn River dammed within Pindari Dam). Severn River intersects the study area latitudinally flowing from the east to the west, regulated by the Pindari Dam wall and spillway. Nearby waterways which flow into Pindari Dam include Scrub Hut Creek, Spring Creek, Ironbark Creek and numerous tributaries.
Important and local wetlands	No mapped important or local wetlands are present in the study area.
Connectivity features	Lake Pindari is surrounded by a mixture of partially cleared and fragmented lands to the west and south-west and larger areas of remnant vegetation to east, forming Severn River Nature Reserve. Pindari Dam is bordered by fragmented areas of remnant vegetation to the north, east and south. In the locality of the study area, remnant vegetation is dissected by cleared areas along Severn River and below (to the south-east of) the Pindari Dam wall, as well as within an overflow are to the north-west of the dam wall.
Areas of geological significance and soil hazard features	No areas of geological significance occur in the study area. Soil reports nearby the study area did not report salting 'salinity' as present (eSpade, 2024).
Geology and Soils	The study area is mapped as being located within the rudosol soil classification (according to the Australian Soil Classification) (eSpade, 2024).

Landscape Context	Landscape Features
Areas of outstanding biodiversity value	Areas of Outstanding Biodiversity Value are special areas with irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally which are declared by the Minister under the BC Act. Theare no Areas of Outstanding Biodiversity Value within the study area.

4.2 Plant community types

The study area consisted of patches of native woodland vegetation and exotic grassland around the margins of Pindari Dam. The narrow areas of native vegetation varied in condition from poor to moderate, with lower condition areas of woodland a result of previous disturbance and ongoing landuse associated with Pindari Dam.

Field validation surveys for Plant Community Types (PCTs) were completed in the study area.

Two PCTs were recorded within the study area. These include:

- PCT 4151: Northwest White Pine-Silver-leaved Ironbark Forest
- PCT 3518: Northwest Pine-Ironbark Grassy Woodland.

A description of these PCTs is provided in Sections 4.2.1, 4.2.2 and 4.2.3 respectively.

A map of PCTs observed within the study area during the field survey is provided in Figure 4.1.

4.2.1 PCT 4151 – Northwest White pine-silver-leaved ironbark forest

PCT 4151 is located in areas both to the northwest and south of the dam wall. The description of this PCT is based on one BAM plot undertaken on the western side of the dam wall (Refer to Figure 4.1). The dominant species within this PCT are provided in Table 4.2 below.

Table 4.2 Dominant plant species within areas mapped as PCT 4151

Layer	Dominant Species
Upper-stratum (Trees)	*Eucalyptus dealbata, Eucalyptus crebra*
Lower stratum	*Olearia elliptica subsp. elliptica, Gaudium brevipes, Cassinia uncata*
Ground stratum	*Aristida ramosa, Aristida jerichoensis, Pimelea neo-anglica, Cheilanthes lasiophylla, Dichondra repens, Glycine clandestina, Oxalis perennans, Phyllanthus carpentariae, Geranium solanderi, Cyperus gracilis, Desmodium rhytidophyllum, Lagenophora stipitata, Melichrus urceolatus, Lomandra multiflora subsp. multiflora, Xanthorrhoea johnsonii*
Exotic species	*Hyparrhenia hirta, Eragrostis curvula*

Areas of PCT 4151 are considered to be in poor to moderate condition. The areas of this PCT contained within the proposed impact area are positioned along the edge of the dam construction, fringed by exotic grasslands (mapped as miscellaneous ecosystem). Previous clearing associated with the dam construction and the resulting long-term edge effects from the proximity of PCT 4151 to the dam construction have resulted in a reduced vegetation condition. Trees present include predominantly young trees, with some larger trees located south of the dam wall.



Photo 4.1 Site photos of PCT4151

4.2.2 PCT 3518 – Northwest Pine-ironbark grassy woodland

PCT 3518 is located in a very small area at the western end of the dam wall (Refer to Figure 4.1). The description of this PCT is based on the PCT profile from BioNet vegetation classification and observations during the field visit. No BAM plot was undertaken in this PCT. The dominant species within this PCT are provided in Table 4.3 below. No large trees are present within this PCT.

Table 4.3 Dominant flora species likely to occur within areas mapped as PCT 3518

Layer	Dominant Species
Upper-stratum (Trees)	*Eucalyptus dealbata, Eucalyptus crebra*
Ground stratum	*Melichrus urceolatus, Leucopogon muticus, Aristida ramosa, Aristida jerichoensis, Cassinia laevis*
Exotic species	*Hyparrhenia hirta, Eragrostis curvula*

Areas of PCT 3518 are considered to be in poor condition, with the canopy, mid-storey and shrub layer being mostly absent, and a very sparse groundcover containing a mixture of native and exotic species.



Photo 4.2 Site photos of PCT 3518

4.2.3 Miscellaneous ecosystem

Contains a mixture of bare soil, surface rocks with vegetation cover dominated by exotic groundcover species such as *Hyparrhenia hirta* and *Eragrostis curvula.*

4.3 Fauna species

A list of common fauna species were recorded by opportunistic surveys during the site visit on May 21, 2024. The recorded species are provided in Appendix E.

The study area has been previously disturbed and is subjected to ongoing disturbance. Despite their absence during surveys, vertebrate pests species such as rabbits, cats and foxes are known to occur within the study area.

4.4 Threatened ecological communities

A BioNet search of the Inverell LGA identified records of 27 TECs including eight EPBC Act listed TECs and 19 BC Act listed TECs. The Protected Matters Search Tool (PMST) search undertaken identified four EPBC Act listed ecological communities that are known to occur in the locality (refer to Appendix B). No EPBC Act listed ecological communities were recorded in the study area. The PCTs identified within the study area are not consistent with any TECs known to occur within Inverell LGA.

In regard to the TEC, White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions, none of the dominant canopy species were present within the study area and therefore the vegetation communities identified are not considered to be consistent this TEC.

In regard to Howell Shrublands in the New England Tableland and Nandewar Bioregions, this TEC is associated with granitic outcrops and has been recorded on Gilgai Granite (undifferentiated), leucoadamellite and Tingha Granite. The geology within the study area is mapped as Emmaville Volcanics (Pfwe) which is not associated with granitic outcrops (Department of Planning, Industry & Environment, 2024). Further to this, the shrub species characteristic of this TEC, *Homoranthus prolixus* and *Babingtonia densifolia* were not recorded. However, Eucalyptus dealbata which was identified within the study area, can occur in a modified version of this TEC, giving the appearance of a low open woodland. Despite the presence of E.dealbata, given the absence of granitic outcrops and characteristic shrub species, it is considered that vegetation within the study area is not consistent with this TEC.

4.5 Threatened species

4.5.1 Threatened flora

Database searches for records of threatened flora species were undertaken for an area of approximately 10km radius centred over the study area. The results of database searches are as follows:

- 7 threatened flora species records from a BioNet search
- 23 EPBC Act listed threatened flora species from a PMST search
- 31 threatened flora species from a PlantNet area search.

A summary of species recorded in database searches is provided in Appendix E.

The following threatened flora species (the assessed species) are considered to have at least a moderate or greater likelihood of occurring within the study area (with BC Act and EPBC Act listing category provided in brackets):

- *Acacia acrionastes* (Pindari Wattle) (E/-)
- *Acacia macnuttiana* (MacNutt's Wattle) (V/V)
- *Astrotricha roddii* (Rodd's Star Hair) (E/E)
- *Callistemon pungens* (-/V)
- *Indigofera baileyi* (Bailey's Indigo) (E/-)
- *Polygala linariifolia* (Native Milkwort) (E/-)
- *Thesium australe* (Austral Toadflax) (V/V).

These threatened flora species are known to occur within the Glenn Innes, Inverell and Tarrington Station Conservation Areas and the general region of the study area, some of which included records of individuals closer to Pindari Dam. The closest of these is the Pindari Wattle found within the Severn River Nature Reserve and also along the peninsula of Pindari Dam approximately 600m from the study area (Refer to Figure 4.1).

A survey of the study area was carried out on 21 May 2024, during which random meander surveys were conducted. No threatened flora species were observed during surveys.

This survey was undertaken outside of the optimal and / or recommended survey period (provided in brackets) for the threatened flora species, with the exception of *Astrotricha roddii.* Recommended survey periods are as follows:

- *Acacia acrionastes* (July to September)
- *Acacia macnuttiana* (August to September)
- *Astrotricha roddii* (All year)
- *Callistemon pungens* (September to February)
- *Indigofera baileyi,* (November to February)
- *Polygala linariifolia* (October to February)
- *Thesium australe* (November to February).

Despite the surveys being undertaken outside of their recommended survey periods, no specimens from any of the above genus were observed within the study area. Given that no specimens were observed and the small size of the proposed impact area, it is considered that any individuals present within the impact area are likely to be in low numbers. A detailed assessment of significance for the assessed threatened flora species under both the BC Act and EPBC Act is provided in Appendix C and Appendix D respectively.

An assessment of the likelihood of occurrence of threatened species is provided in Appendix A.

4.5.2 Threatened fauna

Database searches for records of threatened fauna species were undertaken for an area of approximately 10km radius centred over the study area. The results of database searches are as follows:

- 18 threatened fauna species records from a BioNet search
- 34 EPBC Act listed threatened fauna species from a PMST search.

A summary of species recorded in database searches is provided in Appendix A.

The following threatened fauna species are considered to have at least a moderate or greater likelihood of occurring within the study area (with BC Act and EPBC Act listing category provided in brackets):

- *Anthochaera phrygia* (Regent Honeyeater) (CE/CE) – July to January
- *Artamus cyanopterus cyanopterus* (Dusky Woodswallow) (V/-) – Spring

- *Chthonicola sagittata* (Speckled Warbler) (V/-) – August to January
- *Climacteris picumnus victoriae* (Brown Treecreeper) (V/V) – July to February
- *Daphoenositta chrysoptera* (Varied Sittella) (V/-) – anytime but mostly May to June
- *Geophaps scripta scripta* (Squatter Pigeon (southern sub-species) (CE/V)
- *Glossopsitta pusilla* (Little Lorikeet) (V/-)
- *Haliaeetus leucogaster* (White-bellied Sea-eagle) (V/-)
- *Hieraaetus morphnoides* (Little Eagle) (V/-)
- *Melanodryas cucullata cucullata* (South-eastern Hooded Robin) (E/E)
- *Neophema pulchella* (Turquoise Parrot) (V/-)
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler – eastern subspecies) (V/-)
- *Stagonopleura guttata* (Diamond Firetail) (V/V)
- *Dasyurus maculatus* (Spotted-tailed Quoll) (V/E)
- *Phascolarctos cinereus* (Koala) (E/E).

An assessment of potential habitats for threatened fauna species was undertaken during the field survey, however no detailed targeted surveys were undertaken. These fauna species are known to occur in the locality, with BioNet records of all of the above species, with the exception of the Squatter Pigeon, occurring within close proximity to Pindari Dam. No threatened fauna species were recorded during surveys. Appendix E provides a list of common fauna species recorded.

Habitats within the study area consist of predominantly younger trees with limited shrub or ground cover habitats, a moderate cover of surface rocks and limited litter cover or fallen logs. Flowering trees provide limited foraging habitat for woodland birds while the ground habitats are likely to provide suitable habitat for common reptile species. A summary of impacts is provided in Table 5.1.

No stick nests, smaller nests or tree hollows were observed during surveys and given the sparse densities of shrubs and ground covers observed and the absence of larger trees around the dam edge, it is considered that the study area provides predominantly foraging habitats and is unlikely to provide potential nesting opportunities.

Despite the absence of nests and potential nesting hollows, the site visit was undertaken in May, prior to the majority of the woodland bird breeding activity, which generally starts from June (with the exception of Little Lorikeet and Squatter Pigeon) and continues through to February for some species. A list of the assessed bird species and their breeding seasons is as follows:

- *Anthochaera phrygia* (Regent Honeyeater) – July to January
- *Artamus cyanopterus cyanopterus* (Dusky Woodswallow) - September
- *Chthonicola sagittata* (Speckled Warbler) – August to January
- *Climacteris picumnus victoriae* (Brown Treecreeper) – July to February
- *Daphoenositta chrysoptera* (Varied Sittella) – June to April
- *Geophaps scripta scripta* (Squatter Pigeon (southern sub-species) - anytime but mostly May to June
- *Glossopsitta pusilla* (Little Lorikeet) – May to September
- *Haliaeetus leucogaster* (White-bellied Sea-eagle) – June to September
- *Hieraaetus morphnoides* (Little Eagle) - September
- *Melanodryas cucullata cucullata* (South-eastern Hooded Robin) – July to November
- *Neophema pulchella* (Turquoise Parrot) – August to December
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler – eastern subspecies) – July to February
- *Stagonopleura guttata* (Diamond Firetail) – August to January.

The specific microhabitats required by other threatened fauna species listed in Appendix A are either absent from the study area itself, or the microhabitats within the study area are degraded to the point that the species is unlikely to occur in the study area. This is not to say that a threatened species would not occur in the study area on rare occasion, but that the habitat is significantly altered and degraded to a point where there are no resources that would sustain a resident population and nor would any of the species rely upon this habitat for survival. Some threatened species may visit the study area on rare occasion during dispersal, or as vagrants, but the likelihood of occurrence of most threatened fauna species in the study area is low.

An assessment of the likelihood of occurrence of threatened species is provided in Appendix A.

A detailed assessment of significance for the assessed threatened fauna species under both the BC Act and EPBC Act is provided in Appendix C and Appendix D respectively.

4.5.3 *Migratory species*

The results of the PMST indicate that 11 listed migratory species may occur in the locality. These species include a number of migratory wetland birds that do not have any habitat within or near the study area so have been excluded from the assessment. It is considered that dam habitats are unlikely to provide suitable habitat for migratory birds due to the steep slopes at the fringes of the dam and resulting absence of shallow and / or wading and foraging areas.

While some migratory species of bird could potentially use the study area and locality, the study area would not be classed as an 'important habitat'. A nationally significant proportion of a population of migratory birds would not be supported by the habitats in the study area. The project would not substantially modify, destroy, or isolate an area of important habitat for the migratory species, and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds.

4.6 Priority and high threat weeds

Two exotic plant species, *Hyparrhenia hirta* (Coolatai Grass) and *Eragrostis curvula* (African lovegrass) were present throughout the study area. These species are not listed under the Biosecurity Act as priority weeds (Department of Primary Industries, 2024b) or as Weeds of National Significance (WONS) (Weeds Australia, 2024). Both species have a General Biosecurity Duty for all of NSW to prevent, eliminate or minimise any biosecurity risk so far as reasonably practical. A summary of Table 4.4 outlines the exotic species recorded within the study area.

Table 4.4 Priority weeds and WONS identified within the subject site

Scientific name	Common Name	Duty under the Biosecurity Act	Weeds of National Significance?	High Threat Weed
Hyparrhenia hirta	Coolatai Grass	General Biosecurity Duty	No	Yes
Eragrostis curvula	African lovegrass	General Biosecurity Duty	No	Yes

4.7 Aquatic habitat assessment

An Aquatic Ecology Assessment has been prepared by H20 Consulting Group (Swanson, 2024).

The objectives of the Aquatic Habitat Assessment include:

- Identify any potential impacts from the proposed works on threatened biodiversity, MNES, water quality, fish habitat, aquatic vegetation and fauna and areas of outstanding biodiversity value.
- Provide recommendations regarding adoption of environmental controls and mitigation measures in the Construction Environmental Management Plan (CEMP) and identify any additional permitting and approval requirements under the FM Act, including any requirements for an SIS.
- Provide recommendations regarding ongoing aquatic ecological monitoring in downstream habitats of the Severn River.

An assessment of significance was undertaken for threatened fish species listed under the FM Act and EPBC Act. These assessments concluded that the populations of the threatened freshwater fish species that may utilise habitat in the study area and in the Severn River downstream of Pindari Dam where changes to environmental conditions are expected are unlikely to be significantly detrimentally affected by the proposed system. Intended increases in water temperatures from dam releases are expected to reduce the effects of cold water pollution in the Severn River and contribute to improving habitat suitability, particularly for reproductive success. The project is expected to have a net positive impact on these threatened species by improving environmental conditions and reducing existing impacts that may otherwise impact on the long term survival of these species in the Severn River.

4.8 Riparian areas and key fish habitat

4.8.1 Riparian areas

Riparian areas occur outside the study area, downstream of the dam. These areas are outside of the scope of this report but were assessed as part of the Aquatic Ecology Assessment undertaken by H20 Consulting Group (Swanson, 2024).

A detailed assessment of riparian habitats located along the downstream sections of Severn River are provided in section 3.3 of the Aquatic Ecology Assessment (Swanson, 2024) (Refer also to Section 4.7).

4.8.2 Key fish habitat

Mapping provided by NSW DPIRD considers the Severn River and its banks, Scrub Hut Creek and most of Pindari Dam as Key Fish Habitat (KFH) – Murray Darling Basin North (Department of Primary Industries, 2024a). Investigations were conducted by H20 Consulting Group as part of the Aquatic Ecology Assessment to verify KFH across the study area, resulting in the identification of Type 1 and Type 2 KFH within both the Severn River and Scrub Hut Creek (Swanson, 2024). A summary of KFH is provided in section 3.3.4 of the Aquatic Ecology Assessment.

4.8.3 Threatened entities listed under the FM Act and EPBC Act

An assessment of significance for threatened fish listed under the FM Act and EPBC Act has been completed as part of the Aquatic Ecology Assessment by H20 Consulting Group (Swanson, 2024). Refer to section 4.7.1 and Appendix 4 of the Aquatic Ecology Assessment. The assessed species include:

- Endangered population of Eel-tailed Catfish (*T.tandanus*)
- Endangered species Silver Perch (*B.bidyanus*)

- Vulnerable species Murray Cod (*M.peelii*).

These assessments concluded that the populations of the threatened freshwater fish species that may utilise habitat in the study area and in the Severn River downstream of Pindari Dam where changes to environmental conditions are expected are unlikely to be significantly detrimentally affected by the proposal. Intended increases in water temperatures from dam releases are expected to reduce the magnitude and extent of impacts from the existing CWP in the Severn River and contribute to improving habitat suitability, particularly for reproductive success. The project is expected to have a net positive impact on these threatened species by improving environmental conditions and reducing existing impacts that may otherwise adversely affect the long term survival of these species in the Severn River.

An assessment of significance was also undertaken for the Darling River Endangered Ecological Community (EEC) listed under the FM Act. Refer to section 4.7.2 and Appendix 4 of the Aquatic Ecology Assessment by H20 Consulting Group (Swanson, 2024). The assessment concluded that the parts of the EEC that are present within the aquatic assessment study area, and in the Severn River downstream of Pindari Dam where changes to environmental conditions are expected, are unlikely to be significantly detrimentally affected by the proposal. Intended increases in water temperatures from dam releases are expected to maintain more stable environmental conditions and reduce the magnitude and extent of cold water pollution and cold shock events in the Severn River, downstream of the dam. Some species, such as macroinvertebrates or zooplankton, may experience some disturbances as environmental conditions shift and habitat becomes more homogenised, which may lead to some shifts in community composition and distribution over the entire downstream Severn River. However, this is not expected to occur to such an extent that the EEC would be at risk of extinction.



wsp

PS122845
Pindari Dam bubble plume

Figure 4.1
Survey locations and results

Legend

- BAM Plot Location
- Impact Area
- Exclusion Area
- Construction compound and site facilities including accommodation
- Project Study Area
- Ecology Study Area - field verified

Vegetation

- PCT 4151: Northwest White Pine-Silver-leaved Ironbark Forest
- PCT 3518: Northwest Pine-Ironbark Grassy Woodland
- Miscellaneous Ecosystem
- Area not to be Impacted

DRAFT



Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:7,000 Date: 21/10/2024

Data sources: DELWP, Geoscience Australia

5 Assessment of impacts

5.1 Direct construction impacts

5.1.1 *Impacts on native vegetation*

The proposal would result in the direct removal of approximately 0.63 hectares (ha) of native vegetation. A summary of predicted impacts to native vegetation is provided in Table 5.1. Broad condition classes provided below are based on visual estimates of vegetation condition with guidance from BAM plot data.

Table 5.1 Potential impacts to native vegetation

PCT ID No.	PCT Name	Broad Condition Class	Direct Vegetation Removal (ha)
4151	North White pine-silver-leaved Ironbark Forest	Poor to moderate	0.6007
3518	Northwest Pine-ironbark grassy woodland	Poor	0.0246
Total native vegetation impacts			**0.6253**

5.1.1.1 Impacts to threatened ecological communities

No threatened ecological communities were identified within the study area.

5.1.2 *Impacts to threatened species*

The study area is considered to provide potential habitat for seven threatened flora species including:

- *Acacia acrionastes* (Pindari Wattle)
- *Acacia macnuttiana* (MacNutt's Wattle)
- *Astrotricha roddii* (Rodd's Star Hair)
- *Callistemon pungens*
- *Indigofera baileyi* (Bailey's Indigo)
- *Polygala linariifolia* (Native Milkwort)
- *Thesium australe* (Austral Toadflax).

The study area is considered to provide potential habitat for twelve threatened fauna species including:

- *Anthochaera phrygia* (Regent Honeyeater)
- *Artamus cyanopterus cyanopterus* (Dusky Woodswallow)
- *Chthonicola sagittata* (Speckled Warbler)
- *Climacteris picumnus victoriae* (Brown Treecreeper)
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Geophaps scripta scripta* (Squatter Pigeon (southern sub-species)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Haliaeetus leucogaster* (White-bellied Sea-eagle)
- *Hieraaetus morphnoides* (Little Eagle)
- *Melanodryas cucullata cucullata* (South-eastern Hooded Robin)
- *Neophema pulchella* (Turquoise Parrot)

- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler – eastern subspecies)
- *Stagonopleura guttata* (Diamond Firetail)
- *Dasyurus maculatus* (Spotted-tailed Quoll)
- *Phascolarctos cinereus* (Koala).

A total area of 0.63ha of native vegetation is proposed to be impacted, including 0.6ha of PCT 4151 and 0.02ha of PCT3518. These areas of habitat within the study area consist of predominantly younger trees with limited shrub or ground cover habitats, a moderate cover of surface rocks and limited litter cover or fallen logs. No stick nests, smaller nests or tree hollows were observed during surveys and given the sparse densities of shrubs and ground covers observed and the absence of larger trees around the dam edge, it is considered that the study area provides predominantly foraging habitats and is unlikely to provide potential nesting opportunities. Therefore, the proposal is likely to impact upon only limited areas of potential foraging habitat for the assessed species.

An assessment of the likelihood of occurrence of threatened species is provided in Appendix A.

A detailed assessment of significance for the assessed threatened fauna species under both the BC Act and EPBC Act is provided in Appendix C and Appendix D respectively.

5.1.3 Impacts to aquatic habitats and threatened species

An assessment of significance was undertaken for threatened fish species listed under the FM Act and EPBC Act. These assessments concluded that the populations of the threatened freshwater fish species that may utilise habitat in the project study area and in the Severn River downstream of Pindari Dam where changes to environmental conditions are expected are unlikely to be significantly detrimentally affected by the proposal. Intended increases in water temperatures from dam releases are expected to reduce the magnitude and extent of impacts from the existing CWP in the Severn River and contribute to improving habitat suitability, particularly for reproductive success. The proposal is expected to have a net positive impact on these threatened species by improving environmental conditions and reducing existing impacts that may otherwise impact on the long term survival of these species in the Severn River (Swanson, 2024).

5.1.4 Injury and mortality of fauna

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would occur. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground dwelling reptiles and frogs), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microchiropteran bat species), may find it difficult to rapidly move away from the clearing when disturbed.

Wildlife may also become trapped in or may choose to shelter in machinery that is stored in the study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use. Detailed safeguards and mitigation measures are provided in Section 7.

5.2 Indirect and operational impacts

5.2.1 Wildlife connectivity and habitat fragmentation

Habitat fragmentation relates to the physical dividing up of once continuous habitats into separate smaller fragments.

Lake Pindari is surrounded by a mixture of partially cleared and fragmented lands to the west and south-west and larger areas of remnant vegetation to east, forming the Severn River Nature Reserve. In the locality of the study area, remnant vegetation is dissected by cleared areas along the Severn River and below (to the south-east of) the Pindari Dam wall, as well as within an overflow area to the north-west of the dam wall.

The proposal will impact approximately 0.63ha of native vegetation predominantly along the edges of the existing dam wall and banks and will not dissect any large patches of native vegetation. Therefore, the proposal is unlikely to impact upon local vegetation connectivity or potential movement corridors. This impact would be of low magnitude and mitigation measures are not deemed necessary.

5.2.2 Edge effects on adjacent native vegetation and habitat

The proposal will impact approximately 0.63ha of poor to moderate condition native vegetation along a linear area positioned mostly at the edges of the existing dam wall, dam banks and exotic grassland (refer to areas mapped as Miscellaneous Ecosystem in Figure 4.1) with the exception of a small section to the north which dissects a small area of poor to moderate condition PCT 4151.

Linear infrastructure, such as that proposed, is known to cause disturbance in terms of reducing habitat quality in adjacent areas. This is due to the greater potential for edge effects and habitat fragmentation and barrier effects due to the high perimeter to area ratio of linear developments. The proposal is a linear development however given the position of the proposal being mostly adjacent to existing disturbed areas, with existing edge effects, it is considered that the proposal is unlikely to result in any significant increase in edge effects on adjacent native vegetation and habitats.

This impact would be of low magnitude and mitigation measures are not deemed necessary.

5.2.3 Invasion and spread of weeds

Proliferation of weeds is an indirect impact that is likely to occur during construction and operation of the proposal, although impacts would be greatest because of vegetation clearing during the construction phase. The most likely causes of weed dispersal and importation include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery.

The study area contains significant weed growth, and no undisturbed weed free habitat exists. As such, weeds must be managed during construction. The presence of some high threat weeds may require careful management to ensure spread of these species is limited.

5.2.4 Invasion and spread of pathogens and disease

Three pathogens known from NSW are listed as a key threatening process under either the EPBC Act and/or BC Act including:

- dieback caused by Phytophthora (Root Rot; EPBC Act and BC Act)
- infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and BC Act)
- introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (BC Act).

The potential for pathogens to occur should be treated as a risk during construction. The most likely causes of pathogen dispersal and importation include earthworks, movement of soil, and attachment of plant matter to vehicles and machinery during construction and operation.

5.2.5 Noise and vibration

A detailed Operational Noise Impact Assessment (ONIA) (WSP, 2024) has been completed for operation of the proposal, to support the REF (refer to Chapter 6.7 of the REF). The ONIA found that noise generated by compressor units at Pindari Dam at two potential locations (the top of the Pindari Dam wall and the base of the Pindari Dam) would not result in significant noise impacts on the surrounding environment.

The assessment indicates that, based on 'worst-case' scenarios, noise levels at sensitive receivers (including residential areas, recreational sites, and commercial properties) would comply with the established noise criteria under various operational scenarios. Residential areas are subject to the most stringent noise criteria.

The assessment, which included modelling under various meteorological conditions and dam water levels, confirms that operation of the compressors at either of the proposed locations would remain within the permissible noise limits across all time periods (day, evening, and night), resulting in minimal noise impacts on the surrounding community and environment (WSP, 2024).

During construction, there is potential for impacts to locally common fauna from construction noise and vibration associated with light vehicle movements, construction personnel, and construction plant and equipment. This may result in fauna temporarily avoiding habitats within the study area. However, potential construction noise and vibration impacts would be short-term in duration.

As such, it is unlikely there would be a significant increase in noise and vibration that would result in any long-term increased impacts to biodiversity within the study area.

The magnitude of potential impacts would be low and additional mitigation measures are not deemed necessary.

6 Assessment of impact significance

An Assessment of Significance has been conducted for threatened species that are considered to have at least a moderate or greater likelihood of occurrence within the study area.

Assessments of significance, in accordance with Section 7.3 of the BC Act, have been completed for threatened flora and fauna that may be impacted by the proposal (refer to Appendix C).

Assessments of significance have been completed for the following threatened flora species listed under the BC Act:

- *Acacia acrionastes* (Pindari Wattle)
- *Acacia macnuttiana* (MacNutt's Wattle)
- *Astrotricha roddii* (Rodd's Star Hair)
- *Indigofera baileyi* (Bailey's Indigo)
- *Polygala linariifolia* (Native Milkwort)
- *Thesium australe* (Austral Toadflax).

Assessments of significance have been completed for the following threatened fauna species listed under the BC Act:

- *Anthochaera phrygia* (Regent Honeyeater)
- *Artamus cyanopterus cyanopterus* (Dusky Woodswallow)
- *Chthonicola sagittata* (Speckled Warbler)
- *Climacteris picumnus victoriae* (Brown Treecreeper)
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Geophaps scripta scripta* (Squatter Pigeon - southern sub-species)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Haliaeetus leucogaster* (White-bellied Sea-eagle)
- *Hieraaeetus morphoides* (Little Eagle)
- *Melanodryas cucullata cucullata* (South-eastern Hooded Robin)
- *Neophema pulchella* (Turquoise Parrot)
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler – eastern subspecies)
- *Stagonopleura guttata* (Diamond Firetail)
- *Dasyurus maculatus* (Spotted-tailed Quoll)
- *Phascolarctos cinereus* (Koala).

For threatened biodiversity listed under the EPBC Act, significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment, 2013c). EBPC Act significance assessments are provided in Appendix D.

These significance assessments have been prepared for the following threatened flora species:

- *Acacia macnuttiana* (MacNutt's Wattle)
- *Astrotricha roddii* (Rodd's Star Hair)
- *Callistemon pungens*
- *Thesium australe* (Austral Toadflax).

Significance assessments have also been prepared for the following threatened fauna species:

- *Anthochaera phrygia* (Regent Honeyeater)
- *Climacteris picumnus victoriae* (Brown Treecreeper)
- *Geophaps scripta scripta* (Squatter Pigeon (southern sub-species)
- *Melanodryas cucullata cucullata* (South-eastern Hooded Robin)
- *Stagonopleura guttata* (Diamond Firetail)
- *Dasyurus maculatus* (Spotted-tailed Quoll)
- *Phascolarctos cinereus* (Koala).

Given the implementation of recommended safeguards and mitigation measures (refer to Section 7), it is considered that a significant impact is unlikely. A detailed conclusion is provided in Section 8.

7 Safeguards and mitigation measures

7.1 Safeguards and mitigation measures for terrestrial biodiversity

Safeguards and mitigation measures will be implemented to reduce the potential ecological impacts of the proposal. Mitigation measures outlined in Table 7.1 would be implemented to avoid and manage impacts to flora, fauna and their habitats within and outside of the study area.

Table 7.1 Recommended safeguards and mitigation measures for terrestrial biodiversity

Environmental safeguards and mitigation measures for terrestrial biodiversity impacts	Responsibility	Timing
Pre-clearing checks for fauna and nests are to be undertaken immediately prior to the clearing of vegetation. Any fauna or nests observed are to be managed in consultation with the project ecologist.	Water NSW / Project ecologist	Prior to the commencement of vegetation clearing.
An appropriate Erosion and Sediment Control Plan (ESCP) is to be prepared with consideration for the following: — On-site water management to reduce erosion and sedimentation and potential pollution of adjoining areas of native vegetation, watercourses and management of stormwater and dam water during periods of high rainfall. — Run-off or unplanned overflows from construction must be retained in water quality basins or an appropriate alternative Diverting run-on water from disturbance works occurring on upslope land, using non-erosive methods. — Installing protective measures to prevent sheet erosion where large portions of soil will be exposed. Construction of sediment filters or sediment retention traps where appropriate, particularly below fill batters near waterways.	Water NSW / Construction contractor	Prior to the commencement of works.
Trees will be protected in accordance with the requirements of the Australian Standard 4970-2009 for the Protection of Trees on Development Sites.	Water NSW / Construction contractor	Prior to the commencement of works.
Accurately and clearly mark out the limits of the work zone, areas for parking and turning of vehicles and plant equipment prior to commencement of works. These areas shall be located so that vegetation disturbance is minimised, and the drip-line of trees avoided.	Water NSW / Construction contractor	Prior to the commencement of works.
Materials, plant, equipment, work vehicles and stockpiles will be placed to avoid damage to surrounding vegetation and will be outside tree drip-lines.	Water NSW / Construction contractor	During works.

Environmental safeguards and mitigation measures for terrestrial biodiversity impacts	Responsibility	Timing
Machinery is to be inspected for fauna prior to starting each day. Wildlife may become trapped in or may choose to shelter in machinery that is stored in the study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.	Construction contractor	During works.
If any damage occurs to vegetation outside of the nominated work area (as shown in the Construction Environmental Management Plan (CEMP)), the Environmental Representative will be notified so that appropriate remediation strategies, such as revegetation, can be developed.	Water NSW / Construction contractor	During works.
Erosion and sediment controls will remain in place until all soil stabilisation has been completed.	Water NSW / Construction contractor	During works.
Construction crews will be made aware that any native fauna species encountered must be allowed to leave site without being harassed and WIRES must be called for assistance where necessary.	Water NSW / Construction contractor	During works.
If any threatened or native species (flora or fauna) are discovered during the works, all work will stop immediately, and the Environmental Representative will be notified. Work will only recommence once the impact on the species has been assessed and appropriate control measures provided. A Construction Site Plan will be prepared as part of the CEMP to show the: — No go areas and boundaries of the work area/disturbance corridor. — Locations of parking, lay-down and storage areas for materials, plant and stockpiles. — Location and full extent of any lopping, trimming, clearing or other vegetation disturbance required for the works.	Water NSW / Construction contractor	During works.
All vehicles driving to and from site should follow a protocol to prevent the spread or introduction of pathogens such as phytophthora and chytrid, namely vehicles should be clean, including the tyres and any equipment.	Water NSW / Construction contractor	During works.

Environmental safeguards and mitigation measures for terrestrial biodiversity impacts	Responsibility	Timing
Weed control will be undertaken by suitably qualified and/or experienced, licenced sub-contractors in accordance with contemporary bush regeneration practices. This may include: — Manual weed removal in preference to herbicides. — Replacing non-target species removed/killed as a result of weed control activities. — Protecting Non-target species from spray drift. — Using only herbicides registered for use within or near waterways for the specific target weed. — Applying herbicides during drier times when the waterway level is below the high-water mark. — Not applying herbicide if it is raining or if rain is expected. — Mixing and loading herbicides and cleaning equipment away from waterways and drains.	Water NSW	During works and operation.
Manage priority weeds in accordance with the requirements of the *Biosecurity Act 2015*, if found, including disposal off-site in sealed bags to a licenced waste disposal facility.	Water NSW	During works and operation
All weeds, propagules, other plant parts and/or excavated topsoil material that is likely to be infested with weed propagules that are likely to regenerate will be bagged, removed from site and disposed of at a licenced waste disposal facility.	Water NSW	During works and operation

8 Conclusion

WaterNSW, together with the NSW Government Department of Primary Industries and Regional Development (DPIRD) are proposing to establish a bubble plume destratification system at Pindari Dam in the Inverell Shire Local Government Area (LGA) as a trial mitigation measure to disrupt thermal stratification and reduce potential for cold water pollution to affect downstream fish stocks ('the proposal') (refer to Figure 1.1).

The project would involve construction and operation of a diffuser system within Pindari Dam which would result in potential impacts to both terrestrial and aquatic biodiversity.

In regard to terrestrial biodiversity impacts, the proposal would result in the direct removal of approximately 0.63 hectares (ha) of native vegetation, including:

- 0.6007ha of PCT 4151 – North White pine Silver-leaved Ironbark Forest
- 0.0246ha of PCT 3518 – Northwest Pine-ironbark grassy woodland.

The PCTs identified within the study area are not consistent with any TECs listed under either the BC Act or EPBC Act.

It is considered that the terrestrial habitats provide potential habitat for six threatened flora species and twelve threatened fauna species. No threatened terrestrial flora species were observed during surveys. The potential threatened fauna species assessed were not observed during surveys, however these species are known to occur in the locality.

Habitats within the study area consist of predominantly younger trees with limited shrub or ground cover habitats, a moderate cover of small surface rocks and limited litter cover and fallen logs. No stick nests, smaller nests or tree hollows were observed during surveys and given the sparse densities of shrubs and ground covers observed and the absence of larger trees around the dam edge, it is considered that the study area provides predominantly foraging habitats for the assessed species. Therefore, the proposal is likely to impact upon only limited areas of potential foraging habitat for potential threatened terrestrial fauna species.

In regard to wildlife connectivity, it is considered that the proposal is unlikely to impact upon any local vegetation connectivity or potential movement corridors (refer to Section 5.2.1).

A detailed assessment of significance for the assessed threatened terrestrial flora and fauna species listed under the BC Act and / or EPBC Act has been completed and is provided in Appendix C and Appendix D respectively. This assessment of significance for threatened terrestrial flora and fauna has concluded that a significant impact is considered unlikely.

The potential impacts to aquatic ecology have been addressed in an Aquatic Ecology Assessment by H20 Consulting Group (Swanson, 2024). An assessment of significance for threatened entities listed under the FM Act and EPBC Act was undertaken (refer to Appendix 4 of the Aquatic Ecology Assessment). The Aquatic Ecology Assessment concluded that the project is expected to have a net positive impact on these threatened species by improving environmental conditions and reducing existing potential cold-water pollution impacts that may otherwise impact on the long term survival of these species in the Severn River.

Mitigation measures are to be implemented to avoid and manage impacts to terrestrial flora, fauna and their habitats within and outside of the study area as well as reduce the potential aquatic ecological impacts of the proposal (refer to Section 7).

Given the implementation of mitigation measures to reduce the potential ecological impacts of the proposal, it is considered that the proposal is unlikely to have a significant impact upon any threatened entities listed under the FM Act, BC Act or EPBC Act or their habitats.

9 Limitations

PERMITTED PURPOSE

This Report is provided by WSP for the purpose described in the Agreement and no responsibility is accepted by WSP for the use of the Report in whole or in part, for any other purpose (Permitted Purpose).

QUALIFICATIONS AND ASSUMPTIONS

The services undertaken by WSP in preparing this Report were limited to those specifically detailed in the Report and are subject to the scope, qualifications, assumptions and limitations set out in the Report or otherwise communicated to the Client.

Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and / or recommendations in the Report (Conclusions) are based in whole or in part on information provided by the Client and other parties identified in the report (Information), those Conclusions are based on assumptions by WSP of the reliability, adequacy, accuracy, and completeness of the Information and have not been verified. WSP accepts no responsibility for the Information.

WSP has prepared the Report without regard to any special interest of any person other than the Client when undertaking the services described in the Agreement or in preparing the Report.

USE AND RELIANCE

This Report should be read in its entirety and must not be copied, distributed or referred to in part only. The Report must not be reproduced without the written approval of WSP. WSP will not be responsible for interpretations or conclusions drawn by the reader. This Report (or sections of the Report) should not be used as part of a specification for a project or for incorporation into any other document without the prior agreement of WSP.

WSP is not (and will not be) obliged to provide an update of this Report to include any event, circumstance, revised information or any matter coming to WSP's attention after the date of this Report. Data reported and Conclusions drawn are based solely on information made available to WSP at the time of preparing the Report. The passage of time; unexpected variations in ground conditions; manifestations of latent conditions; or the impact of future events (including (without limitation) changes in policy, legislation, guidelines, scientific knowledge; and changes in interpretation of policy by statutory authorities); may require further investigation or subsequent re-evaluation of the Conclusions.

This Report can only be relied upon for the Permitted Purpose and may not be relied upon for any other purpose. The Report does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise. It is the responsibility of the Client to accept (if the Client so chooses) any Conclusions contained within the Report and implement them in an appropriate, suitable and timely manner.

In the absence of express written consent of WSP, no responsibility is accepted by WSP for the use of the Report in whole or in part by any party other than the Client for any purpose whatsoever. Without the express written consent of WSP, any use which a third party makes of this Report or any reliance on (or decisions to be made) based on this Report is at the sole risk of those third parties without recourse to WSP. Third parties should make their own enquiries and obtain independent advice in relation to any matter dealt with or Conclusions expressed in the Report.

DISCLAIMER

No warranty, undertaking or guarantee whether expressed or implied, is made with respect to the data reported or the Conclusions drawn. To the fullest extent permitted at law, WSP, its related bodies corporate and its officers, employees and agents assumes no responsibility and will not be liable to any third party for, or in relation to any losses, damages or expenses (including any indirect, consequential or punitive losses or damages or any amounts for loss of profit, loss of revenue, loss of opportunity to earn profit, loss of production, loss of contract, increased operational costs, loss of business opportunity, site depredation costs, business interruption or economic loss) of any kind whatsoever, suffered on incurred by a third party.

10 References

ATLAS OF LIVING AUSTRALIA. 2024. *Atlas of Living Australia* [Online]. Available: https://www.ala.org.au/ [Accessed January 2021].

CROPPER, S. C. 1993. *Management of Endangered Plants,* Melbourne, CSIRO Australia.

DAWE 2022. National Recovery Plan for the Koala *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory). *In:* DEPARTMENT OF AGRICULTURE, W. A. T. E. (ed.). Commonwealth of Australia.

DEPARTMENT OF AGRICULTURE, W. A. T. E. 2022. Conservation Advice for Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory. *In:* DEPARTMENT OF AGRICULTURE, W. A. T. E. (ed.).

DEPARTMENT OF ENVIRONMENT WATER HERITAGE AND THE ARTS. 2008. *Approved conservation advice for Astrotricha roddii* [Online]. Available: http://www.environment.gov.au/cgi-bin/sprat/ [Accessed 2008].

DEPARTMENT OF PLANNING AND ENVIRONMENT 2022. NSW State Vegetation Type Map. Edition C1.1.M1 ed.

DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT 2020. Biodiversity Assessment Method.

DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT 2024. eSpade version 2.2 accessed at https://www.environment.nsw.gov.au/eSpade2Webapp/ (Accessed December 2024).

DEPARTMENT OF PRIMARY INDUSTRIES. 2024a. *Key Fish Habitat maps* [Online]. Available: https://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/key-fish-habitat-maps [Accessed October, 2024].

DEPARTMENT OF PRIMARY INDUSTRIES. 2024b. *NSW Weedwise* [Online]. Available: https://weeds.dpi.nsw.gov.au/ [Accessed 2024].

DEPARTMENT OF THE ENVIRONMENT 2013a. Matters of National Environmental Significance - Significant Impact Guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999. Canberra, ACT.

DEPARTMENT OF THE ENVIRONMENT 2013b. Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. *In:* ENVIRONMENT, D. O. (ed.). Canberra, ACT: Commonwealth of Australia.

DEPARTMENT OF THE ENVIRONMENT 2013c. Significant Impact Guidelines 1.1 - Matters of National Environmental Significance Canberra: Department of the Environment.

DEPARTMENT OF THE ENVIRONMENT 2016. National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*). *In:* ENVIRONMENT, D. O. T. (ed.). Canberra.

ENVIRONMENT., D. O. P. A. 2024. *BioNet Vegetation Classification Database* [Online]. Available: https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet/about-bionet-vegetation-classification [Accessed 2024].

OFFICE OF ENVIRONMENT AND HERITAGE, 2025, THREATENED SPECIES PROFILES, https://threatenedspecies.bionet.nsw.gov.au/

SWANSON, A. 2024. Aquatic Ecology Assessment - Pindary Bubble Plume Destratification Strategy. Prepared for WSP Australia Pty Ltd. H20 Consulting Group.

WEEDS AUSTRALIA. 2024. *Weeds of National Significance* [Online]. Available: http://www.weeds.org.au/WoNS/ [Accessed].

Appendix A

Likelihood of occurrence assessments for threatened species

Table A.1 Likelihood of occurrence for threatened flora species

Scientific Name	Common Name	SAII	BC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Acacia acrionastes	Pindari Wattle	Yes	E	-	Bionet (5), Plantnet	Grows in mallee communities on ridges and dunes and very occasionally on rocky outcrops, generally grows in deep, loose, sandy soil. Associated species include White Mallee (*Eucalyptus dumosa*), Red Mallee (*E. socialis*), Yorrell (*E. gracilis*), Ridge-fruited Mallee (*E. costata subsp. murrayana*), Mallee Pine (*Callitris verrucosa*), Native Poplar (*Codonocarpus cotinifolius*) and Porcupine Grass (*Triodia scariosa* subsp. *scariosa*).	Moderate This species is known to occur around Pindari Dam, however it is not associated with the PCTs identified within the study area. This species was not observed during field surveys, however surveys were undertaken outside of the recommended survey period (July – September).
Acacia jucunda	Yetman Wattle	Yes	E	-	Plantnet	Acacia jucunda abundance in populations has been recorded as locally occasional, locally common and frequent, with one population noted as being about one acre in extent. Mainly restricted to dry eucalypt woodland communities on sandy to sandy-loam soils. In Queensland, the species is found in dry ranges on loams or clay-loams in eucalypt communities. Associated species at the NSW sites include *Acacia polybotrya* and *Callitris endlicheri*.	Low Habitat on site is not suitable for the species with no associated vegetation recorded.
Acacia macnuttiana	MacNutt's Wattle	-	V	V	Bionet (4), Plantnet, PMST	MacNutt's Wattle grows in dry forest or woodland and heath vegetation, usually on granite or metasediments and often near streams.	Moderate This species has previously been recorded around Pindari Dam, however no associated habitat was recorded within the study area.
Acacia pubifolia	Velvet Wattle	Yes	E	V	Plantnet, PMST	Velvet Wattle generally grows in dry shrubby woodland on acid volcanic, granite and metasediment soils.	Low No associated habitat for this species was recorded in the study area and species was not recorded during the site visit.
Acacia ruppii	Rupp's Wattle	-	E	E	PMST	Dry open forest and shrubland in sandstone areas, often near creeks and lower slopes.	Low No associated habitat for this species was recorded in the study area and species was not recorded during the site visit.
Arthraxon hispidus	Hairy Jointgrass	-	V	V	PMST	Moisture and shade-loving grass, found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	Low No associated habitat for this species was recorded in the study area and species was not recorded during the site visit.
Asmotricha roddii	Rodd's Star Hair	-	E	E	Bionet (52), Plantnet, PMST	Rodd's Star Hair usually grows in low dry woodland and shrublands on granite and acid volcanic outcrops, often in rock crevices.	Moderate Species has potential habitat within the study area associated with PCT 3518 and 4151 and is known to occur in the locality. This species was not observed during the site visit.

Scientific Name	Common Name	BAM	SC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Boronia granitica	Granite Boronia	-	V	E	BioNet (4), Plantnet, PMST	Grows on granitic soils amongst rock outcrops, often in rock crevices, and in forests and woodlands on granite scree and shallow soils Important site characteristics include low precipitation and high levels of solar radiation. This semi-arid soil environment will have selected the more xerophytic species from the available regional assemblage of rainforest species.	Low This species has previously been recorded around Pindari Dam, however no associated habitat was recorded within the study area and species was not recorded during the site visit.
Cadellia pentastylis	Ooline	-	V	V	Plantnet, PMST	Forms a closed or open canopy mixing with eucalypt and cypress pine species. There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth.	Low No associated habitat for this species was recorded in the study area and species was not recorded during the site visit.
Callistemon pungens	Callistemon pungens	-	-	V	BioNet (1), Plantnet, PMST	Habitats range from riparian areas dominated by *Casuarina cunninghamiana* subsp. *cunninghamiana* to woodland and rocky shrubland. Often in rocky watercourses, usually with sandy granite (occasionally basalt) creek beds.	Moderate This species has associated habitat within the study area in PCT 3518 and PCT 4151. This species was not observed during field surveys, however surveys were undertaken outside of the recommended survey period (September - February).
Capparis canescens	Wild Orange	Yes	E	-	Plantnet	Flowers mainly in summer. Ripe fruits are said to be edible, hence the common names of Wild Orange and Wild Pomegranate Grows in open eucalypt forest Associated species include *Eucalyptus sideroxylon* and *E. microcarpa* woodland on siliceous sediments. Associated species at Queensland sites include *E. decalbata, E. microtheca, E. crebra, E. fibrosa subsp. nubila, E. melanophloia, Callitris glaucophylla, Allocasuarina huehmannii, Lysiphyllum cunninghamii* and *Acacia* and *Alphitonia* species The single known population of Wild Orange in NSW was recently cleared during roadworks. Seven plants are said to still survive at the site. In Queensland plants are usually uncommon and scattered in populations.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Cyperus conicus	Cyperus conicus	-	E	-	Plantnet	Grows in open woodland on sandy soil. In central Australia, the species grows near waterholes and on the banks of streams in sandy soils. In Qld the species usually found on heavy soils Recorded from Callitris forest in the Pilliga area, growing in sandy soil with *Cyperus gracilis, C. squarrosus* and *C. fulvus*. Interstate habitats include floodplains, creek beds and banks, swamps, run-on areas and various watercourses, near or in dams and bores, and in vegetation communities such as Melaleuca swamps, open Box woodland and sedgelands. Soils are usually sandy or silty and damp to wet Often associated with other sedge species including *C. victoriensis, C. difformis, C. iria, C. compressus, C. nervulosus, C. dactylotes, Fimbristylis* and *Eleocharis* species *Cyperus conicus* has been recorded as very rare and occasional, to common and abundant in some populations.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Desmodium campylocaulon	Creeping Tick-Trefoil	-	E	-	Plantnet	Creeping Tick-Trefoil is confined to clay soils, usually with *Astrebla* and *Iseilema* species. In NSW *Desmodium campylocaulon* grows on cracking black soils in the Narrabri, Moree and Walgett local government areas. Associated species include *Acacia harpophylla, Astrebla pectinata* and *Sorghum, Dichanthium* and *Panicum* species.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.

Scientific Name	Common Name	BAM	BC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Dichanthium setosum	Bluegrass	-	V	V	Plantnet, PMST	Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. (Often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched). It is open to question whether the species tolerates or is promoted by a certain amount of disturbance, or whether this is indicative of the threatening processes behind its depleted habitat. Associated species include Eucalyptus albens, Eucalyptus melanophloia, *Eucalyptus melliodora*, *Eucalyptus viminalis*, *Myoporum debile*, *Aristida ramosa*, *Themeda triandra*, *Poa sieberiana*, *Bothriochloa ambigua*, *Medicago minima*, *Leptorhynchos squamatus*, *Lomandra aff. longifolia*, *Ajuga australis*, *Calotis hispidula* and *Austrodanthonia*, *Dichopogon*, *Brachyscome*, *Vittadinia*, *Wahlenbergia* and *Pratalea* species. Locally common or found as scattered clumps in broader populations. The extensive distribution and wide environmental tolerances make predictions about suitable habitat difficult.	Low Marginal potential habitat for this species (PCT 3518) was recorded within the study area, however this vegetation was highly disturbed with limited understorey and high levels of weed invasion. Species were not recorded during the site visit and there are no records within locality.
Digitaria porrecta	Finger Panic Grass	-	E	-	Plantnet	In NSW, the most frequently recorded associated tree species are *Eucalyptus albens* and *Acacia pendula*. Common associated grasses and forbs in NSW sites include *Austrostipa aristiglumis*, *Enteropogon acicularis*, *Cyperus bifax*, *Hibiscus trionum* and *Neptunia gracilis*. Native grassland, woodlands or open forest with a grassy understorey, on richer soils. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire. *Digitaria porrecta* is a perennial tussock-forming grass that can vegetatively reproduce. The total number of *Digitaria porrecta* individuals in the wild is estimated at over 200,000 plants. Plants have been recorded as occurring occasionally and frequently in populations.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Eucalyptus caleyi subsp. ovendenii	Ovenden's Ironbark	-	V	V	Plantnet, PMST	Grows in grassy woodland on dry, shallow soils of moderate fertility. Preferred altitudes are 610 to 820 m, on granitic substrates. Ovenden's Ironbark occupies a higher geographical range than that of subspecies caleyi, occurring on the crests of broad high ridges and replacing subspecies caleyi inhabiting the lower slopes in the same general area. Associated species include *Eucalyptus melliodora*, *Eucalyptus dealbata*, *Eucalyptus albens*, *Eucalyptus melanophloia* and *Grejera parviflora*. Can be locally abundant within its grassy woodland habitat. Juveniles were present in about half the sampled sites within Torrington State Conservation Area, indicating good recruitment.	Low PCT: 4151 suitable habitat is present within the study area; however, species is conspicuous and was not recorded during the site visit.
Eucalyptus mckieana	McKie's Stringybark	-	V	V	Plantnet, PMST	The species is remarkable for its very narrow and numerous sucker leaves, the narrowest of all the stringybarks and which persist to a height of 2 to 4 metres. *Eucalyptus mckieana* is found in grassy open forest or woodland on poor sandy loams, most commonly on gently sloping or flat sites. Associated species at Northern Tablelands sites include *Angophora floribunda*, *Eucalyptus amplifolia*, *Eucalyptus andrewsii*, *Eucalyptus bridgesiana*, *Eucalyptus youmanii*, *Eucalyptus nicholii*, *Eucalyptus blakelyi* and *Eucalyptus conica*, and at North Western Slopes sites *Eucalyptus andrewsii*, *Eucalyptus stannicola*, *Eucalyptus prava* and *Angophora floribunda*. McKie's Stringybark is locally abundant, forming in places a moderately dense forest in association with other local trees. A single population of 33 plants is known from Torrington State Conservation Area. Plants have also been recorded in populations with abundances of locally common to locally abundant.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species is conspicuous and was not recorded during the site visit.

Scientific Name	Common Name	BAE	BC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Eucalyptus nicholii	Narrow-leaved Black Peppermint	-	V	V	Plantnet, PMST	Typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock. Seedling recruitment is common, even in disturbed soils, if protected from grazing and fire. Tends to grow on lower slopes in the landscape.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species is conspicuous and was not recorded during the site visit.
Eucalyptus rubida subsp. barbigerorum	Blackbutt Candlebark	-	V	V	Plantnet	Grassy woodland on medium or high fertility soils. Often on cold flats.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species is conspicuous and was not recorded during the site visit.
Homopholis belsonii	Belson's Panic	-	E	V	PMST	Grows in dry woodland (e.g. Belah) often on poor soils, although sometimes found in basalt-enriched sites north of Warialda and in alluvial clay soils. Habitat and ecology appear to be poorly known.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Homoranthus bebo	Homoranthus bebo	Yes	CE	CE	Plantnet	*Homoranthus bebo* occurs on deep sandy soils over sandstone and is associated with Smooth Barked Apple/Black Cypress Woodland.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Homoranthus prolixus	Barraba Homoranthus	-	V	V	Plantnet	Flowers from October to November Occurs in open and exposed sites in shrubland and low woodland on granite outcrops between 650 - 970 m altitude. Often grows in rock crevices on bare rocky slopes and in the surrounding shallow soils Associated species include *Callitris endlicheri, Eucalyptus prava, Eucalyptus caleyi, Acacia cheelii, Acacia neriifolia, Calytrix tetragona, Leucopogon mesangleus, Ozothamnus obcordatus, Leptospermum novae-angliae, Cryptandra amara var floribunda, Prostanthera howelliae* and *Boronia anethifolia*. At the time of its initial survey, the known distribution of *Homoranthus bornhardtiensis* was restricted to an area of six by seven kilometres. Plant abundances within populations are not known.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Homoranthus prolixus	Granite Homoranthus	-	V	V	Plantnet	Occurs in open and exposed sites in shrubland and low woodland on granite outcrops between 650 - 970 m altitude. Often grows in rock crevices on bare rocky slopes and in the surrounding shallow soils Associated species include *Callitris endlicheri, Eucalyptus prava, Eucalyptus caleyi, Acacia cheelii, Acacia neriifolia, Calytrix tetragona, Leucopogon mesangleus, Ozothamnus obcordatus, Leptospermum novae-angliae, Cryptandra amara var floribunda, Prostanthera howelliae* and *Boronia anethifolia*. Likely to be highly fire-sensitive and intolerant to frequent fire disturbance. At the time of its initial survey, the known distribution of *Homoranthus bornhardtiensis* was restricted to an area of six by seven kilometres. Plant abundances within populations are not known.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Indigofera baileyi	Bailey's Indigo	-	E	-	BioNet (2), Plantnet	Open woodlands on loam and clay loam soils, typically from granite or basalt, but also from sediments in the Clarence lowlands	Moderate. This species has associated habitat in PCT 4151. This species was not observed during field surveys, however surveys were undertaken outside of the recommended survey period (November - February).

Scientific Name	Common Name	BAM	SC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Ipomoea diamantinensis	Desert Cow-Vine	Yes	E	-	Plantnet	Grows on clay soils on floodplains, often in shallow water and mud on cracking grey clay. Interstate habitats include low-lying grasslands with scattered *Atalaya hemiglauca*, *Acacia georginae*, gums and boxes, swamp margins and billabongs, a small floodway with *Acacia stenophylla*, and the water surface of a watercourse with other aquatic plants. Associated species include *Astrebla squarrosa*, *Astrebla elymoides*, *Eremophila bignoniiflora* and *Muehlenbeckia cunninghamii*. Plants recorded as occasional to frequent in populations, with several sites recording only one plant. Plants often grow in mud with stems trailing out and over the water. As a prostrate climber, the species can cover areas as large as 10 x 10 m, producing stunning, white-edged, deep-pink throated flowers.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit
Lepidium aschersonii	Spiny Peppercress	-	V	V	PMST	Found on ridges of gilgai clays dominated by Brigalow (Acacia harpophylla), Belah (Casuarina cristata), Buloke (Allocasuarina luehmannii) and Grey Box (Eucalyptus microcarpa). In the south has been recorded growing in Ifull Mallee (Eucalyptus behriana). Often the understorey is dominated by introduced plants. The species grows as a a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense, with sparse grassy understorey and occasional heavy litter	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit
Lepidium peregrinum	Wandering Pepper Cress	Yes	E	E	PMST	The largest population of Wandering Pepper Cress occurs in an open riparian forest on the banks of the Tenterfield creek at Clifton. Sandy alluvium is the main soil type at the site. Associated species at the Clifton site are dominated by *Eucalyptus camaldulensis* and *Casuarina cunninghamiana*, with a variably dense shrubby understorey of *Hymenanthera dentata*, *Bursaria spinosa*, *Acacia fimbriata*, *Acacia floribunda*, *Callistemon viminalis and Leptospermum brachyandrum*. *Lepidium peregrinum* was most abundant in the tussock grassland fringe of the riparian open forest, comprising *Poa species*, *Lomandra longifolia* and *Paspalum dilatatum*. 66 plants were counted within an area of about 1 hectare, growing on unreserved Crown Land at Clifton. The 2001 targeted surveys recorded a total of 192 mature plants and 123 juveniles (less than 12 months old), with zero recruitment (no juveniles) recorded at four sites and minimal recruitment (2-3 juveniles) at two sites.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Macrozamia humilis	Inverell Cycad	Yes	E	-	Plantnet	The single known population occurs in low dry woodland on sandy soil on an outcrop of laterite-capped granite	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Micromyrtus grandis	Severn River Heath-myrtle	Yes	E	E	Plantnet, PMST	Severn River Heath-myrtle grows in heath and low woodland in crevices of acid volcanic rocky outcrops and in the shallow soil of surrounding areas, at altitudes of 600 to 750 m. It occurs in open and exposed sites Associated species within low woodland include *Eucalyptus crebra*, *Allocasuarina inophloia*, *Acacia sp. aff. pubifolia*, *Xanthorrhoea johnsonii*; *in heath the association comprises Leptospermum novae-angliae*, *Micromyrtus sessilis* and *Leucopogon neo-anglicus*. Some seedling recruitment and germination is often observed after fire, however adult plants of many *Micromyrtus* species are killed by high intensity fire. Very few juveniles of *Micromyrtus grandis* were present in the population, possibly due to the age of the communities as fire had not occurred in the area for some time. An extended population of *Micromyrtus grandis* is found on a single long ridge, where the species dominates or co-dominates communities. The population is estimated as more than 1500 plants and covers an area of at least 4 hectares in total.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.

Scientific Name	Common Name	BAM	BC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Phebalium glandulosum subsp. eglandulosum	Rusty Desert Phebalium	Yes	E	V	PMST	Restricted to granite outcrop country on the New England Tablelands. Favours exposed and heathy granite areas with cracks and depressions of skeletal sandy soil located amongst the boulders. Sites tend to be relatively open, with the shrubs forming a spreading habit over the bare rocks Associated species at sites include *Acacia finbriata, Acacia latisepala, Leptospermum polygalifolium, Kunzea obovata, Brachyloma daphnoides, Calytrix tetragona, Micromyrtus ciliata, Micromyrtus vestalis, Prostanthera staurophylla* and *Prostanthera teretifolia* Rusty Desert Phebalium has been recorded as locally rare, scattered, common and locally abundant in populations	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit
Picris evae	Hawkweed	-	V	V	Plantnet, PMST	Where collected, the species abundance has been rare, locally occasional and locally frequent. All recent collections appear to come from modified habitats such as woody roadside vegetation and paddocks Its main habitat is open Eucalypt forest including a canopy of *Eucalyptus melliodora, E. crebra, E. populnea, E. albens, Angophora subvelutina, Allocasuarina torulosa*, and/or *Casuarina cunninghamiana* with a *Dichanthium* grassy understorey. Soils are black, dark grey or red-brown (specified as shallow, stony soil over basalt for one collection) and reddish clay-loam or medium clay soils.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit
Platyzoma microphyllum	Braid Fern	-	E	-	Plantnet	Grows in sandy or swampy soils, or in clay soils adjacent to streams and lagoons and subject to periodic flooding. Recorded in NSW at Bruxner Highway growing as one localised patch in deep sandy soil, with *Leptospermum* species, *Brachyloma daphnoides* and *Lomandra* species. The fern was growing at Bebo State Forest in Angophora and Callitris woodland in sandy soil, and a very open stony position also in sandy soil. Other associated species include *Hakea dactyloides, Brachyloma daphnoides, Jacksonia scoparia, Xylomelum cunninghamii and Calytrix tetragona.*	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit
Polygala linariifolia	Native Milkwort	-	E	-	Plantnet	Sandy soils in dry eucalypt forest and woodland with a sparse understorey. The species has been recorded from the Inverell and Torrington districts growing in dark sandy loam on granite in shrubby forest of *Eucalyptus caleyi, Eucalyptus dealbata* and *Callitris*, and in yellow podsolic soil on granite in layered open forest. In the Pilliga area, this species has been recorded in Fuzzy Box woodland, White Cypress Pine-Bullook - Ironbark woodland, Rough-barked Apple riparian forb-grass open forest, and Ironbark - Brown Bloodwood shrubby woodland. Other associated species include *Eucalyptus trachyphloia, Eucalyptus sphaerocarpa, Angophora floribunda, Angophora leiocarpa, Lophostemon suaveolens, Corymbia henryi, Allocasuarina torulosa* and *Wahlenbergia* species in the understorey. Has been recorded as rare, sparse, occasional and common in populations.	Moderate. Marginal potential habitat for this species was recorded in PCT 3518 and PCT 4151, however this vegetation is considered to be in low condition due to previous disturbance. Species were not recorded during the site visit and there are no records within locality.
Pomaderris queenslandica	Scant Pomaderris	-	E	-	Plantnet	Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit

Scientific Name	Common Name	BAM	BC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Prasophyllum sp. Wybong (C.Phelps ORG 5269)	a leek-orchid	-	-	CE	PMST	Prasophyllum sp. Wybong (C. Phelps ORG 5269) is known from seven populations in open eucalypt woodland and grassland in New South Wales. The species' area of occupancy is estimated to be 1.5 km2 with an estimated population size based on surveys in 2006 of 460 mature individuals (Holzinger, pers. comm., 2006, 2009; Copeland, pers. comm., 2009). This species occurs within the Sydney Basin, New England Tablelands, Brigalow Belt South and NSW South Western Slopes IBRA Bioregions and the Border Rivers–Gwydir, Namoi, Hunter–Central Rivers and Central West Natural Resource Management Regions.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Rutidosis heterogama	Heath Wrinklewort	-	V	V	Planmet, PMST	Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Swainsona murrayana	Slender Darling Pea	-	V	V	PMST	The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated. Plants produce winter-spring growth, flower in spring to early summer and then die back after flowering. They re-shoot readily and often carpet the landscape after good cool-season rains. The species may require some disturbance and has been known to occur in paddocks that have been moderately grazed or occasionally cultivated.	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.
Thesium australe	Austral Toadflax	-	V	V	Bionet (1), Planmet, PMST	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Moderate Marginal potential habitat for this species was recorded in the study area (PCT 4151). This species was not observed during field surveys, however surveys were undertaken outside of the recommended survey period (November - February).
Tylophora linearis	Tylophora linearis	-	V	E	PMST	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla* and *Allocasuarina luehmannii*. Also grows in association with *Acacia hakeoides, Acacia linearia, Melaleuca uncinata, Myoporum species* and *Casuarina* species. Altitudes are generally in the range of 300 - 400 m a.s.l.	Low Marginal potential habitat for this species was recorded in PCT 3518 and PCT 4151. No associated species were recorded. The vegetation within the study area was highly disturbed with limited understorey and high levels of weed invasion. Species were not recorded during the site visit and there are no records within locality.
Zieria ingramii	Keith's Zieria	-	E	E	Planmet	Grows in dry sclerophyll forest on light sandy soils. All known populations have been recorded in Eucalyptus-Callitris woodland or open forest with a shrubby to heathy understorey. Eucalyptus dwyeri appears to be a key predictor of Z. ingramii distribution Mostly from gentle slopes in red-brown and yellow-brown sandy loams, often with a rocky surface Grows only in small localised populations within the north-east and central areas of Goonoo SCA, however further searches are warranted within the western area of Goonoo SCA. Population sizes vary from 6 to 80 individuals. The age structure within populations may be even and single-aged or uneven and multi-aged	Low Associated habitat for this species was not present within the study area and there are no records from locality. Species was not recorded during the site visit.

Table A.2 Likelihood of occurrence for threatened fauna species

Scientific Name	Common Name	SAB	BC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Bats							
Chalinolobus dwyeri	Large-eared Pied Bat	Yes	V	E	PMST	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Petrochelidon ariel), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in caves, overhangs, mine adits and concrete structures such as derelict buildings. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy. Likely to hibernate through the coolest months. It is uncertain whether mating occurs early in winter or in spring.	Low Potential foraging habitat present. No roost or maternity roost habitat present. Associated with PCT 4151 onsite, however no records of this species occur within the locality.
Nyctophilus corbeni	Corben's Long-eared Bat	-	V	V	PMST	Inhabits a variety of vegetation types, including mallee, buloke Allocasuarina leuhmannii and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground.	Low The species is not associated with the vegetation on site and there is no roost habitat present.
Pteropus poliocephalus	Grey-headed Flying-fox	-	V	V	PMST	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Can travel up to 50 km from the camp to forage; commuting distances are more often <20 km.	Low Species is associated with the vegetation on site (PCT 3518 & 4151). Potential foraging habitat. No GHFF roosts present in locality. The study area provides a limited area of potential foraging habitat.
Birds							
Actitis hypoleucos	Common Sandpiper	-	-	M	PMST	The Common Sandpiper frequents a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity. It is mostly encountered along muddy margins or rocky shores and rarely on mudflats. It has been recorded in estuaries and deltas of streams, banks farther upstream, around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags. Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks.	Low The Pindari Dam does not contain any suitable shoreline habitat that would provide foraging for this species. It does not represent an important staging location for migration of this species and any occurrence would be rare passing vagrants.

Scientific Name	Common Name	BAM	BC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Anthochaera phrygia	Regent Honeyeater	Yes	CE	CE	Bionet (2), PMST	The Regent Honeyeater is a flagship threatened woodland bird whose conservation will benefit a large suite of other threatened and declining woodland fauna. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. Birds are occasionally seen on the south coast. In the last 10 years Regent Honeyeaters have been recorded in urban areas around Albury where woodlands tree species such as Mugga Ironbark and Yellow Box were planted 20 years ago.	Moderate Associated with PCT 3518 onsite. Species is known in the region and has BioNet records present.
Aphelocephala leucopsis	Southern Whiteface	-	V	V	PMST	Southern whiteface occur across most of mainland Australia south of the tropics, from the north- eastern edge of the Western Australian wheatbelt, east to the Great Dividing Range (Schodde & Mason 1999).	Low No BioNet records present and not associated with the vegetation present.
Apus pacificus	Fork-tailed Swift	-	-	M	PMST	Breeds in the northern hemisphere, wintering south to Australia. It is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground. It mostly occurs over inland plains but sometimes above foothills or in coastal areas over cliffs, beaches, islands and well out to sea. It also occurs over towns and cities. It mostly occurs over dry and/or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh, grassland, spinifex sandplains, farmland and sand-dunes. It sometimes occurs above forests. It probably roosts aerially, but has occasionally been observed to land.	Low This species is an aerial specialist and is unlikely to utilise the terrestrial habitats within the study area. If individuals occur on within the locality they would likely be foraging above the study area, the proposed action would not interfere with this behaviours.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	-	V	-	Bionet (19)	Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland. Depending on location and local climatic conditions (primarily temperature and rainfall), the dusky woodswallow can be resident year round or migratory. In NSW, after breeding, birds migrate to the north of the state and to southeastern Queensland, while Tasmanian birds migrate to southeastern NSW after breeding. Migrants generally depart between March and May, heading south to breed again in spring. There is some evidence of site fidelity for breeding. Although dusky woodswallows generally breed as solitary pairs or occasionally in small flocks, large flocks may form around abundant food sources in winter. Large flocks may also form before migration, which is often undertaken with other species.	Moderate The study area provides potential habitat for this species.
Calidris acuminata	Sharp-tailed Sandpiper	-	-	V, M	PMST	During the non-breeding season, approximately 91 percent of the East Asian - Australasian population occurs in Australia and New Zealand (Bamford et al. 2008). Sharp-tailed sandpipers occur within all states of Australia. They are found mostly in the south-east and are widespread in both inland and coastal locations. The species also occurs in both freshwater and saline habitats.	Low Species is not associated with the vegetation on site. No BioNet records within the locality. Species does not breed in Australia.
Calidris ferruginea	Curlew Sandpiper	Yes	E	CE	PMST	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed.	Low Species is not associated with the vegetation on site. No BioNet records within the locality.

Scientific Name	Common Name	BAR	SC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Calidris melanotos	Pectoral Sandpiper	-	-	M	PMST	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species frequents coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. It is usually found in coastal or near coastal habitat but occasionally farther inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. It has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands.	Low Species is not associated with the vegetation on site. No BioNet records within the locality.
Calyptorhynchus lathami lathami	South-eastern Glossy Black-Cockatoo	-	V	V	Biomet (4), PMST	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (Allocasuarina littoralis) and Forest Sheoak (A. torulosa) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, Allocasuarina diminuta, and A. gymnathera. Belah is also utilised and may be a critical food source for some populations. Dependent on large hollow-bearing eucalypts for nest sites. A single egg is laid between March and May.	Low Associated with both PCTs on site, however no Allocasuarina species recorded within study area. No breeding habitat present. If the species is observed, it is likely to be a vagrant moving through the study area.
Chthonicola sagittata	Speckled Warbler	-	V	-	Biomet (6)	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	Moderate. Associated with both PCTs on site. Biomet records present.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	-	V	V	Biomet (13), PMST	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (Eucalyptus camaldulensis) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Hollows in standing dead or live trees and tree stumps are essential for nesting.	Moderate Associated with both PCTs on site. However, no breeding habitat / hollow were recorded within the study area. Foraging habitat present, and BioNet species records within the locality.
Daphoenositta chrysoptera	Varied Sittella	-	V	-	Biomet (3)	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west (Higgins and Peter 2002; Barrett et al. 2003). It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	Moderate. Associated with both PCTs on site. The study area provides potential foraging and breeding habitat. The study area contains limited large trees (providing decorticating bark or dead branches) for foraging and limited high canopy for nesting.
Erythrotriorchis radiatus	Red Goshawk	Yes	E	E	PMST	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, *Melaleuca* swamp forest and riparian *Eucalyptus* forest of coastal rivers. Red Goshawks mainly eat medium to large birds, including species as large as Australian Brush-turkeys, Kookaburras, Tawny Frogmouths, Sulphur-crested Cockatoos and Rainbow Lorikeets, but they also take mammals, reptiles and insects. The breeding behaviour of Red Goshawks is not well known. Breeding is likely to be in spring and summer in southern Queensland and NSW. The birds lay clutches of 1-2 eggs between July and September, in a stick nest in a tall tree (>20 m tall) within 1 km of a watercourse or wetland. Young fledge around November and December. In winter in eastern Australia, the birds appear to move from nesting sites in the ranges to coastal plains, where they are associated with permanent wetlands.	Low to moderate. The dam and riparian may provide potential non-preferred foraging habitat for this species. No BioNet records present, species not associated with the vegetation onsite. No stick nests were observed within the study area.

Scientific Name	Common Name	BAE	BC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Falco hypoleucos	Grey Falcon	-	V	V	PMST	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey.	Low Although the species is associated with both PCTs on site, the study area is out of the known distribution of the species.
Gallinago hardwickii	Latham's Snipe	-	V	V, M	PMST	Latham's snipe is a non-breeding visitor to south-eastern Australia and is a passage migrant through northern Australia (Higgins & Davies 1996). The species has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia, including the Adelaide plains, Mount Lofty Ranges, and the Eyre Peninsula. The range extends inland over the eastern tablelands in south-eastern Queensland, and occasionally from Rockhampton in the north, and west of the Great Dividing Range in New South Wales	Low Species is not associated with vegetation on site. This species does not breed in Australia. No BioNet records occur in the locality. The study area is unlikely to provide foraging habitat for this species.
Geophaps scripta scripta	Squatter Pigeon (southern subspecies)	Yes	CE	V	PMST	Grassy woodlands and plains, preferring sandy areas and usually close to water.	Moderate. No BioNet Records and species is not associated with the vegetation on site, however the study area is mapped as known habitat for this species.
Glossopsitta pusilla	Little Lorikeet	-	V	-	Bionet (1)	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts.	Moderate. Associated with both PCTs on site. No hollows / breeding habitats were observed within the study area. Limited BioNet records occur within the locality.
Grantiella picta	Painted Honeyeater	-	V	V	PMST	Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema/em	Low Not associated with the vegetation on site. No food trees present. No BioNet records present.
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	V	-	Bionet (3)	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat.	Moderate. The species is associated with both PCTs on site. The study area provides potential foraging habitats, with limited nesting potential due to an absence of large trees in close proximity to the water.
Hieraaetus morphnoides	Little Eagle	-	V	-	Bionet (5)	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter	Moderate. Associated with both PCTs on site. BioNet records occur within the locality. No stick nests observed. The study area provides limited foraging habitat for this species.

Scientific Name	Common Name	BAM	EPBC Act	Source	Habitat	Likelihood of Occurrence
Hirundapus caudacutus	White-throated Needletail	-	V	V, M	PMST	The White-throated Needletail is widespread in eastern and south-eastern Australia (Barrett et al. 2003; Blakers et al. 1984; Higgins 1999). In eastern Australia, the species is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Dividing Range and occasionally onto the adjacent inland plains. Migratory and usually seen in eastern Australia from October to April. Breeds in forests in south-eastern Siberia, Mongolia, the Korean Peninsula and northern Japan June-August. Most often seen in eastern Australia before storms, low pressure troughs and approaching cold fronts and occasionally bushfire. These conditions are often used by insects to swarm (eg termites and ants) or tend to lift insects away from the surface which favours sighting of White-throated Needletails as they feed. More common in coastal areas, less so inland.	Low Associated with both PCTs on site. Species does not breed in Australia. No BioNet records present. The study area provides potential foraging habitat for this species.
Lathamus discolor	Swift Parrot	Yes	E	CE	PMST	Migrates to the Australian south-east mainland between February and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany Eucalyptus robusta, Spotted Gum Corymbia maculata, Red Bloodwood C. gummifera, Forest Red Gum E. tereticornis, Mugga Ironbark E. sideroxylon, and White Box E. albens.	Low Associated with both PCTs on site, however the study area provides limited non-preferred foraging habitats only.
Melanodryas cucullata cucullata	South-eastern Hooded Robin	-	E	E	Bionet (6), PMST	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey.	Moderate. Species not associated with the vegetation on site, however this species has been recorded near Pindari Dam. The study area contains limited mature eucalypts and very sparse groundcovers.
Motacilla flava	Yellow Wagtail	-	-	M	PMST	Non-breeding habitat only: mostly well-watered open grasslands and the fringes of wetlands. Roosts in mangroves and other dense vegetation.	Low Species not associated with the vegetation on site. No BioNet records present. Study area is outside of known distribution.
Myiagra cyanoleuca	Satin Flycatcher	-	-	M	PMST	The Satin Flycatcher is widespread in eastern Australia. Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	Low Species not associated with the vegetation on site. No BioNet records present. Study area is outside of known distribution.
Neophema chrysostoma	Blue-winged Parrot	-	V	V	PMST	Foraging and staging habitats found from coastal, sub-coastal and inland areas, right through to semi-arid zones including: grasslands, grassy woodlands and semi-arid chenopod shrubland with native and introduced grasses, herbs and shrubs. Wetlands both near the coast and in semi-arid zones used for foraging and staging.	Low Species not associated with the vegetation on site. No BioNet records present. Study area is outside of known distribution.
Neophema pulchella	Turquoise Parrot	-	V	-	Bionet (7)	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	Moderate. Species not associated with the vegetation on site, however BioNet records occur within the locality. No hollows / breeding habitats observed. Given the presence of records, it is considered that this species may forage within the study area on occasion.

Scientific Name	Common Name	BAM	SC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Oxyura australis	Blue-billed Duck	-	V	-	Bionet (1)	The Blue-billed Duck is endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Blue-billed Ducks will feed by day far from the shore, particularly if dense cover is available in the central parts of the wetland. They feed on the bottom of swamps eating seeds, buds, stems, leaves, fruit and small aquatic insects such as the larvae of midges, caddisflies and dragonflies. Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer.	Low Species not associated with the vegetation on site, although large deep lake and dam present. The dam is unlikely to provide habitat for this species. Species most common in southern Murry Darling Basin Area.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	-	V	-	Bionet (1)	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas	Moderate Associated with both PCTs on site. Potential nesting habitat is present, however limited records of this species occur in the locality and it is considered that the study area does not provide preferred habitats for this species.
Rhipidura rufifrons	Rufous Fantail	-	-	M	PMST	The Rufous Fantail occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, this species mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood, Mountain Grey Gum, Narrow-leaved Peppermint, Mountain Ash, Alpine Ash, Blackbutt or Red Mahogany; usually with a dense shrubby understorey often including ferns. They also occur in subtropical and temperate rainforests; for example near Bega in south-east NSW, where they are recorded in temperate Lilly Pilly rainforest, with Grey Myrtle, Sassafras and Sweet Pittosporum subdominants.	Low Species not associated with the vegetation on site. No BioNet records present. Study area is outside of known distribution.
Rostratula australis	Australian Painted Snipe	-	E	E	PMST	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves.	Low Species not associated with the vegetation on site and the study area is outside of known distribution of this species.
Stagonopleura guttata	Diamond Firetail	-	V	V	Bionet (15), PMST	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.	Moderate Although species is associated with both PCTs on site, there is limited roosting or nesting habitat present (dense shrubs) as the ground is mostly bare. Foraging habitat is present and recent ALA records (2023) exist at Lake Pindari.
Tringa nebularia	Common Greenshank	-	-	M	Bionet (1), PMST	The common greenshank is widespread in coastal regions, occurs in all types of wetlands, and has one of the widest distribution of any shorebird in Australia (Higgins & Davies 1996). In New South Wales, the species is widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling-Baaka River drainage basin, including the Macquarie Marshes, and north-west regions (Higgins & Davies 1996).	Low Species not associated with the vegetation on site. Prefers coastal habitat. Doesn't breed in Australia.
Fish							

Scientific Name	Common Name	BAE	SC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Bidyanus bidyanus	Silver Perch	-	-	E	PMST	The silver perch is endemic to the MDB of eastern Australia (Lintermans 2023). However, the species has been widely translocated into reservoirs and rivers outside the MDB from hatchery-bred fingerlings in many states and territories	Known According to Aquatic Ecology Assessment (Swanson, 2024), mapped threatened species habitat occurs at Lake Pindari. Previous sightings recorded within 10km of the study area (Atlas of Living Australia, 2024) and targeted studies identified the species within the Severn River (Department of Primary Industries, 2024a). Some suitable habitat is present in the Study Area, with species known to occupy flowing water and open sections of rivers, however, use of habitat would likely be transient given limited movement passages.
Maccullochella peelii	Murray Cod	-	-	V	PMST	known to live in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and billabongs. The upper reaches of the Murray and Murrumbidgee Rivers are considered too cold to contain suitable habitat.	Known According to Aquatic Ecology Assessment. (Swanson, 2024) indicative distribution of the species and likely species habitat has been mapped to occur throughout the Severn River. The Study Area provides some suitable habitat for the species, including large rocks and snags, however, use of this habitat would likely be transient given limited movement passages. Additionally, the species has been recorded to occur in the Severn River downstream of Pindari Dam in targeted surveys (Department of Primary Industries, 2024a).
Marsupials							
Dasyurus maculatus	Spotted-tailed Quoll	-	V	E	Bionet (3), PMST	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Quolls use hollow-bearing trees, fallen logs, other animal burrows, small caves and rock outcrops as den sites. Mostly nocturnal, although will hunt during the day, spend most of the time on the ground, although also an excellent climber and will hunt possums and gliders in tree hollows and prey on roosting birds	Moderate Associated with both PCTs on site. Foraging habitat present. Recent BioNet records of species within the locality surrounding Lake Pindari. No hollows for dens but plenty of rock outcrops for potential den sites present.
Petaurus australis australis	Yellow-bellied Glider	-	V	V	PMST	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils.Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein.Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.Live in small family groups of two – six individuals and are nocturnal. Den, often in family groups, in hollows of large trees.Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.	Low Associated with one PCT on site, 3518. No BioNet records. Limited mature trees present. Study area falls outside of known or predicted species distribution.
Petrogale penicillata	Brush-tailed Rock-wallaby	Yes	E	V	PMST	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night when foraging. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Low Associated with both PCTs on site. No BioNet records of the species present. Limited rocky outcrop habitat present.

Scientific Name	Common Name	BAE	SC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Phascolarctos cinereus	Koala	-	E	E	Bionet (6), PMST	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Spend most of their time in trees but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.	Moderate. This species is associated with both PCTs on site. Eucalyptus dealbata, recorded within the study area is listed as a secondary food tree species within the Northern Tablelands Koala Management Area.
Reptiles							
Anomalopus mackayi	Five-clawed Worm-skink	-	E	V	PMST	Close to or on the lower slopes of slight rises in grassy White Box woodland on moist black soils, and River Red Gum-Coolibah-Bimble Box woodland on deep cracking loose clay soils. May also occur in grassland areas and open paddocks with scattered trees. Live in permanent deep tunnel-like burrows and deep soil cracks, coming close to the surface under fallen timber and litter, especially partially buried logs.;2]	Low Associated with both PCTs on site. No BioNet records present. Study area falls outside of known and predicted distribution.
Cacophis harriettae	White-crowned Snake	-	V	-	Bionet (1)	Favours low to mid-elevation dry eucalypt forest and woodland, particularly areas with a varied and well-developed litter layer, where their prey of small lizards may be more abundant. Also occasionally found in moist eucalypt forest and coastal heathland.	Low Species not associated with vegetation on site. No varied or well developed litter layer present, mostly bare ground. Study area falls outside of known and predicted distribution.
Delma torquata	Adorned Delma	-	-	V	PMST	The Collared Delma is known from the western suburbs of Brisbane, Queensland, and the following sites: Ituriya Mountains, Blackdown Tableland National Park (NP), Bullyard Conservation Park, D'Aguilar Range NP, Expedition NP, Naangna and Lockyer Forest Reserves, Western Creek near Millmerran and the Toowoomba Range (Davidson, 1993; Ryan, 2006). The Collared Delma occurs within the South East Queensland, Condamine, Burnett Mary and Fitzroy (Queensland) Natural Resource Management regions. The Collared Delma normally inhabits eucalypt dominated woodland and open forest where it is associated with suitable micro-habitats (exposed rocky outcrops). The ground cover is predominantly native grasses, such as Kangaroo Grass (Themeda triandra), Barbed-wire Grass (Cymbopogon refractus), Wiregrass (Aristida sp.) and Lomandra (Lomandra sp.) (Peck & Hobson, 2007).	Low Although associated with both PCTs on site, the species does not occur in NSW, and mostly in QLD.
Furina dunnalli	Dunnall's Snake	-	-	V	PMST	Preferred habitat is Brigalow forest and woodland with fallen timber and ground litter, growing on cracking clay soils and clay loam soils. Also occurs in eucalypt and Callitris woodland with fallen timber and ground litter	Low Associated with both PCTs on site. No BioNet records present.Study area falls outside of known and predicted distribution.
Hemiaspis damelii	Grey Snake	-	E	E	PMST	Floodplains and ephemeral wetlands associated with heavy clay soils are key habitat features for the Grey Snake In NSW, the Grey Snake's habitat includes the margins of ephemeral wetlands within River Red Gum (Eucalyptus camaldulensis) and Black Box (E. largiflorens) vegetation communities and Tangled Lignum (Duma florulenta) swamps. The species shelters in soil cracks, rocks, logs, flood debris, and abandoned burrows within these habitats The Grey Snake has not been sighted in dry phase wetlands, suggesting its detectability and activity patterns may be related to wetland inundation regimes and suitable weather conditions	Low Associated with both PCTs on site. No BioNet records present. Study area falls outside of known and predicted distribution.

Scientific Name	Common Name	BAE	BC Act	EPBC Act	Source	Habitat	Likelihood of Occurrence
Myuchelys bellii	Western Sawshelled Turtle, Bell's Turtle	-	E	E	PMST	There are six subpopulations recorded of western saw-shelled turtles. In New South Wales they occur in the upper Namoi River and tributaries, upper Gwydir River and tributaries, upper Severn River and tributaries, the Deepwater River and Copes Creek, and Bald Rock Creek in Queensland (Cheesman 2015; Cheesman 2021, pers comm, 2 December 2021). Shallow to deep pools in upper reaches or small tributaries of major rivers in granite country. Occupied pools are most commonly less than 3 m deep with rocky or sandy bottoms and patches of vegetation. Most typically uses narrow stretches of rivers 30 - 40 m wide. Most surrounding habitat has been converted to grazing land. Nests are dug out in riverbanks of sand or loam during late September to January. Eggs take 80 days to hatch and are thus vulnerable to nest predation for an extended period.	Low Species not associated with vegetation on site. Dam is not shallow with a sandy bottom for nesting and foraging habitat. No species records within the locality.
Uvidicolus sphyrurus	Border Thick-tailed Gecko	-	V	V	PMST	As implied by another of its common names (Granite Thick-tailed Gecko), this species often occurs on steep rocky or scree slopes, especially granite. Recent records from basalt and metasediment slopes and flats indicate its habitat selection is broader than formerly thought and may have extended into areas that were cleared for agriculture. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey. These Geckos are active at night and shelter by day under rock slabs, in or under logs, and under the bark of standing trees.	Low Associated with both PCTs on site. No boulders, or rock slabs and limited fallen timber and deep leaf litter present within the study area. Limited dense tree canopy present. No BioNet records present.
Rodents							
Pseudomys novaehollandiae	New Holland Mouse	-	-	V	PMST	More than 95% of the New Holland mouse's range appears to consist of a large cluster of subpopulations that incorporate much of the mid- and north coasts of NSW and extend into southern Qld. The remainder of the species' distribution has historically been contained in small and clearly isolated subpopulations, including two in Tasmania (north-east coast and Flinders Island), three in Victoria (Anglesea, Wilsons Promontory, and Gippsland Lakes), and one in inland NSW, near Parkes.	Low Species not associated with vegetation on site. Study Area falls outside of species distributions. No BioNet records present within locality.

Appendix B

PMST Search result

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 23-Jul-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	57
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	19
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	2
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity	Buffer Status
Banrock station wetland complex	1100 - 1200km upstream from Ramsar site	In feature area
Riverland	1000 - 1100km upstream from Ramsar site	In feature area
The coorong, and lakes alexandrina and albert wetland	1200 - 1300km upstream from Ramsar site	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area	In feature area
New England Peppermint (Eucalyptus nova-anglica) Grassy Woodlands	Critically Endangered	Community may occur within area	In feature area
Weeping Myall Woodlands	Endangered	Community may occur within area	In feature area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat known to occur within area	In feature area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat known to occur within area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat may occur within area	In feature area
FISH			
Bidyanus bidyanus Silver Perch, Bidyan [76155]	Endangered	Species or species habitat known to occur within area	In feature area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area	In feature area
MAMMAL			
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat likely to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area	In feature area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat may occur within area	In feature area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area	In feature area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area	In feature area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
PLANT			
Acacia macnuttiana McNutt's Wattle [10711]	Vulnerable	Species or species habitat known to occur within area	In feature area
Acacia pubifolia Velvet Wattle [19799]	Vulnerable	Species or species habitat may occur within area	In feature area
Acacia ruppii Rupp's Wattle [7559]	Endangered	Species or species habitat known to occur within area	In buffer area only
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Astrotricha roddii [56312]	Endangered	Species or species habitat known to occur within area	In feature area
Boronia granitica Granite Boronia [18598]	Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Callistemon pungens [55581]	Vulnerable	Species or species habitat known to occur within area	In feature area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Eucalyptus caleyi subsp. ovendenii Ovenden's Ironbark [56193]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Eucalyptus mckieana McKie's Stringybark [20199]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Eucalyptus nicholii Narrow-leaved Peppermint, Narrow-leaved Black Peppermint [20992]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Homopholis belsonii Belson's Panic [2406]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area	In feature area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat may occur within area	In feature area
Micromyrtus grandis [64647]	Endangered	Species or species habitat may occur within area	In buffer area only
Phebalium glandulosum subsp. eglandulosum Rusty Desert Phebalium [17140]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Picris evae Hawkweed [10839]	Vulnerable	Species or species habitat may occur within area	In feature area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Swainsona murrayana Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat may occur within area	In feature area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat known to occur within area	In feature area
Vincetoxicum forsteri listed as Tylophora linearis [92384]	Endangered	Species or species habitat may occur within area	In feature area
REPTILE			
Anomalopus mackayi Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area	In feature area
Hemiaspis damelii Grey Snake [1179]	Endangered	Species or species habitat may occur within area	In feature area
Myuchelys belli Western Sawshelled Turtle [86075]	Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Uvidicolus sphyrurus Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area overfly marine area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Pterodroma cervicalis White-necked Petrel [59642]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Severn River	Nature Reserve	NSW	In buffer area only

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
Aerial baiting for wild dog control	2006/2713	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

© Commonwealth of Australia
Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
Canberra ACT 2601 Australia
+61 2 6274 1111

Appendix C

Assessments of significance – NSW BC ACT

C1 Significant impact assessments (BC Act)

C1.1 BC listed flora

Results of the threatened species database searches identified six threatened flora species listed under the BC Act as being considered potentially to occur within the study area (refer to Table C.1).

Table C.1 Threatened flora with a moderate or higher likelihood of occurrence

Scientific Name	Common Name	BC Act[1]	Likelihood of occurrence
Acacia acrionastes	Pindari Wattle	E	Moderate- This species was not observed during field surveys and not typically associated with PCTs present; however this species occurs around the dam it is not completely ruled out of potentially occurring as no targeted surveys were conducted.
Acacia macnuttiana	MacNutt's Wattle	V	Moderate- This species has previously been recorded around Pindari Dam, however no associated habitat was recorded within the study area.
Astrotricha roddii	Rodd's Star Hair	E	Moderate- Species has potential habitat within the study area associated with PCT 3518 and 4151 and is known to occur in the locality.
Indigofera baileyi	Bailey's Indigo	E	Moderate- This species was not observed during surveys; however, it is associated with PCT 4151.
Polygala linariifolia	Native Milkwort	E	Moderate- Marginal potential habitat for this species was recorded in PCT 3518 and 4151 so this species is not completely discounted from occurring.
Thesium australe	Austral Toadflax	V	Moderate- Marginal potential habitat for this species was recorded in PCT 4151 so this species is not completely discounted from occurring.

(1) Listed under the BC Act as E = Endangered V= Vulnerable

C1.2 BC listed fauna

Results of the threatened species database searches identified twelve threatened fauna species listed under the BC Act as being known to occur or considered likely to occur within the study area. Of these, 15 are considered to have a moderate or higher likelihood of occurring within the study area based on the availability of habitat (refer to Table C.2).

Table C.2 NSW threatened fauna with moderate or higher likelihood of occurrence

Scientific Name	Common Name	BC Act[1]	Likelihood of occurrence
Anthochaera phrygia	Regent Honeyeater	CE	Moderate- The study area contains foraging habitat for the species.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	Moderate- The study area contains foraging habitat and potential breeding habitat for the species.
Chthonicola sagittata	Speckled Warbler	V	Moderate- The study area contains foraging habitat and potential breeding habitat for the species.
Climacteris picumnus victoriae	Brown Treecreeper	V	Moderate- The study area contains foraging habitat for the species.
Daphoenositta chrysoptera	Varied Sittella	V	Moderate- The study area contains foraging habitat and potential breeding habitat for the species.
Geophaps scripta scripta	Squatter Pigeon (southern sub-species)	CE	Moderate- The study area contains foraging habitat and potential breeding habitat for the species.
Glossopsitta pusilla	Little Lorikeet	V	Moderate- The study area contains foraging habitat for the species.
Haliaeetus leucogaster	White-bellied Sea-eagle	V	Moderate- The study area contains foraging habitat for the species.
Hieraaetus morphnoides	Little Eagle	V	Moderate – The study area contains a small area of potential foraging habitat.
Melanodryas cucullata	South-eastern Hooded Robin	E	Moderate – The study area contains a small area of potential habitat.
Neophema pulchella	Turquoise Parrot	V	Moderate- The study area contains foraging habitat for the species.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	Moderate- Associated with both PCTs on site. Potential nesting habitat is present, however limited records of this species occur in the locality and it is considered that the study area does not provide preferred habitats for this species.

Scientific Name	Common Name	BC Act[1]	Likelihood of occurrence
Stagonopleura guttata	Diamond Firetail	V	Moderate- The study area contains foraging habitat for the species.
Dasyurus maculatus	Spotted-tailed Quoll	V	Moderate- The study area contains foraging habitat for the species.
Phascolarctos cinereus	Koala	E	Moderate- The study area contains foraging habitat for the species.

(1) Listed under the BC Act as CE = Critically Endangered E = Endangered V= Vulnerable

C2 Threatened flora species listed under the BC Act

The following Vulnerable and Endangered species were identified as having a moderate or higher likelihood of occurrence within the impact area:

- *Acacia acrionastes* (Pindari Wattle)
- *Acacia macnuttiana* (MacNutt's Wattle)
- *Astrotricha roddii* (Rodd's Star Hair)
- *Indigofera baileyi* (Bailey's Indigo)
- *Polygala linariifolia* (Native Milkwort)
- *Thesium australe* (Austral Toadflax).

These species have been assessed together based on habitat preferences and in consideration of the scale of impact from the proposal.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats —

In the case of a threatened species, whether the proposed development or activity:

- *is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*

These threatened flora species are known to occur within the Glenn Innes, Inverell and Tarrington Station Conservation Areas and the general region of the study area, some of which includes recorded individuals closer to Pindari Dam. The closest of these is the Pindari Wattle found within the Severn River Nature Reserve and also along the peninsula of Pindari Dam approximately 600m from the study area. As no threatened flora species have previously been recorded within the study area and despite the surveys being undertaken outside of recommended survey periods (Refer to Section 4.5), no species were not recorded. Therefore, if any individuals occur within the study area, it is considered that in order to remain undetected, they are likely to be in low in numbers. In relation to the surrounding known populations in the locality the proposed impact is unlikely to have an adverse impact on the life cycle of viable local populations of these species. If any at all are impacted the remaining population in the locality is likely to continue to flower, pollinate and set seed.

In relation to the habitat of a threatened species:

- *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity*

The proposed impact will remove 0.63 ha of potential habitat for these species that would represent <0.01% of remaining similar habitat within the immediate locality. The proposed impacted vegetation is not limiting for these species.

- *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality*

Fragmentation is unlikely to occur from the proposal as the work will mostly just remove scattered areas of native vegetation within areas of exotic grassland with the exception of a small patch within the western edge of the dam which is currently separated from the remaining vegetation by approximately 50m that will extend to a 75m clearing following the proposed works. This reduction of area of this outcrop of vegetation is unlikely to be a significant impact for these species. If any are present, this distance is unlikely to impact any cross pollination and reproductive processes

for the remaining individuals. Importantly, the proposal will not result in the breaking apart of large blocks of high-quality habitats. No further habitat fragmentation on a landscape scale will occur because of the proposal. Isolation of habitats is also unlikely to increase as habitat fragments will not be entirely removed from the landscape.

- *whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)*

The proposal will not impact on any declared area of outstanding biodiversity value.

- *whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process*

A KTP is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of a species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, it is considered that five are applicable to this assessment. These include Clearing of native vegetation and removal of dead wood and dead trees, Invasion and establishment of exotic vines and scramblers, Invasion of native plant communities by African Olive *Olea europaea L.* subsp. *cuspidata*, Invasion, establishment and spread of *Lantana camara,* and Invasion of native plant communities by exotic perennial grasses. However, hygiene and weed control measures will reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation and removal of dead wood and dead trees.

Conclusion

Impacts to habitat for these species are expected to be negligible. The proposal is impacting 0.63ha of potential habitat for these species, with <0.01% of available similar habitat in the locality. No threatened flora has been historically recorded within the study area and none were recorded during the site survey. These species are known to occur in the locality with broader populations surrounding the region. If any occur within the impact area the number of individuals are likely to be proportionally insignificant in terms of population viability in the region. The proposal therefore is unlikely to reduce the population size of these species or decrease the reproductive viability of these species. It is considered that the local populations will continue to flower, pollinate and set seed as prior to the proposal. As such the proposal itself is unlikely to place a viable local population of these species at risk of extinction. No significant habitat fragmentation for these species will occur. The proposal will involve KTPs however, the majority of these will be managed.

After consideration of the factors above, an overall conclusion has been made that while if any impact occurs to potential foraging habitat, the impact is not significant, and the proposal is unlikely to result in a significant effect to the Pindari Wattle, MacNutt's Wattle, Rodd's Star Hair, Bailey's Indigo, Native Milkwort and Austral Toadflax.

C3 Threatened woodland bird species listed under the BC Act

The following threatened bird species were identified as having a moderate or higher likelihood of occurrence within the impact area:

- *Anthochaera phrygia* (Regent Honeyeater)
- *Artamus cyanopterus cyanopterus* (Dusky Woodswallow)
- *Chthonicola sagittata* (Speckled Warbler)
- *Climacteris picumnus victoriae* (Brown Treecreeper)
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Geophaps scripta scripta* (Squatter Pigeon - southern sub-species)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Haliaeetus leucogaster* (White-bellied Sea-eagle)
- *Hieraaeetus morphoides* (Little Eagle)
- *Melanodryas cucullata cucullata* (South-eastern Hooded Robin)
- *Neophema pulchella* (Turquoise Parrot)
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler – eastern subspecies)
- *Stagonopleura guttata* (Diamond Firetail).

These species have been assessed together based on listing status, habitat preferences and in consideration of the scale of impact from the proposal.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats —

In the case of a threatened species, whether the proposed development or activity:

- *is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*

These threatened bird species are considered likely to occur based on the presence of suitable foraging habitat for all species and records from the locality. The Little Lorikeet and Regent Honeyeater are blossom chasing nectivores likely to only occur within the site during flowering times of the eucalypts present. There are no hollows present within the study area to provide breeding habitat for the Little Lorikeet and they are not known to breed in the locality. No bird nests were recorded during the site survey and no suitable trees or perches were present that could provide suitable breeding habitat for the White-bellied Sea-Eagle or Little Eagle, however, the impact area does present potential breeding habitat for smaller nest-building birds such as the Regent Honeyeater, Dusky Woodswallow, Speckled Warbler, Varied Sittella, South-eastern Hooded Robin and Grey-crowned Babbler that could utilise a younger canopy cohort. Breeding habitat for the Squatter Pigeon can equally not be ruled out as this species is ground nesting and therefore may be suitable. The remaining species are not considered to have breeding habitat present within the impact area as no suitable shrub layer is present (required for Diamond Firetail nesting), and the absence of hollows (required for Turquoise Parrot and Brown Treecreeper).

While the proposal is potentially impacting breeding habitat for smaller nest-building birds, the proposal is mostly avoiding impacts to surrounding vegetation and is limited to 0.63 ha of native vegetation. As such the extent of more suitable habitat remaining in the locality would provide ample resources to sustain future visitation and localised breeding opportunities, such that the proposal itself is unlikely to place a viable local population of these species at risk of extinction.

In relation to the habitat of a threatened species:

- *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity*

The proposal will remove 0.63 ha of potential habitat. This potential habitat represents <0.01% of remaining similar habitat within the immediate locality. The proposed impacted vegetation is not limiting for these species.

- *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality*

Fragmentation is unlikely to occur from the proposal as it will mostly remove scattered areas of native vegetation within areas of exotic grassland with the exception of a small patch within the western edge of the dam, which is considered a small extension of the remaining native vegetation. Importantly, the proposal will not result in the breaking apart of large blocks of high-quality habitats. These highly mobile species will continue to move across remaining vegetation areas as is possible presently, prior to the proposed works. No further habitat fragmentation on a landscape scale will occur because of the proposal. Isolation of habitats is also unlikely to increase as habitat fragments will not be entirely removed from the landscape.

These species may utilise the habitat on occasion but do not use it as the main or only source of habitat. As no breeding evidence was observed (Refer to section 4.5.2), the study area is likely to provide only marginal supplementary breeding habitat for some of these species and as they are all highly mobile flying birds they will continue to move between remaining habitats.

- *whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)*

The proposal will not impact on any declared area of outstanding biodiversity value.

- *whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process*

A KTP is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of a species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, nine are applicable to this assessment. These include Clearing of native vegetation and removal of dead wood and dead trees, Invasion and establishment of exotic vines and scramblers, Invasion of native plant communities by African Olive *Olea europaea L.* subsp. *cuspidata*, Invasion, establishment and spread of *Lantana camara,* and Invasion of native plant communities by exotic perennial grasses. However, hygiene and weed control measures will reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation and removal of dead wood and dead trees.

Conclusion

Impacts to habitat for these species are expected to be negligible. The proposal is impacting <0.01% of available similar habitat in the locality. Only potential breeding habitat will be impacted for the Dusky Woodswallow, Speckled Warbler, Squatter Pigeon, Varied Sittella, South-eastern Hooded Robin and Grey-crowned Babbler while the impact area lacks features suitable for breeding for the remaining threatened bird species. The proposal is unlikely to reduce the population size of these species or decrease the reproductive success of these species. The extent of habitat remaining in the locality would provide sufficient resources to sustain future visitation, such that the proposal itself is unlikely to place a viable local population of these species at risk of extinction. No habitat fragmentation for these species will occur.

After consideration of the factors above, it is concluded that the proposal will not result in a significant impact to the threatened bird species Dusky Woodswallow, Speckled Warbler, Squatter Pigeon, White-bellied Sea-Eagle, Little Eagle, South-eastern Hooded Robin, Varied Sittella, Little Lorikeet, Regent Honeyeater, Diamond Firetail, Turquoise Parrot, Grey-crowned Babbler and Brown Treecreeper.

C4 Fauna species listed as critically endangered & endangered under the BC Act

This assessment applies to the following threatened mammal species which have been assessed together due to listing status and consideration of the scale of impact from the proposal. These species are considered moderately likely to occur in the area due to suitable foraging habitat being found within the study area and the presence of nearby records.

- Koala (*Phascolarctos cinereus*)
- Spotted-tailed Quoll (*Dasyurus maculatus*).

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats —

In the case of a threatened species, whether the proposed development or activity:

- *is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction*

All vegetation within the PCTs 4151 (North White pine-silver-leaved Ironbark Forest) and 3518 (Northwest Pine-ironbark grassy woodland) is likely to provide suitable foraging habitat for these species. The proposal will remove approximately 0.63 ha of vegetation across these two PCTs. This would remove a small percentage (<0.01%) of the total extent of habitat present within the locality. As such, the proposal is not expected to have an adverse effect on the life cycle of these species such that a viable population is likely to be placed at risk of extinction. Habitat loss is also unlikely to significantly affect the density of prey for the Spotted-tailed Quoll.

The proposal is considered unlikely to reduce population size or reproductive success of either species as no breeding habitat will be impacted.

In relation to the habitat of a threatened species:

- *the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity*

The proposed impact will remove 0.63 ha of suitable habitat, which would represent <0.01% of remaining similar habitat within the immediate locality. The proposed impacted vegetation is not limiting for these species.

- *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality*

The proposal will remove approximately 0.63 ha of potential habitat. Fragmentation is unlikely to occur as a result of this as the proposal will mostly involve the removal of scattered areas of native vegetation within areas of exotic grassland, with the exception of a small patch within the western edge of the dam, which is considered a small extension of the remaining native vegetation. Importantly, the proposal will not result in the breaking apart of large blocks of high-quality habitats.

These species may utilise the habitat on occasion but as no breeding evidence was observed within the study area and the study area is unlikely to be their main or only source of habitat. These species are highly mobile and will freely move substantial distances over open areas to move between habitats and will forage along habitat edges, therefore they will not be limited in movement between habitats as a result of the proposal. No further habitat fragmentation on a

landscape scale will occur because of the proposal. Isolation of habitats is also unlikely to increase as habitat fragments will not be entirely removed from the landscape.

- *whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)*

The proposal will not impact on any declared area of outstanding biodiversity value.

- *whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process*

A KTP is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, nine are applicable to this assessment. These include Clearing of native vegetation and removal of dead wood and dead trees, Invasion and establishment of exotic vines and scramblers, Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata, Invasion, establishment and spread of Lantana camara, and Invasion of native plant communities by exotic perennial grasses. However, hygiene and weed control measures will reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation and removal of dead wood and dead trees.

Conclusion

Impacts to habitat for these species are expected to be negligible. The proposal is impacting <0.01% of available similar habitat in the locality. The habitat which will be impacted is expected to be used for foraging and not considered likely to be breeding habitat, therefore the proposal is unlikely to reduce the population size of these species or decrease the reproductive success of these species. The extent of habitat remaining in the locality would provide sufficient resources to sustain future visitation, such that the proposal itself is unlikely to place a viable local population of these species at risk of extinction. No habitat fragmentation for these species will occur.

After consideration of the factors above, it is concluded that the proposal will not result in a significant impact to the Koala or Spotted-tailed Quoll.

Appendix D

Assessments of significance – Commonwealth EPBC ACT

D1 Significant impact assessments (EPBC ACT)

D1.1 EPBC listed flora

Results of the threatened species database searches identified four threatened flora species listed under the EPBC Act as being known to occur or considered likely to occur within the study area (refer to Table D.1).

Table D.1 Nationally threatened flora with a moderate or higher likelihood of occurrence

Scientific Name	Common Name	EPBC Act[1]	Likelihood of occurrence
Acacia macnuttiana	MacNutt's Wattle	V	Moderate. This species has previously been recorded around Pindari Dam, however no associated habitat was recorded within the study area.
Astrotricha roddii	Rodd's Star Hair	E	Moderate. This species was not observed during surveys; however, it is associated with PCT 3518 and 4151 and is known to occur in the locality.
Callistemon pungens	Callistemon pungens	V	Moderate. This species was not observed during surveys; however, it is associated with PCT 3518 and is known to occur in the locality.
Thesium australe	Austral Toadflax	V	Moderate. This species was not observed during surveys; however, it is associated with PCT 3518 and is known to occur in the locality.

(1) Listed under the EPBC Act as E = Endangered V= Vulnerable

D1.2 EPBC listed fauna

Results of the threatened species database searches identified 34 threatened fauna species listed under the EPBC Act as being known to occur or considered likely to occur within the study area. Of these, seven are considered to have a moderate or higher likelihood of occurring within the study area based on the availability of habitat (Refer to Table D.2)

Table D.2 Nationally threatened fauna with moderate or higher likelihood of occurrence

Scientific Name	Common Name	EPBC Act[1]	Likelihood of occurrence
Dasyurus maculatus maculatus	Spotted-tailed Quoll	E	Moderate- The study area contains foraging habitat for the species.
Phascolarctos cinereus	Koala	E	Moderate- The study area contains foraging habitat for the species.
Anthochaera phrygia	Regent Honeyeater	E	Moderate- The study area contains foraging habitat for the species.
Geophaps scripta scripta	Squatter Pigeon (Southern subspecies)	V	Moderate- No BioNet records occur and the species is not associated with the vegetation present, however the study area is mapped as known habitat for this species.
Melanodryas cucullata cucullata	South-eastern Hooded Robin	E	Moderate- Species not associated with the vegetation on site. The study area contains limited mature eucalypts and very sparse groundcovers.
Stagonopleura guttata	Diamond Firetail	V	Moderate- The study area contains foraging habitat for the species
Climacteris picumnus victoriae	Brown Treecreeper	V	Moderate- suitable foraging habitat may occur within study area.

(1) Listed under the EPBC Act as E = Endangered V = Vulnerable

D2 Flora species listed as endangered under the EPBC Act

D2.1 Astrotricha roddii

Rodd's Star Hair (*Astrotricha roddii)* is listed as Endangered under the Commonwealth EPBC Act. It was not recorded within the study area however is known to occur in the locality and PCTs present are associated with this species, therefore the impact area is considered to contain potential habitat for this species.

Under the EPBC Act an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *Lead to a long-term decrease in the size of a population*

This species was not recorded within the study area and therefore impacts are considered likely to only be indirect impacts with the loss of 0.63ha of potential habitat. If any individuals occur that have yet been recorded it is unlikely to hold a significant proportion of a local population with consideration of the expansive similar habitat surrounding the study area, as it is very likely more individuals would occur past the study area. The proposed works are unlikely to lead to a long-term decrease in the size of the population of the species, given the lack of records, degraded condition of the habitat and the small area to be impacted.

- *Reduce the area of occupancy of the species*

There is no published estimation of extent of occurrence or area of occupancy for this species however populations are recorded around the Ashford area north of Inverell, upstream of the Severn and Macintyre rivers, north of Pindari Reservoir and near Texas in the Darling Downs, south-eastern Queensland (Department of Environment Water Heritage and the Arts, 2008). As the study area is not at the outer boundaries of this distribution and the proposal will remove small patches of potential habitat totalling 0.63ha within a wider landscape of suitable habitat, there will be no reduction in the area of occupancy of this species.

- *Fragment an existing population into two or more populations*

Astrotricha roddii was not recorded in the impact area, therefore it is unlikely the proposal would result in fragmenting an existing population into two or more populations. In addition, the proposal will predominantly remove habitat occurring at the edge of the existing dam and would not result in fragmentation of vegetation with the exception of a small area in the western edge of the dam wall. If any individuals occur here the break in vegetation will extend by 25m from 50m to 75m therefore would unlikely alter the reproductive cycle of existing plants in the area. They would continue to flower, pollinate and set seed as prior to the proposal.

- *Adversely affect habitat critical to the survival of a species*

Habitat critical to the survival of the Rodd's Star Hair has not been specifically identified.

- *Disrupt the breeding cycle of a population*

As pollination or seed dispersal will not be impacted, the proposal is unlikely to disrupt the breeding cycle of the Rodd's Star Hair. It is considered that any specimens of this species potentially located outside of the study area will still flower, set seed and continue to exist in the locality despite impacts from the proposal.

- *Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal would result in the loss of 0.63 ha of potential habitat for the Rodd's Star Hair. The species was not recorded within the impact area or study area. The habitat within the impact area has been previously disturbed and is restricted to marginal habitat condition.

It is unlikely the proposal would further modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- *Result in invasive species that are harmful to a critically endangered or endangered species becoming species established in the established in the endangered species habitat.*

Invasive species are present throughout the landscape. Mitigation measures include but are not limited to spraying down of vehicles and sediment control to prevent weeds from entering the retained areas of native vegetation during construction, and ongoing weed management such as weed spraying during operation. Therefore, it is considered unlikely that the proposal would substantially change the composition of the species habitat within the landscape or increase the spread and establishment of invasive species that could threaten the survival of the species.

- *Introduce a disease that may cause the species to decline*

As there are no known diseases likely to impact this species, given the impacts are well known it is considered unlikely that the proposal would introduce disease that would cause the decline of the species.

- *Interfere substantially with the recovery of the species*

There is no adopted or made Recovery Plan for this species.

Conclusion

The proposal will result in the loss of 0.63ha potential habitat for the species. Noting the species has not been previously recorded in the impact area, and there are no known important populations, it is considered unlikely the proposal would result in a significant impact on *Astrotricha roddii.*

D3 Flora species listed as vulnerable under the EPBC Act

Acacia macnuttiana (MacNutt's Wattle), *Callistemon pungens* and *Thesium australe* (Austral Toadflax) are listed as vulnerable under the EPBC Act and were identified as having a moderate likelihood of occurrence within the impact area.

D3.1 Acacia macnuttiana

Is this part of an important population?

Under the Act, an important population is one that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Acacia macnuttiana has not been recorded within the study area.

This species occurs only on the New England Tablelands, just extending onto the North West Slopes (OEH, 2025). It is found in widely scattered locations in the Tenterfield area and west to Torrington (OEH, 2025). *Acacia macnuttiana* occurs in dry forest or woodland and heath, usually on granite or metasediments and often near streams (OEH, 2025).

This species has been previously recorded in proximity to Pindari Dam. However, given the lack of records from the study area, and the small extent of the assumed habitat to be impacted, it is unlikely that any population occurring within the study area would be of significant size to be important in maintaining genetic diversity or be a key source population for dispersal.

Under the EPBC Act, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *Lead to a long-term decrease in the size of an important population of a species*

Acacia macnuttiana was not recorded in the study area. The proposal is unlikely to lead to a long-term decrease in the size of the population of the species, given the lack of records, degraded condition of the habitat and the small area to be impacted (0.63 ha).

- *Reduce the area of occupancy of an important population*

Acacia macnuttiana was not recorded in the impact area, and there are no important populations known to occur in the impact area or study area.

- *Fragment an existing important population into two or more populations*

Acacia macnuttiana was not recorded in the study area. Therefore, it is unlikely the proposal would result in fragmenting an existing important population into two or more populations. In addition, the proposal is likely to remove habitat occurring at the edge of the existing dam and would not result in any significant fragmentation of vegetation.

– *Adversely affect habitat critical to the survival of a species*

Habitat critical to the survival of a species also refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community.

The species has not been recorded within the study area and the habitat within the study area is degraded. Therefore, it is unlikely habitat within the study area would represent habitat critical to the survival of the species. The proposal would not adversely affect habitat critical to the survival of the species.

– *Disrupt the breeding cycle of an important population*

There are no important populations of *Acacia macnuttiana* known to occur in the study area, therefore it is unlikely the proposal would disrupt the breeding cycle of an important population.

– *Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal would result in the loss of 0.63 ha of potential habitat for *Acacia macnuttiana*. The species was not recorded within the study area. The habitat within the study area has been previously disturbed and is restricted to poor to moderate condition grassy woodland with a very sparse groundcover containing a mixture of native and exotic species.

It is unlikely the proposal would further modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

– *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Invasive species are currently present throughout the landscape. Mitigation measures include but are not limited to the spray down of vehicles and sediment control to prevent weeds from entering the retained area during construction and ongoing weed management such as weed spraying during operation. Therefore, it is considered unlikely that the proposal would substantially change the composition of the species habitat within the landscape or increase the spread and establishment of invasive species that could threaten the survival of the species.

– *Introduce disease that may cause the species to decline, or*

As there is no known disease likely to impact this species, given the impacts are well known it is considered unlikely that the proposal would introduce disease that would cause the decline of the species.

– *Interfere substantially with the recovery of the species*

There is no adopted or made Recovery Plan for the species. The approved conservation advice sets out a number of priority actions for the species including:

- Identify populations of high conservation priority.
- Manage threats to areas of vegetation that contain populations/occurrences/remnants of MacNutt's Wattle.
- Ensure development activities do not adversely impact on known populations of McNutt's Wattle.
- Investigate formal conservation arrangements such as the use of covenants, conservation agreements or inclusion in reserve tenure.
- Develop and implement a suitable fire management strategy for McNutt's Wattle.
- Provide maps of known occurrences to local and state Rural Fire Services and seek inclusion of mitigative measures in bush fire risk management plans, risk register and/or operation maps.

It is unlikely the proposal would substantially interfere with these regional priority actions outlined in the approved conservation advice for the species or the recovery of the species.

Conclusion

The proposal will result in the loss of 0.63 ha potential habitat for the species. Noting the species has not been previously recorded in the study area, it is considered unlikely the proposal would result in a significant impact on *Acacia macnuttiana*.

D3.2 Callistemon Pungens

Is this part of an important population?

Under the Act, an important population is one that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Callistemon pungens has not been recorded within the impact area or study area.

Callistemon pungens is known to occur from near Inverell to the eastern escarpment in New England, along rocky watercourses usually with sandy granite (or occasionally basalt) creek beds, and generally among naturalised species. However, given the lack of records from the impact area and study area, and the small extent of the assumed habitat to be impacted, it is unlikely that any population occurring within the impact area would be of significant size to be important in maintaining genetic diversity or be a key source population for dispersal.

Under the EPBC Act, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *Lead to a long-term decrease in the size of an important population of a species*

Callistemon pungens was not recorded in the impact area, furthermore there are no important populations known to occur within the impact area or study area. The proposal is unlikely to lead to a long-term decrease in the size of the population of the species, given the lack of records, degraded condition of the habitat and the small area to be impacted (0.63 ha).

- *Reduce the area of occupancy of an important population*

Callistemon pungens was not recorded in the impact area, and there are no important populations known to occur in the impact area or study area.

- *Fragment an existing important population into two or more populations*

Callistemon pungens was not recorded in the impact area, and there are no important populations known to occur within the impact area or study area. Therefore it is unlikely the proposal would result in fragmenting an existing important population into two or more populations. In addition, the proposal is likely to remove habitat occurring at the edge of the existing dam and would not result in any significant fragmentation of vegetation.

- *Adversely affect habitat critical to the survival of a species*

Habitat critical to the survival of a species also refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)

- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community.

The species has not been recorded within the impact area or study area and the habitat within the impact area is degraded. Therefore, it is unlikely habitat within the impact area would represent habitat critical to the survival of the species. The proposal would not adversely affect habitat critical to the survival of the species.

- *Disrupt the breeding cycle of an important population*

There are no important populations of *Callistemon pungens* known to occur in the impact area or study area, therefore it is unlikely the proposal would disrupt the breeding cycle of an important population. In addition, the species was not recorded within the impact area or the study area.

- *Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal would result in the loss of 0.63 ha of potential habitat for *Callistemon pungens*. The species was not recorded within the impact area or study area. The habitat within the impact area has been previously disturbed and is restricted to poor to moderate condition grassy woodland with a very sparse groundcover containing a mixture of native and exotic species.

It is unlikely the proposal would further modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Invasive species are currently present throughout the landscape. Mitigation measures include but are not limited to the spray down of vehicles and sediment control to prevent weeds from entering the retained area during construction and ongoing weed management such as weed spraying during operation. Therefore, it is considered unlikely that the proposal would substantially change the composition of the species habitat within the landscape or increase the spread and establishment of invasive species that could threaten the survival of the species.

- *Introduce disease that may cause the species to decline, or*

As there is no known disease likely to impact this species, given the impacts are well known it is considered unlikely that the proposal would introduce disease that would cause the decline of the species.

- *Interfere substantially with the recovery of the species*

There is no adopted or made Recovery Plan for the species. The approved conservation advice sets out a number of priority actions for the species including:

- Identify populations of high conservation priority.
- Manage threats to areas of vegetation that contain populations/occurrences/remnants of *Callistemon pungens.*
- Ensure road widening and maintenance activities (or other infrastructure or development activities as appropriate) in areas where *Callistemon pungens* occurs and do not adversely impact known populations.
- Investigate formal conservation arrangements such as the use of covenants, conservation agreements or inclusion in reserve tenure.
- Develop and implement a management plan for the control of naturalised plants where they pose a threat to *Callistemon pungens* in the local region.

It is unlikely the proposal would substantially interfere with the key priority actions outlined in the approved conservation advice for the species or the recovery of the species.

Conclusion

The proposal will result in the loss of 0.63 ha potential habitat for the species. Noting the species has not been previously recorded in the impact area, and there are no known important populations, it is considered unlikely the proposal would result in a significant impact on *Astrotricha roddii.*

D3.3 *Thesium australe*

Thesium australe is listed as Vulnerable under the EPBC Act. The following assessment has been undertaken following the MNES, Significant Impact Guidelines 1.1 (Department of the Environment, 2013a).

Is this part of an important population?

Under the Act, an important population is one that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Thesium australe is known to occur in the Nandewar, New England Tablelands and NSW North Coast Bioregions of NSW. The proposal is located within this bioregion; however the species was not recorded and there are no known records from within the study area. Habitat for the species within the study area is limited to a very small area of grassy woodland at the western end of the dam wall (PCT 4151). This habitat is considered to be in poor to moderate condition with a very sparse groundcover containing a mixture of native and exotic species. Given the degraded nature of the habitat and lack of records it is unlikely that the impact area would support an important population of the species.

Under the EPBC Act an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of an important population of a species*

The proposal will result in the loss of 0.6 ha of potential habitat . As *Thesium australe* was not recorded during the site investigations within the study area, and given the degraded condition of the habitat (PCT 4151), it is unlikely to support an important population. It is unlikely the proposal would lead to the long-term decrease in the size of an important population of the species.

- *reduce the area of occupancy of an important population*

It is unlikely the loss of 0.6 ha would reduce the area of occupancy of an important population of this species, as there are no important populations known to occur in the study area. Furthermore, the current distribution for this species is considered sporadic but widespread occurring between the Bunya Mountains in south-east Queensland to north-east Victoria and as far inland as the southern, central and northern tablelands in NSW and the Toowoomba region.
The proposal is not located at the limit of the species distribution, and the species was not recorded within the study area during the site investigations.

- *fragment an existing important population into two or more populations*

The proposal will remove 0.6 ha of potential habitat for this species. There are no important populations of *Thesium australe* known to occur in the impact area therefore it is unlikely the proposal would fragment an existing population into two or more populations. In addition, the species was not recorded within the study area during the site investigation.

– *adversely affect habitat critical to the survival of a species*

To date, no critical habitat has been listed for this species on the Register of critical habitat under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of critical habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (DEWHA, 2009).

The species is found on a variety of soil types over a wide range of altitudes in grassland, grassy woodland and grassy heath habitat is known to overlap. This habitat is not unique and is widely represented in the study area and surrounding regions. The proposal is isolated from currently known populations and records of the species. It is considered unlikely the habitat within the impact area would represent habitat critical to the survival of the species.

The proposal is unlikely to adversely impact habitat critical to the survival of the Austral Toadflax.

– *disrupt the breeding cycle of an important population*

There are no important populations of *Thesium australe* known to occur in the impact area or study area therefore it is unlikely the proposal would disrupt the breeding cycle of an important population. In addition, the species was not recorded, and habitat within the study area is limited to poor to moderate condition grassy woodland with a very sparse groundcover containing a mixture of native and exotic species

– *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal would result in the loss of 0.6 ha of potential habitat for *Thesium australe*. The species was not recorded within the study area. The habitat within the study area has been previously disturbed and is limited to poor to moderate condition grassy woodland with a very sparse groundcover containing a mixture of native and exotic species.

It is unlikely the proposal would further modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

– *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Invasive species are both currently present throughout the landscape. Mitigation measures recommended include but are not limited to the spray down of vehicles and sediment control to prevent weeds from entering the retained vegetation area during construction, and ongoing weed management such as weed spraying during operation. Therefore, it is considered unlikely that the proposal would substantially change the composition of the species habitat within the landscape or increase the spread and establishment of invasive species that could threaten the survival of the species.

– *introduce disease that may cause the species to decline, or*

As there are no known diseases likely to impact this species, given the impacts are well known it is considered unlikely that the proposal would introduce disease that would cause the decline of the species.

– *interfere substantially with the recovery of the species.*

There is no made or adopted recovery plan for *Thesium australe*, however both the approved conservation advice for *Thesium australe* indicates that the key priority action for the species is to conserve and maintain known populations and ensure there is no disturbance (except for conservation activities) in areas where the species is known to occur. Habitat for the species is restricted to poor to moderate condition grassy woodland with a very sparse groundcover containing a mixture of native and exotic species.

There are no important populations of *Thesium australe* known to occur in the study area and the species was not recorded. It is unlikely the proposal would substantially interfere with the key priority actions outlined in the approved conservation advice for the species or the recovery of the species.

Conclusion

The proposal will result in the loss of 0.6 ha potential habitat for the species. Noting the species has not been previously recorded in the study area, and there are no known important populations, it is considered unlikely the proposal would result in a significant impact on *Thesium australe.*

D4 Fauna species listed as critically endangered & endangered under the EPBC Act

The following endangered species were identified as having a moderate or higher likelihood of occurrence within the impact area:

- Regent Honeyeater (*Anthochaera Phrygia*)
- Spotted-tailed Quoll (*Dasyurus maculatus*)

D4.1 Regent Honeyeater (*Anthochaera Phrygia*)

Under the EPBC Act an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *Lead to a long-term decrease in the size of a population*

The Pindari Dam occurs in the Inverell LGA which is a subsidiary area of the regularly used area by Regent Honeyeaters for foraging and breeding, Bundarra-Barraba. A population of Regent Honeyeaters is known to occur within the King Plains National Park approximately 19 km south-east of the study area.

The Regent Honeyeater was not recorded during the site investigations, although habitat within the impact area may provide limited foraging resources for the species. The proposal would result in the loss of 0.63 ha of potential foraging habitat for the Regent Honeyeater. Given the species mobility and available habitat in the immediate vicinity and surrounding national parks and reserves, it is unlikely the proposal would reduce the foraging resources for the species enough to lead to a long-term decrease in the size of the population.

- *Reduce the area of occupancy of the species*

The proposal will result in the loss of 0.63 ha of potential grassy woodland and forest habitat for the Regent Honeyeater. Based on the approved conservation advice for the Regent Honeyeater, the species is considered to have a patchy distribution which extends from south-east Queensland, through NSW and the ACT, to central Victoria. The extent of occurrence is estimated at 600 000 km^2 and the area of occupancy at 300,000 km^2.

Given the mobility of the species and extent of similar habitat in the locality, it is unlikely the removal of 0.63 ha of potential habitat would reduce the area of occupancy of the species.

- *Fragment an existing population into two or more populations*

The 0.63 ha of potential habitat to be removed occurs at the edge of the existing dam and would not result in fragmentation of vegetation. Given the mobility of the species, nature, and scale of the impacts, it is unlikely the proposal would result in fragmentating an existing population into two or more populations.

- *Adversely affect habitat critical to the survival of a species*

The Recovery Plan for the species identifies critical habitat as any breeding or foraging habitat in areas where the species is likely to occur (as defined by the distribution map provided in Figure 2 (Department of the Environment, 2016); and any newly discovered breeding or foraging locations. The impact area is identified as an area where the species is known to occur. Figure D.1 shows the areas mapped for the Regent Honeyeater under the Important Habitat Map in relation to the study area. The most significant site is approximately 20km from the study area while the closest minor important area is approximately 10km from the study area.



Figure D.1 Important Habitat Map (Source: Planning, Industry and Environment 2024)

Although no Regent Honeyeaters were recorded during the site investigations, and no new breeding and/or foraging habitat was recorded, the habitat within the area may provide foraging resources for the Regent Honeyeater. Given the species mobility and availability of better quality habitat within the immediate vicinity and surrounding National parks and reserves it is unlikely the loss of 0.63 ha outside the important mapped habitat would adversely affect habitat critical to the survival of the species.

- *Disrupt the breeding cycle of a population*

The Regent Honeyeater is only known to breed at four key breeding areas, Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales, and the Chiltern area in north-east Victoria.

The study area is located 80km north of the Bundarra and Barraba breeding areas. Habitat for the Regent Honeyeater within the study area is restricted to a small area of foraging habitat, the trees within the impact area are predominantly younger trees and are unlikely to provide sufficient resources for breeding. Given the mobility of the species and availability of further foraging and breeding resources within the immediate vicinity and surrounds it is unlikely the loss of 0.63 ha of grassy woodland and forest habitat associated with the proposal would disrupt the breeding cycle of a population of the Regent Honeyeater.

- *Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline*

Within the study area, the Regent Honeyeater is associated with PCT 3518 and 4151. The proposed works will remove 0.63 ha from the study area. The areas proposed to be impacted are in poor to moderate condition. Higher quality

vegetation will persist outside of the study area and is unlikely to be impacted by the proposed works. Therefore, it is unlikely that the proposed works will modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- *Result in invasive species that are harmful to a critically endangered or endangered species becoming species established in the established in the endangered species habitat.*

The study area has been previously disturbed and is subjected to ongoing disturbance such as invasive species. Invasive weeds and vertebrate pests such as rabbits, cats and foxes are already known to occur within the study area (Refer to Section 4.3 and 4.6). It is unlikely the loss of foraging habitat would result in additional species that are harmful to the Regent Honeyeater or its habitat.

- *Introduce a disease that may cause the species to decline*

The key disease likely to impact these species is Psittacine Circovirus Disease (PCD). The disease is believed to have evolved with wild psittacines and is widespread in wild psittacines, including many common Australian species. Noting PCD is already within the landscape and given the nature and scale of the proposal it is unlikely it would introduce a disease that may cause the species to decline.

- *Interfere substantially with the recovery of the species*

The Recovery Plan for the Regent Honeyeater (Department of the Environment, 2016) sets out a number of actions for the recovery of the species including:

- Improve the extent and quality of regent honeyeater habitat.
- Bolster the wild population with captive-bred birds until the wild population becomes self-sustaining.
- Increase understanding of the size, structure, trajectory, and viability of the wild population.
- Maintain and increase community awareness, understanding and involvement in the recovery program.

Based on the potential ecological impacts of the proposal on the Regent Honeyeater it is unlikely the project would be in conflict with the recovery strategies/actions outlined above.

Conclusion

Based on the above assessment it is unlikely the proposal would result in a significant impact on the Regent Honeyeater or its habitat.

D4.2 Spotted-tailed Quoll (*Dasyurus maculatus*)

Under the EPBC Act an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *Lead to a long-term decrease in the size of a population*

The Spotted-tailed Quoll was not recorded during the site surveys however has been recorded previously adjacent to the study area. The proposal would result in the loss of 0.63 ha of potential hunting habitat for the Spotted-tailed Quoll. The poor to moderate condition of habitats within the impact area will not provide breeding habitat suitable for this species and therefore no breeding habitat is expected to be impacted. Given the species mobility and available habitat in the immediate vicinity and surrounding national parks and reserves, it is unlikely the proposal would reduce the feeding resources for the species enough to lead to a long-term decrease in the size of the population.

- *Reduce the area of occupancy of the species*

The Spotted-tailed Quoll southeastern mainland population is widely distributed in south-eastern Queensland, eastern New South Wales, Victoria, and the Australian Capital Territory. The extent of occurrence is estimated at 596,344 km^2 and the area of occupancy at 2,512 km^2.

The Spotted-tailed Quoll is a mobile species with a large home range (88 ha to 5,512 ha); therefore, it is unlikely the removal of 0.63 ha of habitat would reduce the area of occupancy for these species.

- *Fragment an existing population into two or more populations*

The Spotted-tailed Quoll was not recorded during the field surveys. The study area has not been identified as an area containing an important population. Habitat within the study area is already highly fragmented, given the large home range of the species (88 ha to 5,512 ha), if it is present within the study area, it is unlikely that the loss of 0.63 ha of potential habitat would fragment an existing population into two or more populations.

- *Adversely affect habitat critical to the survival of a species*

The recovery plan for the Spotted-tailed Quoll defines habitat critical to the survival as habitat that includes large patches of forest with adequate denning resources and relatively high densities of medium-sized prey. However, thresholds are unknown, therefore it is not possible to define or map habitat critical to the survival for this species. The recovery plan considers all habitat within its distribution range that are known to be occupied as important.

The Spotted-tailed Quoll was not recorded during the field surveys. The study area has not been identified as an area containing a known population of Spotted-tailed Quolls. In addition, habitat within the study area is restricted to patches of poor to moderate condition grassy woodland and forest habitat. Therefore, it is unlikely the proposal would be considered habitat critical to the survival of the Spotted-tailed Quoll.

It is unlikely that the loss of 0.63 ha of potential grassy and forest woodland would adversely affect habitat critical to the survival of the species.

- *Disrupt the breeding cycle of a population*

No breeding habitat was recorded in the study area and there are no known populations of the species within the study area. The proposal will impact on approximately 0.63 ha of potential foraging habitat for the species. Given the large home range and mobility of the species it is unlikely the loss of 0.63 ha would disrupt the breeding cycle of a population.

- *Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal will modify, destroy and/or remove 0.63 ha of potential poor to moderate condition grassy woodland and forest habitat for the species (Refer to Section 4.2). Given the large home range of the species (88 ha to 5,512 ha), and available habitat in the locality, it is unlikely the proposal would modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- *Result in invasive species that are harmful to a critically endangered or endangered species becoming species established in the established in the endangered species habitat.*

The study area has been previously disturbed and is subjected to ongoing disturbance such as invasive species. Invasive weeds and vertebrate pests such as rabbits, cats and foxes are likely to occur within the study area (Refer to Section 4.3 and Section 4.6). It is unlikely the loss of foraging habitat would result in additional species that are harmful to the Spotted-tailed Quoll and /or its habitats becoming established in the potential grassy woodland and forest habitat.

- *Introduce a disease that may cause the species to decline*

Given the nature and scale of the proposal, it is unlikely that the removal of 0.63 ha associated with the proposal would result in a disease being introduced that would cause a decline in the species.

– *Interfere substantially with the recovery of the species*

The recovery plan for the Spotted-tailed Quoll includes the following objectives:

- Determine the distribution and status of Spotted-tailed Quoll populations throughout the range and identify key threats and implement threat abatement management practices.
- Investigate key aspects of the biology and ecology of the Spotted-tailed Quoll to acquire targeted information to aid recovery.
- Reduce the rate of habitat loss and fragmentation on private land.
- Evaluate and manage the risk posed by silvicultural practices.
- Determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on Spotted-tailed Quoll populations.
- Determine and manage the impact of fire regimes on Spotted-tailed Quoll populations.
- Reduce deliberate killings of Spotted-tailed Quolls.
- Reduce the frequency of Spotted-tailed Quoll road mortality.
- Assess the threat Cane Toads pose to Spotted-tailed Quolls and develop threat abatement actions if necessary.
- Determine the likely impact of climate change on Spotted-tailed Quoll populations.
- Increase community awareness of the Spotted-tailed Quoll and involvement in the Recovery Program.

Based on the potential ecological impacts of the proposal on the Spotted-tailed Quoll it is unlikely the proposal would be in conflict with the recovery objectives outlined above.

Conclusion

No Spotted-tailed Quolls were recorded during field surveys, and the study area has not been identified as an area containing a known Spotted-tailed Quoll population. Based on the lack of records, large home range of the species and small area to be impacted it is unlikely the proposal would result in a significant impact on the Spotted-tailed Quoll.

D4.3 Koala (*Phascolarctos cinereus*)

Under the EPBC Act an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

– *Lead to a long-term decrease in the size of a population*

The Koala has been recorded in the locality of the study area including around Pindari Dam although records adjacent to the study area are unconfirmed. The total population of Koala across Australia is estimated between 92,184 to 86,863 with a drastic declined from 2018 estimates up to 184,748. The population decline was exacerbated by the 2019/20 east coast bushfires (DAWE, 2022). The proposed works will remove 0.63 ha of potential habitat for this species in small sections containing mostly young and / or smaller treed habitats, with some larger trees located south of the dam wall (refer to Section 4.2). Given the available habitat in the immediate vicinity, this species ability and tendency to disperse to surrounding national parks and reserves, it is unlikely the proposal would reduce the feeding resources for the species enough to lead to a long-term decrease in the size of the population.

– *Reduce the area of occupancy of the species*

The area of occupancy for the Koala is estimated at 19,400 km^2. These figures are based on the mapping of point records from 2000 from state governments, museums and CSIRO. There is no real chance or possibility that the proposed works will reduce the area of occupancy for Koala. The area of occupancy for this species is extensive.

– *Fragment an existing population into two or more populations*

The Koala was not recorded during the ecological surveys. The Koala's home range (the area an individual needs to survive) is highly variable and dependant on life history stage, soil fertility, habitat quality and nutritional requirements. Consequently, home ranges across the species' distribution are highly variable, with home ranges in Queensland and New South Wales reported to vary between 3 and 500 ha (DAWE, 2022). Habitat within the study area is already highly fragmented, given the large home range of the species if it is present within the study area, it is unlikely that the loss of 0.63 ha of potential habitat would fragment an existing population into two or more populations.

– *Adversely affect habitat critical to the survival of a species*

The *Conservation Advice for* Phascolarctos cinereus *(Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory (Department of Agriculture, 2022)* outlines a number of important criteria to consider in terms of 'habitat critical for survival' of Koala including:

- whether the habitat is used during periods of stress (examples: flood, drought or fire)
- whether the habitat is used to meet essential life cycle requirements (examples: foraging, breeding, nesting, roosting, social behaviour patterns or seed dispersal processes)
- the extent to which the habitat is used by important populations
- whether the habitat is necessary to maintain genetic diversity and long-term evolutionary development
- whether the habitat is necessary for use as corridors to allow the species to move freely between sites used to meet essential life cycle requirements
- whether the habitat is necessary to ensure the long-term future of the species or ecological community through reintroduction or re-colonisation
- any other way in which habitat may be critical to the survival of a listed threatened species or a listed threatened ecological community.

The advice also outlines crucial habitat elements including patches and corridors for gene flow. Over longer-time frames critical habitat includes climate refugia such as drainage lines, riparian zones and patches that are resilient to drying conditions due to favourable hydrological systems. Additionally, it includes areas that may be temporarily unoccupied, because of seral (maturity or time) changes to habitat quality that arise through processes such as fire, drought, timber harvesting or disease (shifting habitat mosaic) or degradation and are available for future recolonisation.

The habitat within the study area is unlikely to be significant in terms of species dispersal, genetic diversity, reintroduction, recovery or long-term maintenance. Preferred feed tree species occur widely within the region. The study area may be used on an intermittent basis during local movements but is unlikely to be significant in terms of species dispersal, genetic diversity, reintroduction, recovery or long-term maintenance. There is no real chance or possibility that the proposal will adversely affect habitat critical to the survival of the species

– *Disrupt the breeding cycle of a population*

The presence of habitat for Koala is largely assessed here based on habitat surrogates given the presence of Koala use trees in the study area. The study area does not contain a resident source population of Koala and would provide habitat for a low-density population. There is no known breeding population of Koala in the study area. As such, there is no real chance or possibility that the proposal will disrupt the breeding cycle of a population.

– *Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal will modify, destroy and/or remove 0.63 ha of potential poor to moderate condition grassy woodland and forest habitat for the species. The habitat has been subjected to ongoing and historic agricultural and anthropogenic impacts. Given the large home range of the species (88 ha to 5,512 ha), and available habitat in the locality it is unlikely the proposal would modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- *Result in invasive species that are harmful to a critically endangered or endangered species becoming species established in the established in the endangered species habitat.*

The impact area has been previously disturbed and is subjected to ongoing disturbance such as invasive species. Invasive weeds and vertebrate pests such as rabbits, cats and foxes are likely to occur within the study area (refer to Section 4.3 and Section 4.6). It is unlikely the loss of foraging habitat would result in additional species that are harmful to the Koala and /or its habitats becoming established in the potential grassy woodland and forest habitat.

- *Introduce a disease that may cause the species to decline*

Chlamydia bacteria in Koalas and *Koala Retrovirus* are primarily transmitted between Koala individuals. There are no known disease issues affecting this species in relation to the proposal. The proposal would be unlikely to increase the potential for significant disease vectors to affect the species. It is the intention to use current best practice hygiene protocols as part of the CEMP to prevent the introduction or spread of pathogens. Consequently, there is no real chance or possibility that the proposal will introduce disease that may cause the species to decline.

- *Interfere substantially with the recovery of the species*

The *National Recovery Plan for the Koala* Phascolarctos cinereus *(combined populations of Queensland, New South Wales and the Australian Capital Territory)* (Department of Agriculture, 2022) outlines a number of key objectives for the recovery effort of the species including:

- The area of occupancy and estimated size of populations that are declining, suspected to be declining, or predicted to decline are instead stabilised then increased.
- The area of occupancy and estimated size of populations that are suspected and predicted to be stable are maintained or increased.
- Metapopulation processes are maintained or improved.
- Partners, communities and individuals have a greater role and capability in listed Koala monitoring, conservation and management.

The objectives of this recovery plan are underpinned by four supporting strategies and two on-ground (direct) strategies, or action areas, as a way of organising and implementing coordinated action:

- Build and share knowledge (Strategy 1).
- Engage and partner with the community in listed Koala conservation (Strategy 2).
- Increase the area of protected habitat for the listed Koala (Strategy 3).
- Integrate listed Koala conservation into policy, statutory and land use plans (Strategy 4).
- Strategically restore listed Koala habitat (Strategy 5).
- Actively manage listed Koala metapopulations (Strategy 6).

The proposal will not interfere with these objectives or supporting strategies.

Conclusion

The Koala would experience a small reduction (0.63ha) in extent of potential foraging habitat from the proposed works. After consideration of the factors above, it is concluded that there is unlikely to be a significant impact to the Koala. The predicted impacts to this species would not trigger the need for an EPBC Act Referral.

D4.4 Squatter Pigeon (*Geophaps script scripta*)

Under the EPBC Act an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *Lead to a long-term decrease in the size of a population*
- *Reduce the area of occupancy of the species*

The Squatter Pigeon is widespread in the north-east and north of the Queensland. Within NSW, records of the species are concentrated on the northwestern slopes, specifically Bourke and Cobar, near Louth west of White Cliffs and 150km NNE of Broken Hill. The approved conservation advice for the species notes that the estimated area of occupancy is 10,000 km^2. The proposal would impact approximately 0.63 ha of habitat for the species, which would represent less than 0.01 per cent of the area of occupancy.

- *Fragment an existing population into two or more populations*

Fragmentation is unlikely to occur from the proposal as the work will mostly just remove scattered areas of native vegetation within areas of exotic grassland with the exception of a small patch within the western edge of the dam in which is considered a small extension of the remaining native vegetation. Importantly, the proposal will not result in the breaking apart of large blocks of high-quality habitats. It is unlikely the proposal would fragment an existing important population into two or more populations of the Squatter Pigeon.

- *Adversely affect habitat critical to the survival of a species*

To date, no critical habitat has been listed for this species on the Register of Critical habitat under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (DAWE, 2022).

The squatter pigeon (southern) inhabits the grassy understorey of open eucalypt woodland, and less often savannas. This habitat is not unique and is widely represented in the surrounding regions. The proposal is isolated from currently known population and records of the species. It is considered unlikely the habitat within the proposal areas would represent habitat critical to the survival of the species.

- *Disrupt the breeding cycle of a population*

No important populations of the species have been identified in the study area therefore, it is unlikely the proposal would disrupt the breeding cycle of an important populations.

While the proposal is potentially impacting breeding habitat for the Squatter Pigeon, the proposal has been sited to mostly avoid impacts to surrounding vegetation and is limited to 0.63 ha of native vegetation. As such the extent of more suitable habitat remaining in the locality would provide ample resources to sustain future visitation and localised breeding abilities, such that the proposal itself is unlikely to disrupt the breeding cycle of a local population of this species.

- *Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal is likely to remove up to 0.63 ha of potential habitat for this species in the form of PCTs 3518 and 4151. This species has not been recorded during the site inspection and there are no records for the species within the study area. The proposal is likely to remove habitat occurring at the edge of the existing dam and would not result in fragmentation of vegetation, though will shift potential edge effects to retained vegetation. However, given the extent of available habitat in the immediate vicinity and surrounding locality, and the mobility of the species it is unlikely to significantly modify or decrease the quality of habitat such that the species would decline.

- *Result in invasive species that are harmful to a critically endangered or endangered species becoming species established in the established in the endangered species habitat.*

The study area has been previously disturbed and is subjected to ongoing disturbance such as invasive species. Invasive weeds and vertebrate pests such as rabbits, cats and foxes are likely to occur within the study area (refer to Section 4.3 and Section 4.6). It is unlikely the loss of habitat would result in additional species that are harmful to the Squatter Pigeon and /or its habitat.

- *Introduce a disease that may cause the species to decline*

Given the nature and scale of the proposal, it is unlikely that the removal of 0.63 ha of land to be developed would result in a disease being introduced that would cause a decline in the species.

- *Interfere substantially with the recovery of the species*

There is no made or adopted Recovery Plan for this species. The approved conservation advice for the species identifies a number of conservation actions for the recovery of the species including:

- Identify sub-populations of high conservation priority, especially in the southern part of the squatter pigeon's (southern) range.
- Protect and rehabilitate areas of vegetation that support important sub-populations.
- Develop and implement a stock management plan for key sites.
- Develop and implement a management plan, or nominate an existing plan to be implemented, for the control and eradication of feral herbivores in areas inhabited by the squatter pigeon (southern).
- Raise awareness of the squatter pigeon (southern) within the local community, particularly among land managers. Survey and Monitoring priorities.
- Monitor selected sub-populations throughout the distribution of the subspecies to identify rates of population change.
- It unlikely the proposal would be in conflict with the recovery strategies/actions outlined above.

Conclusion

The Squatter Pigeon would experience a small reduction (0.63ha) in extent of potential habitat from the proposal. After consideration of the factors above, an overall conclusion has been made that there is unlikely to be a significant impact to this species. The predicted impacts to the Squatter Pigeon would not trigger the need for an EPBC Act Referral.

D4.5 South-eastern Hooded Robin (*Melanodryas cucullata cucullata*)

Under the EPBC Act an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *Lead to a long-term decrease in the size of a population*
- *Reduce the area of occupancy of the species*

The South-eastern Hooded Robin is widespread across Australia with the exception of the driest deserts and wetter coastal areas. The south-eastern form (subspecies cucullata) is found throughout much of inland NSW. The approved conservation advice for the species notes that the estimated area of occupancy is 30,000 km^2. The proposal would impact approximately 0.63 ha of habitat for the species, which would represent 0.000021 per cent of the area of occupancy (0.0063 / 30000 x 100).

- *Fragment an existing population into two or more populations*

Fragmentation is unlikely to occur from the proposal as the work will mostly remove scattered areas of native vegetation within areas of exotic grassland with the exception of a small patch within the western edge of the dam in which is considered a small extension of the remaining native vegetation. Importantly, the proposal will not result in the breaking apart of large blocks of high-quality habitats. It is unlikely the proposal would fragment an existing important population into two or more populations of the South-eastern Hooded Robin.

- *Adversely affect habitat critical to the survival of a species*

To date, no critical habitat has been listed for this species on the Register of Critical habitat under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (DAWE, 2022).

The South-eastern Hooded Robin prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings (OEH, 2025). This species structural diversity, including mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses (OEH, 2025). Despite the presence of records locally, the study area lacks mature eucalypts and native grasses preferred by this species. It is considered unlikely the habitat within the proposal areas would represent habitat critical to the survival of the species.

- *Disrupt the breeding cycle of a population*

No important populations of the species have been identified in the study area therefore, it is unlikely the proposal would disrupt the breeding cycle of an important populations.

While the proposal may be impacting a very small area of potential breeding habitat for the South-eastern Hooded Robin, the proposal has been sited to mostly avoid impacts to surrounding vegetation and is limited to 0.63 ha of native vegetation. As such the extent of more suitable habitat remaining in the locality would provide ample resources to sustain future visitation and localised breeding abilities, such that the proposal itself is unlikely to disrupt the breeding cycle of a local population of this species.

- *Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal is likely to remove up to 0.63 ha of potential habitat for this species in the form of PCTs 3518 and 4151. The proposal is likely to remove habitat occurring at the edge of the existing dam and would not result in fragmentation of vegetation, though will shift potential edge effects to retained vegetation. However, given the extent of available habitat in the immediate vicinity and surrounding locality, and the mobility of the species it is unlikely to significantly modify or decrease the quality of habitat such that the species would decline.

- *Result in invasive species that are harmful to a critically endangered or endangered species becoming species established in the established in the endangered species habitat.*

The study area has been previously disturbed and is subjected to ongoing disturbance such as invasive species. Invasive weeds and vertebrate pests such as rabbits, cats and foxes are likely to occur within the study area (refer to Section 4.3 and Section 4.6). It is unlikely the loss of habitat would result in additional species that are harmful to the South-eastern Hooded Robin and /or its habitat.

- *Introduce a disease that may cause the species to decline*

Given the nature and scale of the proposal, it is unlikely that the removal of 0.63 ha of land to be developed would result in a disease being introduced that would cause a decline in the species.

- *Interfere substantially with the recovery of the species*

There is no made or adopted Recovery Plan for this species. The approved conservation advice for the species identifies a numerous conservation and recovery actions.

It is considered that proposal is unlikely to conflict any of these conservation and recovery actions.

Conclusion

The South-eastern Hooded Robin would experience a small reduction (0.63ha) in extent of potential habitat from the proposal. After consideration of the factors above, an overall conclusion has been made that there is unlikely to be a significant impact to this species. The predicted impacts to the South-eastern Hooded Robin would not trigger the need for an EPBC Act Referral.

D5 Fauna species listed as vulnerable under the EPBC Act

The following listed vulnerable species were identified as having a moderate or higher likelihood of occurrence within the study area:

- Brown Treecreeper (*Climacteris picumnus victoriae*)
- Diamond Firetail (*Stagonopleura guttata*).

D5.1 Woodland birds

The Brown Treecreeper and Diamond Firetail have been grouped together as they have similar habitat requirements and listing status. Both species are listed as vulnerable under the EPBC Act. The following assessment has been undertaken following the MNES, Significant Impact Guidelines 1.1 (Department of the Environment, 2013a).

Habitat for the two woodland bird species is restricted to the grassy woodland and forest habitat within the study area. The proposal is likely to result in the loss of 0.63 ha of potential poor to moderate condition grassy woodland and forest habitats.

Is an important population likely to be present?

Under the EPBC Act, important populations are:

- likely to be key source populations either for breeding or dispersal.
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Based on the approved conservation advice for each of the woodland species and DCCEEWs Species Profile and Threats Database, none of the woodland species would be considered at or near the limit of the species range or have been identified as a key source population for breeding or for maintaining genetic diversity.

No important populations of the Brown Treecreeper or Diamond Firetail are known to occur within the impact area or study area.

Under the EPBC Act, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *Lead to a long-term decrease in the size of an important population of a species*

No important populations of the two woodland birds' species have been identified in the study area. In addition, no important populations were identified in the approved conservation advice for each of the woodland bird species. Therefore, it is unlikely the proposal would lead to a long-term decrease in the size of an important population of Brown Treecreeper or Diamond Firetail.

- *Reduce the area of occupancy of an important population*

No important populations of Brown Treecreeper or the Diamond Firetail have been identified in the study area and therefore, it is unlikely the proposal would reduce the area of occupancy of an important population of the two woodland bird species.

– *Fragment an existing important population into two or more populations*

It is unlikely the proposal would fragment an existing important population into two or more populations, as no important populations of Brown Treecreeper or Diamond Firetail are known to occur within the study area. In addition, the habitat to be removed is at the edge of the existing dam and would not result in fragmentation of the remaining habitat.

– *Adversely affect habitat critical to the survival of a species*

Habitat critical to the survival of a species also refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community.

Habitat critical to the survival of these species includes:

- **Brown Treecreeper (south-eastern).** Areas that have a relatively undisturbed grassy woodland with native understorey. The habitat structure should be quite open at ground level so that birds are able to feed on or near the ground and maintain vigilance against predators. Living and dead trees are essential for roosting and nesting sites and fallen timber which provides essential foraging habitat. Habitat with hollows in standing dead or live trees and tree stumps are also essential for nesting. Habitat within the impact area lacks fallen timber and trees with hollows, therefore it is unlikely the habitat would represent habitat critical for the Brown Treecreeper.
- **Diamond Firetail**. Identified areas of Eucalypt, acacia or casuarina woodlands, open forests, and other lightly timbered habitats, low tree density, few large logs, and little litter cover but high grass cover for foraging, roosting, and breeding. The approved conservation advice also states that any known or likely habitat identified in map 1 of the approved conservation advice should be considered habitat critical to the survival of the species. The impact area falls within the area mapped as known habitat, therefore could be considered habitat critical to the species. However, given the degraded nature of the study area, it is unlikely the impact would represent habitat critical to the survival of the species.

The proposal is likely to remove approximately 0.63 ha of grassy woodland and forest (PCT 3518 and 4151) habitat for Brown Treecreeper and Diamond Firetail. This represents approximately <0.01 % of the extent of PCT 3518 and 4151 within NSW. Noting the mobility of the bird species, lack of essential habitat features and areas of available habitat of better quality in the vicinity of the study area, it is unlikely that the species would be dependent on the foraging resources. Therefore, it is unlikely the proposal would adversely impact habitat critical to the survival of the two woodland bird species.

– *Disrupt the breeding cycle of an important population*

No important populations of the species have been identified in the study area therefore, it is unlikely the proposal would disrupt the breeding cycle of an important population.

– *Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal is likely to remove up to 0.63 ha of potential habitat for this species in the form of PCTs 3518 and 4151. The two woodland birds' species have not been recorded during the site inspection and there are no records for the species within the study area. The proposal is likely to remove habitat occurring at the edge of the existing dam and would not result in fragmentation of vegetation, though will shift potential edge effects to retained vegetation. However, given the extent of available habitat in the immediate vicinity and surrounding locality, and the mobility of the species it is unlikely to significantly modify or decrease the quality of habitat such that the species would decline.

- *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Invasive species are currently present throughout the landscape with much of the understorey within the impact area dominated by exotic species. Mitigation measures will be put in place as part of the CEMP for the proposal including but not limited to the spray down of vehicles and sediment control to prevent weeds from entering the retained area during construction, and follow-up weed control as required. Therefore, it is considered unlikely that the proposal would substantially change the composition of the species habitat within the landscape or increase the spread and establishment of invasive species that could threaten the survival of the two woodland bird species.

- *Introduce disease that may cause the species to decline*

The proposal involves construction works that have potential to introduce disease or pathogens into the study area and surrounding areas. This would be controlled through the implementation of appropriate mitigation measures, making the risk unlikely.

- *Interfere substantially with the recovery of the species*

There is currently no adopted or made recovery plan for the Brown Treecreeper or Diamond Firetail. The approved conservation advice for these species identify a number of regional and local priority actions for each species to assist in recovery. The proposal is unlikely to substantially interfere with any of these actions.

Conclusion

The proposal will result in the loss of 0.63 ha of poor to moderate condition grassy woodland and forest potential habitat for the Brown Treecreeper and Diamond Firetail. Given the modified nature of the habitat, mobility of the woodland bird species and habitat in the vicinity of the proposal, it is unlikely the proposal would result in a significant impact on the Brown Treecreeper or Diamond Firetail.

Appendix E

Species list

Opportunistic records of fauna species were recorded during the site visit (refer to Table E.1).

Table E.1 Fauna species

Scientific Name	Common Name	Observation Type	BC Act[1]	EPBC Act[1]
Birds				
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	Observation	-	-
Anas castanea	Chestnut Teal	Observation	-	-
Anas superciliosa	Pacific Black Duck	Observation	-	-
Aquila audax	Wedge-tailed Eagle	Observation	-	-
Caligavis chrysops	Yellow-faced Honeyeater	Call	-	-
Coracina novaehollandiae	Black-faced Cuckoo-shrike	Call	-	-
Corvus coronoides	Australian Raven	Observation	-	-
Cracticus nigrogularis	Pied Butcherbird	Call	-	-
Egretta novaehollandiae	White-faced Heron	Observation	-	-
Gymnorhina tibicen	Australian Magpie	Observation	-	-
Lichenostomus penicillatus	White-plumed Honeyeater	Observation	-	-
Neochmia temporalis	Red-browed Finch	Observation	-	-
Malurus cyaneus	Superb Fairy-wren	Call	-	-
Manorina melanocephala	Noisy Miner	Observation	-	-
Microcarbo melanoleucos	Little Pied Cormorant	Observation	-	-
Pachycephala rufiventris	Rufous Whistler	Call	-	-
Pelecanus conspicullatus	Australian Pelican	Observation	-	-
Phalacrocorax sulcirostris	Little Black Cormorant	Observation	-	-
Philemon corniculatus	Noisy Friarbird	Observation	-	-
Rhipidura leucophyrys	Willie Wagtail	Call	-	-
Rhipidura fuliginosa	Grey Fantail	Observation	-	-
Sericornis frontalis	White-browned Scrubwren	Call	-	-
Strepera graculina	Pied Currawong	Call	-	-

Scientific Name	Common Name	Observation Type	BC Act[1]	EPBC Act[1]
Tachybaptus novaehollandiae	Australasian Grebe	Observation	-	-
Vanellus miles	Masked Lapwing	Observation	-	-
Mammals				
Macropus robustus	Common Wallaroo	Observation	-	-
Tachyglossus aculeatus	Short-beaked Echidna	Scat	-	-
Trichosurus vulpecula	Common Brushtail Possum	Scat / scratches on trunk	-	-

(1) Listed under the EPBC Act or BC Act as E = Endangered V= Vulnerable

Appendix C

NSW DPIRD Fisheries Consultation

DPIRD Fisheries
Department of Primary Industries and Regional Development

Our Ref: C24/856 FE24/1176

14 October 2024

Mark Maund
WSP Australia Pty Ltd
Level 2, 121 Marcus Clarke Street
Canberra ACT 2601

Re: **Pindari Dam Bubble Plume - Review of Environmental Factors**

Thank you for your consultation on the 10th October 2024 on behalf of WaterNSW and NSW Department of Primary Industries and Regional Development, seeking input into the Review of Environmental factors for this proposal from DPIRD Fisheries, a division of NSW Department of Primary Industries and Regional Development.

DPIRD Fisheries is responsible for ensuring that fish stocks are conserved and that there is no net loss of key fish habitats upon which they depend. To achieve this, DPIRD Fisheries ensures that developments comply with the requirements of the *Fisheries Management Act 1994* (namely the aquatic habitat protection and threatened species conservation provisions in Parts 7 and 7A of the Act, respectively), and the associated *Policy and Guidelines for Fish Habitat Conservation and Management (2013)*. In addition, DPIRD Fisheries is responsible for ensuring the sustainable management of commercial, recreational and Aboriginal cultural fishing, aquaculture, marine parks and aquatic reserves within NSW.

In relation to required approvals/permits, consultation is required by a public authority such as WaterNSW for any proposed *dredging and reclamation* works within *Key Fish Habitat* such as Pindari Dam, in accordance with section 199 of the *Fisheries Management Act 1994* (the Act). Such works may include, but are not limited to construction of waterway structures, pile driving in waterways, excavating or reclaiming the bed or banks of any *Key Fish Habitat* with anchorage or mooring blocks or pipelines. The REF should describe the type and extent of such proposed works within *Key Fish Habitats*.

A permit may also be required to temporarily or permanently block fish passage under section 219 of the Act. Such works may include the bunding an area of a waterway during waterway construction and other similar works. The REF should describe the type, extent and duration of such works.

AQUATIC ECOLOGICAL ASSESSMENT

An aquatic ecological assessment is required that addresses all direct and indirect impacts of the Project on *Key Fish Habitat* and associated flora and fauna including threatened species, populations, and communities during construction and operation for the life of the asset.

The Aquatic Ecological Assessment should cover the assessment requirements outlined in Chapter 3 of the *Policy and Guidelines for Fish Habitat Conservation and Management (2013)* including:

- Recent aerial photograph (preferably colour), map or GIS of the locality which details the Key Fish Habitat of the development site, all habitats impacted by the development, and waterway classification (CLASS) as defined in Tables 1 and 2 of the *Policy and Guidelines for Fish Habitat Conservation and Management (2013).*
- Location details of all temporary and permanent infrastructure and construction activities, such as pipelines, access tracks, mooring blocks, anchorages etc.
- Details of the location of all waterway structures and a timetable for construction of the proposal with details of various phases of construction.
- Mapping of the full aerial extent of *Key Fish Habitat* that will be impacted either directly or indirectly by the development and subsequent operation of the project, with impacted habitats clearly identified on recent aerial photographs, maps or GIS..
- Description, quantification, and mapping of all aquatic and riparian vegetation communities potentially impacted by the development. This should include an assessment of the extent and condition of aquatic and riparian vegetation and the presence of significant habitat features (e.g. gravel beds, cobble beds, large woody debris, reed beds, rock bars, etc) within the dam. DPIRD Fisheries requests information on the chosen pipeline alignment underwater, and the impacts of the pipeline, the 5 tonne mooring blocks and 200kg anchor blocks on any such habitat features.
- Predicted impacts on water quality within and downstream of the dam as a result of the proposed development.
- Addressing the threatened species provisions of the *Fisheries Management Act 1994* for species, populations or communities listed under schedules 4 and 5 whose historical geographical distribution extends to the area of works. The Spatial Data Portal https://www.dpi.nsw.gov.au/fishing/fisheries-research/spatial-data-portal has information on distribution of species within this area.
- Development of mitigation measures during construction (e.g. Environmental Management Plans) and operation (e.g. Operational Management Plan) including monitoring of proposed mitigation measures and plans to confirm their effectiveness. Erosion and sediment mitigation devices are to be erected in a manner consistent with currently accepted Best Management Practice (ie *Managing Urban Stormwater: Soils and Construction 4th Edition Landcom, 2004*) to prevent the entry of sediment into the waterway.

If you require any further information, please do not hesitate to contact me on 0429 908 856.

Yours sincerely

D. Ward

David Ward
Fisheries Manager (Tamworth)

Appendix D

Aquatic Ecology Assessment

Aquatic Ecology Assessment

Pindari Dam Bubble Plume Destratification System

Prepared For: AssetReady Australia Pty Ltd

Report Date: 16 December 2024



H2O Consulting Group Pty Ltd

P: 0414 848 105 | E: info@h2oconsultinggroup.com.au | W: www.h2oconsultinggroup.com.au

H2O Consulting Group Pty Ltd

PO Box 3257, Erina NSW 2250
Email: info@h2oconsultinggroup.com.au
Web: https://h2oconsultinggroup.com.au
Ph: 0414 848 105

Document Details	
Report Title	Aquatic Ecology Assessment
Project Title	Pindari Dam Bubble Plume Destratification System
Prepared For	AssetReady Australia Pty Ltd
Report Date	16/12/2024
Project Team	David Cummings, Alex Swanson
Job No. / Ref	2359

Document Control			
Version	Author	Reviewer	Date
Draft	Alex Swanson BMarBiol	David Cummings BSc (Hons) PhD	11/10/2024
R0	Alex Swanson BMarBiol	Dr Mark Maund (WSP Australia Pty Ltd)	16/12/2024

Disclaimer:

The information provided in this document is based on knowledge, understanding and field observations at the time of review of associated materials and/or site survey. The report should be read and considered in its entirety including consideration of the limitations described in the report.

H2O Consulting Group Pty Ltd has completed this assessment in accordance with the relevant federal, state and local legislation. H2O Consulting Group Pty Ltd accepts no liability or responsibility for contents of this report in respect of any use of, or reliance upon, by any third party or for any use other than the purposes for which it was commissioned. Unauthorised use of this document is prohibited.

© 2024 H2O Consulting Group Pty Ltd. This report is copyright.

Terminology

Term	Definition
Proposal	Proposed installation of a bubble plume system at Pindari Dam
Proposal Site	The location, inclusive of the impact are, where the proposal will occur
Impact Area	Defined area where proposed works will be conducted during construction and operation, including temporary and permanent infrastructure
Study Area	Defined investigation area for field surveys and assessments (please note this definition is different to the definition for other reports)
Locality	10 kilometre area buffering the Study Area and extent of some database searches
Pindari Dam	Physical dam structure including dam wall
Lake Pindari	The impounded reservoir or water storage behind (upstream) of Pindari Dam and area in which the bubble plume system including the air diffuser and buoyancy pipe will be constructed and operated.

Executive Summary

H2O Consulting Group has been engaged by WSP Australia Pty Ltd to provide an Aquatic Ecology Assessment (AEA) for the Pindari Dam Bubble Plume Destratification System in Pindari, NSW ("the project") to support a Review of Environmental Factors (REF).

This report provides supporting information for the REF that is being prepared by AssetReady Australia Pty Ltd to assess the potential for environmental impacts from the proposed strategy. The project will involve the installation and operation of a bubble plume system in the lower area of Lake Pindari, with the objectives to mitigate thermal stratification within the dam and reduce downstream cold-water pollution along the Severn River. The project will be assessed under Part 5, Division 5.1 of the *Environmental Planning and Assessment Act 1979*.

Pindari Dam, located on the Severn River, is one of eight high-priority dams identified during stage one of the NSW Cold Water Pollution Strategy. Pindari Dam was deemed most appropriate to conduct trial mitigation works involving artificial destratification through application of bubble plumes by the University of New South Wales (UNSW) Water Research Laboratory (WRL) (Chaaya and Miller 2023). Successful destratification and reduction of cold-water pollution at Pindari Dam will be used as a framework for remediating stratified reservoirs across the state.

The Pindari Dam Monitoring, Evaluation and Reporting (MER) program was established to assess the installation of the bubble plume system in Lake Pindari, with objectives to evaluate the aerator's impact on water temperature and aquatic biodiversity in the Severn River, as well as provide empirical data and guidance on its strategic application. The MER program is currently in its baseline monitoring stage, establishing baseline conditions for temperature, water quality and ecological community structure in Lake Pindari and Severn River prior to the installation of the aerator. Current data from the program was provided to H2O Consulting Group to inform this assessment. Additionally, a site survey was undertaken along the immediate 2 km of the Severn River downstream of Pindari Dam to inform general habitat conditions.

The proposed Pindari Dam Bubble Plume Destratification System has been designed with the objective to mitigate negative impacts of CWP from dam releases to the Severn River. It is expected that the operation of the bubble plume system in Lake Pindari will break down the thermocline and oxycline that persists in the dam, thus homogenising water quality conditions in the lower dam in vicinity of the offtake. This is expected to increase the temperature of dam releases, thus reducing the temperature differential between releases and the ambient temperature of the Severn River.

A number of positive changes are expected to impact on aquatic habitat in downstream receiving waters of the Severn River that will be beneficial for a number of aquatic species, including threatened fish. Increased temperatures of releases and more stable water temperatures may increase the success of recruitment and survival of threatened fish species, including *M. peelii*, *T. tandanus* and *B. bidyanus*, through increased likelihood of normal temperature cues, increased number of suitable spawning days, increased growth and metabolic rates and increased fitness. Changes to water temperatures may also be beneficial for other aquatic fauna such as Platypus or freshwater turtles, however, may result in some short-term disturbances of fauna at lower trophic levels, such as invertebrates of the Darling River EEC, as they adapt to modifications to the existing environmental conditions. Further assessment has identified that the proposed

system is unlikely to have a significant negative impact on threatened species and populations in Lake Pindari and the Severn River downstream of the dam, with a net positive impact expected.

The major potential risk to aquatic ecology will be the potential to exacerbate conditions that lead to algal blooms of toxic cyanobacteria in Lake Pindari, with potential for spread to downstream habitats of Severn River. The purpose of the bubble plume system is to promote upwelling of bottom waters to increase temperature and dissolved oxygen levels at the sediment / water interface, thereby reducing production of soluble metals and nutrients, which are present as a result of anoxic conditions. However, some risk exists if the plume system does not result in complete mixing. Where soluble metals and nutrients are pushed towards the surface, but where dissolved oxygen levels do not sufficiently increase, they may be metabolised by algae, including cyanobacteria, whilst increases in water temperature may also promote higher growth and metabolic rates in algae and periphyton and contribute to increases in algal biomass. The risks for exacerbation of algal blooms in Lake Pindari, which is already susceptible to toxic cyanobacterial blooms, should be acknowledged and monitored during operation.

There also remains potential for indirect disturbances, particularly the mobilisation of sediments during construction and use of the laydown area and the resulting increased sedimentation and turbidity that can cause short-term reductions in water quality. This may impact the adjoining KFH in Lake Pindari, however, impacts are expected to be localised and short-term.

To manage the potential risks that this proposal may pose to aquatic habitat, flora and fauna and the potential for impacts to adjacent habitat from changes in water quality parameters, a series of recommendation have been provided. These recommendations should be adopted into the CEMP for construction and operational works for this proposal. Additionally, a series of recommendations for water quality and ecological monitoring have been provided for consideration with the existing programs. With adoption of these recommendations, the project is considered unlikely to have a significant impact on any State- and/or Commonwealth-listed threatened aquatic biodiversity.

Table of Contents

1 Background 9
1.1 Overview 9
1.2 Locality and Site 9
1.3 Description of the Works 10
1.4 Background Information 14
1.4.1 Lake Pindari, Pindari Dam and Severn River 14
1.4.2 Stratification and Cold-Water Pollution in Lake Pindari and Severn River 14
1.4.3 Destratification Systems 15
1.4.4 Pindari Dam MER Program 16
1.5 Relevant Legislation and Policies 16
1.5.1 Fisheries Management Act 1994 16
1.5.2 Water Management Act 2000 17
1.5.3 Biodiversity Conservation Act 2016 17
1.5.4 Environmental Planning and Assessments Act 1979 18
1.5.5 Environmental Protection and Biodiversity Conservation Act 1999 18
1.6 Assessment Objectives 18
2 Methodology and Approach 20
2.1 Desktop Review 20
2.1.1 Threatened Species Searches 20
2.1.2 Existing Ecological Mapping 20
2.1.3 Existing Ecological Research – Lake Pindari and surrounding catchments 20
2.2 General Site Investigations 21
2.2.1 Site and Habitat Inspection 21
2.2.2 Key Fish Habitat Mapping 21
2.3 Survey Sites and Assessments 21
2.3.1 Riparian Assessment 21
2.3.2 Qualitative Water Quality 21
2.4 Threatened Species Assessment 22
2.5 Limitations 22
3 Results and Findings 24
3.1 Desktop Review 24

3.1.1 Threatened Biodiversity and Protected Matters 24
3.1.2 Existing Ecological Mapping 28
3.2 Review of Existing Research 28
3.2.1 Stratification Dynamics – Lake Pindari 28
3.2.2 CWP – Severn River 28
3.2.3 Algal bloom formation, position in water column and transport 29
3.2.4 Nutrient and Metal release and transport 29
3.2.5 CWP impacts on primary production (Severn River) 30
3.2.6 CWP impacts on invertebrate production and community composition (Severn River) 30
3.2.7 Fish Communities 30
3.3 Description of Habitat and Biota 33
3.3.1 General Habitat Descriptions 33
Site 1 33
Site 2 33
Site 3 34
3.3.2 Aquatic Flora 34
3.3.3 Aquatic Fauna 34
3.3.4 Key Fish Habitat 35
3.3.5 Water Quality (Qualitative) 35
3.3.6 Riparian Assessment 35
4 Impact Assessment 38
4.1 Potential Construction Impacts 38
4.1.1 Aquatic Flora 40
4.1.2 Aquatic Fauna 41
4.1.3 Riparian Vegetation 42
4.1.4 Water Quality 43
4.2 Potential Operational Impacts 44
4.3 Water Quality 46
4.3.1 Temperature 46
4.3.2 Dissolved Oxygen 47
4.3.3 Nutrients and Cyanobacteria 47
4.4 Aquatic Flora 48
4.4.1 Freshwater Macrophytes 48

4.5 Aquatic Fauna 49
4.5.1 Fish 49
4.5.2 Invertebrates 51
4.5.3 Monotremes 53
4.5.4 Aquatic Reptiles 53
4.6 Riparian Vegetation 54
4.7 Assessments of Significance 54
4.7.1 Freshwater Fish 54
4.7.2 Darling River EEC 54
5 Recommendations and Conclusions 55
5.1 Recommendations 55
5.1.1 Management Measures 55
5.1.2 Operational Requirements 57
5.1.3 Permits and Consultation 58
5.1.4 Offsetting 58
5.2 Conclusions 59
References 61
Plates 65
Appendix 1 – Proposed Destratification System Plans 70
Appendix 2 – Threatened Species Searches 78
Appendix 3 – Existing Ecological Mapping 94
Appendix 4 – Assessments of Significance 98

1 Background

1.1 Overview

H2O Consulting Group has been engaged by WSP Australia Pty Ltd to provide an Aquatic Ecology Assessment (AEA) for the Pindari Dam Bubble Plume Destratification System in Pindari, NSW ("the project") to support a Review of Environmental Factors (REF).

Pindari Dam, located on the Severn River, is one of eight high-priority dams identified during stage one of the NSW Cold Water Pollution Strategy. Pindari Dam was deemed most appropriate to conduct trial mitigation works involving artificial destratification through application of bubble plumes by the University of New South Wales (UNSW) Water Research Laboratory (WRL) (Chaaya and Miller 2023). Successful destratification and reduction of cold-water pollution at Pindari Dam will be used as a framework for remediating stratified reservoirs across the state.

This report provides supporting information for the REF that is being prepared by AssetReady Australia Pty Ltd to assess the potential for environmental impacts from the proposed strategy. The project will involve the installation and operation of a bubble plume system in the lower area of Lake Pindari adjacent to Pindari Dam, with the objectives to mitigate thermal stratification within the dam and reduce downstream cold-water pollution along the Severn River. The project will be assessed under Part 5, Division 5.1 of the *Environmental Planning and Assessment Act 1979*.

1.2 Locality and Site

Pindari Dam is located on the Severn River, approximately 22 km upstream of Ashford and approximately 44 km northeast of Inverell near the NSW-Queensland border, with a total operating capacity of 312 GL and surface area of 11 km^2. The dam was originally completed in 1969 and enlarged in 1995 to over eight times its original capacity (NSW DPE 2019), with the dam wall 954 m long and 85 m high (WaterNSW 2024). It is owned and operated by Water NSW and is operated in association with Queensland's Glenlyon Dam to supply regulated flows for irrigation, stock and household use, town water and industrial use in the Border Rivers of Severn and Macintyre River. Releases from Pindari Dam also provide town water for Ashford, Yetman, Boggabilla, Boomi and Mungindi and environmental flows for the Severn River (NSW DPE 2019).

Lake Pindari and Pindari Dam are situated on the Severn River, just downstream of the Severn River Nature Reserve, and receive water from the extensive Severn River catchment from the east. Water releases from the dam are discharged into the Severn River downstream of the dam wall, which eventually confluences with the Macintyre River over 200 km downstream. The bubble plume system is proposed to be installed in the southern section of the dam within approximately 1 km of the dam wall, with associated infrastructure to be installed around and below the dam wall. This area will be referred to as the 'Impact Area' throughout this AEA. The operation of the proposed destratification system will affect the Severn River downstream of Pindari Dam and the immediate area around the system in Lake Pindari. A Study Area of the first two kilometres of Severn River downstream of Pindari Dam wall and outlets, including lower Scrub Hut Creek, and associated riverbanks was established as part of this assessment (Figure 1). More extensive studies done by others in the downstream stretches of Severn River have also been considered as part of this assessment (Section 1.4.4).

1.3 Description of the Works

WaterNSW and the NSW Government Department of Primary Industries and Regional Development (NSW DPIRD) is proposing to establish a bubble plume destratification system at Pindari Dam as a trial mitigation measure to disrupt thermal stratification within Lake Pindari and reduce potential for cold water pollution to affect downstream fish stocks (the proposal). If successful, bubble plumes will be used as a framework for remediating stratified reservoirs across the state. The bubble plume destratification system in Lake Pindari aims to reduce stratified water in the lake through pumping compressed air through a pipe network to diffusers.

The proposal involves the construction and operation of a bubble plume destratification system within the impounded reservoir called Lake Pindari to reduce potential downstream cold water pollution from thermal destratification. This system involves pumping compressed air through a pipe network to diffusers generally located in the deepest part of a lake; however, depth of the diffusers can be varied.

Key features of the proposal include (WSP Pindari Dam Bubble Plume Destratification System, 2024):

- Site establishment and mobilisation
- Civil construction works
    - Concrete foundations
    - Separate car-port style shade structure over the compressors
    - Perimeter security fencing of compressors site
    - Underground drainage pipes (Poly Vinyl Chloride – Unplasticised) (PVC-U))
    - Asphalt access road and vehicle pavement suitable for a standard 7.8 metre long non-articulated vehicle and concrete pavement for the mechanical and electrical equipment
    - Prototype testing of precast anchor blocks for the diffuser and buoyancy pipes
- Electrical and mechanical construction works (to power the compressors)
    - High voltage (HV) electrical power supply from the Essential Energy grid by an extension from an existing pole at the base of the dam
    - One 1000 kilovolt amps (kVA) pad mounted transformer
    - HV conduit and cables from transformer to switchboard
    - Low-voltage (LV) Switchboard
    - LV conduits, pits, and cabling from switchboard to workshop
    - LV conduits and cabling from switchboard to dam low level outlet
    - Instruments required include pressure transmitter, flowmeter, compressed air dryer
- Aeration pipework assembly – 680 metre air distribution pipe
    - Two oil-free screw type compressors delivering nominal maximum 1000 litres per second free air delivery (FAD) located at the base of the dam embankment
    - Above ground pipework, valves, and fittings and associated metal pipe supports within compressors site
    - Bifurcation of air distribution pipe into air diffuser pipe and buoyancy with isolating valves
    - Tilt-up switch room within the compressors site in reservoir installation of aeration pipework
    - Survey using multi-beam echo sound and sediment sampling of thalweg to gather accurate data for location of the air diffuser pipe
    - Barge mobilisation from the staging points north and south of the dam wall
    - Installation of the buoyancy pipe (855 metres) along reservoir batter and within water

- Installation of air diffuser pipe (500 metres) with airports clustered on top of the air diffuser pipe at 25 metre spacing over the pipe length in the thalweg of the reservoir
    - Drilling holes (airports) on the obvert (highest interior level) of air diffuser pipe
    - Scuba to inspect the location and alignment of the air diffuser pipe and anchor blocks– this will only viable if the lake water depth at the time of construction is less than 30 metres
    - Purging hose and valve at the downstream end of the buoyancy pipe
- Commissioning of compressors and air diffuser pipe
    - Testing and commissioning will need to occur to ensure all interfaces are operating as intended
- Demobilisation.

Construction of the proposal would occur in several stages.

The key construction activities are outlined in Table 1 (WSP Pindari Dam Bubble Plume Destratification System, 2024).

Table 1: Construction methodology and timing

Construction stage	Activities	Estimated duration
Site establishment and mobilisation	• establishment of environmental controls • installation of temporary boundary fencing and site amenities • installation of power generators • establishment of concrete washout bays for construction works, locations for stockpiling earth fill, concrete or other recycle materials • survey of existing structures, abutment, surrounds, and relevant underground infrastructure • relocation of infrastructure which may interfere with undertaking works • installation of traffic controls • vegetation removal	2 weeks
Civil construction: New concrete foundations and awning structures for compressors and electrical switchboard prior to on-site fusion welding of the air diffuser pipe strings	• erosion and sediment control • earthworks cut and fill • slab drainage and electrical pits/conduits • fibre reinforced polymer slab construction and compressor plinths • installation of stormwater and oil separator tank • asphalt surface • security fencing • earthworks will involve removal of approximately 1500 m^3 of rock strata using conventional earthmoving equipment such as 30 tonne excavators with rock hammer attachments, dump trucks, water cart and a 12 tonne excavator — no geotechnical information is available for rock strength at present, it is expected that all excavation works will be into rock and will require the use of rock breakers • stockpile of materials on-site.	17 weeks
Electrical and mechanical construction	• connection of low voltage kiosk and pipework to two 500 kilovolt amps (kVA) transformers • unloading of the two compressors from the delivery truck and installation on the concrete pads • outages are to be arranged with WaterNSW for the installation of compressors • supply, installation and termination of all cables as listed in and schematic drawings to power supply and control systems as necessary • configuration of the power line communication (PLC)/supervisory control and data acquisition (SCADA) network to communicate with the compressor to provide monitoring on the SCADA • testing, including system acceptance test and commissioning of each compressor to meet the design, installation and functional requirements.	9 weeks

Construction stage	Activities	Estimated duration
Aeration pipe assembly	Air distribution pipe: • trenching along the shoulder of existing asphalt access track (to the existing workshop at the base of the dam) using conventional trenching open cut method • restoration of asphalt surfaces will be necessary at road crossings • trenching will be below ground for about 250 metres from the compressor site and will cross the existing outlet channel bridge by an anchorage system to existing access bridge structure • pipe will continue above ground along the base toe of the dam where the slope of the embankment increases from 10 per cent grade (1V:10H) to 40 per cent grade (1V:2.5H) to the northern crest • high-density polyethylene (HDPE) pipe for the section running along the toe of the dam wall will be strung out at the base of the dam and dragged up the base of the embankment using a small dozer or excavator • the section of pipe to run up the embankment wall will be welded together at the crest and spillway, dragged down the slope and then welded to the low-level pipe work • the air diffuser pipe section will also be welded and strung out on the crest of the dam • at the transition from below ground to above ground pipework, a concrete anchor block will be constructed to secure the pipe down the steep batter slope with an additional concrete block at the toe of the batter — the two batter concrete blocks will be connected via cables with the distribution pipeline clamped to this cable — the intention of this arrangement is to eliminate the risk of any batter blocks sliding down the bank and overloading the connecting HDPE pipe • the above ground section in the steep batter will be subject to variable water levels and be exposed to solar radiation when water levels are low — the pipe will be white to mitigate thermal effects and is PN25 pressure rating to accommodate likely pressure de-rating due to exposure to high solar radiations • the air diffuser HDPE pipe will be welded and strung out along the crest of the dam in approximate one kilometre strings and 500 metre distribution pipe strings. Air diffuser pipe: • the pipe size selected minimises pressure losses to ensure uniform flow distribution through holes along the air diffuser pipe to an acceptable level, without oversizing the air diffuser pipe to minimise the size of hold down supports required • the air diffuser pipe will be welded and strung out along the crest of the dam in two approximate 500 metre strings and one 500 metre distribution pipe string • the delivered pipe sections would be stored and welded on the dam spillway, with likely two pipe strings pulled along and stored on the side of crest road • the pipe strings will not block access along the dam crest wall but would impact access • the precast concrete anchor blocks will be stockpiled at the dam spillway and fitted progressively as the pipe is constructed.	5 weeks
Aeration pipework – in dam installation	Barge mobilisation: • mobilisation of a 9 by 12 metre barge for marine operations sized to accommodate a suitable sized crane for lifting and positioning temporary mooring anchors (5 tonnes) and permanent anchor blocks (4 tonnes) • three road transportable barge modules (each 12 x 2.7 metres) will be lifted and assembled on the water using a 100 tonne mobile crane • a marine architect will set out the barge assembly at the boat ramp or dam spillway to meet the load requirements • the loading of the barge crane will be done using ramps • boats will be used to move the barge and materials around the dam • the five tonne mooring blocks will be positioned along the pipeline alignment to help secure the floating pipe against wind and wave action	6 weeks

Construction stage	Activities	Estimated duration
	• the barge will be used to fit the anchor blocks progressively along the pipeline to provide the hold down support for the security/protection of the pipe from environmental factors such as wind and waves during assembly. Air diffuser pipe installation: • the air diffuser pipe will be anchored to resist buoyancy. The pipe size has been optimised to minimise the anchor block size to facilitate installation • anchorage is based on 200 kilogram concrete anchor blocks at five metre spacing along the air diffuser pipe • the 200 kilogram anchor blocks will be progressively attached to the pipe string as the string is pulled into the water using a workboat and barge • the anchor blocks will be clamped to the aeration pipe and jointed by a stainless cable to allow the pipe to float at a controlled height above the dam floor when filled with air • during assembly of the aeration pipe the anchor block will be strapped to the HDPE pipe to minimise potential entanglement of the adjoining block, these straps will be released prior to the sinking of the pipe • counter buoyancy floats will be attached to air diffuser pipe to allow the entire 1,500 metre portion of pipe to be floated onto the water with anchors blocks attached progressively and then positioned in correct alignment prior to sinking • buoyancy pipework will be strung out with the air diffuser pipework and once operational will be utilised in the controlled sinking operation • five tonne mooring blocks will be positioned along the final alignment to help secure the floating pipe and anchor blocks against wind and wave action during its assembly • a global positioning system (GPS) will be used to position the mooring blocks, as the guide to ensure the pipe is along the correct alignment • once the air diffuser pipe correctly aligned the buoyancy pipe and floats will be progressively filled with water by releasing air valves to allow for the steady and controlled sinking of anchor blocks • the air diffuser pipe will be sunk from the shoreline out along the alignment anchored to the mooring blocks to maintain correct positioning. SCUBA: • the requirement for self-contained underwater breathing apparatus (SCUBA) operations will be minimised by undertaking the work on the water from work boats and barges • a dive crew will be on-site during preparations and process of the aeration pipe and concrete blocks to assist when required • during the preparation works the concrete blocks will be released from the pipe allowing it to hang below the connecting cable, the divers will ensure that these cables hang free below the pipe and are not entangled before sinking.	
Commissioning	• commissioning of the bubble plume system will occur in stages with the on-water exclusion zones maintained until after system operation has been proven • factory acceptance testing of equipment will occur off-site throughout the manufacturing process for different operating safeguards, compressors and transformers • once all the equipment is assembled on-site, testing and commissioning will need to occur to ensure all interfaces are operating as intended • after it has been established that power, control and the air system functions correctly, load will be added, air will at this point be pumped through the delivery pipeline to the air diffuser pipe on the dam floor • underwater remotely operated vehicles (ROV's) can be operated around the air diffuser pipe delivering recorded live video feed back to the surface as confirmation of the bubble plumes rising from the pipe suspended at the correct height above the anchor blocks.	8 weeks

Construction stage	Activities	Estimated duration
Demobilisation	• removal of plant and equipment from site • removal of environmental controls • site clean-up and remove temporary fencing • reinstate any fencing or gates • remediation of proposal site • carry out any final inspections and handover of the work site.	1 week

1.4 Background Information

1.4.1 Lake Pindari, Pindari Dam and Severn River

The Severn River catchment is part of the Border Rivers, a series of rivers and their catchments in NSW and QLD that lie to the west of the Great Dividing Range and converge on Barwon River (NSW DPE 2019). In NSW, the Border Rivers include the catchments of Dumaresq River, Severn River, Macintyre River and Barwon River to Mungindi Weir. These rivers are regulated by three dams, including the Glenlyon Dam and Coolmunda Dam in QLD and Pindari Dam in NSW (NSW DPE 2019). Lake Pindari is a popular recreation destination, with camping grounds and boat ramp facilities to accommodate fishing and various water sports.

Stimulus environmental flows have been released from Pindari Dam since 1996, in accordance with the Environmental Impact Statement (EIS) for the enlargement of the dam. Releases were originally made automatically when there were 90 consecutive days of less than 400 ML/day flow at Ashford, which typically occurred twice annually (NSW DPI 2013). The regime of environmental flows was further developed and updated in the NSW Water Sharing Plan for the Border Rivers (NSW DPI 2019), which commenced in 2009 and included a minimum daily release of 10 ML/day from Pindari Dam, seasonal inflow release requirements and stimulus flow release requirements. The objectives of the updated plan were to provide river flow that mirrored the naturally occurring hydrograph, provide targeted pre-season cues to fish breeding, regularly flood riparian areas downstream of Pindari Dam and provide opportunity for more extensive stimulus flows (NSW DPE 2019).

The Severn River downstream of Pindari Dam holds high ecological value, characterised by a number of important habitats and species communities. A series of riparian wetlands rely on the flow of the Severn River, including the wetlands of Kwiambal National Park, whilst the instream habitat of the river provides good refuge conditions for a high diversity of native fish species (NSW DPI 2013). The river also provides habitat for a range of threatened species, including invertebrates, fish and waterbirds, whilst previous ecological studies indicate that the Severn River supports a small population of Platypus (*Ornithorhynchus anatinus*) that is comparable with populations known from other similar rivers in NSW (NSW DPI 2013).

1.4.2 Stratification and Cold-Water Pollution in Lake Pindari and Severn River

Thermal stratification is a naturally occurring vertical separation of a waterbody, based on the density and temperature gradient of the water column and is influenced by external environmental factors. Water at the surface is warmed by sunlight and air temperature, which sits above colder, more dense water. Stratification can occur daily or for months at a time and results in the formation of zones through the water column, including the epilimnion (surface water), metalimnion (mid) and hypolimnion (bottom). A sharp

thermal decline (thermocline) occurs in the metalimnion, separating the warm, lower density waters from the cold, higher density waters. Thermal stratification is particularly an issue in deep reservoirs where natural mixing processes cannot overcome the stratification of the entire depth of the waterbody. This can result in hypolimnion waters becoming anoxic, as this deeper layer has no oxygenation from the atmosphere and oxygenated epilimnion waters are not mixed through the water column. Under anoxic conditions, sediments may also release soluble iron and manganese by reducing metal oxides to facilitate biological oxygen demand, as well as nutrients such as phosphorus and nitrogen. This may contribute to algae blooms and high presence of cyanobacteria (Liu et. al., 2018), particularly if upwelling of hypolimnion waters occur.

Dam releases are typically discharged from low offtakes, located near the bottom of reservoirs, with releases taken from below the thermocline. Pindari Dam has a multi-level offtake tower (MLO) which allows for selective withdrawal throughout the water column. However, at times when water below the thermocline is released, water that is significantly colder than surface waters of the reservoir are released downstream and can cause thermal reductions in downstream habitats, referred to as cold water pollution (CWP) (Michie *et. al.*, 2020). In Australian reservoirs, summer thermal stratification can result in up to ~20°C of stratification and thermal impacts may reach over hundreds of kilometres (Michie *et. al.*, 2020), with CWP recorded to occur in Severn River over 100 km downstream of Pindari Dam during high releases (NSW DPE 2019).

Cold water pollution can have significant environmental impacts on downstream aquatic habitats, by significantly lowering summer water temperatures, reducing thermal amplitudes and causing changes and delays in spring and summer temperature increases. Aquatic species are sensitive to temperature and may show physiological and behavioural changes in response to these changes. This may eventuate as shifts in metabolism and growth, changes to reproductive processes and/or success, cold shock, hypoxic stress and spatial and temporal changes of community distributions (Michie *et. al.*, 2020). Reproduction of fish species is linked to annual variations in water temperature, with CWP creating potential delays in breeding cues or restricting the distribution of species to habitats further downstream. Cold water pollution may also lead to poor recruitment of species, due to the sub-optimal environmental conditions for the survival and development of eggs and young (Michie *et. al.*, 2020). Recent studies of the physiological effects of CWP on Silver Perch (*Bidyanus bidyanus*) and Murray Cod (*Maccullochella peelii*) in the Murray-Darling Basin showed the species experienced both acute and chronic depressive effects on swimming performance and metabolic rates (Parisi *et. al.*, 2020; Parisi *et. al.*, 2022), although *M. peelii* exhibited some thermal plasticity over longer term periods (Parisi *et. al.*, 2022).

1.4.3 Destratification Systems

Management strategies are required to mitigate the negative environmental impacts of thermal stratification in dams and reservoirs. Three strategies were considered in an extensive options review conducted for the project (Chaaya and Miller 2022). These included selective withdrawal through multi-level offtakes, artificial destratification using bubble plumes and artificial destratification using surface mixers. Bubble plume destratification was considered the most versatile and likely to be successful strategy, as it has previously been successful in improving dissolved oxygen concentrations, reducing high concentrations of iron and manganese and reducing cyanobacteria. A full review of these cases can be found within the review by Chaaya and Miller (2022).

Bubble plume destratification systems consist of a series of diffusers or a pipe network at the bottom of a waterbody, through which compressed air is pumped and creates a stream of bubbles that rise through the water column to the surface, a 'bubble plume'. As the plumes rise, it drags the cold, denser waters from the

hypolimnion to the surface, creating a localised vertical mixing current that breaks down the thermal stratification in the vicinity of the system. This also helps to distribute oxygen and nutrients more evenly through the water column, whilst also providing an opportunity for the oxygen-poor or anoxic hypolimnion waters to be oxygenated by the atmosphere (Chaaya and Miller 2022).

1.4.4 Pindari Dam MER Program

The Pindari Dam Monitoring, Evaluation and Reporting (MER) program was established to assess the installation of the bubble plume system in Pindari Dam, with objectives to evaluate the aerator's impact on water temperature and aquatic biodiversity in the Severn River, as well as provide empirical data and guidance on its strategic application. The MER program is currently in its baseline monitoring stage, establishing baseline conditions for temperature, water quality and ecological community structure in Lake Pindari and Severn River prior to the installation of the aerator.

Baseline data gathered as part of the program has focused on three significant parameters, including:

- Thermal Conditions: detailed temperature profiles of water column in Lake Pindari and Severn River.
- Water Quality and Primary Productivity: measurements of physical, chemical and biological water quality parameters such as dissolved oxygen, nutrients and heavy metals, in conjunction with algal community assessments in Lake Pindari and Severn River.
- Ecological Communities: presence and abundance surveys of various fish species, zooplankton and macroinvertebrates.

The baseline data gathered as part of the preliminary stages of the program is essential for an understanding of existing environmental conditions, including identification of habitat zones that are currently most affected by CWP, pre-existing water quality issues and current ecological community compositions. The data collected up to June 2024 by the project was presented as an Interim Report and has been reviewed to inform this AEA (NSW DPI 2024a).

1.5 Relevant Legislation and Policies

The following legislation and policies have been considered in this ecological assessment:

- NSW *Environmental Planning and Assessment Act* 1979
- NSW *Fisheries Management Act 1994*
- NSW *Water Management Act 2000*
- NSW *Biodiversity Conservation Act 2016*
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The legislative context for the assessment is outlined in the following sections.

1.5.1 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. This includes for all 'Fish' under the definition of the FM Act 'that are identified as 'marine, estuarine or freshwater fish or other aquatic animal life at any stage of their life history (whether alive or dead)'. However, it excludes whales, mammals, reptiles, birds and amphibians which are managed under other legislation.

To meet the primary objectives, Part 7 of the FM Act deals with the protection of aquatic habitats, with Part 7A addressing the conservation of threatened species. Part 7 commonly applies to dredging and reclamation works, protection of marine vegetation including mangroves and seagrass, protection of spawning of certain fish, and noxious fish and marine vegetation.

To assist in applying the legislative requirements of the FM Act in assessing developments in NSW, NSW DPI Fisheries have prepared the 'Policy and guidelines for fish habitat conservation and management' (Fairfull 2013).

Listings of threatened species, populations and ecological communities gazetted under the FM Act are relevant to this assessment. Threatened biota impacted by this construction proposal must be assessed with consideration of the factors identified in Section 5A of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) known as the '7 Part Test'.

Key fish habitat policy

NSW DPI recognises that certain types of activities have varying degrees of impact on key fish habitats and, as such, require different levels of control and regulation. As a general principle, NSW DPI requires that proponents should, as a first priority, aim to avoid impacts upon key fish habitats. Where avoidance is impossible or impractical, proponents should then aim to minimise impacts. For any unavoidable remaining impacts consideration is to be given to establishment of suitable offsets or compensation.

Where key fish habitat is impacted by this construction proposal, suitable offsets or compensation may be required to be negotiated with NSW DPI Fisheries.

1.5.2 Water Management Act 2000

The objectives of the NSW Water Management Act 2000 (WM Act) are to provide for the sustainable and integrated management of the water sources of the state for the benefit of both present and future generations and, in particular, ecologically sustainable development and to protect, enhance and restore watercourses.

The Department of Climate Change, Energy, the Environment & Water (DCCEEW) and WaterNSW share the responsibility for granting and managing water licences and approvals in NSW. The Natural Resources Access Regulator (NRAR) is the independent regulator that ensures compliance with these licences and approval.

Lands within 40 m of the riverbank are considered waterfront land under the WM Act and a controlled activity approval may be required before undertaking any work or development.

1.5.3 Biodiversity Conservation Act 2016

The Biodiversity Conservation Act 2016 (BC Act) provides for legal protections of biodiversity and threatened species in NSW. In regard to this assessment it includes for marine birds and shorebirds, whales, marine and aquatic mammals, and marine or aquatic reptiles.

Listed items of threatened biodiversity under the BC Act with potential to be impacted by this proposal will require further consideration. The BC Act sets the criteria for determining whether a proposal is likely to have a significant impact on threatened biodiversity listed under the BC Act.

1.5.4 Environmental Planning and Assessments Act 1979

Development in NSW falls under the provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and subordinate legislation. Under Section 5.1 of the EP&A Act, there is a duty for the determining authority to consider the environmental impacts of proposed activities. The specific aspects of these environmental considerations are detailed in Clause 171 of the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation). Under section 5.1 of this Act, determining authorities are required to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity. These include items of biodiversity listed under the BC and FM Acts.

1.5.5 Environmental Protection and Biodiversity Conservation Act 1999

The purpose of the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) is to ensure that actions likely to cause a significant impact on matters of national environmental significance undergo an assessment and approval process. Under the EPBC Act, an action includes a project, undertaking, development, or activity. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed to be a controlled action and may not be undertaken without prior approval from the Commonwealth Minister for the Department of Climate Change, Energy, the Environment & Water (DCCEEW).

The matters of national environmental significance (MNES) that will require consideration as part of this assessment include:

- Threatened species and ecological communities
- Migratory species

Listings of MNES identified with potential to be impacted by this proposal will require further considered under the guidance provided by the EPBC Act. This guidance is referred to as the 'Significant Impact Guidelines' and provides a set of criteria known as the "Significant Impact Criteria' that must be followed to determining whether an action is likely to have a significant impact on a MNES.

1.6 Assessment Objectives

The objectives of this assessment are to:

- Identify any potential impacts from the proposed works on threatened biodiversity, MNES, water quality, fish habitat, aquatic vegetation and fauna, and areas of outstanding biodiversity value; and
- Provide recommendations regarding adoption of environmental controls and mitigation measures into the Construction Environmental Management Plan (CEMP) and identify any additional permitting and approval requirements under the FM Act, including any requirements for an SIS.
- Provide recommendations regarding ongoing aquatic ecological monitoring in downstream habitats of the Severn River.



Figure 1: Location of proposed bubble plume destratification system, Impact Area, Study Area and survey sites

2 Methodology and Approach

2.1 Desktop Review

2.1.1 Threatened Species Searches

Relevant databases were searched during July 2024, applying a ~10 km radius around the Study Area to identify threatened biodiversity, migratory species and MNES that may potentially occur at the locality. The following databases and information sources were searched:

- Bionet, Atlas of NSW Wildlife (last 20 years),
- NSW DPI Fisheries Threatened Species Lists (NSW DPI 2024b),
- EPBC Act Protected Matters Report tool; and
- Atlas of Living Australia (FM Act listings only).

2.1.2 Existing Ecological Mapping

Mapping of existing aquatic ecological features important to this assessment was reviewed using the following online tools:

- Fisheries NSW Spatial Data Portal – Mapping of Key Fish Habitats, Freshwater Fish Community Status and Threatened Freshwater Fish Species (NSW DPI 2024c),
- SEED NSW Map (The Central Resource for Sharing and Enabling Environmental Data in NSW) – Mapping of freshwater wetlands (NSW State Government and DCCEEW 2010)
- Various recent aerial imagery captures (Nearmap 2023 and 2024).

A review of the potential environmental constraints identified via these maps was undertaken.

2.1.3 Existing Ecological Research – Lake Pindari and surrounding catchments

The MER Program for the Pindari Dam Bubble Plume Destratification System is currently underway as the primary means to assess the ecological outcomes of the project. The MER Program targets three primary components, the summary data to date for three of which were reviewed as part of this assessment. The three primary studies included:

- Water quality and algal assessment within Lake Pindari – by UNSW Water Research Laboratory (WRL) and University of Technology Sydney (UTS),
- Riverine temperature, water quality and algae assessment – by UTS; and
- Riverine fish population and physiological monitoring – by NSW DPI Fisheries.

Additional previous studies reviewed that involved targeted research in Lake Pindari included:

- Pindari Dam fish monitoring project (Wilson and Ellison 2010) – prepared for the NSW Office of Water.

2.2 General Site Investigations

2.2.1 Site and Habitat Inspection

Site investigations of the Severn River in the 2 km immediately downstream of Pindari Dam were completed on 21 May 2024 as part of this assessment. This included an inspection and description of general habitat, creek bank flora and fauna, and subtidal flora and fauna that was visible from the banks within and adjacent to the Study Area.

2.2.2 Key Fish Habitat Mapping

Existing mapped KFH conducted by NSW DPI (2024) was verified *in-situ* at each site and throughout the 2 km stretch of the Study Area, as per Fairfull 2013. This included a categorisation of KFH Type and classification of the waterway class (Fairfull 2013).

2.3 Survey Sites and Assessments

Targeted surveys were conducted at three sites along the Severn River downstream of Pindari Dam, detailed in Table 2 and Figure 1.

Table 2: Survey sites in the Study Area along Severn River

Site	Coordinates	Description
Site 1	-29.392548, 151.239458	Site 1 is located approximately 500 m downstream of the confluence of Scrub Hut Creek, which facilitates low level releases, with the Severn River. This location is also where the high-level spillway on the western side of the dam wall confluences with the Severn River.
Site 2	-29.395052, 151.236814	Site 2 is located 1 km downstream of the confluence of Scrub Hut Creek with Severn River (500 m downstream of Site 1). This site is located just upstream of a large rocky riffle area along the first bend of the river.
Site 3	-29.396694, 151.228749	Site 3 is located 2 km downstream of the confluence of Scrub Hut Creek with Severn River (1 km downstream of Site 2).

2.3.1 Riparian Assessment

A visual assessment of the riparian zone was undertaken at each site along a 50 m stretch of the river bank. The riparian assessment is derived from the AUSRIVAS riparian protocols, including physical characteristics of the stream, site observations, substrate description, stream features, disturbances, riparian characteristics and composition and observable macrophytes.

2.3.2 Qualitative Water Quality

A qualitative water quality assessment was undertaken at each site along a 50 m stretch of the creek bank. The assessment comprised of characterisation of stream size, water level, visual water quality, presence of algae and surface films and description of any aquatic macrophytes.

2.4 Threatened Species Assessment

The threatened species assessment was undertaken by desktop review of 'sightings', assessment of the habitat in the Study Area, and determining the likelihood of occurrence of each species using the criteria outlined in Table 3. Species considered further were those in the 'Known', 'High' and 'Moderate' categories and where impacts on the species from the proposed works are considered to possibly or likely occur. Those species with a moderate or higher likelihood of occurrence with potential of being impacted will be assessed further through the 5 / 7 Part Test and/ or Impact Assessment criteria processes.

Table 3: Likelihood of occurrence criteria

Likelihood of occurrence	Criteria
Known	The species was observed within the Study Area. The species is known to inhabit the Study Area.
High	The species has frequently been recorded previously in the Study Area or similar habitats in the locality. The species is known or likely to maintain resident populations surrounding the Study Area. It is likely that the species utilises habitat or resources that are abundant or in good condition within the Study Area. The species is known or likely to visit the Study Area during regular seasonal movements or migrations.
Moderate	The species has infrequently been recorded previously in the Study Area or similar habitats in the locality. The Study Area contains potential marginal and/or modified habitat and resources for the species, which it may occasionally utilise. The species is unlikely to maintain sedentary populations but may seasonally use resources within the Study Area opportunistically or during migrations.
Low	The species has not been recorded previously in the Study Area or similar habitats in the locality. The Study Area is beyond the current distribution range of the species. If present in the Study Area the species would likely be a transient visitor. The Study Area contains only very marginal habitat for the species, which would not be relied upon for its on-going local existence.
Unlikely	The species is highly restricted to certain geographical areas not including the Study Area. The habitat within the Study Area is unsuitable for the species.

2.5 Limitations

Threatened species sightings searches were limited to sightings data within Bionet (from the last 20 years), with the exception of fish for which sightings data from the Atlas of Living Australia were also reviewed. Threatened species searches were undertaken in July 2024 following engagement for this project. Some more current sightings data may be available for some species.

Fauna surveys (unless otherwise specified) were limited to the assessment of habitat values and other opportunistic observations. Habitat assessments are conservative, defaulting to assume presence where there is insufficient knowledge to determine otherwise.

Numerous threatened species of fauna are seasonal in geographical distribution and/or may be transient in nature. For instance, some fauna are only present during certain seasons (e.g. migration patterns or seasons).

Site investigations were limited to visual and qualitative observations within the Study Area, as a representative portion of the larger expected impact area in Severn River downstream of Pindari Dam. Quantitative and detailed studies conducted to June 2024 as part of the MER Program (NSW DPI 2024a) were considered sufficient to inform the existing ecological and environmental conditions in the Severn River and Lake Pindari for this assessment.

The Study Area in the Severn River for this assessment was limited to the first 2 km of habitat downstream of Pindari Dam and was used as reference habitat to assess potential impacts to the receiving aquatic habitat and biota. It is acknowledged that CWP impacts may affect up to 80 km of habitat downstream of the dam, thus impacts from the destratification system may also affect habitat to this extent. However, within the scope of this assessment and considering the extensive monitoring studies already being conducted as part of the MER Program, site inspection of habitat along this 80 km stretch of the Severn River was not considered feasible as part of this assessment. The impact assessment (Section 4) and recommendations (Section 5) have, however, considered potential impacts beyond the 2 km Study Area utilising data collected from other sources (predominantly the MER Program) combined with data collected during the site survey.

3 Results and Findings

3.1 Desktop Review

3.1.1 Threatened Biodiversity and Protected Matters

Searches of the Bionet database identified sightings data for 389 items listings under the BC Act within a ~10 km radius of the Study Area (Figure 2). The majority of these species were confined to terrestrial species with aquatic species relevant to this study including only one threatened freshwater turtle.

Review of listings under the FM Act of Threatened Species that may occur in the Study Area or wider locality (catchment or adjacent waters) identified the following listings relevant to the Study Area:

- Two Threatened freshwater fish,
- Two Endangered Populations; and
- One Endangered Ecological Community

Searches of the EPBC Protected Matters Report Search identified MNES relevant to this study (i.e. freshwater species or those that use freshwater habitat) within ~10 km radius of the Study Area (Appendix 2). Aquatic species relevant to this study included three listed threatened species.

Of the Commonwealth listed Threatened species and communities, the following were identified for consideration as part of this assessment:

- One freshwater turtle; and
- Two freshwater fish.

In total one freshwater turtle, three freshwater fish, two freshwater Endangered Populations and one Endangered Ecological Community which are considered threatened were identified to require consideration as part of this assessment. A summary of all threatened species considered as part of this assessment, along with consideration of their likelihood of occurrence within the Study Area and potential to be impacted, is provided in Table 4.

Those species with a likelihood of occurrence of 'Moderate' or higher are considered further as part of this assessment in Section 4.

Table 4: Habitat and likelihood of occurrence table for threatened freshwater species identified from searches.

Common Name	Scientific Name	NSW Status	Comm. Status	Sightings		Likelihood of Occurrence
Freshwater Reptiles				*Bionet*	*ALA (FM Act only)*	
Western Sawshelled Turtle	*Myuchelys belli*	E	E	3	3	Possible – The species is restricted to habitat in the Severn River upstream of Pindari Dam, with no sightings recorded below the dam wall (Bionet 2024; ALA 2024). The species may occur in upstream areas of the dam, where the channel is narrower and possesses shallow areas or riffles (NSW DPE 2022), however, habitat suitability for the species in downstream, deep areas of the dam is considered unlikely. It is likely that the dam acts as a movement barrier for this species, thus the species is unlikely to occur in the Study Area or downstream in Severn River.
Freshwater Fish						
Silver Perch, Bidyan	*Bidyanus bidyanus*	V	E		3	**Known** – Previous sightings recorded within 10 km of the Study Area (ALA 2024) and targeted studies identified the species within the Severn River (NSW DPI 2024a). Some suitable habitat is present in the Study Area, with species known to occupy flowing water and open sections of rivers, however, use of habitat would likely be transient given limited movement passages.
Murray Cod	*Maccullochella peelii*		V			**Known** – Indicative distribution of the species and likely species habitat has been mapped to occur throughout the Severn River. The Study Area provides some suitable habitat for the species, including large rocks and snags, however, use of this habitat would likely be transient given limited movement passages. Additionally, the species has been recorded to occur in the Severn River downstream of Pindari Dam in targeted surveys (NSW DPI 2024a).
Southern Purple Spotted Gudgeon	*Mogurnda adspersa*	E				Low – No sightings of the species have been recorded on ALA (2024) in the Severn River catchment in the last 20 years, however, the species has been recorded in targeted surveys in upstream sections of the Severn River (NSW DPI 2024a). The species typically prefers slow-flowing or still waters with aquatic or overhanging vegetation. Habitat in the Study Area is very marginal for this species.

Common Name	Scientific Name	NSW Status	Comm. Status	Sightings		Likelihood of Occurrence
Endangered Populations						
Olive Perchlet (Western Population)	*Ambassis agassizii*	EP				Low - Few sightings of the species have been recorded in the Severn River catchment in the last 20 years with no sightings in the Study Area (ALA 2024). The species typically prefers slow-flowing or still waters with aquatic or overhanging vegetation. Habitat in the Study Area is very marginal for this species.
Eel tailed catfish - Murray Darling Basin	*Tandanus tandanus*	EP			3	**Known –** Previous sightings recorded within 10 km of the Study Area (ALA 2024a) and were identified within the Severn River in targeted species (NSW DPI 2024a). The species typically occupies a home range of ~5 km (NSW DPI 2015), with suitable habitat available in the Study Area, however, use of habitat would likely be transient given limited movement passages.
Endangered Ecological Communities						
Darling River EEC	*n/a*	EEC				**Known -** Includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, flow diversions to anabranches, the anabranches, and the floodplains of the Darling River within the State of New South Wales and including Menindee Lakes and the Barwon River. This includes the border rivers including the MacIntyre River below Graman Weir (29o25'S; 150o58.8'E), Severn River downstream of Pindari Dam (29o23'S; 151o14'E) and the Dumaresq River below the junction with the Mole River (28o59.7'S; 151o31'E).

CD = Conservation Dependent, P = Protected, V = Vulnerable, E = Endangered, CE = Critically Endangered, EP = Endangered Population, EEC = Endangered Ecological Community

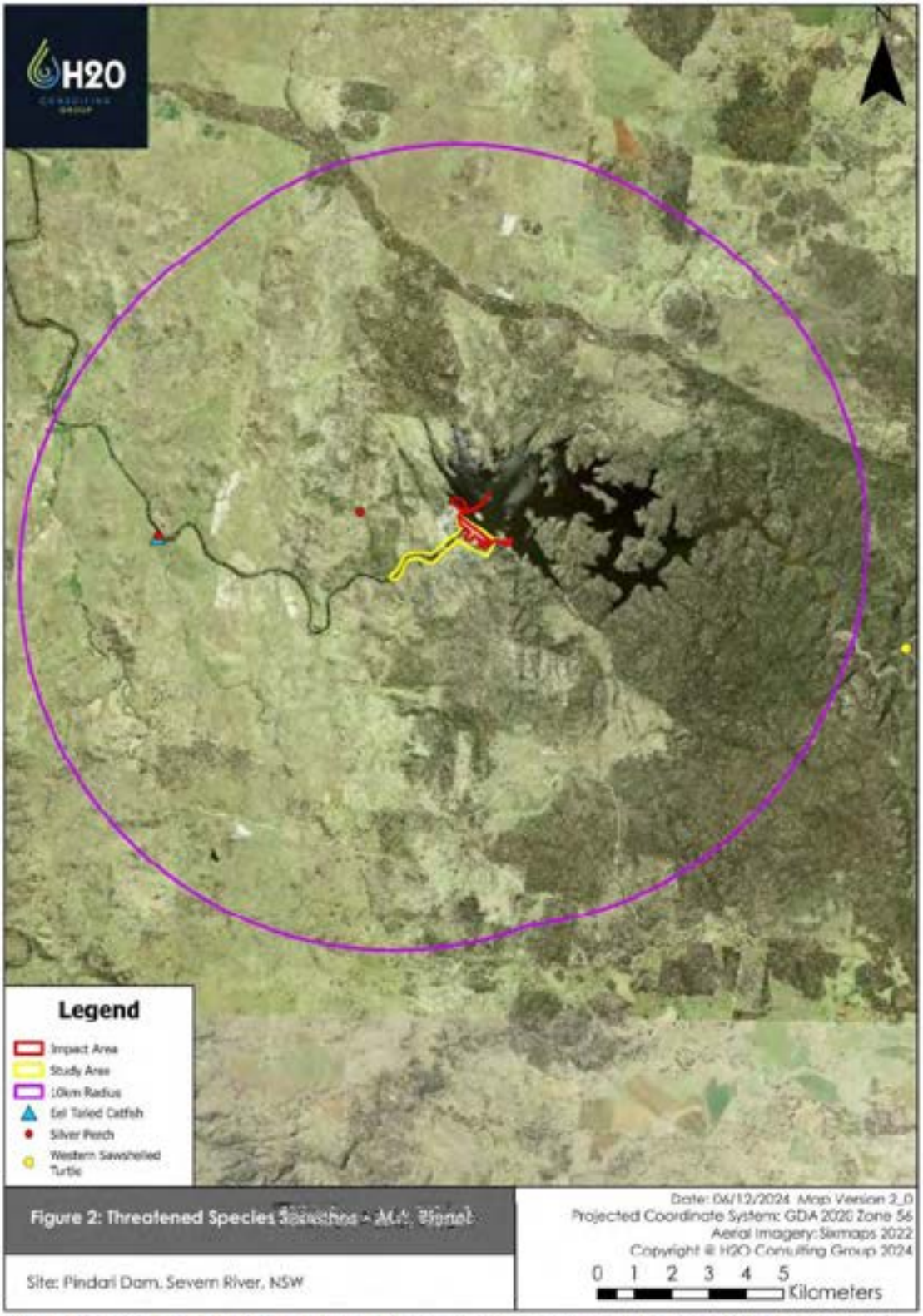


Figure 2: Bionet and ALA sightings of threatened species within 10km of the Study Area.

3.1.2 Existing Ecological Mapping

The entirety of aquatic habitat and adjacent riverbanks inside the Study Area, as well as further downstream along Severn River and upstream in Lake Pindari, are identified as Key Fish Habitat (KFH) – Murray Darling Basin North (NSW DPI 2024a) (Appendix 3). Key Fish Habitat type and class was verified *in-situ* and is detailed in Section 3.3.4.

Mapping of freshwater fish communities indicates that the Severn River, both upstream and downstream of Pindari Dam, has a 'fair' freshwater fish community status. However, Lake Pindari itself has a 'poor' status, due to the barrier in fish passage (NSW DPI 2024a) (Appendix 3). Additionally, three threatened freshwater fish species have indicative distribution mapping that passes through the Study Area along the Severn River, including the Silver Perch (*Bidyanus bidyanus*), Southern Purple Spotted Gudgeon (*Mogurnda adspersa*) and Eel Tailed Catfish (*Tandanus tandanus*) (NSW DPI 2024a).

3.2 Review of Existing Research

The following information is a review of the existing data collected to date as part of the MER Program (NSW DPI 2024a).

3.2.1 Stratification Dynamics – Lake Pindari

Lake Pindari exhibited strong thermal stratification that was persistent between October 2023 and April 2024. During this time, the hypolimnion temperature remained stable at ~12.5 °C. The stratification was most pronounced during summer, with temperature differences between the hypolimnion and epilimnion reaching up to 20°C between December and February 2023/2024. While the thermocline fluctuated throughout the study period, it typically did not extend beyond 12 m depth.

Oxygen stratification was also identified to occur within the dam. Dissolved oxygen (DO) levels were near saturation at the surface, while anoxic conditions were present in the hypolimnion for the entire study period between October 2023 and May 2024. The oxycline varied seasonally between 7 and 15 m, being closer to the surface in summer and deeper at the start of spring.

3.2.2 CWP – Severn River

Water temperatures downstream of Pindari Dam were colder than upstream reaches during spring, summer, and autumn, evidencing the presence of CWP in Severn River. The mean daily water temperatures downstream of the dam were ~10°C colder than upstream, with the greatest temperature difference occurring in December and January. The effects of CWP were influenced by release practices at Pindari Dam; cessation of water deliveries was associated with increases of up to 8°C within 24 hours at a monitoring site 8 km downstream. The magnitude of CWP was also greater during the day than at night.

Cold water pollution was most notable during the warmer months, as temperature differences between sites closer to the dam and those further downstream increased. The downstream recovery distance (the distance at which the modelled mean daily temperature reached that which was recorded upstream of the dam) occurred 82 km downstream, noting that the upstream reference site is 438 m higher in altitude.

3.2.3 Algal bloom formation, position in water column and transport

The concentration of chlorophyll a was variable, but typically higher in warmer months. Increased concentrations were recorded in surface waters compared to bottom waters. Cyanobacteria dominated surface water communities, maintaining its position in the water column throughout the study period. The highest overall cell concentrations of cyanobacteria were recorded during the October 2023 sampling, with the species *Dolichospermum circinale* nearing 500,000 cells/mL and *Microcystis aeruginosa* near 50,000 cells/mL. Another potentially toxic cyanobacteria species, *Dolichospermum crassum* was only present in April and May of 2023. Cell concentrations of cyanobacteria in the water column were generally less than 1000 cells/mL after 10 – 15 m depth, a gradient corresponding to the typical thermocline of the dam.

In the cooler months, the concentration of chlorophyll a downstream was generally similar to that upstream of the dam. However, between December 2023 and April 2024, chlorophyll a concentrations were over two times greater downstream of the dam. While concentrations of cyanobacteria were generally low downstream of the dam, in October and November of 2023, *D. circinale* and *M. aeruginosa* were detected at high concentrations (>8,000 cells/mL). This finding suggests that cyanobacteria are entraining into the hypolimnion, or the depth of the outlet is approaching the epilimnion or metalimnion.

3.2.4 Nutrient and Metal release and transport

Within the dam, concentrations of oxidised nitrogen were variable but remained below 120 µg/L throughout the study. These concentrations are substantially above the ANZECC guideline for reservoirs of 10 µg/L. Ammonia concentration exhibited a trend of increasing concentration in bottom waters over the sampling period, with significantly higher concentrations recorded in bottom waters compared to surface waters. The very high concentration of ammonia in bottom waters (exceeding 600 µg/L) is indicative of nutrient release from sediments on the dam floor.

Phosphorous concentrations were also higher in bottom waters (~75-150 µg/L) compared to surface waters (<70 µg/L), exceeding the ANZECC guideline of 5 µg/L. These results suggest that phosphorous is released from sediments during periods of thermal stratification, potentially as a result of anoxic reduction processes at the sediment-water interface on the dam floor. Despite this, a trend of decreasing concentration of soluble reactive phosphorous was recorded over the sampling period (November 2023 to May 2024).

Analysis of metal concentrations in the dam found a general trend of increasing Mn concentration in bottom waters over time and higher concentrations of manganese (Mn) and iron (Fe) in bottom hypolimnion waters than surface waters, reflecting anoxic and reducing processes. The presence of iron release and high phosphorous levels indicates the breaking of Fe-P bound complexes under anoxic conditions and release of P and Fe.

Downstream of the dam, NOx concentrations were, on average, greater than levels recorded in the hypolimnion of the dam, and much greater than concentrations recorded upstream of the dam. Ammonia concentrations downstream were lower than those recorded in the hypolimnion, and similar to that of the upstream site. It is possible that a proportion of the ammonia from the hypolimnion is being converted to NOx with aeration through release valves and transport down river. Ammonia may also be taken up by microbes and algae between the outlet and the site 8 km downstream of the dam, as it is highly bioavailable.

The concentration of phosphorous at the site downstream of the dam resembled that in the hypolimnion of the dam at around 100 µg/L but was notably higher than the upstream site (20 µg/L). Likely reflecting the uptake of nutrients by microorganisms, a trend of decreasing nutrient concentrations with distance downstream from the dam was observed.

Compared to sites upstream, Mn and Fe concentrations were higher downstream of the dam but were lower than concentrations recorded in the hypolimnion. The concentration of these metals decreased with distance from the dam downstream, potentially as a result of uptake, chemical change, sedimentation, dilution and/or flushing. The higher concentrations downstream of the dam may stimulate cyanobacterial growth alone or in conjunction with nitrogen and phosphorous.

3.2.5 CWP impacts on primary production (Severn River)

The concentration of planktonic chlorophyll a in Severn River exhibited considerable temporal variation, and was not significantly different from the reference rivers. A trend of increasing chlorophyll a with distance downstream was observed, likely due to increasing phytoplankton growth downstream. Benthic chlorophyll a was also variable, but was generally similar to reference rivers, with biomass between 1.6 - 3.0 µg/cm^2.

3.2.6 CWP impacts on invertebrate production and community composition (Severn River)

Overall, zooplankton abundance was lower in Severn River compared to the reference sites. The lowest abundance was observed 38 km downstream from the dam in December of 2023, with an average of 8.3 individuals / m^3. The zooplankton community in Severn River was dominated by Cladocera taxa (mainly *Chydorus* spp. and *Bosmina* spp.) with the general absence of copepods noted, except during March and May 2024 when water temperatures exceeded 20 °C. There is potential that the dam may act as a source of Cladocera taxa, that are regularly released to the Severn River.

Macroinvertebrate community assemblage in Severn River was found to differ significantly from the Mole River, which was considered a reference river in the study. The taxa contributing to the biggest differences included mayfly taxa (Leptophlebiidae, Baetidae, and Caenidae), diptera taxa (Chironomidae and Simuliidae), and tricopteran taxa (Hydropsychidae). In other systems, CWP has been associated with declines in macroinvertebrate abundance. However, there is currently insufficient data to determine the influence of temperature on macroinvertebrate communities in this system.

3.2.7 Fish Communities

Fish communities were assessed using electrofishing boat surveys conducted in 2023 and 2024. Nine fish species were captured in Severn River, compared to 14 at the reference sites (Table 5), despite double the sampling effort within the Severn River. However, catch rates of certain large-bodied native fish were higher from the Severn River, including Eel-tailed Catfish and Silver Perch, although several species including Bony Herring were not observed during surveys within the Severn River. The abundance and richness of small-bodied fish were limited in Severn River, with Carp Gudgeon being the only species recorded, compared to a diverse assemblage of small-bodied fish present at the reference sites. The Olive Perchlet, Southern Purple-spotted Gudgeon, and Un-specked Hardyhead exhibited considerably higher catch rates at the reference sites (in the Mole River and Severn River upstream of Pindari Dam), demonstrating a potential sensitivity to CWP.

The water temperatures in Severn River did not consistently meet the requirements of local fish communities for spawning and reproduction during the 2022/2023 breeding season. Temperatures were suitable for several species in the beginning of the breeding season. However, in January, a cold shock event led to a decrease in temperature from 23 °C to 15 °C, which was sustained until late March. This event had the potential to cause mortality of new recruits of some species. Suitable temperatures for spawning were not met for the Eel-tailed Catfish or Un-specked Hardyhead at any point in the breeding season upstream of and at this site (4 km downstream of Pindari Dam). The 2023/2024 breeding season was marked by significant temperature fluctuations of up to 8 °C. Compared to reference sites, the number of suitable spawning days in Severn River was considerably lower, with up to 75% less suitable days for some species. This trend was consistent for small and large-bodied native fish.

Young-of-year (YOY) native and introduced fish were detected in Severn River during targeted surveys in March of 2024, albeit in small numbers. No Silver Perch or Golden Perch YOY were identified during surveys, suggesting a potential lack of successful recruitment for these species during the prior breeding period. In the 2024 surveys, only mature Eel-tailed Catfish were recorded, providing no evidence for recent recruitment. The Murray Cod, however, displayed a diverse size structure across all locations. Some YOY Murray Cod were also observed in the Spring 2023 sampling event, suggesting shifts in the species reproductive timing, with the spawning window typically from September to December. This trend indicates delayed growth rates or late spawning outside the expected window, however, may also reflect the regular stocking of Murray Cod in the study zone, which is likely to confound the use of this index.

Based on long-term data, Golden Perch and Silver Perch populations in the Study Area have been consistently dominated by older fish, with no evidence found to suggest that stocked Golden Perches have successfully contributed to population growth or recruitment. Eel-tailed Catfish populations are generally composed of larger fish, although some fish in smaller size classes have been recorded in low numbers. This suggests that few YOY Eel-tailed Catfish individuals are surviving to reach adulthood. In contrast, the Murray Cod populations showed a diverse size structure, which may reflect that the species has experienced consistent recruitment in recent years, however, this may also be influenced by regular stocking of the species.

Table 5. Fish species recorded during electrofishing boat surveys conducted in 2023 and 2024 at reference sites and Severn River (NSW DPI 2024a).

Common name	Scientific name	Status	Location
Olive Perchlet	*Ambassis agassizii*	Native, Endangered Population (FM Act)	Reference sites only
Silver Perch	*Bidyanus bidyanus*	Native, Vulnerable (FM Act), Endangered (EPBC Act)	Severn River only
Goldfish	*Carassius auratus*	Introduced	Severn River, reference sites
Un-specked Hardyhead	*Craterocephalus stercusmuscarum fulvus*	Native	Reference sites only
Common Carp	*Cyprinus carpio*	Introduced	Severn River, reference sites
Eastern Gambusia	*Gambusia holbrooki*	Introduced	Severn River, reference sites
Carp Gudgeon	*Hypseleotris* spp.	Native	Severn River, reference sites

Spangled Perch	*Leiopotherapon unicolor*	Native	Severn River, reference sites
Murray Cod	*Maccullochella peelii*	Native, Vulnerable (EPBC Act)	Severn River, reference sites
Golden Perch	*Macquaria ambigua*	Native	Severn River, reference sites
Murray-Darling Rainbowfish	*Melanotaenia fluviatilis*	Native	Reference sites only
Southern Purple-spotted Gudgeon	*Mogurnda adspersa*	Native, Endangered (FM Act)	Reference sites only
Bony Herring	*Nematalosa erebi*	Native	Reference sites only
Australian Smelt	*Retropinna semoni*	Native	Reference sites only
Eel-tailed Catfish	*Tandanus tandanus*	Native, Endangered Population (FM Act)	Severn River, reference sites

3.3 Description of Habitat and Biota

3.3.1 General Habitat Descriptions

The Study Area includes the 2 km of the Severn River directly downstream of the Pindari Dam wall, with aquatic habitat in the Study Area characterised as freshwater. The Severn River downstream of the dam receives flow from the high- and low-level outlets, on the south-eastern and north-western ends of the dam wall respectively, and from the full supply level spillway at the northwestern end of the dam wall. Additional flow enters with the Severn River at the confluence of Scrub Hut Creek, approximately 275 m downstream of the dam wall. Scrub Hut Creek drains from the south-east, with its headwaters in the Severn River National Park stretching over 13 km (straight line distance) to the south-east and possesses altitude up to 250 m above that at the confluence. The high-level flows from Pindari Dam and a number of seepage weirs discharge into the most downstream section of Scrub Hut Creek just before its confluence with the Severn River (Plate 1).

Habitat in the immediate vicinity of the dam wall is highly modified and predominantly terrestrial. On the southern side of the Severn River, adjoining habitat is arid with a thin line of riparian vegetation close to the riverbank. On the northern bank of the river, land is moderately vegetated by canopy species between the riverbank and the bedrock spillway. The dam spillway is located on the north-west end of the dam wall and comprises a large area of predominantly barren bedrock and rocky rubble, with established flow paths flowing to the south-west to the Severn River. The spillway is inundated periodically, associated with full dam supply levels, and provides minimal stable aquatic habitat. The top of the spillway comprises a large, flat bedrock area and is largely unvegetated, with the exception of a small area directly adjacent to the northern end of the dam wall. Vegetation in this area comprises native canopy, scrub and ground cover, however, is highly disturbed by road and dirt tracks.

Site 1

Located approximately 500 m downstream of the confluence of Scrub Hut Creek with the Severn River, at the location where overspill flow would discharge into the river from the Pindari Dam spillway. The riverbanks at the site are comprised of hard substrata, with the southern bank predominantly consisting of extensive bedrock and the northern bank consisting of a combination of bedrock, boulder, cobble and pebbles. Topography of the site is a broad to moderate valley, with the majority of instream habitat at the site characteristic of pool habitat. Some instream large boulders exist just downstream of the site, creating some small riffle habitat. Stream width at the time of survey varied between approximately 12 to 30 m, with an average width of approximately 25 m (Plate 2). Surrounding land use included dam infrastructure and buildings upstream with some nearby dirt roads, some limited vegetation and grazing lands, whilst adjoining land was predominantly natural arid landscape and vegetation.

Site 2

Located approximately 500 m downstream of Site 1, at the start of the first bend of the Severn River downstream of Pindari Dam. At this location, the river widened to approximately 100 m and contained a number of small islets in the middle of the channel. The riverbanks were more sediment dominated, comprising some silts and sands, with a high coverage of vegetation along the banks and islets. Topography of the site is a moderately steep valley and comprises pool and run habitat, with a large area of exposed bedrock and large boulders that create riffle habitat directly downstream (Plate 3). Surrounding land use included rural residential to the south but was predominantly natural bushland.

Site 3

Located approximately 1 km downstream of Site 2 and downstream of the first river bend. Riverbank and bed substrate was found to be more variable with greater habitat complexity than at Sites 1 and 2, with banks and bed consisting predominantly of bedrock, with areas of cobble, pebble and gravel deposits and some areas of soft sediment. Similarly to Site 2, the site possessed an islet with a number of smaller raised areas of the riverbed, resulting in multiple channels across the width of the river (Plate 4). At the time of survey, the stream width varied between approximately 10 to 45 m, with an average width estimated at 35-40 m. Topography of the site is a broad valley, with the site possessing riffle and run habitat. Surrounding land use was predominantly native bushland.

3.3.2 Aquatic Flora

Aquatic flora observed in the Study Area was typically limited to areas between Sites 2 and 3, where riverbed and banks comprised of a lower percentage of bedrock. Macrophytes were present in low density along the riverbanks and along the edges of river islets, with all aquatic flora observed limited to shallow areas immediately adjacent to the banks and comprising of emergent species. Species observed were generally limited to the native Common Rush (*Juncus usitatus*), with occasional various sedges. Other vegetation was typically limited to riparian areas along the riverbanks, or higher areas of the islets that may only periodically be inundated during high releases.

3.3.3 Aquatic Fauna

Opportunistic fauna sightings in the Study Area during site surveys identified the presence of Platypus (*Ornithorhynchus anatinus*). An individual Platypus was observed instream at Site 1, that appeared to be foraging with intermittent diving behaviour. This individual was first sighted at 1015 at the start of site surveys, whilst another sighting was recorded again 2 hours later upon return to the site. It is not known whether this was the same individual or a second Platypus. Platypus are known to occur in the Severn River, with 4 sightings recorded within a 10 km radius of the Study Area, the closest of which is approximately 12 km downstream of the Study Area (ALA 2024). An additional 15 sightings have been recorded in the remainder of the Severn River downstream of the Study Area before its confluence with the Macintyre River (ALA 2024).

At Site 3 and along the northern shore of the Severn River between Sites 2 and 3 where banks were more sediment dominated, numerous shells of the freshwater Billabong Mussel (*Velesunio ambiguus*) were observed. Both *V. ambiguous* and the Southern River Mussel (*Alathyria jacksoni*) are known to occur in northern areas of the Murray-Darling Basin (Sheldon and McCasker 2020) and have been recorded in the Severn and Macintyre River catchments (ALA 2024).

Other aquatic fauna such as freshwater fish, eels and turtles were not opportunistically observed within the Study Area during site surveys, however, it is likely that the Study Area and downstream areas of Severn River provide semi-permanent or permanent habitat for these species. Three species of freshwater turtles have been recorded in the vicinity of the Study Area (10 km radius), including the Murray River Turtle (*Emydura macquarii*), Eastern Long-necked Turtle (*Chelodina longicollis*) and the Endangered (EPBC Act and BC Act) Western Sawshelled Turtle (*Myuchelys belli*) (ALA 2024), which has a sub-population in the Severn River but is restricted to habitat upstream of Pindari Dam. Both *E. macquarii* and *C. longicollis* may utilise the Severn River downstream of Pindari Dam as permanent habitat, with both species known to occupy deep, clear, flowing waters (NSW DPE 2022). Fish populations identified in the Severn River are discussed in Section 3.2.7.

3.3.4 Key Fish Habitat

Previous mapping conducted by NSW DPI considered the Severn River and its banks, Scrub Hut Creek and much of Lake Pindari as Key Fish Habitat (KFH) – Murray Darling Basin North (NSW DPI 2024a). *In situ* investigations were conducted to verify KFH across the Study Area.

Within the Study Area, the Severn River was classified as Type 1 – Highly sensitive KFH due to the abundance of snags over 300 mm in diameter or 3 m in length, large rock boulders over 500 mm in diameter and known protected and threatened species habitat under the FM Act (Fairfull 2013) (Figure 3). Some areas, particularly in the vicinity of Site 2, also supported native aquatic plants and instream gravel beds (Fairfull 2013) (Figure 3). Downstream areas of Scrub Hut Creek were also identified to be Type 1 KFH due to the presence of large rocky boulders. Aquatic habitat in the Severn River and Scrub Hut Creek that is adjoining or directly adjacent to the dam wall or infrastructure was classified as Type 2 – Moderately sensitive KFH, under a classification as dam up to full supply level where the weir or dam is across a natural waterway (Fairfull 2013) (Figure 3). The entirety of the Severn River within the Study Area was classified as a Class 1 Major KFH, given it is a permanently flowing or flooded freshwater waterway (Fairfull 2013) (Figure 3).

Additionally, the lower section of Lake Pindari at Pindari Dam within the Impact Area was classified as Type 1 – Highly sensitive KFH as expected threatened species habitat under the FM Act (Figure 3).

3.3.5 Water Quality (Qualitative)

The Severn River and habitat at the survey sites comprise pool, run and riffle habitat, with an average width of approximately 20 metres at Site 1, 80 metres at Site 2 and 45 metres at Site 3. Depth was typically between 0.5 to 2.0 metres at each site; however, Site 1 possessed some deeper pool habitat with an estimated depth of approximately 6.0 metres. At the time of survey, water level was relatively low across all sites with a low to moderate flow observed. Water appeared turbid at Sites 1 and 2, whilst it was tannin coloured but relatively clear at Site 3, further downstream. No surface films or noticeable odours were observed at any site.

Quantitative water quality parameters recorded as part of the MER Program are presented in Section 3.2.

3.3.6 Riparian Assessment

Riparian vegetation coverage differed across the Study Area, associated with the geomorphology of the riverbank and adjoining land. Vegetation communities were relatively uniform throughout the Study Area, with an even composition of native and exotic species that was characteristic of woodlands. Extensive areas of high and very high coverage of native woody riparian vegetation is known to occur in the western and eastern midlands of the NSW Border Rivers, including the Severn River below Pindari Dam (NSW DPE 2019). Riparian vegetation at Site 1 was higher in density on the northern bank and was regularly spaced, dominated by exotic pine trees with some occasional native grassy ground cover. On the southern bank, riparian vegetation within 20 m of the water's edge was isolated, with the occasional small Wattle (*Acacia* sp.) and tussock grass, with all other nearby vegetation restricted to areas further back from the river where substrate composition was more favourable. At Site 2, riparian vegetation was more regularly spaced with a moderate density. Along the immediate riverbanks, vegetation was dominated by River She-oak (*Casuarina cunninghamiana*) and small stands of *J. usitatus* whilst areas 5 to 10 m back from the bank were vegetated by a range of *Eucalyptus* species, including River Red Gum (*Eucalyptus camaldulensis*), Apple Box (*Eucalyptus bridgesiana*), Grey Gum (*Eucalyptus punctata*) and Ironbark, with some small wattles. The

islets were typically dominated by large, established Willows (*Salix* sp.), *C. cunninghamiana* and various rush and sedge species. Downstream at Site 3, riparian vegetation was semi-continuous with very low disturbance, high density and a higher native to exotic species ratio. Riparian community composition was similar to that at Site 2, with *C. cunninghamiana* and rush species dominating riverbanks and bordered by various *Eucalypts*. Islets at Site 3 were largely vegetated by *C. cunninghamiana* and rushes with occasional Willows and pines.

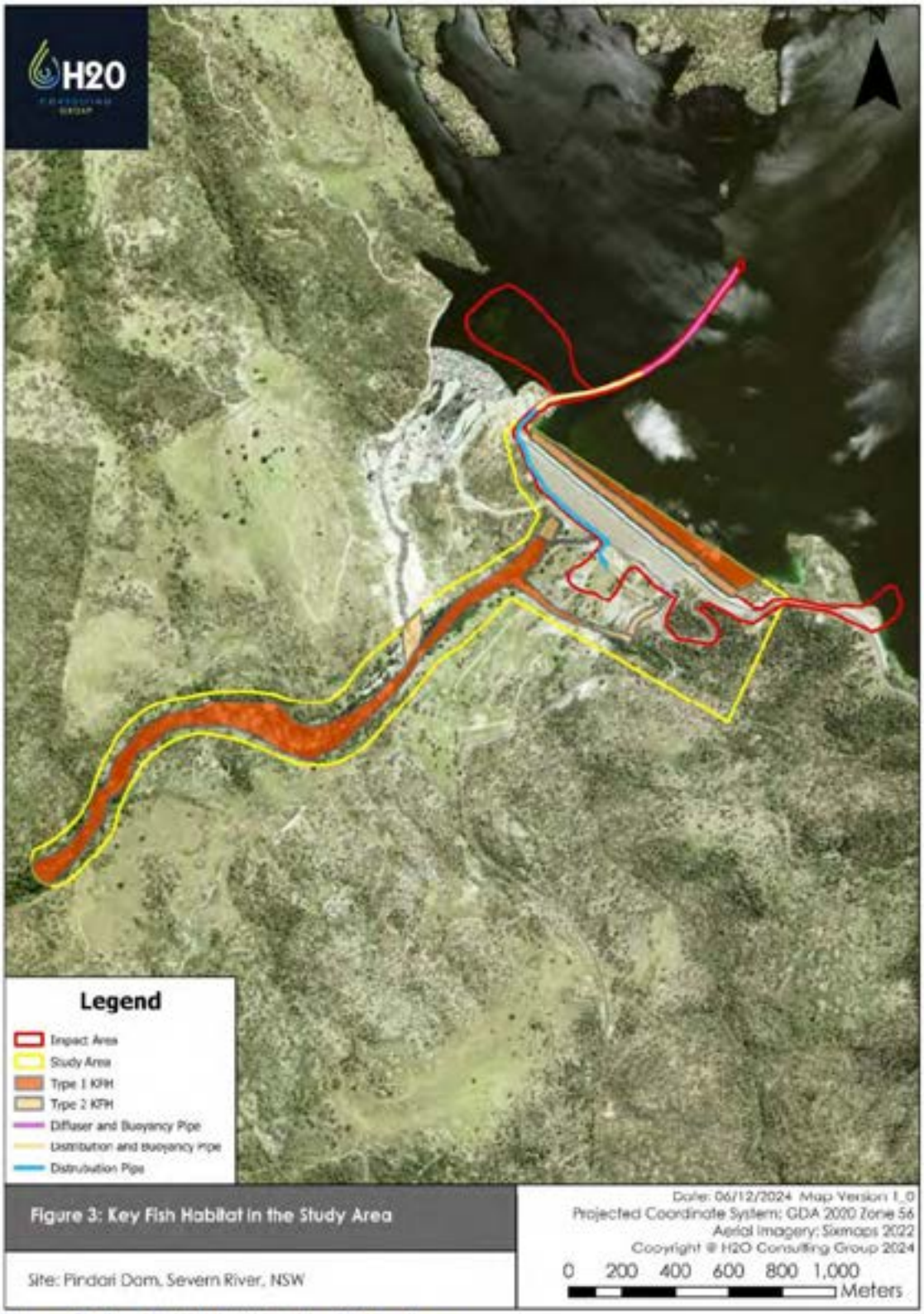


Figure 3: Key Fish Habitat in the Study Area.

4 Impact Assessment

The Guidelines for Aquatic Ecology in Environmental Impact Assessment identifies that environmental disturbances to aquatic ecology can be categorised in terms of potential physical, chemical and biological effects, which allows for the nature of impacts and their likely magnitude to be assessed (Lincoln Smith 2003). More recently, research on impacts to marine fauna has had increased focus on behavioural impacts as a result of additional sources of disturbance such as underwater noise (Erbe 2012) and light (Tidau 2021). To recognise this, behavioural effects have been added as a fourth category of impacts summarised in Table 6.

4.1 Potential Construction Impacts

Table 6 details the potential aquatic impacts from construction works. Impacts in Table 6 are limited to the aquatic habitat of Lake Pindari and Severn River upstream of the dam wall, unless explicitly stated.

Table 6: Identification of potential aquatic impacts from the project.

Impact	Likelihood	Description
Physical		
Removal or modification of Key Fish Habitat	Known	The installation of the bubble plume distribution pipeline and pipeline diffuser in Lake Pindari will result in the modification of some Type 1 KFH. Modifications will include the placement of the bubble plume infrastructure along the deepest section of the dam and will involve some construction disturbances to the KFH.
Removal or loss of aquatic vegetation	Possible	The construction works within Lake Pindari will include the installation of the air distribution and the air diffuser header pipes. The construction of the air distribution header pipe near Anchor Block 'A' will result in some shoreline disturbance. Regardless of the final construction methodology, some short-term disturbances are expected for any freshwater macrophytes (e.g. rushes) that may be growing along the shoreline or shallow waters within the construction footprint at the time of construction. The installation of the air diffuser header pipe along the dam bed is not expected to result in the removal or loss of aquatic vegetation, as the pipe is to be laid at depths of >40m in an anoxic area of the dam floor.
Removal or loss of a threatened ecological community or population	Unlikely	Construction works associated with the installation of the air distribution and diffuser pipelines and associated anchor blocks are not expected to result in the removal or loss of a threatened ecological community or population. There are two threatened fish populations that may occur in the locality, the Eel-tailed Catfish and Olive Perchlet, and one EEC, the Darling River EEC, which is restricted to the Severn River below the dam wall. The two threatened fish populations both include highly mobile species that are expected to disperse from any disturbances. The construction works are not expected to impact on important habitats that are critical to the survival of any individuals within these populations. Additionally, the pipeline will be sunk to depths over 40 m and in anoxic waters that are not expected to support aquatic fauna.
Removal or loss of a threatened species	Unlikely	Construction works associated with the installation of the air distribution and diffuser pipelines and associated anchor blocks are not expected to result in the removal or loss of a threatened

		species. Threatened aquatic species in the locality are confined to mobile fish, turtle and monotreme species that would be expected to disperse from disturbances by the construction barge, work boats and materials. Additionally, the pipeline will be sunk to depths over 40 m and in anoxic waters that are not expected to support diverse communities of aquatic fauna.
Disturbance to a threatened aquatic species or their habitat	Possible	Construction works associated with the installation of the header pipes and anchor blocks may result in disturbances to threatened aquatic species or their habitat. These disturbances are expected to be restricted to the presence of work boats and the construction barge and associated construction noise. A majority of assembly of the pipeline is expected to be conducted onshore, which will reduce noise disturbances. Mobile threatened species are expected to disperse from construction disturbances if present in the vicinity of works. Considering the minor footprint of the construction area compared to the dam's total size, any expected disturbances to habitat from the construction works are not expected to be of an ecologically significant scale.
Disturbance and/or modification to dam floor and/or shoreline habitat	Known	The installation of the air diffuser header pipeline and the associated anchor blocks will result in disturbance and modification of the shoreline and dam floor. The pipeline will have an outer diameter of 180 mm and is positioned along ~700 m of the dam floor, with a 200 kg concrete anchor block every ~5 m once on the bottom or galvanised chain structures in shallower areas.
Physical disturbance to aquatic fauna and flora	Likely	Construction works may result in some disturbances to aquatic fauna and flora in the epilimnion. Freshwater macrophytes along the riverbanks or in shallow areas near the shore may be disturbed as the pipeline and anchor blocks are laid. Additionally, macroinvertebrates utilising edge habitat associated with the dam shoreline, or benthic infauna inhabiting shallow sediments may be lost or smothered by the pipeline and supports. Impacts to benthic infauna will likely be restricted to infauna inhabiting sediments in the epilimnion and potentially metalimnion, whilst infauna in hypolimnion is considered to be unlikely and low under anoxic conditions. Considering the small footprint of works compared to the available habitat of Lake Pindari, this is not expected to be ecologically significant. Some mobile species may also be deterred from the area as a result of construction vessels and materials, as well as during the sinking of the structure.
Barriers to fish passage	Unlikely	The construction works are unlikely to result in any temporary or permanent barriers to fish passage. If used in very shallow areas, sediment curtains
Injury caused by ingestion of, or entanglement in, harmful marine debris	Possible	Materials used or rubbish generated during the works that are not contained or disposed of correctly have potential to find their way into the water and be ingested by marine fauna.
Potential for increased risk of vessel strike for marine fauna	Unlikely	The works are not expected to result in any notable or sustained increase in vessel movements in the Study Area that pose a risk to marine fauna that occupy waters at or near the surface. The dam is regularly used recreationally by vessels.
Generation of noise resulting in injury	Unlikely	The level of underwater noise to be generated by construction works is expected to be well below levels considered potentially harmful to marine fauna. A majority of the pipeline assembly will be conducted onshore, before the pipeline is moved to its alignment

		and sunk. Given this, the potential to produce levels of underwater noise capable of injury to marine fauna is negligible.
Chemical		
Changes in water quality	Likely	Construction activities may result in some short-term disturbances to the adjacent aquatic habitat in Lake Pindari as a result of increased turbidity and sedimentation from works on the top of the spillway. The sinking of the pipeline and anchor blocks may also result in a temporary sediment plume, which may disturb and disperse anoxic sediments and sediments with high concentrations of metals and nutrients.
Unexpected spill of potential contaminants	Unlikely	The construction of the pipeline system is not expected to result in the mobilisation of contaminants, provided appropriate controls are in place to prevent spillages from the laydown area on the spillway to the adjacent waterway.
Nutrification	Possible	Waters in the hypolimnion were recorded to have elevated levels of soluble metals and nutrients (Manganese, iron and phosphorus). The sinking of anchor blocks and the pipeline has potential to result in a small disturbance of sediment on the dam floor that may disperse these nutrients to the photic zone, which may be utilised by cyanobacteria.
Biological		
Invasion or spread of non-native or invasive species	Possible	It is not expected that the works will facilitate the introduction or spread of aquatic pest species. However, given the existing frequency of algal blooms in Lake Pindari, machinery may facilitate the spread of algal species if not cleaned thoroughly between sites.
Introduction of disease or pathogens	Unlikely	No known diseases or pathogens have been identified in the Study Area that pose an environmental issue for aquatic fauna and flora.
Behavioural		
Generation of underwater noise with potential for behaviour affect	Unlikely	The level of underwater noise to be generated by construction works is unlikely to have potential to impact on the behaviour of any aquatic fauna.
Generation of construction noise with potential for ecological affect	Unlikely	Vessel movements and the transport and alignment of pipeline may at times produce some construction noise. However, it is expected to be negligible in comparison with the existing vessel and recreational boating that occur at this location and not of a magnitude for ecological impact.

4.1.1 Aquatic Flora

Macrophytes throughout the wider Study Area were limited, as the predominant bed rock substrate of the riverbed and banks provided limited potential habitat for the establishment of rooting freshwater macrophytes. Potential construction disturbances to aquatic flora are limited to potential species that have opportunistically utilised substrate within the construction footprint of the distribution pipeline in along the dam shoreline and in shallow sediments. Any aquatic flora within the footprint may experience some disturbances during construction, such as damage or physical disturbance from construction materials, infrastructure or equipment. Given shoreline substrate in the vicinity of works on the western end of the dam wall comprises bed rock, the establishment of aquatic flora is considered unlikely. Thus, construction impacts to aquatic flora are considered to be minimal as a result of these works. Freshwater macrophytes downstream of Pindari Dam are not expected to be impacted by construction works.

4.1.2 Aquatic Fauna

Disturbances to habitat quality are expected to occur within the localised area of construction works. Native freshwater fish, turtles, other vertebrates and invertebrates in the vicinity of works may experience short-term impacts related to reduced habitat quality and physical disturbances to the shoreline and surface waters in the lower dam. The fauna with the greatest potential for impact are invertebrate species residing along the shoreline or dam bed within the construction footprint at the time of works, where habitat may be impacted by the installation of the distribution and diffuser pipes. Direct disturbances that have potential for removal are likely to occur during any excavation works along the water's edge, establishment of the laydown areas, as well physical injury, crushing, and smothering from the placement of the distribution pipeline and anchor blocks. Fauna affected may include infauna and macroinvertebrates inhabiting sediments, shorelines and overhanging vegetation, including various benthic infauna or epibenthic fauna such as freshwater polychaetes, crustaceans, bivalves and insect larvae, which are less mobile and may not be able to disperse from construction disturbances. These species are a key component of aquatic food webs and provide a food source for various larger fish and vertebrate species. The location of the proposed above-water section of the distribution pipe is along an area of bedrock at the top of the spillway, with minimal fringing vegetation stands or aquatic flora. The abundance of these invertebrate communities is expected to be low within the construction footprint in comparison to areas of the dam with a higher sediment composition along the shoreline and with increased vegetation. Impacts may also occur to infauna species inhabiting sediment along the dam bed where the distribution pipeline, diffuser pipeline, anchor blocks and any associated holding down systems are installed along the dam bed. Impacts would likely include crushing and smothering of infauna underneath these structures, however, are expected to be largely limited to infauna inhabiting sediment within the epilimnion. Data collected as part of the MER Program identified that waters in the hypolimnion (below approximately 15 m depth) were anoxic (absent of oxygen) for the entire duration of monitoring from October 2023 to May 2024 (NSW DPI 2024a). Hypoxic (very low oxygen) conditions are known to influence infauna behaviour, with prolonged exposure shown to result in mortality (Sturdivant et. al., 2012). Studies have shown that infaunal bioturbation is severely reduced or absent in periods of hypoxia, with few species able to survive in these conditions (Sturdivant et. al., 2012). Considering this, impacts to infauna in sediments within the construction footprint along the dam bed are expected to be predominantly confined to the pipeline footprint within the first ~15 m depth, with impacts in deeper waters expected to be minimal. Thus, overall disturbances to macroinvertebrates within the construction footprint are expected to be minimal and not of ecological significance.

For larger animals such as fish, turtles and larger invertebrates, works will likely result in temporary deterrence from habitat, but may also result in physical injury, smothering, or death from machinery, vehicles or equipment. A number of sightings have been recorded of the Eastern Long-necked Turtle (*Chelodina longcollis*) and Murray River Turtle (*Emydura macquarii*) (ALA 2024) in the Severn River within approximately 10 km of the Study Area, whilst the threatened Western saw-shelled Turtle (*Myuchelys bellii*) has been recorded just beyond 10 km of Study Area in upstream Severn River. It is likely that Lake Pindari and the Severn River, both upstream and downstream of the dam, also provide permanent habitat for these species. It is expected that foraging adult individuals would move out of the area and avoid any disturbances during construction. However, any nesting turtles may not be able to avoid disturbances. All NSW freshwater turtles nest in terrestrial habitats, by digging a hole in moist soils to lay their eggs. The threatened *M. bellii* will typically dig out a nest in sandy or loam riverbanks during Spring (NSW OEH 2024). Nesting habitat for freshwater turtles in the vicinity of works is highly limited due to minimal soft sediment and soil, whilst general recreational use of the dam and the operation of the dam outlets likely already deter individuals from the immediate lower dam. There also remains some potential that freshwater turtles may

be crushed or injured by vehicles and when ashore and moving between water bodies or habitats. An appropriate unexpected fauna encounter procedure will need to be included in the project's Flora and Fauna Management Plan (FFMP) or similar document to manage and appropriately mitigate this risk during construction works.

Sightings of Platypus (*Ornithorhynchus anatinus*) have also been recorded throughout the Severn River catchment, however, are predominantly confined to areas downstream of Pindari Dam or upstream of the Severn River Nature Reserve (ALA 2024). A sighting was observed below the dam, near Site 1, during site investigations. Large dams are known to fragment Platypus populations and whilst Platypus can climb though terrestrial habitats between aquatic habitats, it is unlikely that the species would be able to migrate between the Pindari Dam and downstream stretches of the Severn River. In the Severn River downstream of the dam wall installation of the distribution pipe along the lower dam wall may temporarily deter Platypus from waters between Scrub Hut Creek and the dam wall, as a result of noise, vibrations or presence of workers and equipment. However, habitat is not expected to be significantly disturbed in the Severn River downstream of the dam. Within the dam, presence of Platypus in the vicinity of works would likely be restricted to transient movements as part of foraging efforts, with individuals expected to be confined to more suitable habitat in upstream areas of the dam or associated tributaries. Impacts to any individuals in the vicinity are expected to be limited to deterrence from the immediate works zone.

General construction works also have potential to result in injury caused by ingestion of or entanglement in harmful marine debris, a KTP under the EPBC Act. Any debris left within or adjacent to the waterway, such as plastic, strapping, sheeting, piping, adhesives, ropes, paints and general rubbish has potential to be ingested or entangle vertebrate marine life (DCCEEW 2021). This may include various fish, turtles, mammals and birds both within the Study Area and downstream in the wider Severn River. A suitable Waste Management Plan (WMP) will need to be included in the project CEMP to manage this risk.

4.1.3 Riparian Vegetation

Riparian vegetation in the Study Area was prevalent along the Severn River downstream of Pindari Dam, however, limited communities were observed directly adjacent to the dam wall. The degradation of native riparian vegetation along water courses in NSW is considered a KTP under the FM Act, whilst the clearing of native vegetation is considered a KTP under the BC Act. Riparian vegetation, comprised of plant communities that adjoin and influence water bodies, is a critical element of many aquatic ecosystems. The plants in riparian zones provide important ecosystem services such as energy sources, temperature control via shading, bank and bed stabilisation, erosion control, flow regulation, filtration of water and aquatic microhabitat (Riis et. al., 2020). Degradation of native riparian vegetation as part of project construction, particularly trenching works, may include clearing or trampling, which has potential to negatively impact the wider ecosystem and downstream receiving waters. These actions can be detrimental to environmental health and water quality and by association, habitat quality. Many species of fish and macroinvertebrates use microhabitats provided by overhanging riparian vegetation and macrophyte beds (Crook and Robertson 1999).

Riparian vegetation in the Impact Area is expected to experience some minor disturbances during construction works, however, the placement of the distribution pipe in aboveground areas has been designed to avoid existing riparian and terrestrial vegetation. The distribution pipeline will run along the unvegetated lower dam wall and around existing vegetation stands on the western side of the wall before veering down to the water's edge. A small amount of riparian vegetation present within the distribution pipeline footprint, limited to ground cover comprised of native rushes, may be disturbed during construction. Considering the small disturbance to riparian vegetation expected, construction works to install the

distribution pipeline are not expected to result in any significant fragmentation of habitat or loss of connectivity. Any removal of vegetation does however increase the potential for erosion and sedimentation of adjacent waterways, which will need to be appropriately managed during construction to mitigate or minimise this risk.

4.1.4 Water Quality

The construction of the pipeline system is expected to result in some short-term water quality impacts within Lake Pindari. Whilst typically restricted to areas on land for the project, excavation works including trenching and backfilling in vicinity of the shoreline to install areas of the distribution pipeline have potential to mobilise sediments. Increase in suspended sediments in the water column can alter the physical chemistry of the water, increase turbidity and reduce available light to the dam bed, eventually settling on the dam bed. Without proper sediment and erosion controls during construction, this may result in short term reductions in habitat quality for instream and fringing macrophyte stands and any freshwater fauna in the vicinity of works. Additionally, the laydown and storage area for works is located on the top of the dam spillway, adjacent to the water. Vehicle movements, construction equipment and materials, construction of the pipeline string and potential spillages have potential to impact on adjacent water quality. Contaminants such as some hydrocarbons and pesticides can be toxic to aquatic fauna and/or have significant impacts on their physiology (Clarke 2001). Material that is brought to site to be used for any infilling of the shoreline or adjacent areas following trenching has potential to result in elevated nutrients or contaminants entering the adjacent water body. Backfill should preferentially be comprised of material from the site where possible. Sediment and erosion controls will need to be implemented along the lower spillway during construction to prevent and minimise potential water quality impacts.

High concentrations of Manganese (Mn), Iron (Fe) and Phosphorous (P) were observed in hypolimnion waters in Lake Pindari, reflective of the anoxic conditions and reducing processes occurring within the dam (NSW DPI 2024a). Waters and sediments in the hypolimnion are anoxic, yet biological oxygen demand to facilitate processes such as decomposition are still required, thus sediments reduce oxides and release soluble forms of these elements into the water column. The sinking of the diffuser pipeline and associated anchor blocks has potential to disturb these sediments and bottom waters. A 200 kg anchor block is proposed every 5 m along the ~500 m pipeline, with ~100 anchor blocks totalling ~20 tonnes to be sunk during installation. It is expected that upon impact with the dam bed, the anchor blocks will result in a small and isolated disturbance, with potential to disperse these soluble elements. If mobilised sediments reach the photic zone, cyanobacteria may metabolise using these metals and nutrients, with potential to result in an algal bloom. However, it is unlikely that the disturbance as a result of the sinking anchors will be of a magnitude with capacity to cause a plume to rise (between ~10-25 m) to the photic zone. Potential risks associated with these interactions during operation are further discussed in detail within Section 4.3.3. A majority of the pipeline will be laid in areas of the dam that are >40 m deep, with anoxic sediments restricted to deep waters in the hypolimnion. It is expected that the sediments with the greatest risks associated with pluming are restricted to those deepest areas. A controlled and slow sinking of the pipeline and anchor blocks will minimise the potential for sediment pluming and upwelling of anoxic bottom waters.

4.2 Potential Operational Impacts

Table 7 details the potential aquatic impacts from the operation of the bubble plume system. Impacted areas include aquatic habitat both within Lake Pindari and receiving waters of the Severn River downstream of the dam wall.

Table 7: Identification of potential aquatic impacts from the project.

Impact	Likelihood	Description
Physical		
Removal or modification of Key Fish Habitat	Known	Operation of the bubble plume system will result in modification of Type 1 KFH in Lake Pindari and the Severn River, as a result of changes in water quality parameters. This is expected to have an intended increase in temperature and DO in dam release waters and mixing of epilimnion and hypolimnion waters in the vicinity of the plume within Lake Pindari to reduce the effects of CWP from the Dam's existing operation.
Removal or loss of aquatic vegetation	Possible	Aquatic macrophytes were uncommon in the Study Area and largely restricted to riverbanks in downstream areas of Severn River. Temperatures changes may increase productivity of these stands. Where aquatic macrophytes are present in shallow areas along the pipeline footprint, they may be disturbed during periods of low water levels where the pipeline and Type 3 holding down systems may lay or drag along the dam bed.
Removal or loss of a threatened ecological community or population	Unlikely	All native fish and aquatic invertebrates in the Severn River downstream of Pindari Dam are included in the Darling River EEC. The operation of the destratification system is not expected to directly impact on fish or invertebrates such that a community or population would be lost. Impacts are expected to be limited to habitat changes to reduce the effects of CWP and some potential shifts in community distributions back to natural state.
Impact to a threatened aquatic species or their habitat	Likely	Impacts to aquatic habitat in the Severn River downstream of Pindari Dam are expected to provide improved habitat for aquatic fauna. Threatened fish species include *M. peelii*, *T. tandanus* and *B. bidyanus*, which currently face pressures from CWP. Expected increases in temperatures of dam releases and a reduced temperature differential between releases and the river is expected to reduce the extent and magnitude of CWP and cold shock events, with potential for positive impacts for reproduction cycles.
Disturbance to aquatic fauna and flora	Likely	Some disturbances to aquatic fauna and flora are expected as a result of plume operation. Aquatic fauna have an optimal thermal range for metabolic and physiological functioning and changes in environmental conditions may impact on the capacity and function of different organisms. This is discussed in reference to different fauna groups below. Particularly, changes in temperature dynamics may cause some shifts in invertebrate distribution, which may cause some minor shifts in prey habitat for upper trophic levels, however, this is not expected to occur at any ecologically significant levels.
Barriers to fish passage	Unlikely	The works are not expected to result in any temporary or permanent barriers to fish passage. The proposal will also assist in reducing any chemical barriers to fish passage in the Severn River directly below the dam created by the CWP of the existing dam discharge.
Injury caused by ingestion of, or	None	Materials or rubbish are not expected to be generated during operation of the bubble plume system.

entanglement in, harmful marine debris		
Potential for increased risk of vessel strike for marine fauna	Unlikely	The works are not expected to result in any notable or sustained increase in vessel movements in the Study Area that pose a risk to marine fauna that occupy waters at or near the surface. An exclusion zone will be implemented surrounding the plume infrastructure, which is expected to reduce the risk of vessel strike in the southern section of Lake Pindari at Pindari Dam.
Generation of noise resulting in injury	Unlikely	The level of underwater noise expected to be generated via the diffuser pipeline, distribution pipeline and generators is not considered potentially harmful to marine fauna. Given this, the potential to produce levels of underwater noise capable of injury to marine fauna is negligible.
Chemical		
Changes in water quality	Known	The operation of the bubble plume system will change water quality parameters of Lake Pindari waters in vicinity of the plume by mixing anoxic and cold bottom waters with oxygenated, warmer surface waters. This is expected to homogenise temperature and DO conditions within the dam. As a result, the temperature of dam releases is expected to increase, thus reducing the temperature differential between the ambient water temperature of the Severn River downstream of Pindari Dam and the water temperature of dam releases. There is some potential that operation of the bubble plume system may circulate soluble metals and nutrients from the hypolimnion that could exacerbate conditions for potential algal blooms.
Mobilisation of contaminants	Unlikely	Mobilisation of contaminants are not expected to occur as a result of the operation of the bubble plume system. There is some potential that maintenance of supporting infrastructure associated with the compressors at the base of the dam wall may at times result in spillages of contaminants such as hydrocarbons. Rain events may wash these contaminants into the surrounding swale and discharge into the adjacent waterway.
Nutrification	Possible	The operation of the bubble plume system has potential to result in nutrification of Lake Pindari and the Severn River. Waters in the hypolimnion were recorded to have elevated levels of soluble metals and nutrients (Manganese, iron and phosphorus). As these waters are entrained to the surface, cyanobacteria may utilise these nutrients to metabolise and create a feedback loop, resulting in potential algal blooms. Whilst the system may not solely cause an algal bloom, it may be exacerbated by surrounding environmental conditions in Lake Pindari, which is already susceptible to algal blooms.
Biological		
Invasion or spread of non-native or invasive species	Possible	The operation of the bubble plume system has potential to exacerbate the spread of cyanobacteria into downstream areas of Severn River. As mixing of waters may facilitate a higher proportion of algae to be drawn into release waters.
Introduction of disease or pathogens	Unlikely	No known diseases or pathogens have been identified in the Study Area that pose an environmental issue for aquatic fauna and flora.
Behavioural		
Generation of underwater noise with potential for behaviour affect	Unlikely	The level of underwater noise expected to be generated via the bubble plume system will be highly unlikely to have potential to impact on the behaviour of any aquatic fauna.

4.3 Water Quality

4.3.1 Temperature

Water temperature is one of the most significant contributing factors to habitat quality and the ecological processes and functions of aquatic ecosystems. Water temperature influences various water quality parameters, including solubility of gases and pollutants, pH levels, electrical conductivity and the toxicity of pollutants (Bonacina et. al., 2022). Water temperature also influences the nutrient cycle, including both primary production and the decomposition of organic matter, with warmer temperatures typically supporting higher rates of metabolic activity and photosynthesis (Bonacina et. al., 2022). It is also an essential ecological trigger, responsible for prompting life cycle phases of aquatic species such as migration, spawning, hatching or emergence. Water temperature may also affect the functioning of aquatic communities, with each species possessing different specific temperature requirements for optimal performance and growth. Resulting thermal stress can result in behavioural, physiological and metabolic impacts (Bonacina et. al., 2022). As reviewed in Section 1.4, CWP is known to cause thermal stress on aquatic species, which may eventuate as shifts in metabolism and growth, changes to reproductive processes and/or success, cold shock, hypoxic stress and spatial and temporal changes of community distributions (Michie et. al., 2020).

The primary objective of the bubble plume system at Pindari Dam is to mitigate CWP in downstream receiving aquatic habitats in the Severn River. Monitoring conducted as part of the MER Program to date exhibited strong thermal stratification in Lake Pindari, persistent in the warmer months from October 2023 to April 2024. Thermal stratification was more pronounced during Summer with temperature differences between the epilimnion and hypolimnion differing up to 20°C between December 2023 and February 2024. Typically, the hypolimnion temperature remained relatively stable at 12.5 °C, whilst the thermocline typically did not extend beyond 12 m depth (NSW DPI 2024a). During operation, the bubble plume system will entrain the dense and cold hypolimnion water, raising it to the surface. The denser, colder water will then begin to sink back to a neutral buoyancy, away from the centre of the plume, resulting in mixing of waters, with an expectation of the breaking down of the thermal stratification in the vicinity of the plume. This is expected to result in a homogenisation of water temperatures in the vicinity of the plume and is expected to reduce the surface to bottom temperature differential, as well as increase the temperature of the water drawn for discharge to the Severn River. However, this will likely result in a decrease in temperature of surface waters in the vicinity of the plume as the colder waters are raised to the surface. This may result in some behavioural changes of aquatic fauna utilising habitat in the lower dam within ~1 km of the dam wall and the diffuser, where aquatic fauna that prefer warmer surface temperatures may avoid the decreased temperatures and disperse to other areas of the dam. Mixing and homogenising the water temperature within the vicinity of the diffuser may also reduce a small area of cold-water habitat that may be utilised by some zooplankton.

Initial monitoring in the Severn River demonstrated that water temperatures were colder at sites downstream of Pindari Dam compared to sites upstream during Spring, Summer and Autumn, indicating the presence of CWP (NSW DPI 2024a). On average, the daily water temperature differences between upstream and downstream sites were ~10°C, with the greatest differences occurring over Summer (NSW DPI 2024a). Thermal destratification within Lake Pindari as a result of mixing from the bubble plume system is expected to result in increases to average water temperatures in the Severn River downstream of the dam. The resulting temperatures are expected to be more reflective of those natural ambient conditions in upstream reference sites and in turn, reduce the temperature differential between dam releases and

ambient river temperatures. Increased release temperatures may also contribute to reducing the magnitude and severity of cold water shock events. Where increases in average daily temperatures that are more reflective of natural conditions do occur, it is expected that a number of positive impacts will occur in the downstream receiving waters of Severn River, including favourable behavioural and physiological changes. These are discussed in the relevant sections in detail below.

4.3.2 Dissolved Oxygen

Dissolved oxygen (DO) is one of the most important factors for the survival of aquatic organisms. It refers to oxygen that has been dissolved in water, such as from diffusion from the atmosphere or that has been released from photosynthesis that is available for respiration by aquatic organisms. Aquatic organisms require specific DO concentrations, much like temperature, for optimal performance and growth with bottom feeders such as crustaceans and polychaetes requiring lower amounts of oxygen than shallow water fish. Where the DO requirements of aquatic organisms cannot be met, such as in anoxic or hypoxic waters, this can result in various physiological impacts including stress, stunted growth, susceptibility to disease and mortality, whilst it can also affect species community structure, diversity and distribution (Anushka and Mishra 2022). Dissolved oxygen is also required for the decomposition of organic material by bacteria and microbes on the bottom of a riverbed.

Monitoring conducted as part of the MER Program identified oxygen stratification in Lake Pindari, with DO concentration (%) near saturation at the surface and anoxic in the hypolimnion. The oxycline was recorded to vary seasonally at depths between 7 and 15 m and was recorded to occur at shallower depths during warmer months and at greater depths following the colder months. This concurs with the patterns observed associated with the thermocline in Lake Pindari.

During operation, the bubble plume system will entrain the denser and anoxic hypolimnion water, raising it to the less dense and more highly oxygenated epilimnion waters. Concentrations of DO in the hypolimnion waters are expected to increase as water raised by the plume is aerated by atmospheric gas exchange and through direct surface contact with the bubbles (Birt et. al., 2021). As the water is continuously mixed, the oxycline will likely eventually be broken down. However, it is likely that during the initial commencement of the bubble plume system and establishment of the mixing processes, the upwelling of anoxic waters may result in a decrease in DO of the waters in the vicinity of the plume. This may cause the temporary dispersal of some aquatic fauna species inhabiting surface waters away from the plume if their biological oxygen demands cannot be met during the initial stages of the operation. Additionally, it is unlikely the bubble plume system will significantly increase the DO of waters released into the Severn River. Existing release waters undergo oxidisation as they are pumped, run over rocks and mix with the much shallow waters in the Severn River. Whilst the bubble plume system will likely increase the DO concentrations of these waters before release, it is not expected to significantly increase DO concentrations in the Severn River.

It is expected that a number of processes and interactions may be affected by changes in DO, these are discussed in the below sections.

4.3.3 Nutrients and Cyanobacteria

Water quality as part of the MER Program to date identified that iron (Fe) and manganese (Mn) concentrations were much greater in bottom hypolimnion waters of Lake Pindari than in surface waters. High concentrations of these nutrients in the hypolimnion are reflective of the anoxic conditions and reductive processes occurring in the dam, whilst high phosphorus (P) concentrations that were also

recorded in the hypolimnion indicate the breaking of Fe-P bound complexes (NSW DPI 2024a). In waters with low DO concentrations, sediments may reduce metal oxides and nutrients to accommodate for the continued biological oxygen demand required for the decomposition of organic matter, which results in the release of soluble and bioavailable Fe, Mn, P and nitrogen (N). As these soluble nutrients are entrained from hypolimnion waters to the surface and mix with atmospheric oxygen, highly oxygenated waters and the bubble plume air, they are expected to be oxidised and soluble forms reduced. However, where these waters are entrained to the surface and water flow is too great or not enough oxygen is supplied to allow for oxidisation, risks of algal blooms occur. The upwelling of bioavailable limiting nutrients to the photic zone without an opportunity for oxidisation provides fuel for cyanobacteria to metabolise, and in excess, has potential to lead to an algal bloom. This may also occur at lower depths near the thermocline where low-light-tolerant algae are present (Preece et. al., 2019). This can create a feedback loop where entrained bioavailable nutrients stimulate algal growth, creating organic matter that falls to the anoxic hypolimnion, requiring decomposition (Preece et. al., 2019).

Algal blooms are an existing and ongoing management issue within Lake Pindari. Recent Red Alert warnings for high levels of potentially toxic blue-green algae were issued from April – May 2024 and most recently from late August 2024 (WaterNSW 2024). Toxins from blue-green algae are poisonous to a variety of farm stock and cattle, can be damaging or poisonous for aquatic species such as fish and frogs, and accumulate in shellfish species. Bloom events can also result in fish kills as DO in the water column is rapidly depleted. As the water column DO levels and nutrient levels establish following the initial commissioning of the bubble plume system, the risk of an algal bloom is increased. It is expected that over time, the destratification system will increase DO throughout the water column and may decrease concentrations of soluble forms of Fe, Mn, P and N (NSW DPI 2024a). However, modelling of water flow rate and the position of mixing in the water column should be considered to minimise the creation of favourable conditions for algal blooms, such as maintaining a mixing depth below the photic zone (Birt et. al., 2021). Additionally, ongoing monitoring will be required to manage algal bloom risk in the dam as surrounding environmental conditions such as temperature, rainfall, storms, droughts and any further development or land use changes within the catchment will result in accumulative impacts on algal growth.

Data collected to date also identified that Fe and Mn concentrations were higher in the Severn River downstream of Pindari Dam compared to the reference sites upstream of the Dam, however, were not higher than the concentrations of the hypolimnion waters inside the Dam (NSW DPI 2024a). Any algal blooms in the lower area of Lake Pindari have potential to extend downstream as cyanobacteria suspended in the water column are mixed, possibly with waters at the depth of the offtake. During periods where flow is slow or still such risks may be elevated. This may have implications for downstream habitats, which would be more vulnerable to fish kills, reduced water quality and exposure to potentially toxic species.

The continuation of existing management and monitoring, with consideration of new changes and potential risks from the proposed destratification system will be required to mitigate and manage these potential impacts.

4.4 Aquatic Flora

4.4.1 Freshwater Macrophytes

Freshwater macrophytes were limited along the Severn River within the Study Area, where they were confined to emergent rush species along the riverbanks, or along some of the river islets. Operation of the proposed destratification system is expected to result in increased water temperature of dam releases and

more stable temperatures in the Severn River downstream of Pindari Dam. Many studies have been conducted to investigate macrophyte responses to climate change and rising air and water temperatures. These studies indicate that macrophyte responses to increases in water temperature are typically species and site specific, with some species showing increased growth rates, leaf surface area and biomass and others showing an overall reduction in macrophyte cover (Lind et. al., 2022). The Severn River below Pindari Dam currently experiences CWP, with the objective of the proposed plume to increase the average river temperature to be more reflective of natural conditions. Thus, the increases in water temperature are expected to be within a natural temperature range and not expected to result in 'heating' of the river such that detrimental impacts would occur to freshwater macrophytes. A small increase in water temperatures, particularly during spring and summer months, may result in earlier commencement of growth and increased macrophyte production and coverage (Lind et. al., 2022). This in turn could result in increased growth or growth rates of opportunistic species that may smoother or foul native macrophytes. Thus, direct impacts from operation of the destratification system are expected to generate more stable environmental conditions, reducing thermal stress on natural growth rates of native macrophytes species downstream of the dam.

Within the dam, operational direct impacts to aquatic flora are expected to be minimal. Potential impacts may occur if aquatic flora species establish in shallow areas along the dam bed in the vicinity of the pipeline alignment where Type 3 holding down systems are used. In periods of lower water levels, the galvanised chain and pipeline may sit and drag on the bed of the dam and damage or remove aquatic flora beneath or near the structure. However, considering this would only occur when water levels are low and during periods of high flow or surface disturbances during weather events, aquatic flora would likely be already disturbed by the surrounding environmental conditions.

Increases to water temperature in the Severn River and Lake Pindari may also result in increases in periphyton and algae biomass. Periphyton and algae growth and biomass are influenced by complex interactions between temperature and nutrient availability. Higher water temperatures will provide opportunity for increased growth and metabolic rates and may affect the rate of decomposition of organic material leading to increased nutrient availability. Opportunistic species may be benefited at the expense of slower growing species (Rasconi et. al., 2015), resulting in a reduction in periphyton diversity and the potential increased appearance of monotypic assemblages on rocks, snags and other submerged hard substrata in the downstream Severn River. Where increases in algae biomass are in excess and algal blooms occur, some impacts to freshwater macrophytes in downstream areas may occur. Algal blooms have potential to negatively impact macrophytes by limiting available light to submerged macrophytes and increasing nutrient and resource competition.

4.5 Aquatic Fauna

4.5.1 Fish

Changes to habitat conditions are expected to occur in the Severn River downstream of Pindari Dam that may positively change environmental conditions for native freshwater fish species. The threatened Murray Cod (*Maccullochella peelii*), Eel tailed Catfish (*Tandanus tandanus*) and Silver Perch (*Bidyanus bidyanus*) were identified as having a 'likely' or higher likelihood of occurrence in the lower Severn River and were recorded to occur within the Severn River as part of the MER Program. Additionally, the Darling River Endangered Ecological Community (EEC) includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, flow diversions to anabranches, the anabranches, and the floodplains of the Darling River within the State of New South Wales and

including Menindee Lakes and the Barwon River and including the Severn River downstream of Pindari Dam.

One of the most significant factors that contributes to the reduction of threatened freshwater fish species is the modification of natural river flow regimes and temperatures as a result of dams and weirs. As it can result in disruptions to natural lifecycle cues and the creation of suboptimal environmental conditions for spawning, growth and ultimately, survival of fish (NSW DPI 2018). In the upper Murray-Darling system, the cold water released by large dams is often below the lower thresholds for growth and hatching of native species and impacts migration cues, with thermal pollution typically impacting several hundred kilometres of habitat before reaching ambient natural temperatures (Astles et. al., 2003; TSSC 2013). Some species may also abandon spawning efforts as a result of CWP (DOE 2024). The three threatened freshwater fish species identified in the Severn River downstream of Pindari Dam (*M. peelii, T. tandanus* and *B. bidyanus*) spawn in Spring and Summer months, when water temperatures exceed a temperature threshold, which are approximately 15ºC, 24ºC and 21-23ºC for each species, respectively (Koehn and Harrington 2005; TSSC 2013; Davis 1977). The length of day and flow conditions also contribute to cues for spawning or breeding events, whilst flooding events are not typically considered a trigger for these species (DOE 2024; NSW DPI 2018 TSSC 2013). Suitable temperatures in the Severn River at a site 4 km downstream of Pindari Dam were not met at any point during the 22/23 breeding season for *T. tandanus*, whilst suitable temperatures were only met for 35 days in the 23/24 season at a site 15 km downstream, approximately 73% less than reference sites without CWP impacts (NSW DPI 2024a). Similarly, at the same site, only 20 suitable spawning days occurred for *M. peelii* (75% less than reference sites) and 27 suitable spawning days for *B. bidyanus* (71% less than reference sites) (NSW DPI 2024a). During the 23/24 breeding season, water temperatures in downstream Severn River also experienced fluctuations in water temperatures of up to 8ºC, which prevented stable temperatures during these critical months (NSW DPI 2024a). The destratification strategy in Lake Pindari is expected to increase the water temperatures of dam releases, which is expected to reduce the temperature differential between release waters and ambient river waters, and objectively should create more stable conditions. This may result in an increased number of suitable spawning days for the above species by reducing the magnitude of temperature differences from dam releases and cold shock events that would otherwise significantly reduce water temperatures to below suitable conditions for spawning. It is also likely that as the magnitude of CWP and cold shock events are reduced, so is the extent of impact downstream of the dam, resulting in an increased occurrence of suitable spawning habitat in more upstream areas.

Some successful recruitment is still possible under suboptimal conditions, however, is not likely viable under long term temperature stress for species that do not have capacity for thermal plasticity. The Young of Year (YOY) sampling (NSW DPI 2024a) indicated a low number of recent natural recruits for *T. tandanus*, with much of the population sampled of mature size and indicating limited successful survival of recruits over the last few years. Contrastingly, surveys showed evidence of recent recruitment and survival of *M. peelii*, with a diverse size structure recorded (NSW DPI 2024a), indicating the species may have some thermal plasticity to adapt to CWP impacts. However, YOY for *M. peelii* were captured at the start of the spawning window in the 23/24 season, indicating that they either spawned after the expected window in the previous season or showed delayed and slower growth rates (NSW DPI 2024a). Evidently, whilst the species may be able to adapt to CWP impacts, suboptimal conditions still affect their overall fitness and natural growth process. Cold water pollution can affect the development, growth and survival of freshwater fish species and includes impacts at all life stages. Eggs of *B. bidyanus* in lower temperatures take longer to hatch, increasing the time for potential predation, whilst freshwater juvenile and adult fish may experience reduced growth rates (as evident above with *M. peelii*), reduced swimming ability and reduced adult size, all of which impede on individuals' ability to survive (Michie et. al., 2020). Additionally, studies

have indicated that *B. bidyanus* is more susceptible to impacts from CWP and has a significantly higher mortality rate from cold shock events compared to other similarly sized species (Michie et. al., 2020). The destratification system in Lake Pindari is expected to increase the water temperatures of dam releases and reduce the temperature differential between release waters and ambient river waters. This is expected to reduce the magnitude of CWP cold shock events and thereby increase potential for more stable conditions and average higher river temperatures following releases. It is expected that these more optimal conditions would encourage increases in size and/or weight of freshwater fish species, with studies of both *M. peelii* and *B. bidyanus* fish recording as much longer and heavier when kept in 24ºC environments than in 13-14ºC (DOE 2024; Parisi et. al., 2020). It is also expected to reduce the depressive effects of CWP on fitness such as swimming speed, which may in turn increase foraging efficiency and predator avoidance (Parisi et. al., 2020). This is particularly applicable to species such as *B. bidyanus* which experience more significant physiological impacts from CWP (Parisi et. al., 2020).

Whilst the destratification system is not expected to rectify disturbances to water temperature and flow regimes to such a degree that dam releases would mimic natural conditions on the Severn River, it is expected to reduce the negative impacts associated with CWP on freshwater fish life cycles. For reproduction stages this may include an increase in on-time spawning period temperature cues, suitable spawning days and potential habitat with suitable conditions, and a reduction in prolonged hatching periods. For growth and fitness, this may include an increase in growth rates of juvenile fish, increase in adult sizes and an increase in successful survival of recruits, which would be evident by diverse size populations in monitoring following operation of the destratification system.

Changes in water temperatures and DO concentrations are also expected to impact on fish species at various trophic levels, with the above species typically occupying higher trophic levels being opportunistic carnivores and omnivores. For these higher trophic level species, the main prey items include other freshwater fish, crustaceans, insects, zooplankton and algae, with *M. peelii* considered the apex predator of the Murray Darling Basin (DPI 2015; SOQ 2024; DOE 2024). Potential impacts to these species are addressed in the following sections.

4.5.2 Invertebrates

Severn River

As established in Section 4.5.1, the Darling River EEC includes all native aquatic invertebrates within natural waterbodies of the Darling River within NSW, including the Severn River downstream of Pindari Dam. This EEC includes an extensive diversity of invertebrate species, including two Annelida, 18 Crustaceans, 33 Coleoptera, 15 Diptera, six Hemiptera, 32 Odonata, four Trichoptera, two Ephemeroptera, 25 Mollusca, six Porifera and 88 Rotifers (NSW Fisheries 2005). Aquatic invertebrates are major secondary producers and a critical element in aquatic food webs, linking primary sources of carbon with upper trophic levels. They are highly diverse, with adaptations to survive in varying environmental conditions, making them excellent bioindicators of environmental disturbances (Bonacina et. al., 2023). Regulation of flows and natural temperature regimes affect the normal biological cues and metabolic and physiological processes of invertebrates, similarly to fish species.

The MER Program sampled abundance and community compositions of zooplankton and macroinvertebrate species in the Severn River and at reference sites in the Macintyre River and Mole River (NSW DPI 2024a). Overall zooplankton abundance was lower in the Severn River than the Macintyre River and dominated by Cladocera (water fleas), with some potential that Lake Pindari acts as a source of Cladocera to downstream Severn River (NSW DPI 2024a). Macroinvertebrate communities were

significantly different in structure compared to those in the Mole River, with Mayfly, Diptera and Trichoptera taxa contributing the largest differences (NSW DPI 2024a). Water temperature is one of the primary factors that affects macroinvertebrates and zooplankton and can impact on reproductive capacity, spawning, hatching, emergence and development timings and growth rates (Bonacina et. al., 2023; NSW DPI 2024a). Like other fauna, macroinvertebrates have a thermal tolerance range, with specific ranges for optimal performance. Macroinvertebrates are typically more limited by upper thermal limits than cold, with many taxonomic insect groups preferring cool water habitats (Stewart et. al., 2013). Upper thermal tolerance (UTT) levels are typically higher for species that can tolerate varied temperatures and lower for stenothermal species, including sensitive taxa in the Ephemeroptera, Plecoptera and Trichoptera groups, which are commonly used to detect environmental disturbances within water bodies. These UTT levels can be as low as 21°C for sensitive taxa and up to 37°C for less sensitive taxa (Stewart et. al., 2013). For macroinvertebrates, increased temperatures can result in reduced body sizes, extended or reduced development times and earlier emergence dependent on the species. It can also reduce reproductive success as a result of smaller female body size, faster hatching and lower egg survival. Behaviourally, macroinvertebrates may also migrate downstream in search of suboptimal temperatures (Bonacina et. al., 2023).

The proposed destratification system is expected to increase the water temperature of dam releases and may create more homogenised temperature conditions, which could result in some changes to community distributions in the lower Severn River. Average temperature increases will likely have little effect on eurythermal invertebrate species but may result in some zonation of stenothermal invertebrates. Species that are more sensitive and have lower UTTs may become further confined to upstream areas closer to the dam releases where temperatures will be coolest, compared to current distributions. Zonation of macroinvertebrate species may result in some minor changes to the assemblage of prey items. However, changes in distribution relative to water temperature will also be impacted by ambient weather conditions, flow and shading from riparian vegetation and macrophytes along the river.

Lake Pindari

Zooplankton are typically more resistant to oxygen deficit conditions than other invertebrates, such as crustaceans. Operation of the bubble plume system is expected to mix DO levels through the water column in the vicinity of the plume and eventually break down the oxycline. This may in turn increase the depth limits and overall potential habitat for zooplankton species, however, it may also reduce potential refuge habitat in deeper, lower DO waters where predators cannot survive under the existing conditions (Preece et. al., 2019). Thus, zooplankton in the vicinity of the plume may have less respite from fish predation as waters become more homogenised. Considering the populations of the zooplankton in Lake Pindari and the vast other potential habitat throughout the dam, it is not expected that the operation of the bubble plume system and resulting increased predation, would impact on zooplankton species at an ecologically significant scale. However, potential reductions of zooplankton within the vicinity of the plume may reduce grazing rates on other algae species in the lower dam area (Preece et. al., 2019). This has potential to result in a trophic cascade, leading to localised increased algal biomass, which when combined with potential mobilisation of bioavailable nutrients from hypolimnion waters (Section 4.3.3), may exacerbate the risk of algal blooms.

In periods of low water, benthic or epibenthic invertebrates inhabiting shallower areas along the pipeline alignment may be disturbed by drag or presence of the pipeline and galvanised chain structure where Type 3 holding down systems are present. It is expected that the reduction in water to the extent where the system and pipeline would be above water would be a gradual process and mobile species would retreat to

suitable habitat within the water. Sessile invertebrates would likely succumb to drying out regardless of the pipeline infrastructure presence.

4.5.3 Monotremes

The Severn River supports a small community of Platypus (*Ornithorhynchus anatinus*) (NSW DPI 2013), whilst at least one individual was sighted during site investigations. Platypus can maintain their body temperature in cold waters down to 5ºC (Gaughan et al 2015) and can typically tolerate temperatures between 0ºC and 30ºC. The species have a body temperature of 32ºC, which conserves energy in cold water, and have a number of adaptations to facilitate survival in these conditions, including a specialised network of veins, a dense undercoat and guard hairs. As the species is well adapted for cold conditions, warmer air and water temperatures can be detrimental, with studies in captivity showing the species as lethargic in water temperature greater than 29ºC and ambient temperatures over 34ºC considered dangerous (Booth and Connolly 2008). In natural habitats, Platypus may regulate their body temperatures in instances of warmer environmental temperatures by roaming to cooler areas or retreating to their burrows. Considering that the species tolerates a wide temperature range and increases in dam release temperatures are not expected to consistently result in river conditions over 29ºC, it is not anticipated that the proposed system will impact on the species range of occupancy in the Severn River. Although the Platypus may experience some short-term disturbances to foraging habitat and prey item availability as other fauna, specifically small fish and invertebrates, adapt to changed environmental conditions. This is expected to be limited to minor shifts in community structure and distribution of prey species, however, is not considered to significantly impact on overall successful foraging efforts.

4.5.4 Aquatic Reptiles

The Eastern Long-necked Turtle (*Chelodina longcollis*), Murray River Turtle (*Emydura macquarii*) and the threatened Western saw-shelled Turtle (*Myuchelys bellii*) are known to occur within the border rivers, including the Severn River (NSW DPE 2022). It is likely that Lake Pindari and the Severn River, both upstream and downstream of the dam, provide permanent habitat for these species. As ectotherms, freshwater turtles are largely influenced by ambient environmental conditions and can experience both physiological and behavioural impacts from cold temperatures. Species vary in their ability to thermoregulate and may periodically leave the water to bask or may float at the surface to alter their body temperatures. In the Murray River, responses by *E. macquarii* to CWP from the Hume Dam showed that individuals were extending their overwintering period into Spring, resulting in delayed activity and reduced foraging opportunities (Singh 2018; NSW DPE 2022). Increases to water temperatures in the Severn River downstream of Pindari Dam may provide turtles with opportunities for increased activity, feeding and growth in the water. These opportunities have also been identified in association with the projected average air and water temperature increases of ~2ºC in southeast Australia in the coming decades, however, this may also increase the risk of overheating and dehydration when turtles are on land (Chessman 2019). Given that a longitudinal thermal gradient is still expected from areas close to the dam release to further downstream, an increase in the average river temperature is not expected to significantly impact on freshwater turtles' habitat or physiology, with turtles able to thermoregulate and move up and downstream or onto land as required. It is expected that a reduction in the temperature differential of releases and the ambient river temperature will provide more stable conditions for these species in downstream habitats, albeit less habitat variability.

Turtles may also experience some short-term disturbances to foraging habitat and success as other fauna, specifically small fish and invertebrates, adapt to changed habitat conditions. This is expected to be limited

to minor shifts in community structure and distribution of prey species, however, is not considered to significantly impact on successful foraging efforts.

4.6 Riparian Vegetation

Riparian vegetation in the Severn River is not expected to experience direct disturbances from the operation of the destratification system. Riparian vegetation, particularly along the islets that may occasionally be inundated during high release periods, may benefit from more stable water temperature conditions.

Potential still remains for some indirect disturbances to riparian vegetation as a result of shifts in water quality conditions associated with expected increases in temperature. Riparian vegetation is sensitive to surrounding environmental conditions including water quality and may respond to changes in pH or nutrients. Increased water temperatures may result in decreases in pH of the water and soils along the riverbank. This may alter the existing environment for riparian vegetation, particularly those stands along the edges of the river islets and lower banks that are exposed to more regular inundation, with potential for some disturbance or dieback if changes create suboptimal conditions.

4.7 Assessments of Significance

4.7.1 Freshwater Fish

A 7-Part Test and Significant Impact Criteria was undertaken for threatened fish species under the FM Act and EPBC Act, which included the Endangered Population of Eel-Tailed Catfish (*T. tandanus*), the Endangered Silver Perch (*B. bidyanus*) the Vulnerable Murray Cod (*M. peelii*). These assessments concluded that the populations of the threatened freshwater fish species that may utilise habitat in the Study Area and in Severn River downstream of Pindari Dam where changes to environmental conditions are expected are unlikely to be significantly detrimentally affected by the proposed system. Intended increases in water temperatures from dam releases are expected to reduce the magnitude and extent of impacts from the existing CWP in the Severn River and contribute to improving habitat suitability, particularly for reproductive success. The project is expected to have a net positive impact on these threatened species by improving environmental conditions and reduce existing impacts that may otherwise impact on the long term survival of these species in the Severn River (Appendix 4).

4.7.2 Darling River EEC

A 7-Part Test was undertaken for the Darling River Endangered Ecological Community under the FM Act, which includes all native fish and aquatic invertebrates within aquatic habitats in Severn River downstream of Pindari Dam. The assessment concluded that the EEC that utilises habitat in the Study Area and in Severn River downstream of Pindari Dam where changes to environmental conditions are expected are unlikely to be significantly detrimentally affected by the proposed system. Intended increases in water temperatures from dam releases are expected to maintain more stable environmental conditions and reduce the magnitude and extent of CWP and cold shock events in the Severn River, downstream of the dam. Some species, such as macroinvertebrates or zooplankton, may experience some disturbances as environmental conditions shift and habitat becomes more homogenised, which may lead to some shifts in community composition and distribution over the entire downstream Severn River. However, this is not expected to occur to such an extent that species of the EEC would be at risk of extinction (Appendix 4).

5 Recommendations and Conclusions

5.1 Recommendations

This section details how the project proposal would, in the first instance, avoid ecological impacts on the aquatic environment, then apply mitigation measures where avoidance is not possible.

5.1.1 Management Measures

Before works Commence

The following recommendations should be implemented to avoid, minimise and mitigate impacts to aquatic flora, fauna, infauna and their habitats before works commence:

- Further detailed water quality and ecological monitoring should be undertaken prior to the commencement of works, to establish baseline data and trends. This should be used following completion of works to measure changes in temperature, water quality and ecological communities in Lake Pindari and the Severn River. This monitoring should include:
    - Fish populations and Young of Year,
    - Macroinvertebrate and zooplankton assemblages,
    - Algae concentrations and species, including within Lake Pindari and Severn River,
    - Water quality parameters including, but not limited to, temperature (stratification in Lake Pindari and longitudinally in Severn River compared to reference sites), dissolved oxygen, nutrients, metals and chlorophyll a.
- A pre-works inspection of the laydown area and habitats within 200m at the top of the spillway for fauna habitat, especially threatened turtles, and where required fauna clearance works, must be undertaken before any works in these areas commence.
- The CEMP or equivalent document should include information to assist in identifying the threatened fish and turtle species that occurs or may occur within the locality.
- An appropriate Erosion and Sediment Control Plan (ESCP) that adequately protects aquatic habitat during construction must be prepared before works commence. The ESCP will need to consider:
    - On-site water management to reduce sedimentation and potential pollution of watercourses and management of stormwater and dam water during periods of high rainfall.
    - Run-off or unplanned overflows from construction must be retained in water quality basins or an appropriate alternative
    - Diverting run-on water from disturbance works occurring on upslope land, using non-erosive methods.
    - Installing protective measures to prevent sheet erosion where large portions of soil will be exposed.
    - Construction of sediment filters or sediment retention traps where appropriate, particularly below fill batters near waterways.

During works

The following recommendations should be implemented to avoid, minimise and mitigate impacts to aquatic flora, fauna, infauna and their habitats during works:

- If the threatened Western saw-shelled turtle is seen within 50 m of any works, works must stop immediately until the turtle moves away. If the turtle remains in the area or continuously returns an aquatic ecologist should be notified. The aquatic ecologist and project team must consult with the Department of Climate Change, Energy, the Environment and Water to determine appropriate management actions to allow works to continue. Threatened fish in Lake Pindari are expected to be mobile enough to disperse from disturbances.
- The storing of construction machinery, equipment, materials, vehicles and the pipeline string along the top of the spillway must be appropriately managed to avoid impacts on the adjacent waterway. This includes:
    - The storing of hydrocarbon-based products on any water sites within the Impact Area should be avoided and must be stored in a suitable bunded area within the site laydown area.
    - Hydrocarbons are to be stored in a bunded area with adequate spill kits available. All staff are to be made aware of the location of the spill kit and trained in its use.
    - All machinery must be routinely checked for leaks, with an emergency spill kit to be kept on site at all times.
- Hydrocarbon booms should be placed around all stationary machinery on the water and be on hand for deployment around vessels.
- Where practical, floating containment booms should be in place to control any unplanned spills of hydrocarbons around machinery operating on or over water.
- All equipment to be brought to the Study Area must be thoroughly cleaned and free of substrate to avoid introduction of species such as cyanobacteria. Given the potential for toxic cyanobacteria in nearby areas, equipment should be also thoroughly cleaned following the completion of the project to prevent spread of the species to other areas.
- If an algal bloom is present within Lake Pindari, it should be avoided and not disturbed to minimise further spread to other areas. Works should not be conducted while an algal bloom is present within Lake Pindari. If vessels or equipment are found to have been covered by algae during works, they should be thoroughly cleaned with fresh water, with all biota safely disposed of on land.
- The sinking of the pipeline and anchor blocks must be conducted in a controlled and slow manner, to minimise the disturbance to the dam floor.
- Visual monitoring of water quality monitoring during construction works should be undertaken daily. Monitoring of water quality parameters, including algal counts and limiting factors (nitrogen, phosphorus, manganese, iron) should also be conducted regularly during works.
- Environmental controls such as sediment and erosion controls, and if necessary, the position of pipeline string, should be inspected weekly by an Environmental Scientist during construction.
- Waste products and materials must be adequately managed and stored in designated areas on site to prevent injury caused by ingestion or entanglement in debris. Designated litter bins should be provided.

Following completion of the works

The following recommendations should be implemented to avoid, minimise and mitigate impacts to aquatic flora, fauna, infauna and their habitats following completion of the works:

- All materials, machinery and rubbish must be removed from site.
- An inspection of the site by an Environment Officer or Project Manager must be undertaken.
- Any notification requirements of permits must be filled and submitted.

5.1.2 Operational Requirements

Water Quality Monitoring Program

A Water Quality Monitoring Program (WQMP) should be established for the operation of the Pindari Dam Bubble Plume Destratification System. Water quality monitoring will be critical for the assessment of actual and potential emerging water quality impacts over the long-term operation of the bubble plume destratification system, as well as to measure the success of mitigating CWP in downstream areas of the Severn River. This WQMP may be incorporated into the existing monitoring conducted by WaterNSW, the Border Rivers monitoring program and the existing MER Program and should include:

- The continuation of monthly monitoring within Lake Pindari and Severn River catchment, including physical water quality parameters, cyanobacteria, rainfall, discharge and dam capacity.
- At least two years of water quality monitoring at previously established sites under the MER Program, including the existing daily riverine temperature monitoring in the Severn River and reference sites, and daily temperature and dissolved oxygen monitoring in Lake Pindari, using a thermistor chain.
- Regular (monthly to quarterly) water quality monitoring (physical, chemical and biological parameters) within Lake Pindari and the Severn River for the first two years of operation of the destratification system. This should include at least 2 sites in the Severn River upstream of the dam and at least 8 sites downstream of the dam (across a distance of ~100 km). Preferably, this monitoring would be continued for up to 8 years following the commissioning of the system and then on a less regular basis, for the duration of operation of the destratification system.
- Water quality monitoring should be reviewed against existing baseline data for the Severn River. Emerging trends should be assessed, to review with changes in frequency of operation or pressure should be applied to the system at various times throughout the year.

Ecological Monitoring Program

An Ecological Monitoring Program (EMP) should be established for the operation of the Pindari Dam Bubble Plume Destratification System. Ecological monitoring will be critical for identifying emerging and potential ecological impacts for aquatic flora and fauna communities occurring in the vicinity and downstream of the plume's operation. Two years has been recommended as the minimum monitoring period for the below ecological parameters, however, these monitoring programs would preferably run up to 8 years after commissioning to capture the true ecological measure in response to the destratification system, with changes monitored over the longer term more beneficial for measuring success of the system. The program should focus on those communities targeted by the existing MER Program.

- Fish
    - Annual Spring and Autumn fish community surveys in the Severn River and a reference river, for at least two years following commissioning.
    - Annual targeted Young-of-Year sampling at the end of Summer or early Autumn in the Severn River, for at least two years following commissioning.
- Invertebrates
    - Incorporate ecological health monitoring using AUSRIVAS methodology, including EPT taxa, abundance and species richness in both Spring and Autumn in the Severn River. Surveys should include at least one site upstream and at least three sites downstream of the dam for at least two years following commissioning.
- Water Quality, Algae and Food Web
    - Continuation of the existing MER Program water quality, algae and food web monitoring. Monthly sampling between September and May sampling nutrients, metals, zooplankton, chlorophyll a and phytoplankton. This should be conducted for at least two years following commencement of operation.
- Periphyton
    - Incorporate monitoring of periphyton coverage and composition in the Severn River downstream of Pindari Dam. This may be incorporated into the above existing MER Program monthly monitoring, to be conducted for at least two years following commencement of operation.

5.1.3 Permits and Consultation

WaterNSW, as a public authority, is required to consult with NSW DPI Fisheries for activities involving dredging and reclamation works as per Section 199 of the FM Act.

A permit to block fish passage under Section 219 of the FM Act may be required, at the discretion of NSW DPI Fisheries.

The proposed project is expected to modify known habitat of known threatened species and a known EEC. As the project is not expected to 'harm' or 'damage' the species, EEC or their habitat and is likely to have a net positive outcome, a licence to harm threatened species under Part 7A (s220ZW) of the FM Act is not likely to be required.

5.1.4 Offsetting

NSW DPI enforces a 'no net loss' habitat policy as a permit condition or condition of consent. This may require proponents to conduct habitat rehabilitation and/or provide environmental compensation. In circumstances where aquatic vegetation is likely to be negatively impacted to a degree that cannot be avoided or mitigated, environmental compensation will be required and calculated at the rate of 2:1 habitat offset requirement (Fairfull 2013). At this stage, no aquatic vegetation is expected to be directly impacted and will be dependent on any opportunistic growth within the construction footprint at the time of works.

Impacts from the operation of the bubble plume destratification system will be determined following sufficient post-operation monitoring. Where the bubble plume system is found to result in negative impacts to aquatic habitat, the system should be removed and releases revert to current operating protocols. The

bubble plume destratification system is expected to have a net positive impact on downstream receiving KFH, which may offset any construction or lesser unexpected disturbances of KFH.

5.2 Conclusions

The proposed Pindari Dam Bubble Plume Destratification System has been designed with the objective to mitigate negative impacts of CWP from dam releases to the Severn River. It is expected that the operation of the bubble plume destratification system in Pindari Dam will break down the thermocline and oxycline that persists in the dam, thus homogenising water quality conditions in the lower dam in vicinity of the offtake. This is expected to increase the temperature of dam releases, thus reducing the temperature differential between releases and the ambient temperature of the Severn River.

A number of positive changes are expected to impact on aquatic habitat in downstream receiving waters of the Severn River that will be beneficial for a number of aquatic species, including threatened fish. Increased temperatures of releases and more stable water temperatures may increase the success of recruitment and survival of threatened fish species, including *M. peelii, T. tandanus* and *B. bidyanus*, through increased likelihood of normal temperature cues, increased number of suitable spawning days, increased growth and metabolic rates and increased fitness. Changes to water temperatures may also be beneficial for other aquatic fauna such as Platypus or freshwater turtles, however, may result in some short-term disturbances of fauna at lower trophic levels, such as invertebrates of the Darling River EEC, as they adapt to modifications to the existing environmental conditions. Further assessment has identified that the proposed system is unlikely to have a significant negative impact on threatened species and populations in Lake Pindari and the Severn River downstream of the dam, with a net positive impact expected.

The major potential risk to aquatic ecology will be the potential to exacerbate conditions that lead to algal blooms of toxic cyanobacteria in Lake Pindari, with potential for spread to downstream habitats of Severn River. The purpose of the bubble plume system is to promote upwelling of bottom waters to increase temperature and dissolved oxygen levels at the sediment / water interface, thereby reducing production of soluble metals and nutrients, which are present as a result of anoxic conditions. However, some risk exists if the plume system does not result in complete mixing. Where soluble metals and nutrients are pushed towards the surface, but where dissolved oxygen levels do not sufficiently increase, they may be metabolised by algae, including cyanobacteria, whilst increases in water temperature may also promote higher growth and metabolic rates in algae and periphyton and contribute to increases in algal biomass. The risks for exacerbation of algal blooms in Lake Pindari, which is already susceptible to toxic cyanobacterial blooms, should be acknowledged and monitored during operation.

There also remains potential for indirect disturbances, particularly the mobilisation of sediments during construction and use of the laydown area and the resulting increased sedimentation and turbidity that can cause short-term reductions in water quality. This may impact the adjoining KFH in Lake Pindari, however, impacts are expected to be localised and short-term.

To manage the potential risks that this proposal may pose to aquatic habitat, flora and fauna and the potential for impacts to adjacent habitat from changes in water quality parameters, a series of recommendations have been provided. These recommendations should be adopted into the CEMP for construction and operational works for this proposal. Additionally, a series of recommendations for water quality and ecological monitoring have been provided for consideration with the existing programs. With

adoption of these recommendations, the project is considered unlikely to have a significant impact on any State- and/or Commonwealth-listed threatened aquatic biodiversity.

References

Abergeldie Contractors Pty Ltd (2024). WNSW Pindari Aeration System – High Level Construction Methodology. 22 August 2024

Anushka, B. A., and Mishra, A. (2022). Effects of dissolved oxygen concentration on freshwater fish: A review, *International Journal of Fisheries and Aquatic Studies*. Vol 10, Issue 4, pp 113-127.

Billerman, S. M., Keeney, B. K., Rodewald, P. G. and Schulenberg T. S. (Editors) (2020). Birds of the World. Cornell Laboratory of Ornithology, Ithaca, NY, USA. https://birdsoftheworld.org/bow/home

Birdlife Australia (Birdata). (2024). Data Portal. Accessed online April 2024 (https://birdata.birdlife.org.au/explore#map=-22.5083100_136.0786120_4)

Birt, D., Wain, D., Slavin, E., Zang, J., Luckwell, R. and Bryant, L. (2021). Stratification in a Reservoir Mixed by Bubble Plumes under Future Climate Scenarios, *Water*, Vol 13, Issue 18, **https://doi.org/10.3390/w13182467**

Bonacina, L., Fasano, F., Mezzanotte, V., and Fornaroli, R. (2023). Effects of water temperature on freshwater macroinvertebrates: a systematic review, *Biological Reviews*, Vol 98, pp 191-221

Chaaya, F. C., and Miller, B. M. (2022). A review of artificial destratification techniques for cold water pollution mitigation. Prepared for NSW Department of Primary Industries – Fisheries. University of New South Wales Water Research Laboratory

Chaaya, F. C., and Miller, B. M. (2023). Pindari Dam – mitigating cold water pollution through artificial destratification. Prepared for NSW Department of Primary Industries – Fisheries. University of New South Wales Water Research Laboratory.

Chessman, B. (2019). Behavioural thermoregulation by Australian freshwater turtles: interspecific differences and implications for responses to climate change, *Australian Journal of Zoology*, 2019, Vol 67, pp 94-105

Clarke, R. B. (2001). *Marine Pollution*. Fifth Edition. Oxford University press, Oxford UK.

Davis TLO (1977). Reproductive biology of the freshwater catfish, *Tandanus tandanus* Mitchell, in the Gwydir River, Australia. II. Gonadal cycle and fecundity. *Marine and Freshwater Research*, 28, 159-169

DAWE (2020). Species Profile and Threats Database, Department of Agriculture, Water and the Environment (DAWE). Available Online http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Department of Environment (2013). Matters of National Environmental Significance: Significant impact guidelines 1, Environment Protection and Biodiversity Conservation Act 1999. Australian Government

Department of the Environment (DOE) (2024).*Maccullochella peelii* in Species Profile and Threats Database, Department of the Environment, Canberra. Accessed August 2024, https://www.environment.gov.au/sprat.

Dernie, K.M., Kaiser, M.J. and Warwick, R.M. (2003). Recovery rates of benthic communities following physical disturbance. *Journal of Animal Ecology*, 72 pp:1043–1056.

Erbe, C. (2012). Effects of Underwater Noise on Marine Mammals. *Advances in Experimental Medicine and Biology*. January 2012 DOI: 10.1007/978-1-4419-7311-5_3.

Fairfull, S. (2013), *Policy and guidelines for fish habitat conservation and management.* NSW Department of Primary Industries, Fisheries, Woolongbar, NSW.

Fernadez, R. L., Bonansea, M., Cosavella, A, Bresciano, J., Monarde, F., and Testa, A. (2011). The interaction between a bubble plume and the near field in a stratified medium: implications for water quality amelioration, *International Symposium on Outfall Systems*. May 15-18, 2011. Mar del Plata, Argentina.

Fisheries Scientific Committee (FSC), (2003). Final recommendation - aquatic ecological community in the natural drainage system of the lowland catchment of the darling river. Ref. Nos. FR 22 File No. FSC 01/10

Kirkman, H. and Kuo, J. (2012). Seagrasses of south-east Australia— An Introduction. *Estuary Plants and whats happening to them in south-east Australia.* Sanity, G., Hosking, J., Carr, G. and Adam. P. (Eds). Published by Sanity and Associates Pty Ltd, Potts Point, NSW.

Koehn, J.D., and Harrington, D. J. (2005). Environmental conditions and timing for the spawning of Murray cod (*Maccullochella peelii peelii*) and the endangered trout cod (*M. macquariensis*) in southeastern Australian rivers, *River Research and Application,* Vol 22(3), pp 327-342 https://doi.org/10.1002/rra.897

Lincoln Smith, M (2003). Aquatic Ecology in Environmental Impact Assessment. EIA Guideline Series May 2003. Prepared on behalf of Department of Planning.

Lind, L., Eckstein, R. L., and Relyea, R. A. (2022). Direct and indirect effects of climate change on distribution and community composition of macrophytes in lentic systems, *Biological Reviews*. Vol 97, Issue 4, pp 1677-1690

Liu, J., Tan, K., He, L., Qiu, Y., Tan, W., Guo, Y., Wang, Z., and Sun, W. (2018). Effect of limitation of iron and manganese on microalgae growth in fresh water, *Microbiology*. 2018, Issue 164, pp 1514-1521, DOI 10.1099/mic.0.000735

Lunt, J. and Smee, D.L. (2015). Turbidity interferes with foraging success of visual but not chemosensory predators. Peer J, 3, e1212

Michie, L. E., Hitchcock, J. N., Thiem, J. D., Boys, C. A., and Mitrovic, S. M. (2020). The effect of varied dam release mechanisms and storage volume on downstream river thermal regimes. *Limnologica*, Vol. 81, 125760

NSW Department of Planning and Environment (NSW DPE) (2019). NSW Border Rivers Surface Water Resource Plan Area Resource Description – Appendix A. INT17/228128

NSW Department of Planning and Environment (NSW DPE) (2022). Review of freshwater turtle ecology and flow. ISBN/ISSN: 978-1-76058-532-7

NSW Department of Primary Industries (NSW DPI) (2013). Pindari Dam Stimulus Flow - An Assessment of the December 2012 Release. Prepared by Neal Foster, Environmental Flows management Unit, NSW Office of Water, Tamworth, NSW.

NSW Department of Primary Industries (NSW DPI) (2015). Eel-Tailed Catfish population in the Murray-Darling Basin, *Tandanus tandanus*. Primefact 1321, Aquatic Ecosystems Unit, Port Stephens Fisheries Institute

NSW Department of Primary Industries (NSW DPI) (2018). Protecting Eel-Tailed Catfish in Western NSW – a guide for fishers and land managers. State of New South Wales through the Department of Industry 2018.

NSW Department of Primary Industries (NSW DPI) (2024a). Pindari Dam Bubble Plume Destratification Project Monitoring, Evaluation and Reporting (MER) Program Interim Report June 2024. Department of Primary Industries, Department of Regional NSW.

NSW Department of Primary Industries (NSW DPI) (2024b). Threatened Species Lists. NSW Department of Primary Industries. https://www.dpi.nsw.gov.au/fishing/species-protection/what-current, Accessed April 2024.

NSW Department of Primary Industries (NSW DPI) (2024c). Fisheries Spatial Data Portal. NSW DPI website. Link: Fisheries Spatial Data Portal (nsw.gov.au). Accessed April 2024.

NSW Fisheries, (2005). Fisheries Scientific Committee. Aquatic ecological community in the natural drainage of the lower Murray Catchment. New South Wales Fisheries. Ref. No. FR 16(2), File No. FSC 01/01.

NSW Office of Environment and Heritage (NSW OEH). (2024). Western Sawshelled Turtle, Bell's Turtle – profile, NSW Government Office of Environment and Heritage, Accessed online October 2024 https://threatenedspecies.bionet.nsw.gov.au/profile?id=10266

Parisi, M., Cramp, R., Gordos, M., and Franklin, C. (2020). 'Can the impacts of cold-water pollution on fish be mitigated by thermal plasticity?', *Conservation Physiology*, 8(1), https://doi.org/10.1093/conphys/coaa005.

Parisi, M., Franklin, C., and Cramp, R. (2022). 'Can slowing the rate of water temperature decline be utilized to reduce the impacts of cold water pollution from dam releases on fish physiology and performance?', *Journal of Fish Biology*, 100(4), pp 979-987, https://doi.org/10.1111/jfb.15002

Preece, E. P., Moore, B. C., Skinner, M. M., Child, A. and Dent, S. (2019). A review of the biological and chemical effects of hypolimnetic oxygenation, *Lake and Reservoir Management*, Vol 35, Issue 3, pp 229-246

Rasconi, S., Gall, A., Winter, K. and Kainz, M. J. (2015). Increasing water temperature triggers dominance of small freshwater plankton, *PLOSone*, DOI:10.1371/journal.pone.0140449

Rehwinkel, R., and Sharpe, C. (2009). Status of freshwater catfish (*Tandanus tandanus*) populations in Gunbower Creek 2009. A Murrary-Darling Freshwater Research Centre report prepared for the North Central Catchment Management Authority

SEWPAC (2012). Species group report card – seabirds. Supporting the marine bioregional plan for the Temperate East Marine Region. Prepared by the Department of Sustainability, Environment, Water, Population and Communities

Sheldon, F., and McCasker, N. (2020). Habitat and flow requirements of freshwater mussels in the northern Murray-Darling Basin. Report to the Commonwealth Environmental Water Office. Australian Rivers Institute, Griffith University and Institute of Land, Water and Society, Chales Sturt University.

State Government of NSW and NSW Department of Climate Change, Energy, the Environment and Water, (NSW State Government and DCCEEW) (2010). NSW Wetlands, accessed from The Sharing and Enabling

Environmental Data Portal [https://datasets.seed.nsw.gov.au/dataset/36c734bd-1c9c-40b9-966a-0ad0f7500a09], date accessed 2024-08-12.

Stewart, B. A., Close, P. G., Cook, P. A., and Davies, P. M. (2013). Upper thermal tolerances of key taxonomic groups of stream invertebrates, *Hydrobiologica*. 2013, Vol 718, pp 131-140

Sturdivant, S. K., Diaz, R, J., and Cutter, G. R. (2012). Bioturbation in a declining oxygen environment, in situ observations from Wormcam. *PLoS One*, Vol 7, Issue 4, e34539 doi:10.1371/journal.pone.0034539

The State of Queensland (SOQ) (2024). Silver perch aquaculture. Queensland Government, Accessed August 2024, https://www.business.qld.gov.au/industries/farms-fishing-forestry/fisheries/aquaculture/species/silver-perch

Threatened Species Scientific Committee (TSSC), (2013). Conservation Advice *Bidyanus bidyanus* (silver perch). 5 March 2013 Threatened Species Scientific Committee.

WaterNSW (2024a). Pindari Dam Bubble Plume Destratification System Drawings, 90% Design re-isue. Prepared by WaterNSW and AssetReady, 9 September 2024.

WaterNSW (2024b). Pindari Dam, WaterNSW. Accessed online August 2024 waternsw.com.au/nsw-dams/regional-nsw-dams/pindari-dam

Plates



Plate 1: General site photos, showing a) overlooking Lake Pindari and the dam wall, b) below the dam wall and looking west at the access road, c) seepage weir number 4; and d) seepage weir number 3.



Plate 2: Site 1 showing a) looking upstream at the confluence of the spillway and the Severn River, b) looking upstream at the Severn River on the southern bank, c) looking downstream on the Severn River along the southern bank; and d) looking downstream on the Severn River along the northern bank.



Plate 3: Site 2 showing a) looking upstream on the Severn River across to the northern bank, looking downstream on the Severn River along the southern bank, c) slightly downstream of Site 2, looking upstream at riffle habitat; and d) slightly downstream of Site 2 looking across to the northern bank.



Plate 4: Site 3 showing a) looking upstream along the southern bank at riffle habitat, b) looking downstream on the northern side of an islet, c) looking downstream on the southern side of an islet; and d) sediment dominated river bed, with fringing macrophytes on islet.



Plate 5: General site photos showing a) large pooling habitat, b) moderately flowing riffle habitat with bedrock, c) slow flowing, small pooling habitat; and d) pooling habitat with smaller, cobble and pebble substrate.

Appendix 1 – Proposed Destratification System Plans



wsp

PS122845
Pindari Dam bubble plume

Figure 1.2
Impact Area

Legend

- Compressor Site Location
- Construction compound and site facilities including accommodation
- Exclusion Area
- Impact Area
- Study Area

Current Design Features

- DE_PIPE-DISTRIBUTION
- DE_PIPE-BOUYANCY
- DE_PIPE-DIFFUSER
- MECH-BACKGROUND
- PLAN-C-MECH-COMPRESSOR

DRAFT



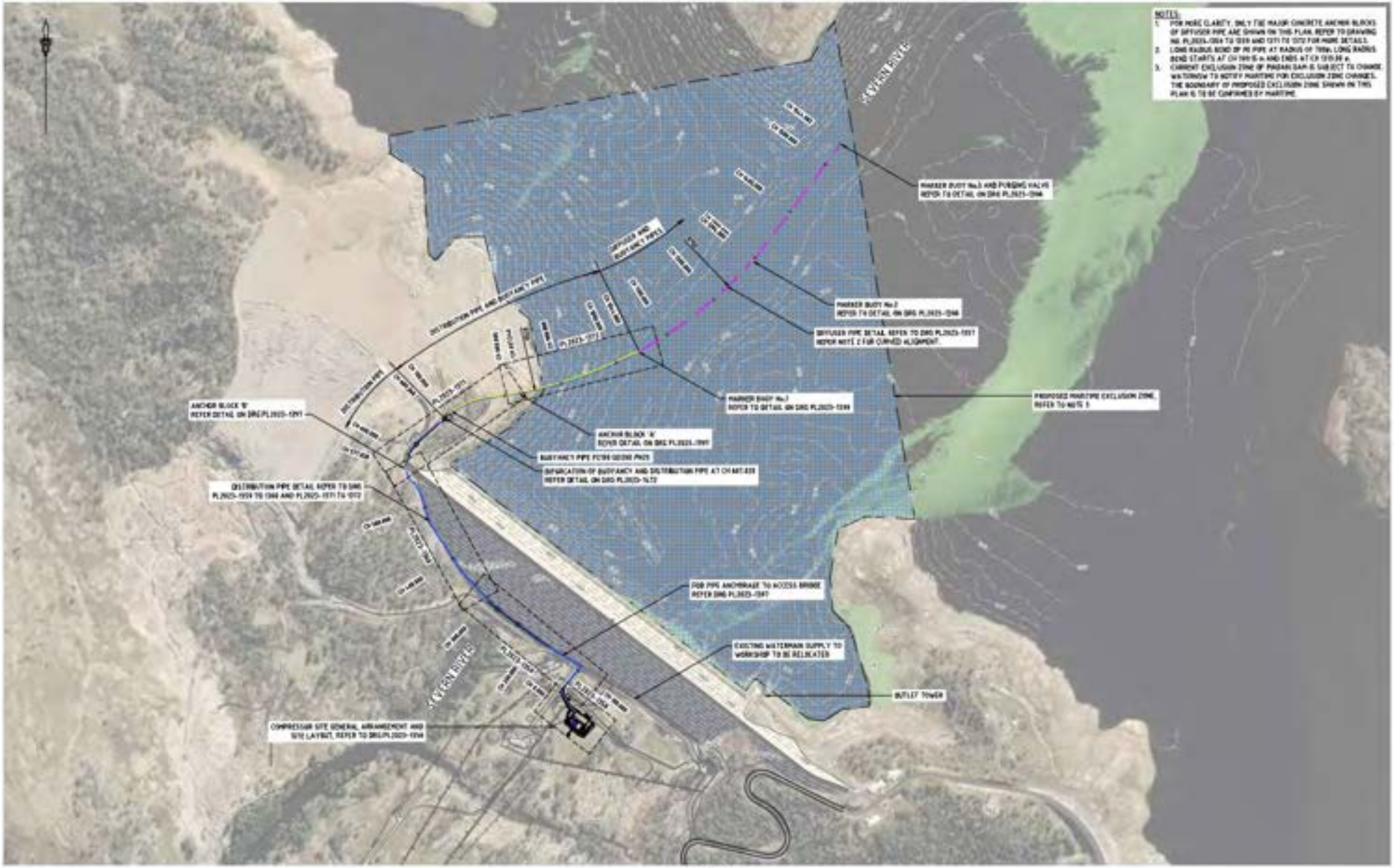
Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:7,000 Date: 22/10/2024

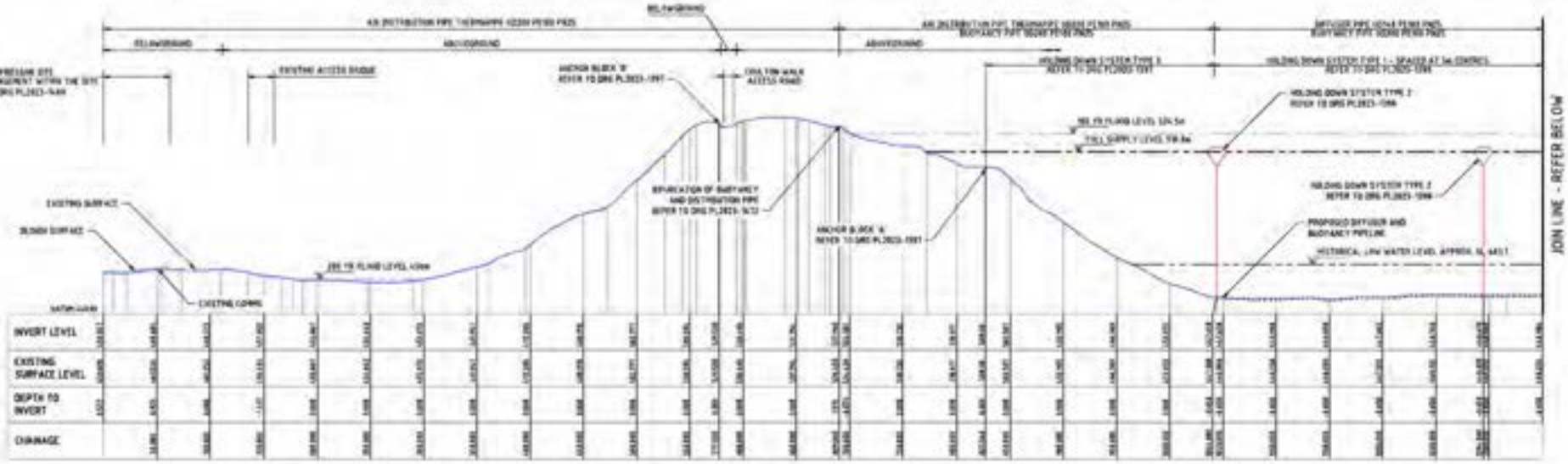
Data sources: DELWP, Geoscience Australia

© WSP Australia Pty Ltd (WSP) Copyright in the drawings, information and data recorded in this document is the property of WSP. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that which it was supplied by WSP. WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. WSP Australia Pty Ltd ABN 80 078 004 798



SITE PLAN

NTS



DISTRIBUTION, DIFFUSER AND BOUYANCY PIPES LONGITUDINAL SECTION

HORIZONTAL SCALE 1:2000, VERTICAL SCALE 1:200



BOUYANCY AND DIFFUSER PIPES LONGITUDINAL SECTION

HORIZONTAL SCALE 1:2000, VERTICAL SCALE 1:200

LEGEND

PROPOSED PIPELINE

EXISTING SURFACE

FULL SUPPLY LEVEL

HISTORICAL LOW WATER LEVEL

0 20 40 60 80 100 METRES
SCALE 1:2000

0 40 80 120 160 200 METRES
SCALE 1:4000

ASSETREADY

WaterNSW

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM

DISTRIBUTION AND DIFFUSER PIPE LONGITUDINAL SECTION AND HOLDDOWN SYSTEM

PL2023-1357



PLAN
SCALE 1:500

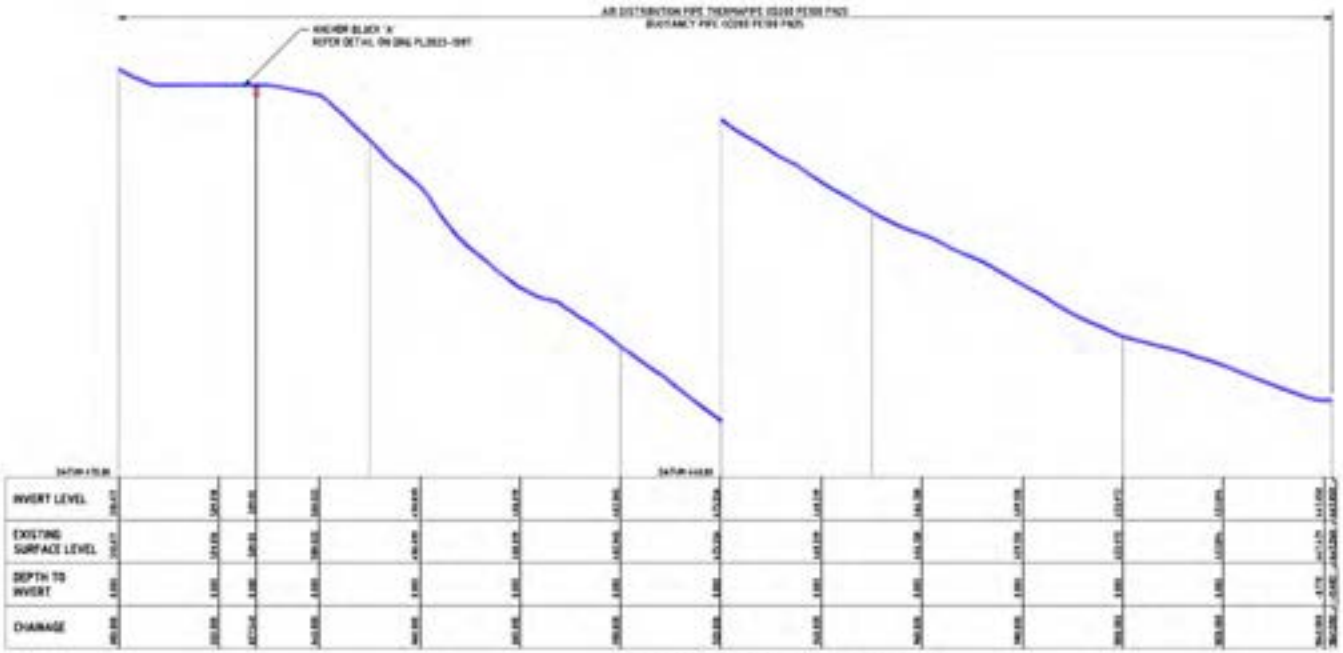
LEGEND:

PROPOSED PIPELINE

EXISTING SURFACE

NOTES:

1. WHERE NO DEFLECTIONS ARE SPECIFIED, DEFLECT PIPE ON CURVE TO SUIT ALIGNMENT.

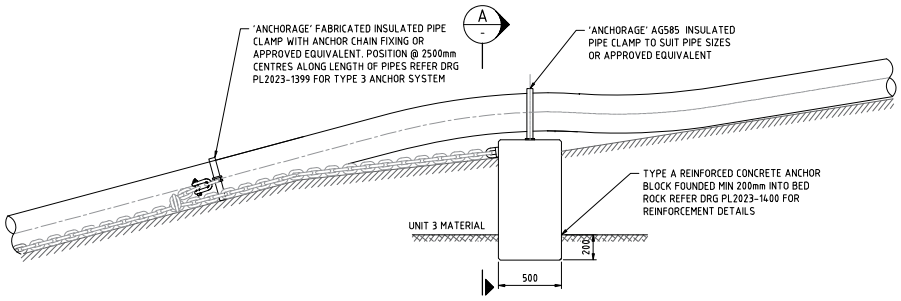


LONGITUDINAL SECTION - CH800-CH1034.822
HORIZONTAL SCALE 1:500, VERTICAL SCALE 1:250

0 10 20 30 40 50 METRES
SCALE 1:500

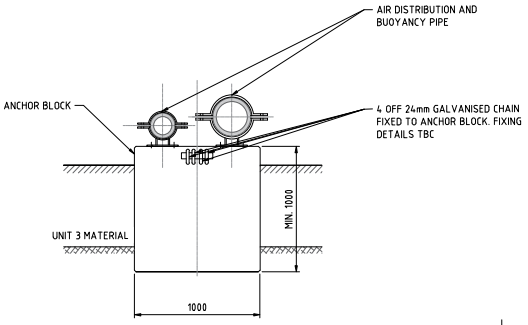
0 5 10 15 20 25 METRES
SCALE 1:250

FACILITY NAME: PINDARI DAM										
LOCATION CODE: PINDARI										
DISCIPLINE: CIVIL										
DRAWING TYPE: LONGITUDINAL SECTION										
DRAWING STATUS: 60% DESIGN RELEASE										
PLOT DATE: 19/10/2024 1:50:11 PM										
ASSETREADY										



ANCHOR BLOCK - TYPE A

SCALE 1:20

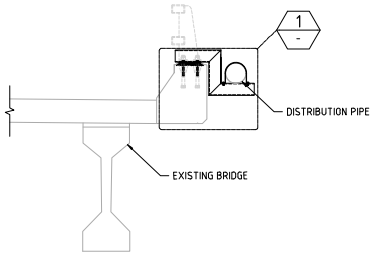


SECTION A

SCALE 1: 20

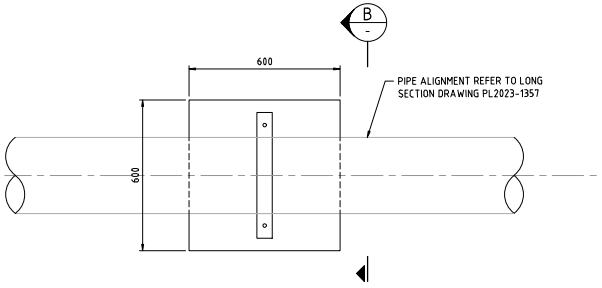
NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH
   a. STRUCTURAL NOTES DRG PL2023-1380,
   b. CIVIL NOTES DRG PL2023-1355,
   c. CIVIL LAYOUT DRG PL2023-1367.
2. FOR UNIT 3 MATERIAL REFER GEOTECHNICAL REPORT PS122845-WSP-SYD-GEO-REP-0001



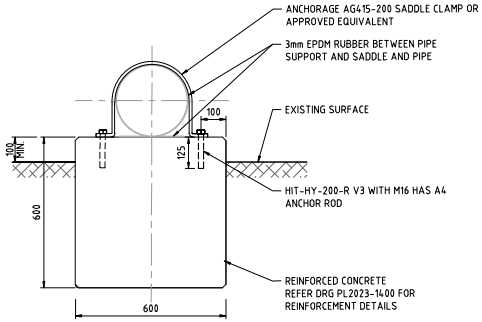
TYPICAL PIPE BRIDGE CROSSING SUPPORT PS 4

SCALE NTS



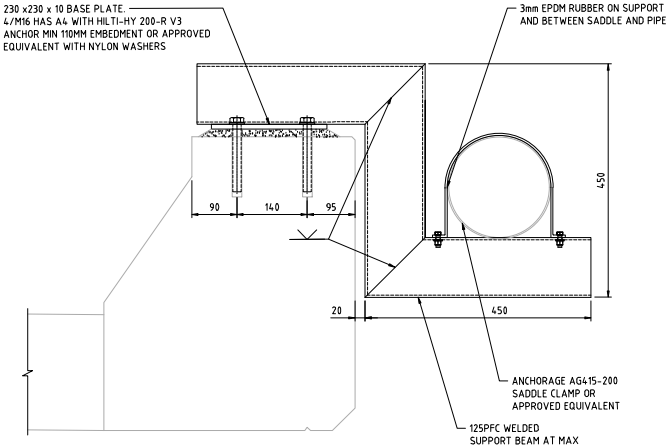
ANCHOR BLOCK - TYPE B

SCALE 1:10



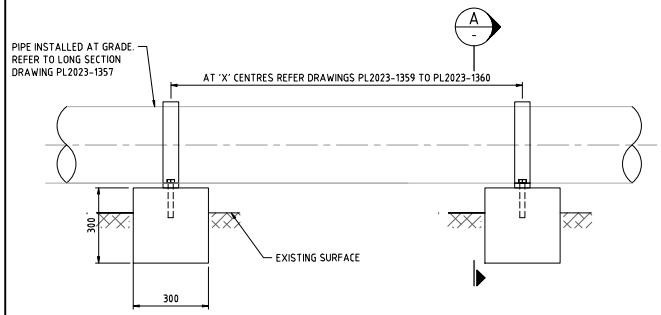
SECTION B

SCALE 1: 10



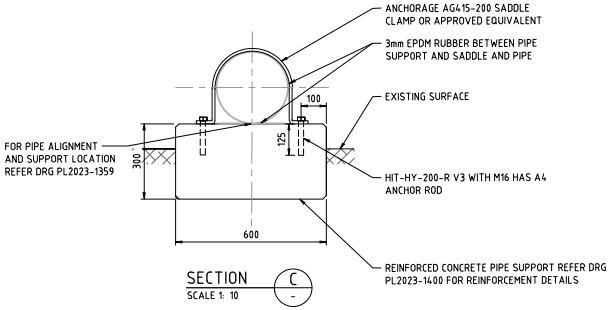
DETAIL 1

SCALE 1: 5



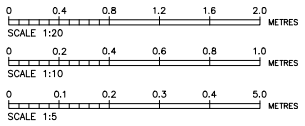
TYPICAL PIPE SUPPORT PS 6

SCALE 1:10



SECTION C

SCALE 1: 10



FACILITY NAME:	PINDARI DAM
LOCATION CODE:	TBC
DISCIPLINE:	STRUCTURAL
DRAWING TYPE:	DETAIL DRAWING
DRAWING STATUS:	90% DESIGN ISSUE
PLOT DATE:	17/10/2024 4:30:25 PM

ASSETREADY

REVISION	DETAILS OF AMENDMENT	CHK'D	DATE
C	90% DESIGN RE-ISSUE	R.H.	18.10.24
B	90% DESIGN RE-ISSUE	R.B.	
A	90% DESIGN ISSUE	R.B.	

DRAWN	ARNEL SOLOMON
DESIGNED	ROSLYN HANSEN
CHECKED	N.TAYLOR / R.BEHESHTI
SCALES	AS SHOWN
SHEET SIZE	A1
FILE NO.	N/A
REPORT NO.	N/A
JOB/PROJECT NO.	D2023/158944

RYAN BEHESHTI
PROJECT MANAGER

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

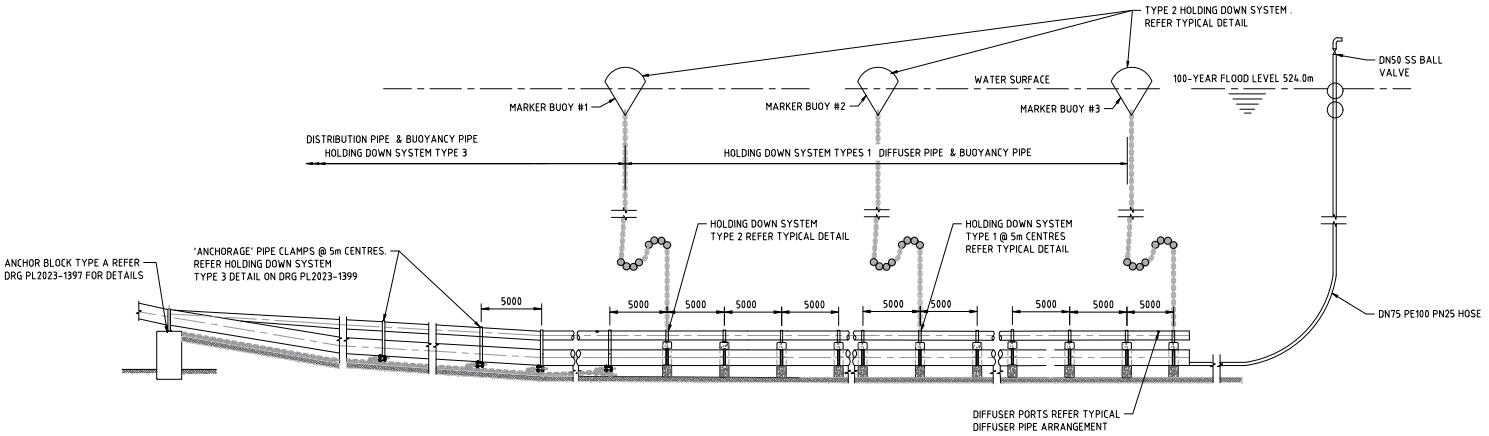
PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
MISCELLANEOUS DETAILS
PIPE SUPPORTS AND ANCHORS

REV.	PLAN No.
	PL2023-1397
C	SHEET 1
B	
A	TBC

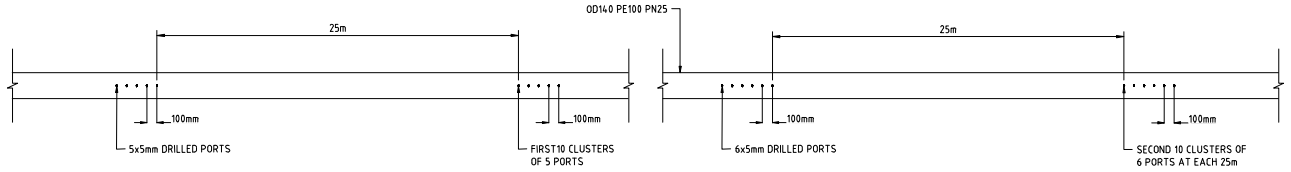
NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH
   a. STRUCTURAL NOTES DRG - PL2023-1380,
   b. CIVIL NOTES DRG - PL2023-1355,
   c. CIVIL LAYOUT DRG - PL2023-1356.
2. REFER DRG NUMBER PL2023-1356 AND 1357 FOR THE SET OUT LOCATIONS OF THE HOLD DOWN SYSTEM



HOLDING DOWN SYSTEM GENERAL ARRANGEMENT

SCALE NTS



DIFFUSER PIPE ARRANGEMENT

SCALE NTS

FACILITY NAME:	PINDARI DAM
LOCATION CODE:	TBC
DISCIPLINE:	STRUCTURAL
DRAWING TYPE:	DETAIL DRAWING
DRAWING STATUS:	90% DESIGN ISSUE
PLOT DATE:	17/10/2024 6:18:52 PM

ASSETREADY

REVISION	DETAILS OF AMENDMENT	CHK'D	DATE
C	90% DESIGN RE-ISSUE	R.H.	18.10.24
B	90% DESIGN RE-ISSUE	R.B.	
A	90% DESIGN ISSUE	R.B.	

DRAWN	ARNEL SOLOMON
DESIGNED	ROSLYN HANSEN
CHECKED	N.TAYLOR / R.BEHESHTI
SCALES	AS SHOWN
FILE NO.	N/A
	RYAN BEHESHTI PROJECT MANAGER
SHEET SIZE	A1
REPORT NO.	N/A
JOB/PROJECT NO.	D2023/158944

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

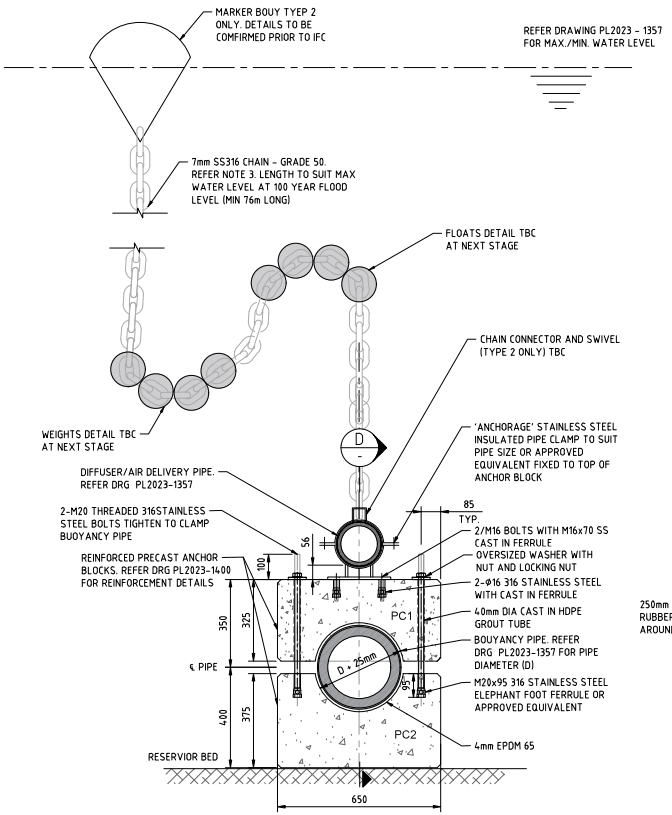
PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
DIFFUSER PIPE HOLD DOWN SYSTEM
GENERAL ARRANGEMENT

REV.	PLAN No.
C	PL2023-1398
B	SHEET 1
A	TBC

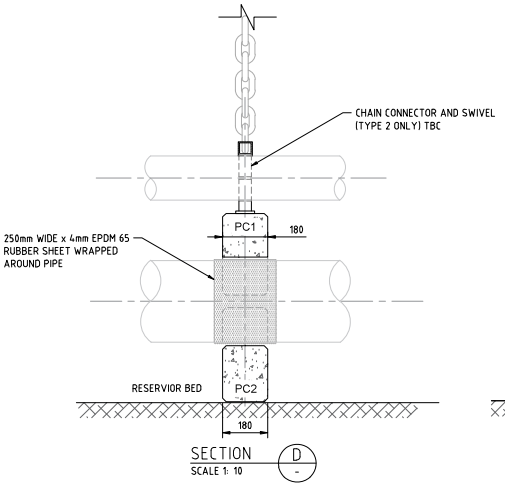
NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH
   a. STRUCTURAL NOTES DRG - PL2023-1380,
   b. CIVIL NOTES DRG - PL2023-1355
   c. CIVIL LAYOUT DRG - PL2023-1356.
2. REFER DRG NUMBER PL2023-1357 FOR THE SET OUT LOCATIONS OF THE TYPE OF SUPPORTS (TYPE 1 - 3).
3. STAINLESS STEEL CHAIN 7mm SIZE G316 - GRADE 50 SPECIFIED TO SUIT MAX CAPACITY OF 10kN AND BREAKING LOAD OF 40kN
4. ALL HOLD-DOWN WEIGHT BLOCKS SHALL BE PRECAST.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR THE LIFTING DESIGN. THE MARKER BOUYS PROVIDED SHALL NOT BE USED FOR LIFTING.
6. ALL BOLTS IN CONTACT WITH DISSIMILAR MATERIAL MUST INCORPORATE NYLON BUSHES AND WASHERS.



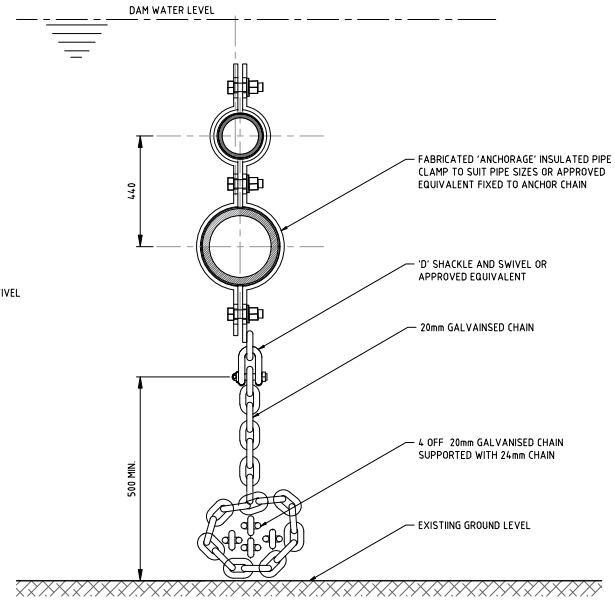
HOLDING DOWN SYSTEM TYPE 1 AND 2

SCALE 1:10



SECTION D

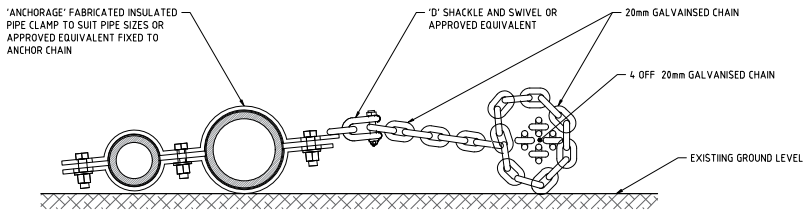
SCALE 1: 10



HOLDING DOWN SYSTEM - TYPE 3 (BELOW WATER LEVEL)

SCALE 1:10

PRECAST ELEMENT	APPROX WEIGHT (kg)
PC 1	95
PC 2	125



HOLDING DOWN SYSTEM - TYPE 3 (NO WATER)

SCALE 1:10

0 0.2 0.4 0.6 0.8 1.0 METRES

SCALE 1:10

FACILITY NAME:	PINDARI DAM
LOCATION CODE:	TBC
DISCIPLINE:	STRUCTURAL
DRAWING TYPE:	DETAIL DRAWING
DRAWING STATUS:	90% DESIGN ISSUE
PLOT DATE:	18/10/2024 9:53:11 AM

ASSETREADY

REVISION	DETAILS OF AMENDMENT	CHK'D	DATE
B	90% DESIGN RE-ISSUE	R.H.	
A	90% DESIGN ISSUE	R.H.	

DRAWN: ARNEL SOLOMON
DESIGNED: ROSLYN HANSEN
CHECKED: N.TAYLOR / R.BEHESHTI

SCALES: AS SHOWN
FILE NO.: N/A
RYAN BEHESHTI
PROJECT MANAGER

SHEET SIZE: A1
REPORT NO.: N/A
JOB/PROJECT NO.: D2023/158944

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
DIFFUSER PIPE HOLD DOWN SYSTEM
TYPICAL DETAILS

REV.: B, A

PLAN No.: PL2023-1399

SHEET 1

TBC

Appendix 2 – Threatened Species Searches

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records	Info
Animalia	Reptilia	Chelidae	2825	*Myuchelys bellii*		Western Sawshelled Turtle, Bell's Turtle	E1,P	E	3	

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 07-Aug-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	59
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	19
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	2
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Banrock station wetland complex	1100 - 1200km upstream from Ramsar site
Riverland	1000 - 1100km upstream from Ramsar site
The coorong, and lakes alexandrina and albert wetland	1200 - 1300km upstream from Ramsar site

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
New England Peppermint (Eucalyptus nova-anglica) Grassy Woodlands	Critically Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anthochaera phrygia		
Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat known to occur within area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat known to occur within area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat may occur within area
FISH		
Bidyanus bidyanus Silver Perch, Bidyan [76155]	Endangered	Species or species habitat known to occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area
MAMMAL		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
PLANT		
Acacia macnuttiana McNutt's Wattle [10711]	Vulnerable	Species or species habitat known to occur within area
Acacia pubifolia Velvet Wattle [19799]	Vulnerable	Species or species habitat may occur within area
Acacia ruppii Rupp's Wattle [7559]	Endangered	Species or species habitat known to occur within area
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat likely to occur within area
Astrotricha roddii [56312]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Boronia granitica Granite Boronia [18598]	Endangered	Species or species habitat known to occur within area
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Callistemon pungens [55581]	Vulnerable	Species or species habitat known to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus caleyi subsp. ovendenii Ovenden's Ironbark [56193]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus mckieana McKie's Stringybark [20199]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus nicholii Narrow-leaved Peppermint, Narrow-leaved Black Peppermint [20992]	Vulnerable	Species or species habitat likely to occur within area
Homopholis belsonii Belson's Panic [2406]	Vulnerable	Species or species habitat may occur within area
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area
Lepidium monoplocoides Winged Pepper-cress [9190]	Endangered	Species or species habitat may occur within area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Micromyrtus grandis [64647]	Endangered	Species or species habitat known to occur within area
Phebalium glandulosum subsp. eglandulosum Rusty Desert Phebalium [17140]	Vulnerable	Species or species habitat may occur within area
Picris evae Hawkweed [10839]	Vulnerable	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat likely to occur within area
Swainsona murrayana Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat known to occur within area
Vincetoxicum forsteri listed as Tylophora linearis [92384]	Endangered	Species or species habitat may occur within area
REPTILE		
Anomalopus mackayi Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat likely to occur within area
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Hemiaspis damelii Grey Snake [1179]	Endangered	Species or species habitat may occur within area
Myuchelys belli Western Sawshelled Turtle [86075]	Endangered	Species or species habitat known to occur within area
Uvidicolus sphyrurus Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat likely to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area overfly marine area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat may occur within area overfly marine area
Pterodroma cervicalis White-necked Petrel [59642]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat may occur within area overfly marine area

Extra Information

State and Territory Reserves		[Resource Information]
Protected Area Name	Reserve Type	State
Severn River	Nature Reserve	NSW

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
Not controlled action (particular manner)			
Aerial baiting for wild dog control	2006/2713	Not Controlled Action (Particular Manner)	Post-Approval

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

© Commonwealth of Australia
Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
Canberra ACT 2601 Australia
+61 2 6274 1111

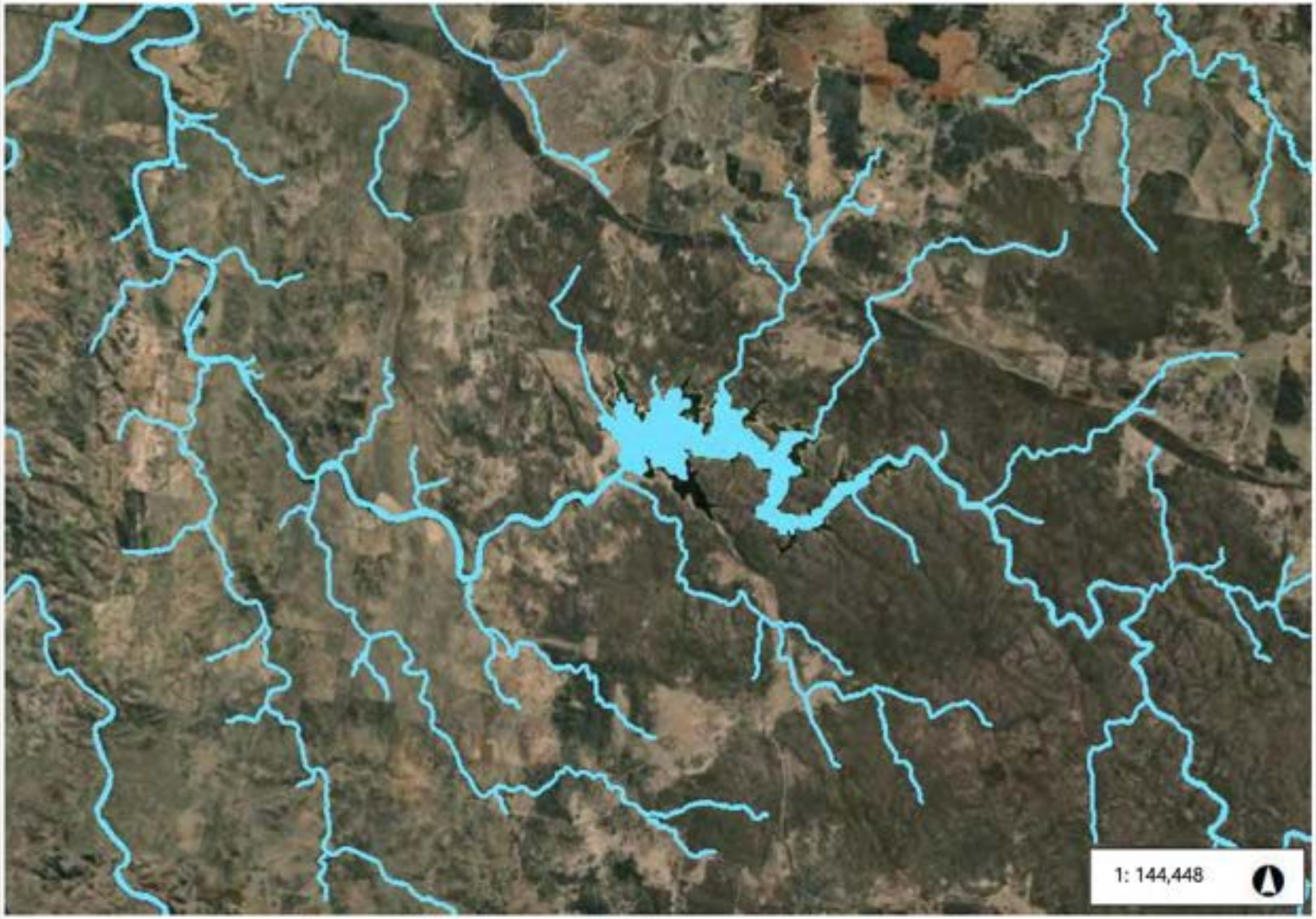
Appendix 3 – Existing Ecological Mapping

NSW Key Fish Habitat

Indicative Distribution of Threatened Fish Species

Freshwater Fish Community Status

Department of Primary Industries





Legend

- Key Fish Habitat - Murray Darli
- World Imagery
- Low Resolution 15m Imagery
- High Resolution 60cm Imagery
- High Resolution 30cm Imagery
- Citations
- 38m Resolution Metadata

Notes

7.3 0 3.67 7.3 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

© Department of Trade and Investment NSW

07-Aug-2024

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Department of Primary Industries





Legend

- Eel Tailed Catfish
- Southern Purple Spotted Gudg
- Silver Perch
- World Imagery
- Low Resolution 15m Imagery
- High Resolution 60cm Imagery
- High Resolution 30cm Imagery
- Citations
- 38m Resolution Metadata

Notes

7.3 0 3.67 7.3 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

© Department of Trade and Investment NSW

07-Aug-2024

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Department of Primary Industries





Legend

Freshwater Fish Community St
- Very Good
- Good
- Fair
- Poor
- Very Poor

World Imagery
Low Resolution 15m Imagery
High Resolution 60cm Imagery
High Resolution 30cm Imagery
Citations
38m Resolution Metadata

Notes

7.3 0 3.67 7.3 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere
© Department of Trade and Investment NSW

07-Aug-2024

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Appendix 4 – Assessments of Significance

Threatened Freshwater Fish

Species Review

Species	Name	Status FM Act	Status EPBC Act
Bidyanus bidyanus	Silver Perch	Vulnerable	Endangered
Maccullochella peelii	Murray Cod	-	Vulnerable
Tandanus tandanus	Eel-tailed Catfish	Endangered Population (Murray-Darling Basin)	-

Species	Distribution	Habitat and Prey	Breeding
B. bidyanus	Formerly widespread throughout the Murray-Darling system, but now the only self-sustaining population occurs in the central Murray River downstream of Yarrawonga weir, and several anabranches and tributaries. Breeding, aquaculture and conservation stocking programs are common in NSW for this species.	Typically prefer faster flowing freshwater habitats, such as rapids or races and open sections of rivers, however, have been found in a wide range of habitats including slow flowing, turbid rivers. The species is omnivorous and feeds on aquatic insects, worms, crustaceans, molluscs, zooplankton and algae.	Spawning occurs in Spring and Summer, triggered by a rise in water temperatures over 21-23ºC. Adults may migrate long distances during spawning, whilst juveniles often travel upstream. Eggs and larvae drift with river drift for a number of days and eggs typically hatch within ~30 hours.
M. peelii	Historically widespread throughout the Murray-Darling system, from southern QLD, through NSW, ACT and VIC to SA. Species typically still occurs in most parts of its natural distribution within altitude of ~1000 m above sea level. Stocking also occurs.	Utilises a diverse range of freshwater habitats, including clear rocky streams, slow-flowing and turbid rivers or billabongs. Preferred habitat includes features such as large rocks, snags, overhanging banks and woody structures. Species is the apex predator of the Murray-Darling Basin and feeds on crayfish, yabbies, shrimps, other large freshwater fish and occasionally birds, smalls reptiles and frogs. Young feed on zooplankton and insects.	Spawning in northern parts of the distribution typically occurs in Spring coinciding with an increase in day length and water temperature, typically triggered by temperatures over 15ºC. The species form breeding pairs prior to spawning and have been shown to undertake long-distance migrations upstream. Once developed, larvae drift downstream for up to 10 days to settle in protected habitat.
T. tandanus	Natural distribution occurs within the Murray-Darling system, but is typically distributed in the northern tributaries and in the eastern drainages of NSW north of Newcastle.	Typically utilises benthic habitats and occupies a 5 km home range within varied freshwater habitats, such as rivers, creeks, lakes, lagoons and billabongs. Preferred habitat includes clear, slow or still waters but may be found in rivers with flow and turbid waters. The species is typically an opportunistic carnivore and preys on fish, prawns, yabbies, zooplankton and aquatic insects.	Spawning occurs in Summer months when water temperatures rise above ~24ºC. Males build and defend a nest, where the female lays the eggs. Eggs typically hatch after ~7 days.

7-Part Test – FM Act

Threatened Fish –FM Act ***Bidyanus bidyanus* – Vulnerable** ***Tandanus tandanus* – Endangered Population**
(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Silver Perch are adapted to variable environmental conditions, such as river flows, periods of drought and floods, however, the regulation of rivers and introduction of water extraction mechanisms along freshwater systems in NSW have had major impacts on the species populations. These impacts include changes to natural seasonal flow patterns, reductions in water temperature and creation of barriers to fish passage, which has negatively impacted natural spawning cues, recruitment success, growth and fitness and habitat. Targeted recent studies found that over the 2023/2024 breeding season, only 27 suitable spawning days occurred for this species (NSW DPI 2024a) in the Study Area. The proposed destratification system intends to modify this species habitat by reducing the magnitude and extent of cold water pollution (CWP) in the Severn River downstream of the dam. This is expected to have a net positive effect on the life cycle of the species by reducing the temperature differential of dam releases to the ambient river temperature, thus providing more stable water temperatures that are more reflective of natural temperatures, increased opportunity for on-time natural spawning temperature cues and increased suitable spawning days. Additionally, Silver Perch eggs have been shown to exhibit longer hatching periods in colder water temperatures, thus increased water temperatures may reduce hatching times and reduce potential opportunities for predation. Therefore, it is not expected that the proposed activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
As Eel-tailed Catfish typically only occupy a home range of ~5 km and are a non-migratory species, they can be particularly susceptible to environmental and habitat disturbances, such as loss of habitat and spawning sites, alterations to flow patterns and the loss of spawning temperature cues due to river regulation. As with other freshwater species, this can impact natural spawning cues, recruitment success, growth and fitness and habitat. Targeted recent surveys indicated that suitable temperatures in the Severn River at a site 4 km downstream of Pindari Dam were not met at any point during the 22/23 breeding season for *T. tandanus*, whilst suitable temperatures were only met for 35 days in the 23/24 season at a site 15 km downstream (NSW DPI 2024a). The proposed destratification system intends to modify this species habitat by reducing the magnitude and extent of CWP in the Severn River downstream of the dam. This is expected to have a net positive effect on the life cycle of the species by reducing the temperature differential of dam releases to the ambient river temperature, thus providing more stable water temperatures that are more reflective of natural temperatures, increased opportunity for on-time natural spawning temperature cues and increased suitable spawning days. It may also increase areas of habitat that are suitable for spawning and nesting sites by the species. Therefore, it is not expected that the proposed activity is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
(c) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Not applicable
(d) in relation to the habitat of a threatened species, population or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality

i)	Aquatic habitat in the Severn River downstream of Pindari Dam will be modified by the proposed destratification system. Modifications will include an intended increase of water temperatures of the Pindari Dam releases in an effort to mitigate CWP impacts in downstream receiving habitats. It is expected that temperature increases will be of an extent that is more reflective of natural river temperatures for the region. The existing environmental flow releases will not be modified as a result of this proposal. Habitat that may be transiently used by these species in Lake Pindari will be modified by the installation of the pipeline, which will predominantly lie along the dam bed and is not expected to significantly modify any important habitat.
ii)	Habitat in the Severn River is not likely to become fragmented or isolated from other areas of habitat as a result of the proposed destratification system. In Lake Pindari, the proposed pipeline and associated anchorages are not expected to result in fragmentation or isolation of other areas of habitat.
iii)	Habitat in the Severn River downstream of Pindari Dam is important for facilitating reproduction of the Silver Perch and Eel-tailed Catfish. Modification of this habitat from the proposed destratification system is expected to result in a net positive impact by reducing the impacts of CWP and improving conditions for successful spawning and recruitment.

(e) Whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly)

Not applicable

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A Silver Perch Recovery Plan has been prepared by the NSW DPI Fisheries (NSW DPI, 2006). The objectives or actions of the recovery plan are:

- Increase awareness of the current status of silver perch throughout its range.
- Increase scientific knowledge of the current distribution, ecological and habitat requirements and population genetics of silver perch.
- Protect and enhance remaining natural populations of silver perch.
- Ameliorate the impacts of known major threats to silver perch.
- Minimise any fishing impacts on natural populations through enhanced compliance with fishing regulations and involvement of recreational fishers.
- Improve management of aquaculture and stocking programs.
- Encourage and support the involvement of indigenous communities in the implementation of recovery actions.
- Establish a program to monitor the status of silver perch and evaluate the effectiveness of recovery actions.

The proposed destratification system meets a number of the plan's objectives. The increase of dam release water temperatures is intended to ameliorate the negative impacts of CWP in the Severn River downstream of Pindari Dam, enhancing habitat suitability for the species and increasing the likelihood of more natural temperature cues and conditions for spawning. Monitoring programs to assess the baseline fish populations and measure the success of the destratification system will contribute to scientific understanding of the species distribution in the Severn River, response to habitat conditions and evaluate the effectiveness of destratification as an action to mitigate CWP in freshwater habitats.

(g) Whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A KTP that **threatens these species is the 'Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and stream'. This proposal includes the installation and operation of an instream structure** that is expected to alter habitat conditions in downstream receiving environments, however, it is not expected to change the existing environmental flow regimes operating at Pindari Dam. Thus, KTPs are not expected to be exacerbated by the proposed development do not have potential to impact on Silver Perch or Eel-tailed Catfish.

Conclusion	Populations of Silver Perch and Eel-tailed Catfish that may utilise habitat in the Study Area and in Severn River downstream of Pindari Dam where changes to environmental conditions are expected are unlikely to be significantly detrimentally affected by the proposed system. Intended increases in water temperatures from dam releases are expected to reduce the magnitude and extent of impacts from the existing CWP in the Severn River and contribute to improving habitat suitability, particularly for reproductive success. The project is expected to have a net positive impact on these threatened species by improving environmental conditions and reduce existing impacts that may otherwise impact on the long-term survival of these species in the Severn River.

NSW Department of Primary Industries (NSW DPI), (2006). Silver Perch NSW Recovery Plan. Fisheries Management Branch, Port Stephens Fisheries Centre.

Significant Impact Criteria: Silver Perch and Murray Cod

Significant Impact Criteria: (EPBC Act) *Bidyanus bidyanus* – Endangered *Maccullochella peelii* – Vulnerable	Likelihood of Impact
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species,	
The proposed destratification system is expected to reduce negative impacts of CWP by improving the suitability of spawning habitat and species growth and fitness success by increasing water temperatures of Pindari Dam releases. Operation of the system may result in some short-term disturbances to prey availability but is not expected to result in a long-term decrease of the populations of Silver Perch or Murray Cod in downstream areas of the Severn River. The successful implementation may result in a long-term increase in population size of these species.	Unlikely
Reduce the area of occupancy of an important population,	
The proposed destratification system is not expected to reduce any area of occupancy important to Silver Perch or the Murray Cod populations in the locality. Individuals present in Lake Pindari may be temporarily deterred from the area during construction an initial operation of the plume. In the Severn River, increased water temperatures may provide suitable temperature conditions for spawning over a wider area. Thus, the proposal has minimal potential to impact the area of occupancy of the population at any ecologically significant scale.	Unlikely
Fragment an existing important population into two or more populations,	
The proposal is not expected to result in any habitat that the Silver Perch or Murray Cod may use to become fragmented or isolated from other areas of habitat.	Unlikely
Adversely affect habitat critical to the survival of a species,	
The proposed system is not expected to adversely affect habitat critical to the survival of the Silver Perch or Murray Cod, whilst no critical habitat has been identified in the recovery plans for either species. Operational impacts from the proposal are likely to increase habitat suitability and environmental cues for spawning that are important to the long-term survival of the species.	Unlikely
Disrupt the breeding cycle of an important population,	
The proposed system may result in changes to the existing breeding and spawning temperature cues in downstream Severn River. However, these changes are expected to be more reflective of natural and on-time seasonal temperature cues and may increase the number of days where suitable conditions for breeding occurs.	Unlikely
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline,	
The proposed system is not expected to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that Silver Perch or Murray Cod is likely to decline.	Unlikely
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat,	
No known invasive species harmful to Silver Perch or Murray Cod are likely to be released or become newly established in the Severn River. However, reduction of CWP impacts may also benefit those invasive fish species that currently exist in the downstream Severn River.	Unlikely
Introduce disease that may cause the species to decline, or	
The proposed system is unlikely to result in the introduction of disease that may cause a decline in the local Silver Perch or Murray Cod populations.	Unlikely
Interfere substantially with the recovery of the species.	
The proposed system is unlikely to substantially interfere with the recovery of Silver Perch or Murray Cod. Instead, the proposed system aims to contribute to the recovery of these species by improving habitat quality and opportunities for successful recruitment and growth.	Unlikely
Conclusion	
Populations of Silver Perch and Murray Cod that may utilise habitat in the Study Area and in Severn River downstream of Pindari Dam where changes to environmental conditions are expected are unlikely to be significantly detrimentally affected by the proposed system. Intended increases in water temperatures from dam releases are expected to reduce the magnitude and extent of impacts from the existing CWP in the Severn River and contribute to improving habitat suitability, particularly for reproductive success. The project is expected to have a net positive impact on these threatened species by improving environmental conditions and reducing existing impacts that may otherwise impact on the long-term survival of these species in the Severn River.	

Darling River Endangered Ecological Community

Species Review

Aquatic Ecological Community	Region	Status FM Act	Status EPBC Act
Darling River EEC (all native fish and aquatic invertebrates)	Natural Drainage System of the Lowland Catchment of the Darling River. Relevant to this assessment, includes the border rivers including the MacIntyre River below Graman Weir (29o 25'S; 150o 58.8'E), Severn River downstream of Pindari Dam (29o 23'S; 151o 14'E) and the Dumaresq River below the junction with the Mole River (28o 59.7'S; 151o 31'E).	Endangered Ecological Community	

Species Assemblage	Number of Species Included	Species Assemblage	Number of Species Included
Worms (Annelida)	2	Crustaceans	18
Finfishes (Osteichthyes)	21	Insects (Coleoptera)	33
Insects (Diptera)	15	Insects (Hemiptera)	6
Insects (Odonata)	32	Insects (Tricoptera)	4
Insects (Ephemeroptera)	2	Mollusca	25
Porifera	6	Rotifera	88

7-Part Test – FM Act

Darling River EEC – FM Act
(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Not applicable
(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction
Not applicable
(c) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

i)	The proposed destratification system will result in the modification of aquatic habitat conditions in the Severn River downstream of Pindari Dam. The predominant modification will be an intended increase in water temperature of dam releases to improve habitat quality, however, other modifications may include some shifts in nutrient availability, physical water quality and algal biomass which may impact species included in the Darling River EEC. Such impacts may result in temporary reductions in habitat quality, particularly for periphyton communities and benthic species that are more restricted in movements, as a result of changed optimal temperature ranges or an increase in algal biomass. Some invertebrates may experience some disturbances and elevated levels of stress during initial temperature changes and at times throughout the operation of the destratification system if they have cold water preferences, and as a result could disperse to areas up or downstream where conditions are more suitable. Where environmental conditions are suboptimal for fish species, they are expected to disperse to more suitable areas. However, given the intended purpose of the system is to reduce CWP impacts and provide more stable and natural temperatures, adverse impacts that would affect the extent of the EEC such that its local occurrence is likely to be placed at risk of extinction is considered unlikely.
ii)	Considering the wide diversity of species under the Darling River EEC, changes to water temperature in the Severn River as a result of the proposed destratification system will not affect all species equally. Whilst some species, such as fish, may benefit from more stable temperature that are more reflective of natural conditions, some species of invertebrates have preferences or optimal temperature ranges under colder conditions. Distributions of species may show slight modifications as species adapt to increases in water temperatures. Additionally, where increased temperatures promote increased algal biomass, competition for attachment space may increase and distribution of some species shift. Shifts at lower trophic levels may result in some changes to foraging value for upper trophic levels. These changes are expected to balance out over the entirety of the lower Severn River and are not expected to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
(d) in relation to the habitat of a threatened species, population or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality	
i)	Aquatic habitat in the Severn River downstream of Pindari Dam will be modified by the proposed destratification system. Modifications will include an intended increase of water temperatures of the Pindari Dam releases in an effort to mitigate CWP impacts in downstream receiving habitats. It is expected that temperature increases will be of an extent that is more reflective of natural river temperatures for the region. The environmental flow releases will not be modified as a result of this proposal.
ii)	Habitat in the Severn River is not likely to become fragmented or isolated from other areas of habitat as a result of the proposed destratification system.
iii)	Habitat in the Severn River downstream of Pindari Dam is important for the survival and reproduction of native freshwater fish and aquatic invertebrate species. Modification of this habitat from the proposed destratification system is expected to result in a net positive impact by reducing the impacts of CWP and improving conditions for successful spawning and recruitment for fish species. For invertebrates, increased temperatures can have both positive and negative effects, depending on the upper thermal tolerances of each species. Species that are eurythermal are not expected to be adversely affected by changes in temperatures, however stenothermal species that may possess lower ranges of upper thermal tolerances may become restricted to cooler upstream areas. Whilst changes in distribution may occur, it is not expected that they would occur to such an extent that would threaten the long-term survival of species of the EEC.
(e) Whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly)	
Not applicable	
(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	
Not applicable.	
(g) Whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process	
A KTP that threatens these species is the 'Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and stream'. This proposal includes the installation and operation of an instream structure that is expected to alter habitat conditions in downstream receiving environments, however, it is not expected to change the existing environmental flow regimes operating at Pindari Dam. Thus, KTPs are not expected to be exacerbated by the proposed development do not have potential to impact on the Darling River EEC.	

Conclusion	The Darling River EEC that utilises habitat in Severn River downstream of Pindari Dam where changes to environmental conditions are expected are unlikely to be significantly detrimentally affected by the proposed system. Intended increases in water temperatures from dam releases are expected to maintain more stable environmental conditions and reduce the magnitude and extent of CWP and cold shock events in the Severn River, downstream of the dam. Some species, such as macroinvertebrates or zooplankton, may experience some disturbances as environmental conditions shift and habitat becomes more homogenised, which may lead to some shifts in community composition and distribution over the entire downstream Severn River. However, this is not expected to occur to such an extent that species of the EEC would be at risk of extinction and is expected to assist in promoting changes back towards the natural state of the Severn River.

H2O Consulting Group Pty Ltd

E: info@h2oconsultinggroup.com.au | W: www.h2oconsultinggroup.com.au

Appendix E

Aboriginal Objects Due Diligence Assessment

Aboriginal Object Due Diligence Assessment

Pindari Dam Bubble Plume - Pindari

Inverell Shire Local Government Area

Prepared for Water NSW

by [redacted] and Dharawal Environment and Heritage

21 August 2024



Acknowledgement

Water NSW would like to acknowledge all First Nations people throughout NSW, their connection and legacy to this country is continually shown through their ongoing spiritual, physical and cultural knowledge and practices of the lands and waters.

We pay our respects to all Elders past, present and emerging and acknowledge their ongoing connection and commitment to the waters and lands on which we operate.

We recognise their vast cultural knowledge and management of country and together we will commit to reconciliation and through these partnerships will care for country and waterways on, and all, of our operations and infrastructure areas (Water NSW, 2023).

Document Information

Issue Date	Version	Author	Reviewer
2.8.2024	DV 1	[redacted]	[redacted]
20.8.2024	DV 2	[redacted]	[redacted]
26.8.2024	Final	[redacted]	

©Water NSW

This Document is and shall remain the property of Water NSW. The document may only be used for the purposes for which it was intended. Unauthorised use of this document in any form whatsoever is prohibited.

Disclaimer:

Water NSW has completed this assessment with the relevant federal, state and local legislations and current industry best practice codes. Water NSW accepts no liability for any damages or loss incurred as a result of reliance placed upon the report content or for any purpose other than that for which it was intended.

Executive Summary

WaterNSW is undertaking an Aboriginal Objects Due Diligence assessment (DD) for Pindari Dam Bubble Plume project located at Nucoorima (Pindari) on the traditional lands of the Kwiambal people (here on referred to as the 'Activity Area').

Pindari Dam has been identified as a reservoir with cold water pollution as a result of stratification, resulting in ecological impacts downstream on the Severn River. The dam has been recognised out of eight high-priority dams with cold water pollution to be most appropriate to conduct trial mitigation works involving artificial destratification through application of bubble plumes. Successful destratification and reduction of cold-water pollution at Pindari Dam would be used as a framework for remediating stratified reservoirs across the state.

The Due Diligence Assessment and associated field survey has considered the proposed works, in relation to potential for Aboriginal objects to be present and is all-inclusive of the entire Activity Area.

An assessment in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCWb, 2010) has been undertaken in order to inform Water NSW of their responsibilities with regards to Aboriginal cultural heritage in the Activity Area.

The archaeological field survey of the Activity Area was undertaken on the 19 July 2024. The survey followed the archaeological survey requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCWa, 2010) and industry best practice methodology.

There is low potential for Aboriginal objects to remain in the Activity Area. No Aboriginal objects will be impacted by the proposed works in the Activity Area.

Prior to any impacts occurring within the Activity Area, the following is recommended:

Recommendation 1: Aboriginal Community Monitoring Recommendation

During the field assessment, Aboriginal community representatives, requested that during the groundbreaking components of the project, an Aboriginal community representative is required to be present.

Recommendation 2: No further archaeological assessment is required in the Activity Area.

Following the Aboriginal object due diligence desktop review and field assessment observations, and Recommendation 1, no further archaeological assessment is required in the Activity Area in regard to the proposed project.

Recommendation 3: Site Awareness Induction.

Prior to initiation of works in the Activity Area, all site workers should undertake a site awareness training, inclusive of the history of AHIMS sites associated with the Pindari Dam wall infrastructure.

Recommendation 4: Discovery of Unanticipated Aboriginal Objects

All Aboriginal objects and Places are protected under the NPW Act. It is an offence to knowingly disturb an Aboriginal object or Place without consent permit issued by the Department of Climate Change, Energy, Environment and Water (DCCEEW) under the NPW Act 1974. Should any Aboriginal objects be encountered during works associated with this assessment proposal, works must cease immediately, and the find should not be moved until

assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object, the archaeologist will provide further recommendations. These may include notifying the DCCEEW and Aboriginal Stakeholders.

Recommendation 5: Discovery of Aboriginal Ancestral remains.

Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity, you must:

1. Immediately cease all work at that location, and no further movement or disturbance of the remains and with a buffer of at least 20 metres, to avoid further harm.
2. Refer to and follow the Water NSW unexpected finds procedure (Appendix 5)
3. Notify the NSW Police and DCCEEW Environmental line on 131555, as soon as practicable and provide details of the remains and their location.
4. Not recommence work at that location unless authorised.

Follow up Recommendations:

AHIMS registered sites outlined below in recommendation 6 and 7 are not within the Activity Area, and will not be impacted by the proposed works, therefore these recommendations are in regard to WaterNSW future management responsibilities and are not required to be completed prior to or during the proposed works.

Recommendation 6: Site cards should be updated

[redacted]

Recommendation 7: Confirmation of AHIMS site preservation

[redacted]

Contents

Executive Summary ..... **ii**

Acronyms and abbreviations ..... **vii**

1. Introduction **1**

1.1. Background 1

1.2. Location 1

1.3. Restrictions 1

1.4. Objectives 4

1.5. Methodology 6

1.6. Field Assessment Attendance 6

1.7. Statutory Controls 8

1.8. Planning legislation 9

2. Aboriginal Objects Due Diligence Assessment **10**

2.1. Is the proposed activity a low impact activity as defined by the regulation? 10

2.2. Will the activity disturb the ground surface or any culturally modified trees? (Step 1) 10

2.3. Are there any relevant confirmed site records or other associated landscape feature information on AHIMS (or other heritage registers)? (Step 2a) 10

2.4. Are there any other sources of information of which a person is already aware? (Step 2b) 17

2.5. Are there any landscape features that are likely to indicate the presence of Aboriginal objects? (Step 2c) 20

2.6. Can the harm or the activity be avoided? (Step 3) 23

2.7. Does a desktop assessment and site inspection confirm that there are Aboriginal Objects or that they are likely? (Step 4) 23

2.8. Further Investigations and Impact Assessment (Step 5) 23

3. Site Assessment Details **24**

4. Conclusion **27**

5. Recommendations **28**

6. References **30**

Appendix 1: AHIMS Basic and Extensive Search Results **32**

Appendix 2: Previous AHIP approvals **33**

Appendix 3: AHIMS Site Cards **34**

Appendix 4: Native Title Tribunal Search results **35**

Appendix 5: WaterNSW: Unexpected Finds Procedure **36**

Tables

Table 1: Field assessment attendees.....6

Table 2: Statutory Controls 8

Table 3: Summary of previously recorded AHIMS sites identified in the basic and extensive search. 10

Table 4: Listed items in proximity to the Activity Area.....15

Table 5: Previous Archaeological studies within the region of the Activity Area.....18

Figures

Figure 1: Regional overview of the Activity Area location (Source: WaterNSW, Produced by Wollondilly Hire) 2

Figure 2: Partial location of the Activity Area (Source: WaterNSW, Produced by Wollondilly Hire) 3

Figure 3: AHIMS sites (Source: Heritage NSW, Produced by Wollondilly Hire). 12

Figure 4: AHIMS site extensions and current status as presented in Hagland (Archaeology survey of the proposed Pindari Dam Extension and associated works, 1984, p. 33). 14

Figure 5: Historical Aerial Imagery (1975 and 1994) (Source: DPI, Produced by Wollondilly Hire). 16

Figure 6: Soil Landscapes and Hydrology in the local area (Source: DPI, Produced by Wollondilly Hire). 22

Plates

Plate 1: Location of Activity Area, inclusive of reservoir and previously established areas to be utilised that have no surface or subsurface disturbance (Source: WaterNSW). 4

Plate 2: The Due Diligence Assessment Process Flow Chart (Source: DECCW 2010).....7

Plate 3: Overview of 100% visibility from the northeast section of the Activity Area, showing disturbance and introduced vegetation, facing east.....25

Plate 4: Overview of 100% visibility, showing dam bank disturbance, facing northwest. 25

Plate 5: Overview of clear visibility and historical native regrowth in the Activity Area, facing south.....25

Plate 6: Overview of 100% visibility, showing dam bank disturbance, facing north. 25

Plate 7: Overview of historically constructed Dam wall, below the catchment area, facing northeast. 26
Plate 8: Overview of historically constructed dam infrastructure, facing west. 26
Plate 9: Overview of the Activity Area, facing south. 26
Plate 10: Overview of the northwest section of the Activity Area, facing west. 26

Acronyms and abbreviations

Terminology	Definitions
Aboriginal cultural heritage	The tangible (objects) and intangible (dreaming stories, legends and places) cultural practices and traditions associated with past and present-day Aboriginal communities.
ACHA	Aboriginal Cultural Heritage Assessment.
Aboriginal object(s)	The legal definition for material Aboriginal cultural heritage under the NSW National Parks and Wildlife Act 1974.
Aboriginal stakeholders	Members of a local Aboriginal land council, registered holders of Native Title, Aboriginal groups or other Aboriginal people who may have an interest in the Project.
AHIMS	Aboriginal Heritage Information Management System.
AHIP	Aboriginal Heritage Impact Permit.
Archaeology	The scientific study of human history, particularly the relics and cultural remains of the distant past.
Archaeological deposit	A layer of soil material containing archaeological remains.
Archaeological investigation	The process of assessing the archaeological potential of an impact area by a qualified archaeologist.
Archaeological site	A site with material evidence of past Aboriginal or non-Aboriginal activity in which material evidence (artefacts) of past activity is preserved.
Artefact	An object made by human agency (e.g., stone artefacts).
Assemblage	A group of stone artefacts found in close association with one another. Any group of items designated for analysis – without any assumptions of chronological or spatial relatedness.
Avoidance	A management strategy which protects Aboriginal sites within an impact area by avoiding them totally in development.
Catchment	The area from which a surface watercourse or a groundwater system derives its water.
Code of Practice	*Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.*
Cumulative impacts	Combination of individual effects of the same kind due to multiple actions from various sources over time.
DCCEEW	Department of Climate Change Energy Environment and Water (Current NSW department: previously DPE) in which Heritage NSW resides.
DECCW	The Department of Conservation, Climate Change and Water, replaced by the biodiversity and Conservation Division (BCD) of the Department of Planning, Industry and Environment (DPIE) and now Heritage NSW in the Department of Premier and Cabinet (DPC).
Development	The operations involved in preparing a mine for extraction, including cutting roadways and headings. Also includes tunnelling, sinking, crosscutting, drifting, and raising.
DPE	Department Planning and Environment. (previous DPIE)
DPIE	The Department of Planning, Industry and Environment.
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water.
EP&A Act	*NSW Environmental Planning and Assessment Act 1979.*
FGS	Fine Grained Siliceous. A raw material type from which stone artefacts were manufactured.
Flake	A piece of stone detached from a core, displaying a bulb of percussion and striking platform.
Harm	With regard to Aboriginal objects this has the same meaning as the *NSW National Parks and Wildlife Act 1974.*
HMP	Heritage Management Plan.
Heritage NSW	Aboriginal cultural heritage regulator in the Department of Premier and Cabinet. Responsible for the management of Aboriginal Cultural Heritage (ACH) regulation functions under the National Parks and Wildlife Act 1974. Formerly BCD of DPIE.

Terminology	Definitions
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Impact area	An area that requires archaeological investigation and management assessment. In situ Latin words meaning 'on the spot, undisturbed'.
Isolated artefact/ find	A single artefact found in an isolated context.
L	Length of a stone artefact measured in mm.
Landscape character	The aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. Includes all aspects of a tract of land – built, planted and natural topographical and ecological features.
Land unit	An area of common landform, and frequently with common geology, soils and vegetation types, occurring repeatedly at similar points in the landscape over a defined region. It is a constituent part of a land system.
Landform	Any one of the various features that make up the surface of the earth.
LALC	Local Aboriginal Land Council.
LEP	Local Environmental Plan.
LGA	Local Government Area.
Management plans	Conservation plans which identify short- and long-term management strategies for all known sites recorded within a (usually approved) Activity Area.
MD	Maximum dimension of a stone artefact measured in mm.
Methodology	The procedures used to undertake an archaeological investigation.
Mitigation	To address the problem of conflict between land use and site conservation.
NPW Act 1974	*National Parks and Wildlife Act 1974.*
NPWS	National Parks and Wildlife Service.
NPW Regulation	*National Parks and Wildlife Regulation 2009.*
OEH	Office of Environment and Heritage, predecessor of the current DCCEEW in which Heritage NSW resides
Open camp site	An archaeological site situated within an open space (e.g., archaeological material located on a creek bank, in a forest, on a hill, etc.).
PAD	Potential archaeological deposit. A location considered to have a potential for subsurface archaeological material.
RAP	Registered Aboriginal Party.
Site recording	The systematic process of collecting archaeological data for an archaeological investigation.
Site	A place where past human activity is identifiable.
Survey coverage	A graphic and statistical representation of how much of an impact area was surveyed and therefore assessed.
Th	Thickness of a stone artefact measured in mm.
W	Width of a stone artefact measured in mm.

1. Introduction

1.1. Background

WaterNSW is undertaking an Aboriginal Objects Due Diligence assessment (DD) for Pindari Dam Bubble Plume project located at Nucoorima (Pindari) on the traditional lands of the Kwiambal people (here on referred to as the 'Activity Area'), (Figure 1).

Pindari Dam, constructed in 1969, has been identified as a reservoir with cold water pollution as a result of stratification, resulting in ecological impacts downstream on the Severn River. The dam has been recognised out of eight high-priority dams with cold water pollution to be most appropriate to conduct trial mitigation works involving artificial destratification through application of bubble plumes. Successful destratification and reduction of cold-water pollution at Pindari Dam would be used as a framework for remediating stratified reservoirs across the state. Pindari Dam operates in conjunction with Queensland's Glenlyon Dam to meet irrigation, stock and household water needs in the Border Rivers region (WaterNSW, 2023).

The survey has considered the proposed works, in relation to the potential for Aboriginal objects that may transpire and is all-inclusive of the entire Activity Area as presented in Figure 2 and Plate 1.

An assessment in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCWb, 2010) has been undertaken for the study in order to inform responsibilities with regards to Aboriginal cultural heritage in the area, further informing the Review of Environmental Factors(REF).

1.2. Location

Pindari Dam is located at 1627 Pindari Dam Road, Pindari (Lot 31 DP914703, Lot 1 DP1175290, Lot 1 DP232186 and Lot 1 DP810544), in the Inverell Shire Local Government Area (LGA), Parish of Egerton, County of Arrawatta. It is a sport and recreation destination situated on the Severn River about 22 kilometres upstream of Ashford and 80 kilometres north-east of Inverell, near the New South Wales/Queensland border.

The Activity Area lies within the Ashford Local Aboriginal Land Council footprint and is under the Gomeroi Peoples Native Title land claim area.

1.3. Restrictions

There are no restrictions identified regarding the information and distribution of this report.

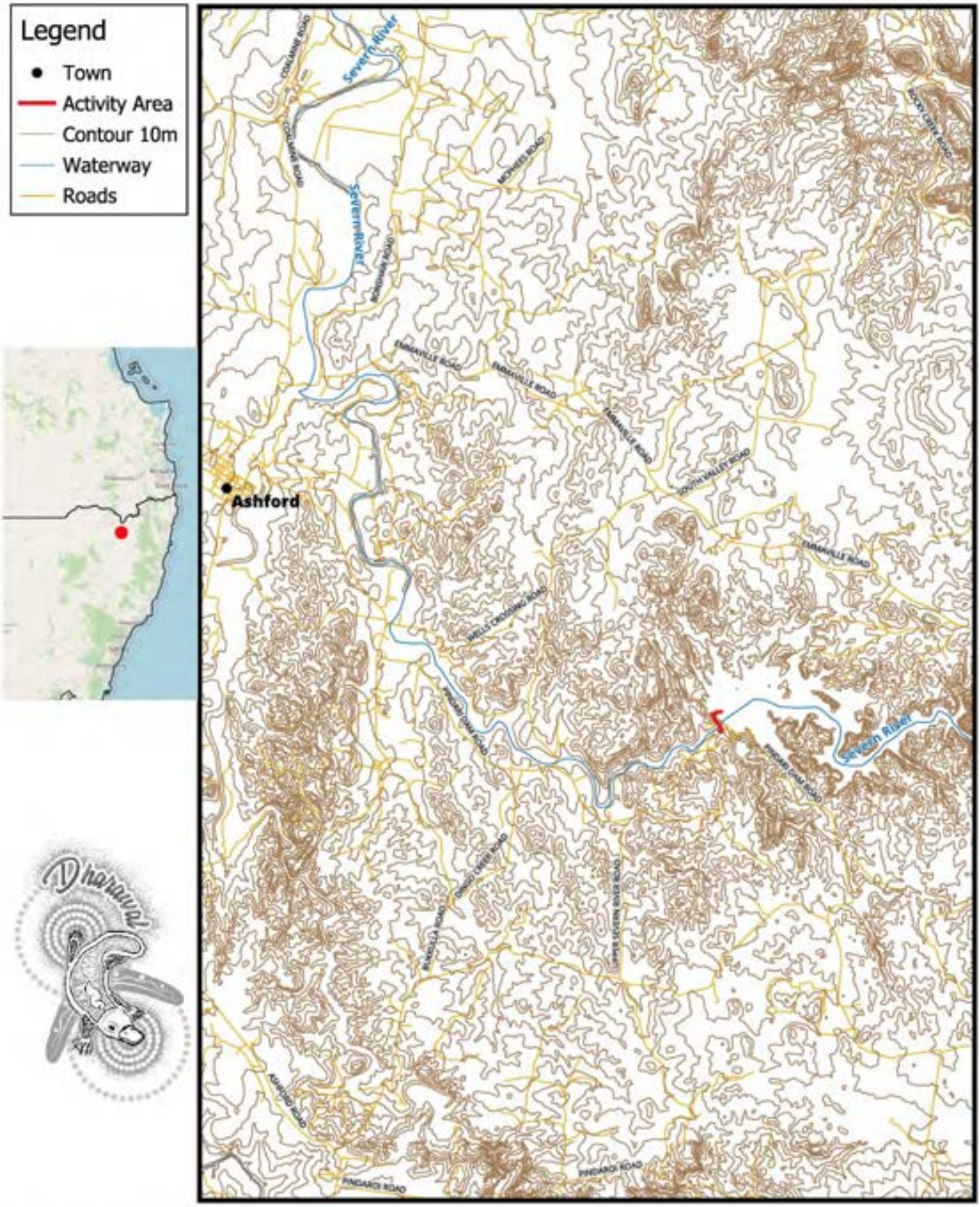


Figure 1: Regional Location of Activity Area

Project Number: 211 Pindari Dam DD
Client: WaterNSW
DEH Project Manager: Rebecca Chalker
Map Creator: K Chalker
Date 01/08/2024

0 2 4 6 8 km

Coordinate System: GDA 1994 MGA Zone 55
Imagery: Google Earth

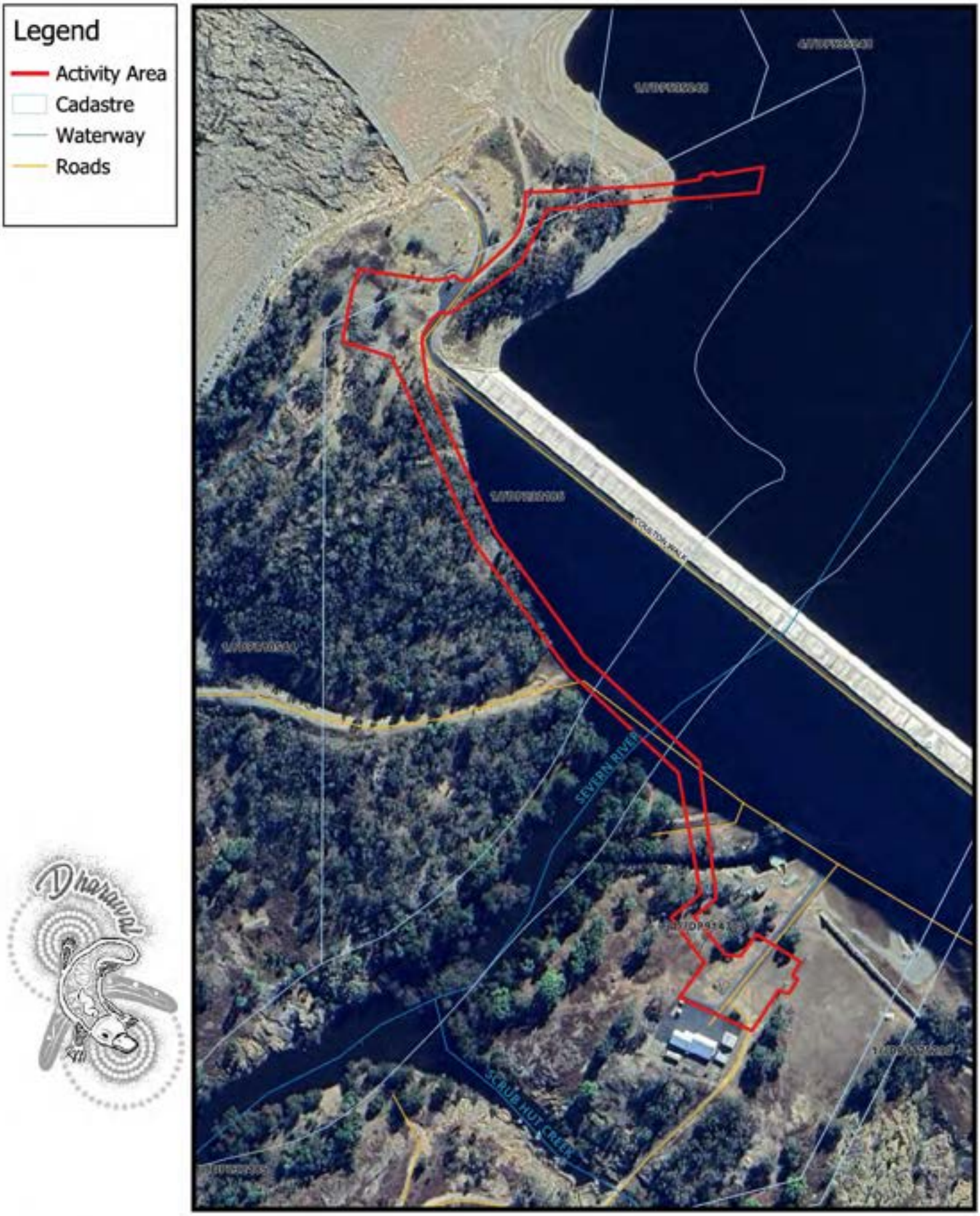


Figure 2: Location of Activity Area

Project Number: 211 Pindari Dam DD
Client: WaterNSW
DEH Project Manager: Rebecca Chalker
Map Creator: K Chalker
Date 01/08/2024

0 50 100 150 200 m

Coordinate System: GDA 1994 MGA Zone 55
Imagery: Google Earth



Plate 1: Location of Activity Area, inclusive of reservoir and previously established areas to be utilised that have no surface or subsurface disturbance (Source: WaterNSW).

1.4. Objectives

WaterNSW are undertaking the Pindari Dam Bubble Plume Project at the Activity Area (Figure 2 and Plate 2).

WaterNSW and Dharawal EH understands that the use of existing road ways and boat ramps will be utilised during the proposed works as outlined below:

Enabling works

- establishment of environmental controls, including sediment and erosion control measures
- installation of temporary fencing
- establishment of onsite water tanks, toilets, and washing facilities including site sheds, waste disposal bins and site fencing.
- installation of power generators
- establishment of concrete washout bays for construction works

- establishment of locations for stockpiling earth fill, concrete or other recyclable materials.
- survey of existing structure, abutment, surrounds and relevant underground infrastructure and;
- relocation of infrastructure which may interfere with undertaking works.

High voltage distribution line

- vegetation removal and trimming to provide clearance for construction works and safety clearances from high voltage distribution lines.
- relocate pole mounted transformer to new pole south of Pindari Power Station, and installation of two new pole mounted transformers at the proposed aerator site northeast of the Pindari Dam wall.
- up to 100 meters of trenching to accommodate installation of underground high voltage connection south of Pindari Power Station and;
- up to 550 meters of above ground high voltage distribution lines connecting the high voltage supply south of Pindari Power Station to the proposed aerator site northeast of the Pindari Dam wall, including 9 new transmission poles at 12 meters high.

Aerator construction

- excavation of footing base
- placement of reinforced concrete for aerator footing
- install power connection and;
- delivery and installation of aerator infrastructure.

Bubble plume pipeline installation

- Installation of OD180 HDPE aeration pipeline (perforated pipe) approximately 800 meters long submerged in Pindari Dam reservoir,
- The construction of protective buoys in the reservoir to prevent general public boat access during the construction period and in the future, and;
- Connection to aerator infrastructure,

Demobilisation

- testing and commissioning of new infrastructure
- removal of temporary environmental controls
- site clean-up and remove temporary fencing
- reinstate any fencing or gates
- remediation of project site and;
- carry out any final inspections and handover of the work site.

The following is a summary of the objectives of the assessment:

- Conduct background research in order to recognise any identifiable trends in site distribution and location, including a search of the Aboriginal Heritage Information System (AHIMS) and other relevant Heritage registers.

- Undertake a field assessment with members of the Aboriginal community that focuses on exposed areas and landforms that have high potential for archaeological objects and modified trees, as identified through the predictive modelling.
- Record and assess sites identified during the survey in compliance with the guidelines endorsed by Heritage NSW.
- Determine levels of archaeological and cultural significance of the Activity Area and;
- Make recommendations to mitigate and manage any cultural heritage values identified within the Activity Area.

1.5. Methodology

This DD follows the process outlined in Plate 2. The Due Diligence Flow Chart, and includes a site inspection by attendees outlined in Table 1.

All areas of ground disturbance were assessed during the field assessment.

1.6. Field Assessment Attendance

Table 1 outlines the attendance, for the field assessment component of this project, undertaken on 19 July 2024. This report was developed based on the WaterNSW field assessment results. There was no representation by Dharawal EH staff during the field assessment.

Table 1: Field assessment attendees

Date	Attendees Name	Representing	Project Role
19/06/2024	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]

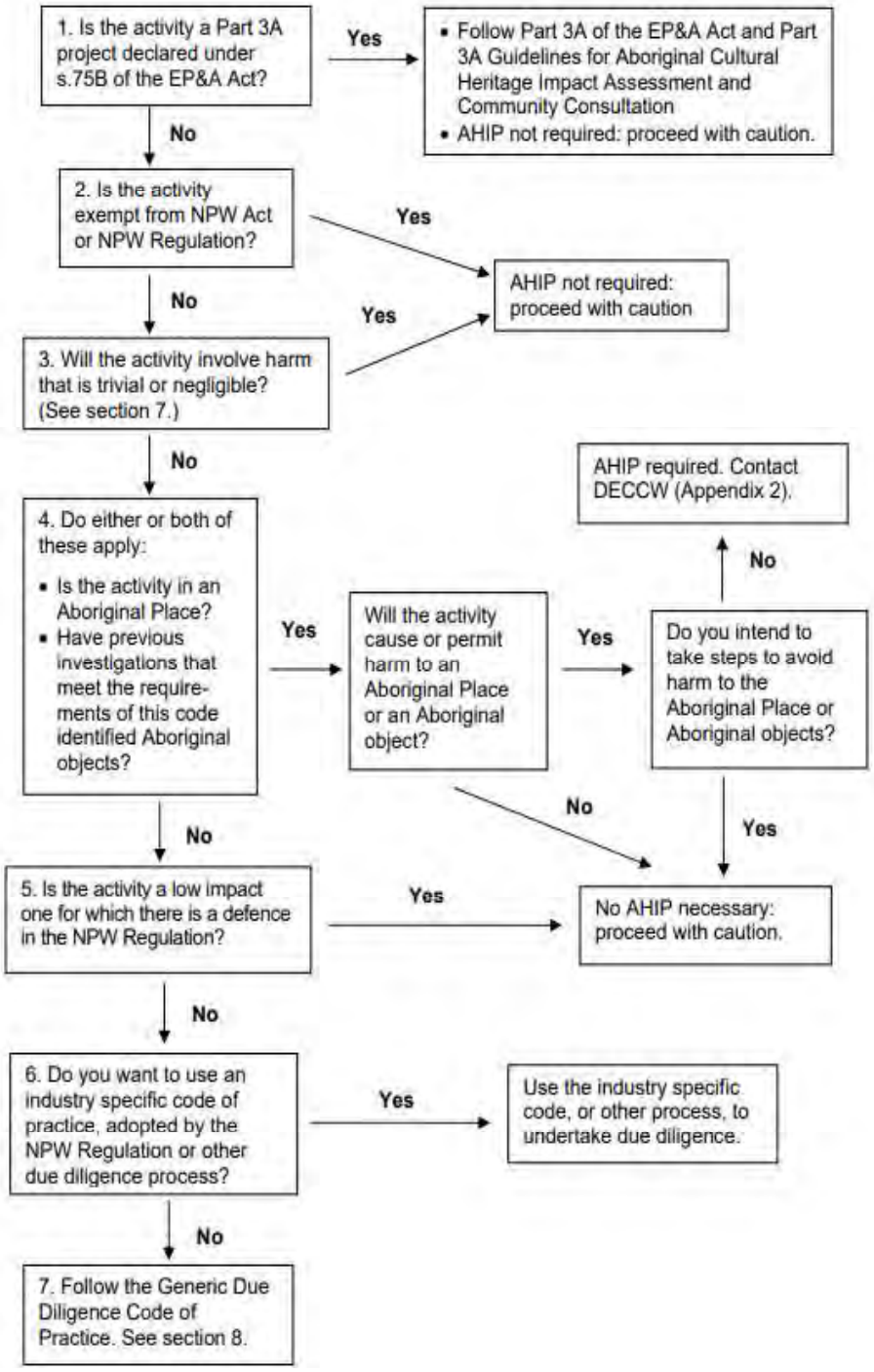


Plate 2: The Due Diligence Assessment Process Flow Chart (Source: DECCW 2010).

1.7. Statutory Controls

Table 2 below provides a summary of additional statutory controls and guidelines applicable to this assessment that are used to guide the protection and management of Aboriginal Cultural Heritage in NSW.

Table 2: Statutory Controls

Control/ Guideline	Description
The NPW Act 1974	The NPW Act, administered by Heritage NSW of the Department of Climate Change, Energy, the Environment and Water, is the primary legislation for the protection of some aspects of Aboriginal cultural heritage in NSW[1]. Part 6 of the NPW Act provides specific protection for Aboriginal objects and declared Aboriginal places by establishing offences of harm. The Act provides that a person who exercises due diligence in determining that their actions will not harm Aboriginal objects has a defence against prosecution if they later unknowingly harm an object without an Aboriginal Heritage Impact Permit (AHIP). Anyone proposing to carry out an activity that may harm an Aboriginal object or a declared Aboriginal Place must investigate, assess and report on the harm that may be caused by the activity they propose.
The Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (DECCW, 2010) (The Due Diligence Code)	The Due Diligence Code sets out a process for individuals and organisations to follow to determine whether an Aboriginal object is likely to be harmed by an activity, whether further investigation is needed, and whether an AHIP is required.
Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH, 2011).	These guidelines provide further guidance for undertaking investigation and impact assessment for Aboriginal cultural heritage in NSW.

[1] For further information visit: https://www.environment.nsw.gov.au/licences/archregulation.htm

1.8. Planning legislation

The Environmental Planning & Assessment Act, 1979

The NSW Environmental Planning and Assessment Act 1979 (The EPA Act) establishes the framework for cultural heritage values to be formally assessed in the land use planning and development consent process and requires that environmental impacts are considered prior to land development; this includes impacts on heritage items. The EPA Act also requires that local governments prepare planning instruments (such as Local Environmental Plans) in accordance with the principles of the legislation to provide guidance on the level of environmental assessment required.

Inverell Local Environmental Plan (LEP) 2023

Clause 5.10 of *the Inverell Local Environmental Plan 2023* outlines the controls for heritage conservation including the conservation of Aboriginal objects and Aboriginal places of heritage significance.

1. Aboriginal Objects Due Diligence Assessment

2.1. Is the proposed activity a low impact activity as defined by the regulation?

No.

The activity is not a low impact activity as defined under Section 58 of the National Parks and Wildlife Regulation 2019 ('the Regulation') because:

1. It involves earthworks within the Activity Area.
2. It is not listed as a low impact activity as defined under Section 58.

2.2. Will the activity disturb the ground surface or any culturally modified trees? (Step 1)

Yes.

The proposed works will disturb the ground surface.

There are no culturally modified trees in the Activity Area. The Activity will not impact any culturally modified trees.

2.3. Are there any relevant confirmed site records or other associated landscape feature information on AHIMS (or other heritage registers)? (Step 2a)

Yes.

AHIMS (Aboriginal Heritage Information Management System)

A basic and advanced search of the Aboriginal Heritage Information System (AHIMS) database was undertaken on the 31 July 2024 by Rebecca Chalker (Client ID# 915339) at Lat, Long from:- 29.4241, 151.2001 - Lat, Long To : -29.3493, 151.3237 (Appendix 1). The search results of the AHIMS database identified nine registered Aboriginal sites, and no declared Aboriginal places in or near the Activity Area. Table 3 and Figure 3 present the details and location of AHIMS sites.

Table 3: Summary of previously recorded AHIMS sites identified in the basic and extensive search.

AHIMS ID#	AHIMS Site Name	Aboriginal Site Type	Located in Activity Area	Site Status as per AHIMS search	Site Status (as per data interrogation)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

AHIMS ID#	AHIMS Site Name	Aboriginal Site Type	Located in Activity Area	Site Status as per AHIMS search	Site Status (as per data interrogation)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

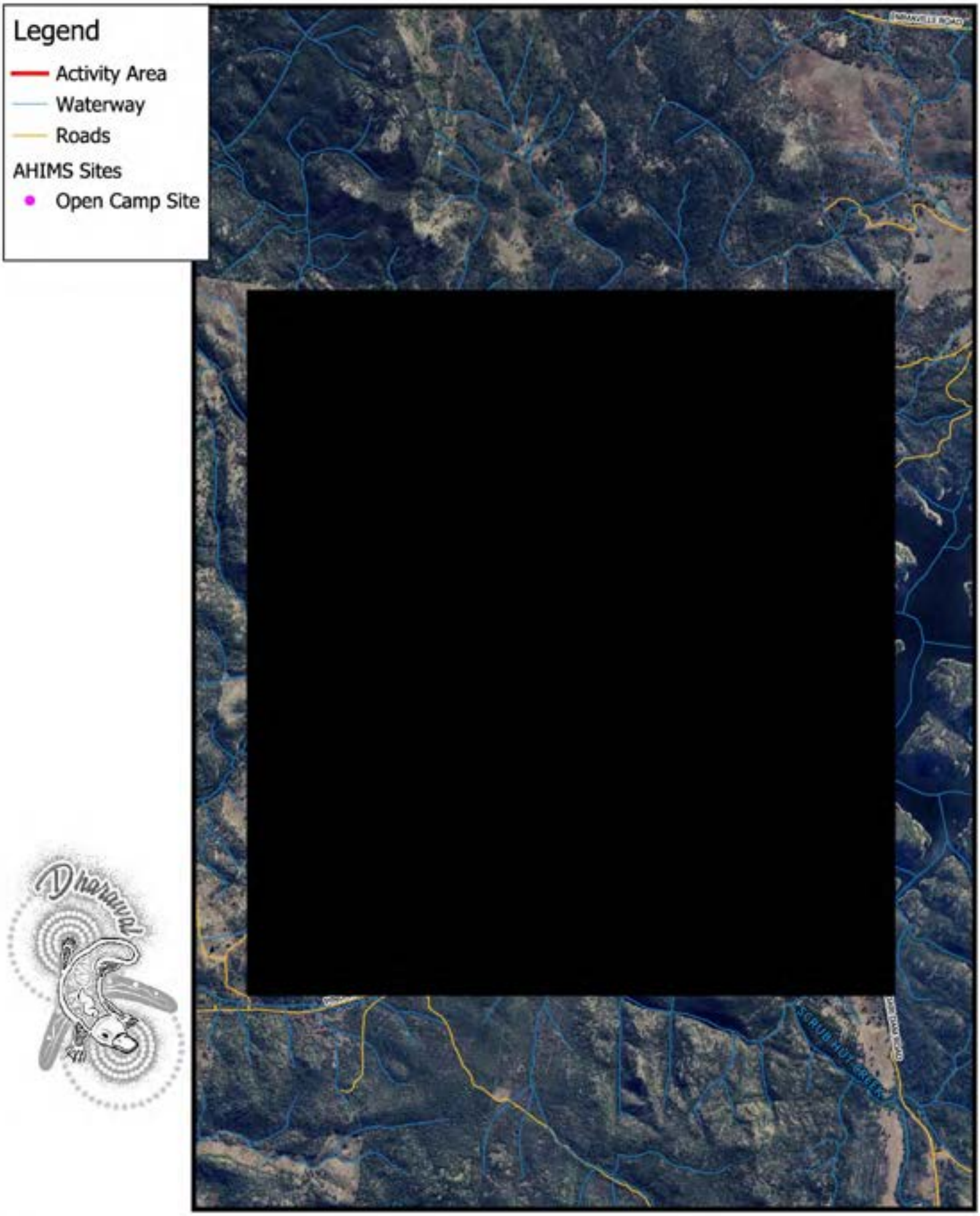


Figure 3: Location of AHIMS

Project Number: 211 Pindari Dam DD
Client: WaterNSW
DEH Project Manager: Rebecca Chalker
Map Creator: K Chalker
Date 01/08/2024

Coordinate System: GDA 1994 MGA Zone 55
Imagery: Google Earth

Due to the close vicinity of AHIMS sites with the Activity Area, data interrogation and further background research has been undertaken to confirm the location of AHIMS sites and their history in relation to the construction of the Pindari Dam infrastructure and the proposed works.

The nine recorded Aboriginal Heritage sites in the AHIMS search were all recorded as 'open camp site, site types. The following paragraphs and Table 3 above have utilised the information from previous archaeological reports associated with the Pindari dam wall extension (Haglund, 1984; Haglund, 1992).

On the 1st October 1991, a NPWS permit (Appendix 2) to carry out preliminary research was approved for AHIMS site:

- [redacted]

Following preliminary test excavation, the following conclusion and recommendations were provided for AHIMS [redacted]:

> *'As noted above, the site does not appear to be threatened by the extension of Pindari Dam. However, surface erosion will gradually expose additional artefact scatters unless the surface is allowed to revegetate.*
>
> *Note: As the site may retain areas of undisturbed archaeological deposit, neither grazing nor traffic across the site should be allowed, and visitors should be discouraged. If some traffic is necessary for the maintenance of the powerline, this should be confined to the existing track'* (Haglund, 1992, p. 28).

On the 25th October 1991, a NPWS consent to destroy and research permit (Appendix 2) was approved for the following sites:

- [redacted]
- [redacted]
- [redacted]
- [redacted]

In addition, five isolated finds with no AHIMS ID# and no confirmed locations were also approved under the consent to destroy approvals(Appendix 2):

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

The impacted AHIMS sites, and their associated site cards have been stamped (site destroyed), though this information is not reflected in the AHIMS search. Information on the salvaged artefact's location is not confirmed, and it can only be presumed that they have been stored in the Australian Museum as per the NPWS Consent to Destroy and Research Permit specific conditions (6), which specified the artefact storage to be in the Australian Museum, or at another place, designated by the museum. Impacted site cards are presented in Appendix 3.

It is acknowledged by Dharawal EH the AHIMS registered sites outlined in the previous paragraphs are not within the Activity Area, and will not be impacted by the proposed works. therefore the recommendations that are specific to these sites (Section 5) are in regard to WaterNSW future management responsibilities and are not required to be completed prior to or during the proposed works.

Figure 4 presents the AHIMS site boundaries and the current status, as per the data interrogation (Haglund, 1984).

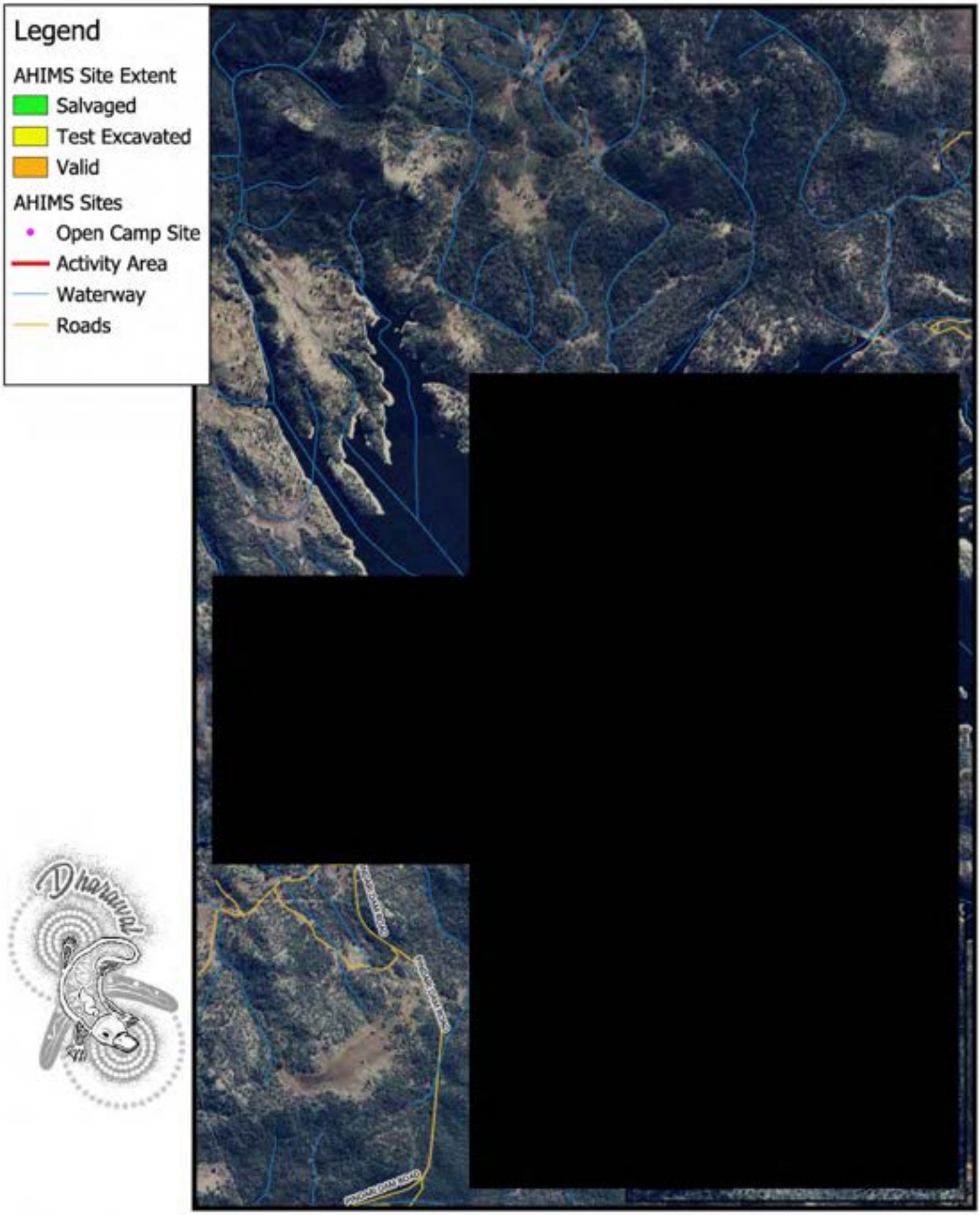


Figure 4: Location of AHIMS and Site Extent

Project Number: 211 Pindari Dam DD
Client: WaterNSW
DEH Project Manager: Rebecca Chalker
Map Creator: K Chalker
Date 01/08/2024

0 0.5 1 1.5 km

Coordinate System: GDA 1994 MGA Zone 55
Imagery: Google Earth

Additional Heritage Registers

Searches of the National Native Title Claims, Australian World Heritage Database, National Heritage List, Commonwealth Heritage List, Register of National Estate, the State Heritage Register, the State Heritage Inventory, and the Inverell Local Environmental Plan (2024) were conducted on 1 August 2024.

The searches confirmed that there is a current Native Title Claim and no historic listings. The listings identified are presented in Table 4. The Native Title Search Results are presented in detail in Appendix 4.

Table 4: Listed items in proximity to the Activity Area.

Heritage Register	Heritage items in Activity Area	Heritage listings nearby the Activity Area
National Native Title Claims	Yes NC2011/006- Gomeroi People	Yes NC2011/006- Gomeroi People
Australian World Heritage Database	N/A	N/A
National Heritage List	N/A	N/A
Commonwealth Heritage List	N/A	N/A
Register of National Estate	N/A	N/A
State Heritage Register	N/A	N/A
State Heritage Inventory	N/A	N/A
Schedule 5 of Inverell LEP	N/A	N/A

Figure 5 presents historical aerial imagery from 1975 and 1994. The 1975 historical imagery is the first aerial imagery available for this area. Viewing of historical aerial imagery in 1975 shows the construction of the Pindari Dam to already exist, though the spill way has not yet been constructed, with several AHIMS sites lying close to the edge of the water storage. Some surrounding areas appear to have been extensively cleared with vegetation remaining dominant on the steeper hillsides and ridges on the north and northeastern side of the dam storage.

1994 imagery provides a clear of overview of the construction footprint associated with the construction of the spillway and the expansion of the dam wall. This imagery has been taken following the NPWS permits to salvage and destroy on the associated AHIMS sites as presented above in this section. It also presents evidence of extensive clearing and movement of subsurface materials associated with the proposed works in the Activity Area.

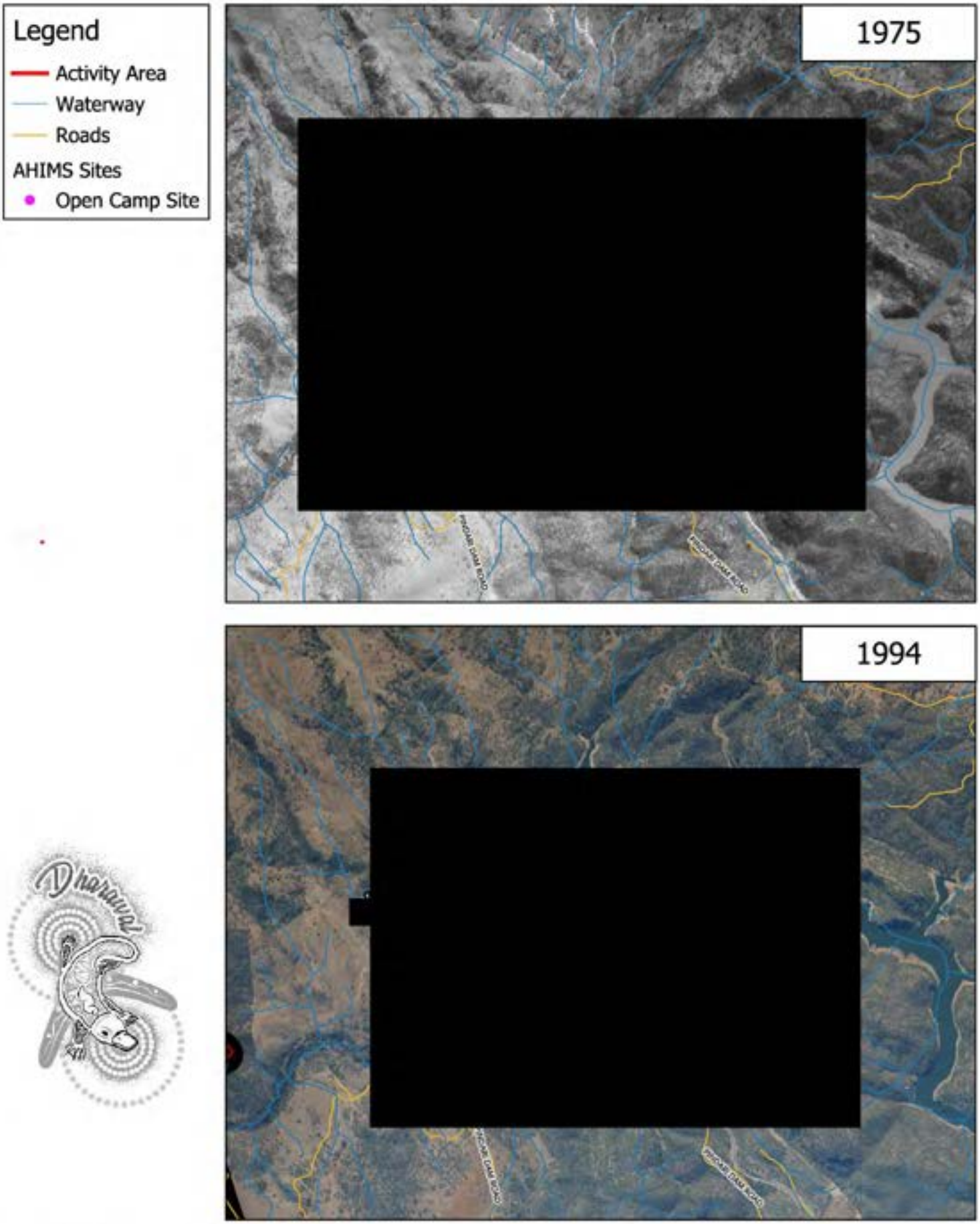


Figure 5: Historical Aerial Photographs

Project Number: 211 Pindari Dam DD
Client: WaterNSW
DEH Project Manager: Rebecca Chalker
Map Creator: K Chalker
Date 01/08/2024

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 56
Imagery: Google Earth

2.4. Are there any other sources of information of which a person is already aware? (Step 2b)

Yes.

The region is on the traditional lands of the Kwiambal people of the Gamileroi Nation and within the Gomeroi Native Title Claim boundaries.

Traditionally, the Inverell districts fertile rivers and valleys was home to several Clans of the Gomeroi nation, whose language and association gave rise to many place names in the area. Traditional lands extend as far as Moree to the Queensland border and into the Hunter River region, within the Ashford Local Aboriginal Land Council Boundaries. The Gomeroi people are extremely resourceful, with a range of resource material utilisation recorded by Parker (1909) and Mitchell (1839).

Prior to European settlement, the tablelands and adjacent slopes between Glen Innes and Inverell supported dense woodlands, which provided habitat for a broad range of plant and animal species that formed the core of Aboriginal dietary items prior to contact with early European explorers and settlers. Groups are documented as having exploited a broad range of plant species as both food and material resources, including bracken fern, orchids, tubers and lilies, kurrajong trees and the daisy yam, to mention just a few (Morris, 1999:4-6). Major water courses such as the Macintyre and Severn River as well as the many perennial creeks were also a valuable source of plant and animal food and material resources. Resources as far as the Pilliga forests are used extensively in the technology of the central west region, heavily dependent on the wood and bark fibre for use in spears, clubs, shields and boomerangs (Parker 1909). Stone tool utilisation of the region included axes, and small unspecialised flakes, though it is noted that analysis of stone tool assemblages in the region is sparse (Piper, Hill and Mazlin 2019).

Aboriginal traditional lifestyles were disrupted by the spread of European settlement by the 1840s. Following on the explorer's steps, squatters moved into the district from about 1835, establishing large sheep and cattle stations. While some squatters and their employees lived peaceably with the Aboriginal people, others were determined to exploit or eradicate the traditional way of life and the people. In June 1838 the Myall Creek massacre occurred 35km from present Inverell. This became famous in Australian history as it was the first-time white men were punished (hung) for the killing of Aboriginal people. This was not an isolated incident. Many subsequent massacres have continually gone unreported (Wiedemann 2012).

Events, as such led to a rapid decline in traditional communities as people were gradually absorbed into the pastoral workforce or forced removal from traditional lands to missions or reserves, though a strong traditional ink continues to remain to the area (Haglund, 1992).

In the region there has been several small Aboriginal reserves: one in the Nullamanna district in the 1850's, the Sevington Aboriginal Reserve at Pindari and Murroombah (or Ngoorumba, Aboriginal settlement near Tingha in the 1890s. Tingha was dismantled in 1914 and moved to Nucoorilma, which was abandoned by the 1920s. In 1938 the Toomelah Aboriginal Reserve was established, where the Aboriginal people from Ashford went to live, with most returning to Ashford over time (Haglund, 1992).

In 1982, Howell interviewed local Aboriginal people, which included details and comments relevant to the Activity Area and surrounds, including the Ashford area, noted below as presented in Haglund (1992):

> *'Regular living sites were used, on a circuit. Much time was spent along the Severn River and on Frazer's Creek. In historic time Aboriginal lived along the Severn River near the*

Emmaville turnoff and a bridge across the river, and north of Ashford righ along to Tarrangower, as well as further along the Emmaville Road at places known as Grass Trees and Thunder bolts rock (some of the places are now under Pindari Dam)'.

'Flat open ground with morning sun and near water were preferred for living sites. The 'skirts' of large trees were used for shelter in rain, particularly by old people'.

'Rafts and canoes were used where the water was wide enough and in times of flood'.

(Howell, 1982)

The lack of archaeological investigation in the area has limited the number of AHIMS recordings, though it is acknowledged that identification of Aboriginal heritage sites is growing in significance as the recognition and value of Aboriginal heritage is respectfully acknowledged. Haglund, acknowledges that longer term camping sites in the area, are most likely below the historical Pindari dam storage area, with the first stages of the dam being constructed prior to any archaeological assessments being undertaken.

Haglund (1992) identifies several sites of historical significance in the Pindari dam area:

- 11-3-003 Nucoorilma Aboriginal Cemetery
- 11-3-001 Good Food Place and mythological site
- 11-3-015 Glen Orchy Burial Ground.

Archaeological and Cultural Heritage studies in the region are limited but have presented valuable archaeological findings supported with tangible evidence of nomadic seasonal movements and continued occupation in the area (Table 5). The results indicate that, despite clearing associated with agricultural practices in the wider regional area, and the construction of the Pindari dam prior to any archaeological assessments, or Aboriginal heritage assessments, Aboriginal sites are still likely to be located on landforms next to permanent water sources (OzArk 2018), as well as other landforms identified by NSW NPWS (2002).

A summary of previous heritage assessments in the of the Activity Area are presented in Table 5, with details regarding AHIMS sites directly related to the infrastructure of the Pindari Dam presented in Section 2.3.

Table 5: Previous Archaeological studies within the region of the Activity Area.

Author and Year of Assessment	Details of Assessment
Archaeological Survey of the proposed Pindari Dam Extension and associated works (Haglund, 1984)	This survey is directly related to the extension and associated works of the Pindari Dam, therefore is significant to the Aboriginal heritage associated within the Activity Area. The assessment considered *"two kinds of Aboriginal sites, a site of traditional importance and a series of prehistoric sites"*. The reference to traditional importance refers to a mythological site (storyline)located within the Severn River, as reported by elder, Mrs Clarissa Connors of Tingha, whilst the prehistoric sites refer to visible stone artefacts. Nine open camp sites and five isolated artefacts were identified and recorded as part of the survey. This survey presented the foundation for future permits and infrastructure planning associated with AHIMS protection mitigation measures.

Author and Year of Assessment	Details of Assessment
Pindari Dam Proposed extension: Archaeological Investigation including Salvage excavation results (Haglund, 1992)	This survey is directly related to the extension and associated works and infrastrucutre of the Pindari Dam, therefore is significant to the Aboriginal heritage associated within the Activity Area. Salvage excavations were completed in accordance with an Aboriginal Heritage Impact Permit (AHIP_ prior to the dam extension over 5 days in 1991, at AHIMS sites - [redacted] In addition, test excavations for research and following management recommendations were also completed at - [redacted]
Aboriginal Cultural Heritage Assessment: White Rock Solar Farm (NGH, 2016)	This survey was undertaken as part of a State Significant Development (SSD) and lies 48 km southeast of the Activity Area. No Aboriginal objects were identified during the survey, though it was noted that not all mature trees were inspected, and the survey had limitations of visibility, therefore not all landforms were able to be assessed, and no further archaeological investigations were undertaken. The survey is significant to the regional archaeology as it lies within a cultural significant network of water ways across the region, being identified as areas of cultural sensitivity, though does not lie within 200 metres of a waterway and was not assessed in its entirety.

2.5. Are there any landscape features that are likely to indicate the presence of Aboriginal objects? (Step 2c)

Yes

The following landscape features listed in the Due Diligence Code signify a high potential for the presence of Aboriginal objects:

- Within 200 m of waters, or
- Located within a sand dune system, or
- Located on a ridge top, ridge line or headland, or
- Located within 200 m below or above a cliff face, or
- Within 20 m of or in a cave, rock shelter, or a cave mouth.

The Activity Area is associated within 200 m of waters and lies on the Severn River directly below the historically established Pindari Dam Wall. The Severn River is a tributary to the Macintyre River, which drains the southern of two major catchments within the Borders Rivers basin. The basin contributes to the Murray Darling catchments/River systems.

The upper basin contains several landforms, including mountains and rugged hills, which form deeply incised streams in the Great Dividing Range to the east. In the western hills and slopes the landform is more undulating. The Activity Area lies between these two distinct landforms. The Activity Area lies on an area where the river is flanked by an increase of extensive alluvial flats and gentle foot slopes, providing an ideal landscape for traditional camping. The present dam water storage covers up to 30 metres of the original landform, as discussed by Haglund (1992) would cover most of the landforms used for traditional occupation and resource gathering.

Figure 6 presents the soil landscapes and hydrology associated with the Activity Area. Soil data in the region was limited to raster layers and is presented as being 65% accurate. The limitation with the available data means that the soil overlay is unable to provide transparency, limiting the landscape features and associated imagery from being shown in Figure 6. Despite this limitation, all other presentable features (AHIMS, Water and Activity Area) are visible.

The underlying geological formations of the Activity Area and surrounds are dominated by Permian intrusive and extrusive porphyries and porphyrites. Undifferentiated granites, mudstones, lithic sandstones, hornfels, pebbly conglomerate and ash flow tuff, tertiary basalt and dolerite all occur in the area (Haglund, 1992). Several of these geological rock formations were commonly used by people for stone tool manufacturing.

The Rudosols soil landscape is associated with the Activity Area. The landscape according to Haglund (1992) contains rocky outcrops, with lithosols common on steep slopes and rocky crests. Downslopes the soils are dominated by hard setting loamy materials, with mottled yellow clayey subsoils. Erosion from grazing and clearing activities has occurred in the local area, which in turn has effect on the ability for archaeological evidence to retain traditional context.

The archaeological characteristics and potential of an area are additionally defined through a range of factors, including the availability of past resources, stability of the soil matrix, underlying geology and land use history. The potential for in-situ Aboriginal objects is lower on land that has been disturbed by more recent European land use. The Activity Area has been modified during historical and recent times, as demonstrated through historical aerial imagery (Figure 5) and confirmed during the field assessment.

Considering the extensive historical disturbance associated with the construction of the dam wall, and the previous Aboriginal Cultural Heritage Assessments and associated AHIPs and salvage excavations, there is low archaeological potential in the Activity Area.

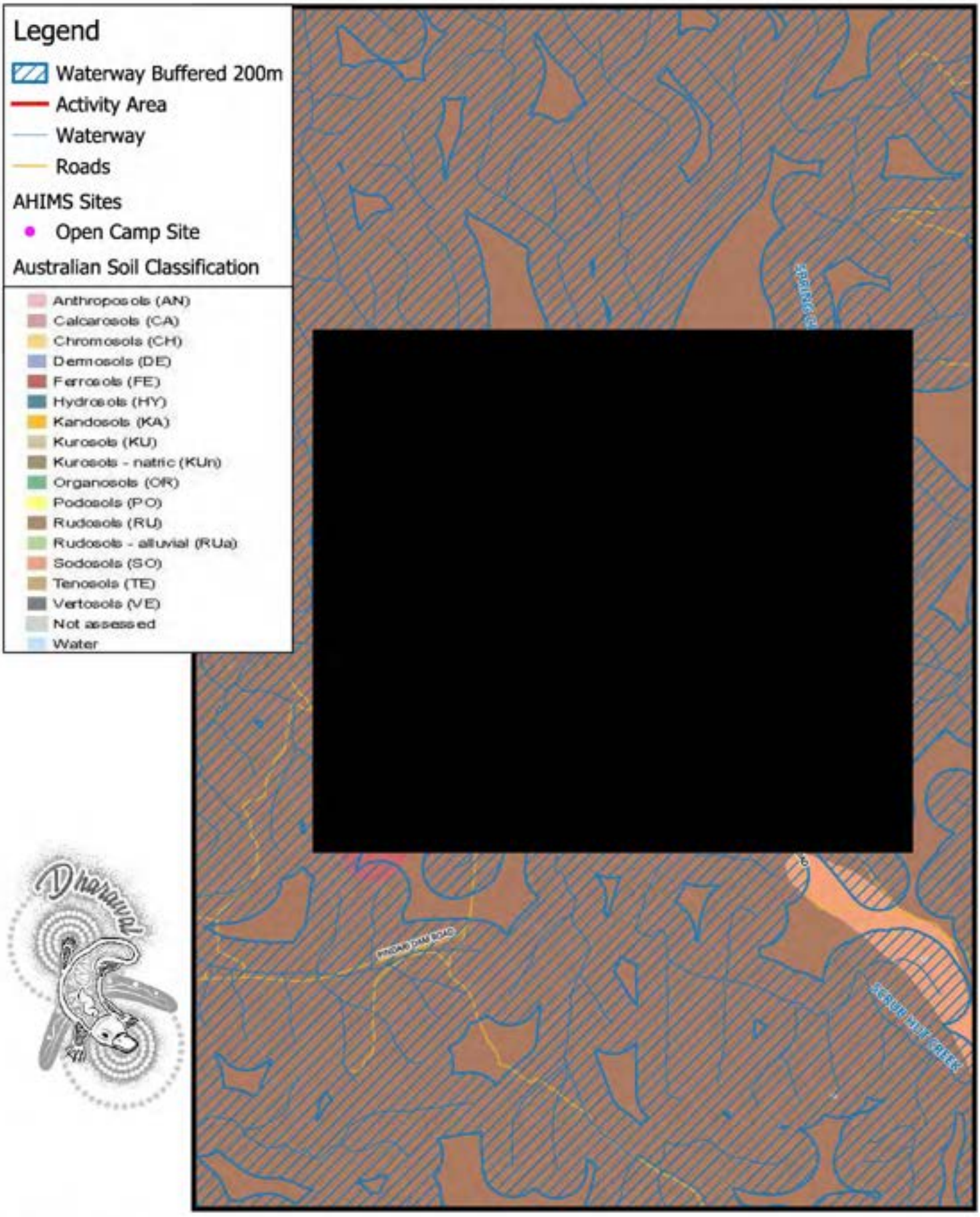


Figure 6: Soil Landscapes and hydrology in the Local Area

Project Number: 211 Pindari Dam DD
Client: WaterNSW
DEH Project Manager: Rebecca Chalker
Map Creator: K Chalker
Date 01/08/2024

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 55
Imagery: Google Earth

2.6. Can the harm or the activity be avoided? (Step 3)

Not applicable.

There is no harm to any Aboriginal objects associated with the proposed works in the Activity Area.

2.7. Does a desktop assessment and site inspection confirm that there are Aboriginal Objects or that they are likely? (Step 4)

No.

The desktop assessment, using available information such as AHIMS search results, relevant archaeological reports and landscape features identified the requirement to undertake a visual site assessment to determine the archaeological potential for Aboriginal objects to occur, and confirm the location of previously recorded AHIMS sites associated with the Activity Area.

A site assessment of the Activity Area was undertaken on 19th July 2024, and was inclusive of all areas of ground disturbance within the Activity Area. Details and results of the site inspection are presented in Section 3 of this report.

2.8. Further Investigations and Impact Assessment (Step 5)

No.

On the basis of this assessment, it has been determined that no further archaeological assessment is required for the for the proposed works in the Activity Area, due to significant historical ground disturbance during the construction of the dam wall and associated infrastructure.

3. Site Assessment Details

The field assessment followed the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (*2010) guidelines on the 19 July 2024.

No Aboriginal objects were identified during the field assessment in the Activity Area, details are provided in section 3.1.

3.1. Survey Results and Discussion

The survey was conducted on foot in the Activity Area and concentrated on the immediate vicinity of construction and laydown areas. Visibility was high and clear the Activity Area has been highly disturbed historically and there visually appears to be no existing natural surface and subsurface materials present

No Aboriginal Heritage sites were identified during the field assessment in the Activity Area. with details provided below.

Overview

The Activity Area lies to the west, directly below the water catchment storage area of the Pindari Dam wall on the Severn River, also known historically as Lake Pindari.

Landforms

Landforms across the Activity Area are historically disturbed but remain consistent with the hillslopes associated with dam wall construction.

Visibility

Visibility was between 80 to 100% across the entire Activity Area, providing evidence of high disturbance during construction of the Pindari dam and associated infrastructure.

Exposures

Exposures in the Activity Area were less than 5%, with exposures limited to small erosional washouts in the northwest section of the Activity Area.

Soils

The level of disturbance is high due to the construction of the dam and dam wall and roads, with an estimated 90% introduced materials.

Vegetation

The vegetation in the Activity Area has been introduced and planted by WaterNSW staff.

Survey limitations.

The Activity Area lie in pre-disturbed areas due to the construction of the dam and dam wall; rocks and vegetation has been introduced, removal of natural layers of soil and vegetation, previous blasting and excavations make it difficult to identify any sites or objects.

Photographic record

Plate 3 to Plate 10 present the photographic record of the field assessment and Activity Area locations.



Plate 3: Overview of 100% visibility from the northeast section of the Activity Area, showing disturbance and introduced vegetation, facing east.



Plate 4: Overview of 100% visibility, showing dam bank disturbance, facing northwest.



Plate 5: Overview of clear visibility and historical native regrowth in the Activity Area, facing south.



Plate 6: Overview of 100% visibility, showing dam bank disturbance, facing north.



Plate 7: Overview of historically constructed Dam wall, below the catchment area, facing northeast.



Plate 8: Overview of historically constructed dam infrastructure, facing west.



Plate 9: Overview of the Activity Area, facing south.



Plate 10: Overview of the northwest section of the Activity Area, facing west.

4. Conclusion

The archaeological field survey of the Activity Area was undertaken on the 19 July 2024 assessed for archaeological evidence and potential.

No Aboriginal Heritage sites were identified during the field assessment in the Activity Area.

Due to the extensive historical disturbance associated with the construction of the dam wall and associated infrastructure, and considering previous archaeological investigations, there is low potential for Aboriginal Objects to remain in the Activity Area.

5. Recommendations

The following management recommendations have been developed relevant to the Activity Area and influenced by:

- Predicted impacts to Aboriginal cultural heritage.
- The planning approvals framework.
- Current best conservation practice, widely considered to include:
    - *The Australian ICOMOS Burra Charter* (2020).
    - *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (*2010).

Prior to any impacts occurring within the Activity Area, the following is recommended:

Recommendation 1: Aboriginal Community Monitoring Recommendation

During the field assessment, Aboriginal community representatives, requested that during the groundbreaking components of the project, an Aboriginal community representative is required to be present.

Recommendation 2: No further archaeological assessment is required in the Activity Area.

Following the Aboriginal object due diligence desktop review and field assessment observations, and Recommendation 1, no further archaeological assessment is required in the Activity Area in regard to the proposed project.

Recommendation 3: Site Awareness Induction.

Prior to initiation of works in the Activity Area, all site workers should undertake a site awareness training, inclusive of the history of AHIMS sites associated with the Pindari Dam wall infrastructure.

Recommendation 4: Discovery of Unanticipated Aboriginal Objects

All Aboriginal objects and Places are protected under the NPW Act. It is an offence to knowingly disturb an Aboriginal object or Place without consent permit issued by the Department of Climate Change, Energy, Environment and Water (DCCEEW) under the NPW Act 1974. Should any Aboriginal objects be encountered during works associated with this assessment proposal, works must cease immediately, and the find should not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object, the archaeologist will provide further recommendations. These may include notifying the DCCEEW and Aboriginal Stakeholders.

Recommendation 5: Discovery of Aboriginal Ancestral remains.

Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity, you must:

1. Immediately cease all work at that location, and no further movement or disturbance of the remains and with a buffer of at least 20 metres, to avoid further harm.
2. Refer to and follow the Water NSW unexpected finds procedure (Appendix 5)
3. Notify the NSW Police and DCCEEW Environmental line on 131555, as soon as practicable and provide details of the remains and their location.
4. Not recommence work at that location unless authorised.

Follow up Recommendations:

AHIMS registered sites outlined below in recommendation 6 and 7 are not within the Activity Area, and will not be impacted by the proposed works, therefore these recommendations are in regard to WaterNSW future management responsibilities and are not required to be completed prior to or during the proposed works.

Recommendation 6: Site cards should be updated

The following Aboriginal Heritage Information Management System (AHIMS) site cards should be updated, within six months of the project's completion to reflect the current information available in Section 2.3 of this report,:

- [redacted]

Recommendation 7: Confirmation of AHIMS site preservation

The following AHIMS site should be assessed to confirm that the preservation and protection is being adhered to as per the recommendations noted in Section 2.3 of this report, and update the site card if necessary, within six months of the project's completion:

- [redacted]

6. References

DECCWa. (2010). *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW.* Sydney: Department of Environment, Climate Change and Water. Retrieved from https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Aboriginal-cultural-heritage/code-of-practice-for-archaeological-investigation-of-aboriginal-objects-100783.pdf

DECCWb. (2010). *Due Dilligence Code of Practice for the Protection of Aboriginal Objects in New South Wales.* Sydney: Department of Environment, Climate Change and Water. Retrieved from https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Aboriginal-cultural-heritage/due-diligence-code-of-practice-aboriginal-objects-protection-100798.pdf

DECCWb. (2010). *Due Dilligence Code of Practice for the Protection of Aboriginal Objects in New South Wales.* Sydney: Department of Environment, Climate Change and Water. Retrieved from https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Aboriginal-cultural-heritage/due-diligence-code-of-practice-aboriginal-objects-protection-100798.pdf

Haglund, L. (1984). *Archaeology survey of the proposed Pindari Dam Extension and associated works.* Balmain: Haglund and Associated for Water Resources Commission of New South Wales.

Haglund, L. (1992). *Pindari Dam: Proposed Extension, Archaeological Investigations including salvage excavation of NPWS 11-3-17+PD2 NPWS 11-3-18+PD3 and some collection of 11-3-16+PD1.* Balmain: Haglund and Associates for Water Resources Commission of NSW.

Howell, R. (1982). *History and culture of the Aboriginal people of the Ashford district.* Government Printer.

Mitchell, T. l. (1839). *Three Expeditions into the Interior of Eastern Australia.* London: T. and W. Boone.

NGH. (2016). *Aboriginal Cultural Heritage Assessment: White Rock Solar Farm.* Ngh Environmental.

NSW NPWS. (2002). *Aboriginal Cultural Heritage Assessment: Brigalow Belt South, Stage 2, NSW Western Regional Assessments.* Sydney: NSW National Parks and Wildlife Service. Retrieved from https://www.environment.nsw.gov.au/resources/forestagreements/wra18.pdf

OzArk . (2018). *Newell Highway Heavy Duty Pavements, Narrabri to Moree: Aboriginal and historic archaeological survey report.* Roads and Maritime Services.

OzArk. (2018). *Aboriginal Cultural Heritage Assessment Report: Yarrabee Solar Project.* Dubbo: OzArk forSLR Consulting Australia Pty Ltd.

Parker, K. (1909). *The Euahlayi Tribe: A Study of Aboriginal Life in Australia.* Archibald Constable: London.

Piper, A., Hill, T., & Mazlin, R. (2019). *Baiada Poultry Pty Ltd 'Oakburn' Processing Facility Tamworth, NSW: Aboriginal Cultural Heritage Assessment.* Brisbane: Everick Heritage Pty Ltd unpublished report prepared for Baiada Poultry Pty Ltd.

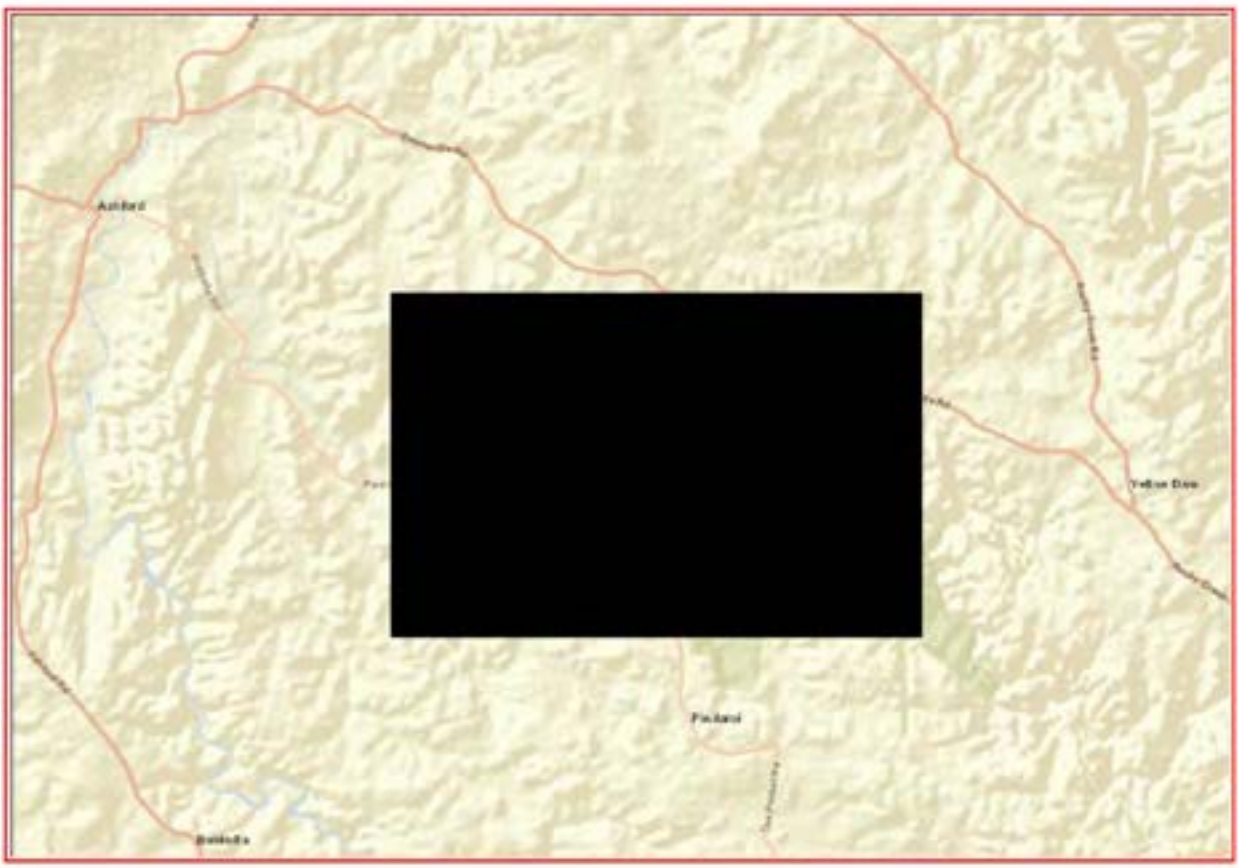
Water NSW. (2023). *Water NSW Reconciliation Action Plan.* Water NSW. Retrieved from https://www.waternsw.com.au/__data/assets/pdf_file/0006/218679/WaterNSW_Reflect_RAP_2022.pdf

Wiedemann, E. (2012). *Historical Notes from State Heritage Inventory*. Retrieved July 10, 2023, from State Heritage Inventory: https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=1820411

Appendix 1: AHIMS Basic and Extensive Search Results

AHIMS Web Services (AWS)
Search Result

[redacted]



[redacted]

AHIMS Web Services (AWS)

Extensive search - Site list report

[redacted]

[redacted] Status

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 31/07/2024 for Rebecca Chalker for the following area at Lat, Long From : -29.4241, 151.2001 - Lat, Long To : -29.3493, 151.3237. Number of Aboriginal sites and [redacted] Heritage NSW and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

Appendix 2: Previous AHIP approvals

APPENDIX A:
NPWS CONSENT TO DESTROY AND RESEARCH PERMIT

NATIONAL PARKS
AND
WILDLIFE SERVICE

NATIONAL PARKS AND WILDLIFE ACT 1974
SECTIONS 86, 87 AND 90

CONSENT AND PERMIT TO SALVAGE

CONSENT TO CARRY OUT THE DESTRUCTION OF AN ABORIGINAL RELIC/PLACE AND PERMIT TO COLLECT AND/OR EXCAVATE FOR THE PURPOSE OF SALVAGE

WHEREAS the Aboriginal relics described in Schedule "A" are situated upon the land described in Schedule "B", and constitute relics within the meaning of Section 90 of the National Parks and Wildlife Act 1974, and WHEREAS application has been made by:

Mr Mark Lau,

of:

Dept Water Resources
PO Box 3720
Parramatta NSW 2150

for CONSENT to destroy those relics in the course of:

enlargement of the Pindari Dam

NOW I, William J. Gillooly Director of National Parks and Wildlife, in pursuance of Section 90 of the said Act, and subject to the conditions hereunder set out DO HEREBY CONSENT to the destruction of the said relics by the said applicant, AND FURTHER, in accordance with the said Conditions and in pursuance of Section 87 of the said Act, I DO HEREBY PERMIT the salvage collection and/or excavation of the said relics from the aforesaid land, prior to destruction of the relics, by Dr. Laila Haglund the qualified person named in the said conditions.

TERMS AND CONDITIONS OF THIS CONSENT

This Consent is issued subject to General Terms and Conditions covering all archaeological Permits and Consents, as well as the Specific Terms and Conditions pertaining to Consents to destroy Aboriginal relics all of which conditions are detailed in the attached pages.

DATED at Sydney this 25th day of October, 19 7.

H Clemens

for Director of National Parks and Wildlife

SCHEDULE A:

	Site No.
Sites NPWS 11-3-17	2
NPWS 11-3-18	3
NPWS 11-3-20	5
NPWS 11-3-21	6

Isolated finds: IF 1 to 5, in Report NPWS C-829
(Dr. L. Haglund, 1984, p17).

Permit for the salvage (excavation/collection) to apply to sites NPWS 11-3-17 and 11-3-18

SCHEDULE B:

NPWS 11-3-17	32905 E	674737 N
NPWS 11-3-18	33095 E	674815 N
NPWS 11-3-20	33168 E	674888 N
NPWS 11-3-21	33207 E	674868 N

Isolated finds; within the Pindari Dam pool,
as shown on attached map, edged in red.

SPECIAL CONDITIONS APPLYING TO CONSENT AND PERMIT TO SALVAGE

1. A specific objective of the salvage of sites 11-3-17 and 11-3-18, is to carry out an anlaysis of inter and intra site variability in this area. The sample recovered should reflect the requirements of statistical analysis appropriate to this objective.

2. A report of the excavation/collection will be submitted to the National Parks and Wildlife Service, not later than six months after the start of the work.

SPECIFIC CONDITIONS APPLYING TO CONSENT AND PERMIT TO SALVAGE

1. The Consent covers only those relics described in the instrument of Consent and in any Schedules thereto.

2. In the case of Consents granted to cover development activities, the Consent is granted to cover only those circumstances described in the Schedules, and subject to there not being discovered in the course of further operations, in the progress of that development requiring the Consent, any other relics which will be damaged or destroyed by the continuation of the operation. (Destruction of such relics would require the granting of a separate Consent).

3. The Consent is conditional upon all relevant development approvals having been obtained.

4. Should the relics listed in Schedule 'A' above remain in existence two (2) years from the date of this document, the Consent shall be deemed to be void, and any further damage to the relics will require the preparaton of a new Consent document.

5. Prior to the Consent becoming effective, the relics described in the Schedules must be salvaged, following the guidelines attached. The salvage work is to be carried out by Dr. Laila Haglund, who is a qualified person, competent to undertake this work.

6. Any Aboriginal relics recovered, being the property of the Crown, shall be deposited at The Australian Museum, or at another place, designated by the Museum, after these relics have been fully examined, or before a period of two years from the date of expiration of the Permit or any renewal thereof, whichever occurs first.

7. Should any 'relic', defined under the Heritage Act of NSW be uncovered, then excavation or disturbance of that area is to stop immediately and the Heritage Council of NSW is to be informed in accordance with S.146 of the Heritage Act, 1977 (as amended).

Historic Archaeologists of the Heritage Council can be contacted on

(02) 266 7111
(02) 266 7265
(02) 266 7267
(02) 266 7248

'relic' is defined as any deposit, object or material evidence-

(a) which relates to the settlement of the area that comprises NSW, not being Aboriginal settlement; and

(b) which is 50 or more years old.

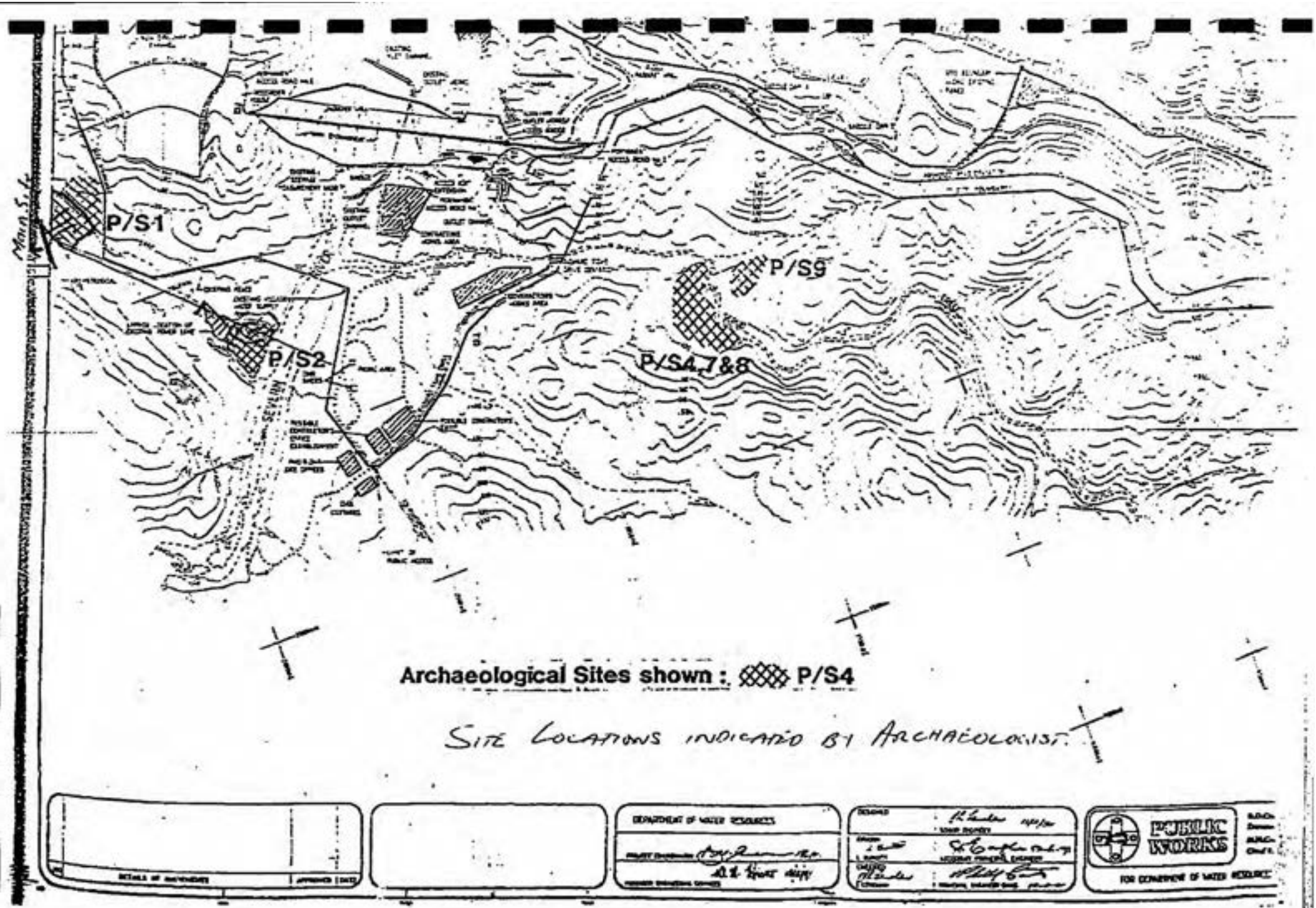
The holder of the Permit shall furnish the National Parks and Wildlife Service with a report at the completion of the salvage work or expiry of the Permit or any renewal thereof, or as specified in the guidelines, whichever occurs first. Such report shall include:

- a complete list of all material recovered;

- a detailed description of the methods of excavation/collection and analysis used;

- a detailed plan of the site, including the location of collection areas, all trenches, auger holes and spoil heaps;

- summary of consultation undertaken with relevant Local Aboriginal Land Councils or relevant Aboriginal Community Groups.



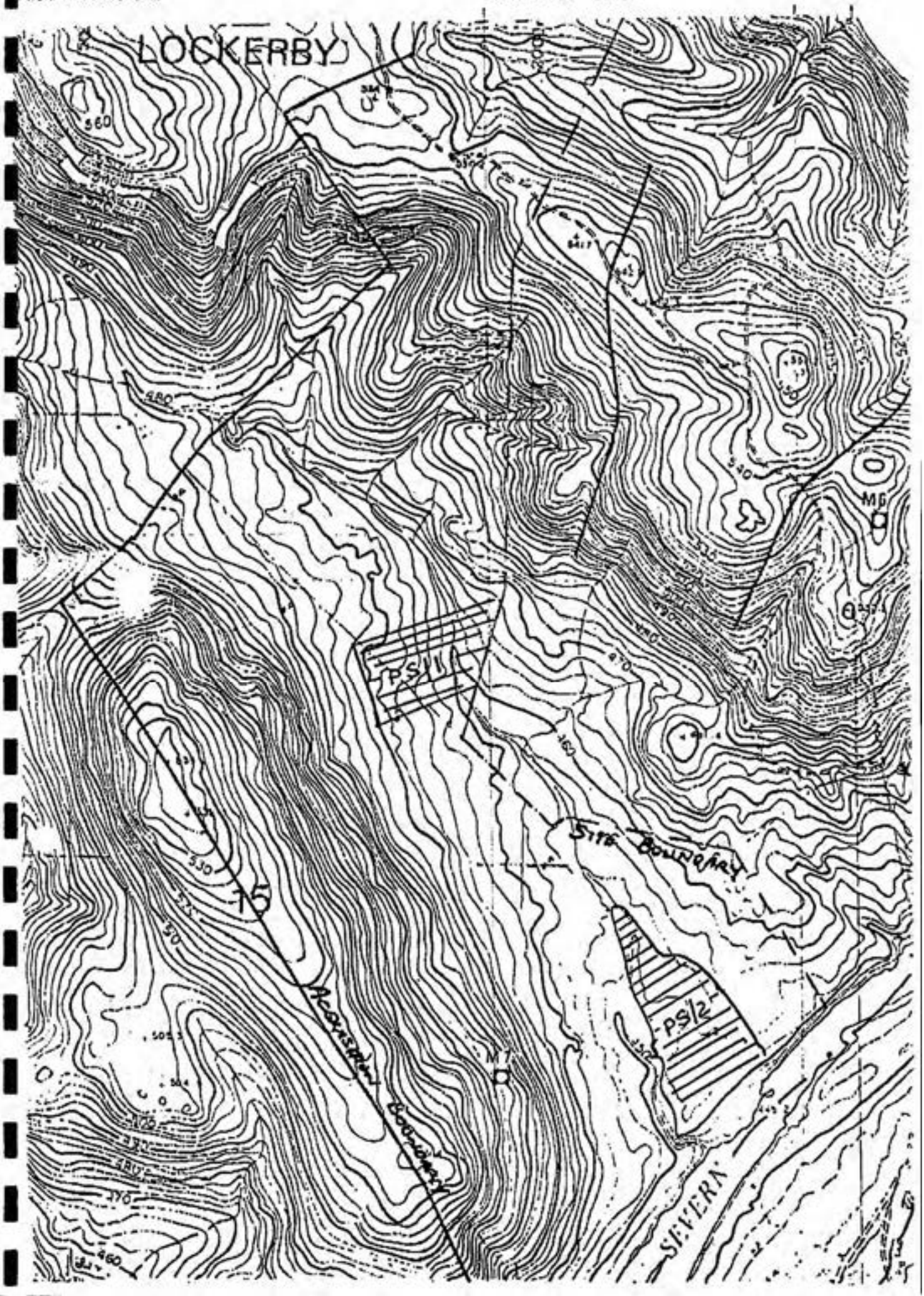
Archaeological Sites shown : P/S4

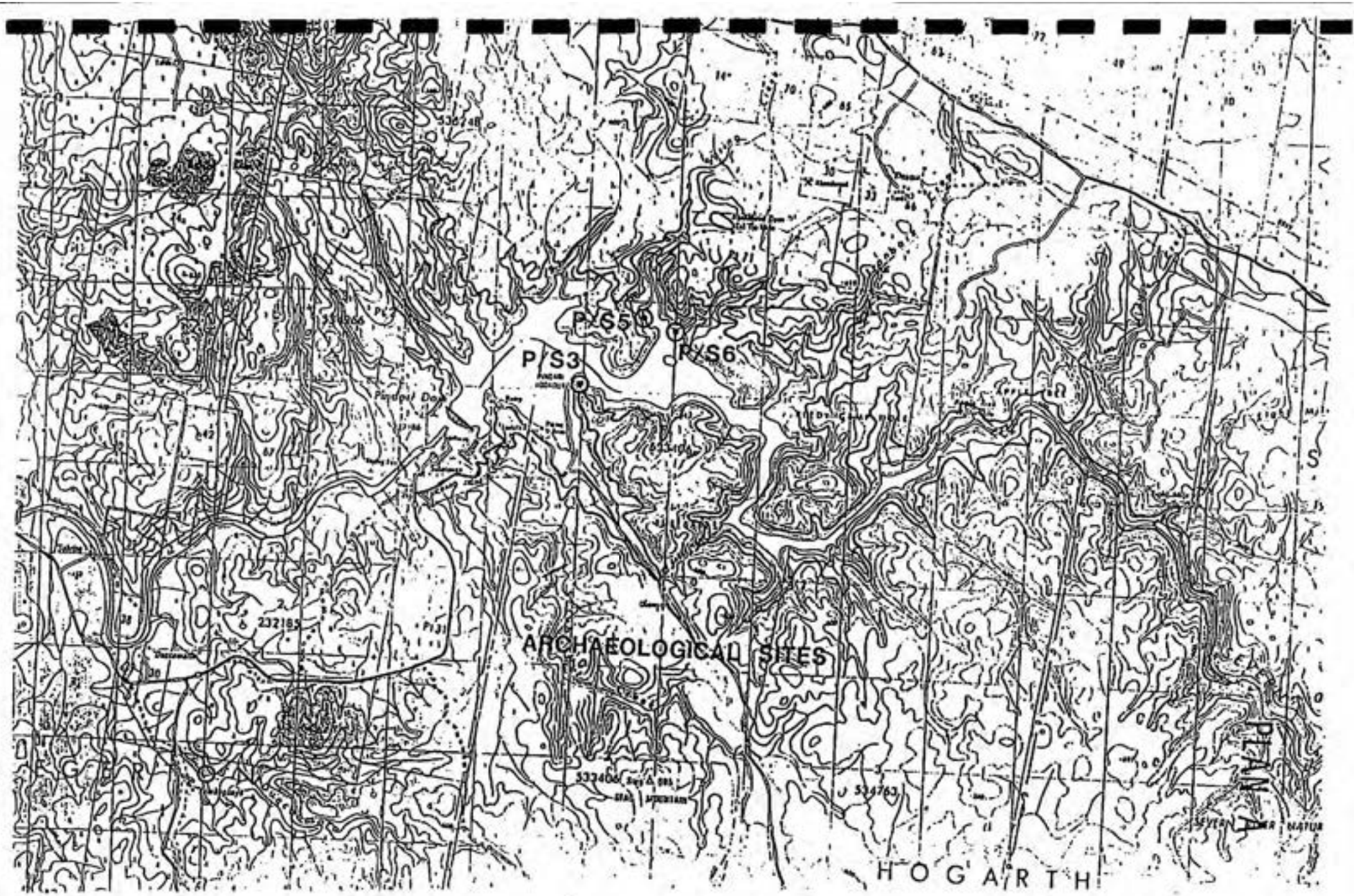
SITE LOCATIONS INDICATED BY ARCHAEOLOGIST.

DEPARTMENT OF WATER RESOURCES

PUBLIC WORKS

FOR CONSERVATION OF WATER RESOURCES


LOCKERBY
PS/1
PS/2
SITE BOUNDARY
ACCESS ROAD BOUNDARY
SEVERN


P/S5
P/S6
P/S3
ARCHAEOLOGICAL SITES
HOGARTH

NATIONAL PARKS AND WILDLIFE SERVICE

NATIONAL PARKS AND WILDLIFE ACT 1974
SECTION 87 (1)

P E R M I T

PERMIT TO CARRY OUT PRELIMINARY RESEARCH

PERMIT ISSUED TO: Dr. Laila Haglund

of

1 Cameron Street
Balmain NSW 2041

AUTHORITY is hereby given for the person named above to conduct an archaeological survey for preliminary research to record Aboriginal art, collect material for analysis, conduct small test excavations, or other activities as specified under Section 86 of the National Parks and Wildlife Act 1974.

AREA COVERED by Permit for purpose as named above:

the site registered as NPWS 11-3-16, located in Por. 2 Parish Egerton, County Arrawatta, at AMG 32864 E 674798 N

TERM OF PERMIT: Commences - 1st October 1991
Expires - 1st January 1992

REPORTS DUE: 1st March 1992

TERMS AND CONDITIONS OF THIS PERMIT

This Permit is issued subject to General Terms and Conditions covering all archaeological Permits and Consents, as well as those Specific Terms and Conditions pertaining to each type of Permit. Both are detailed in the attached pages. This Permit is also issued subject to any Special Conditions determined by the Director, which appear hereunder:

Special Conditions:
No special conditions.

R. Clemens
29.10.91
for ~~Issued by~~ the Director of
National Parks and Wildlife

SPECIFIC CONDITIONS APPLYING TO PRELIMINARY RESEARCH PERMITS

1. All areas recorded or test-excavated are to be left in a condition satisfactory to the National Parks and Wildlife Service, immediately after the completion of the recording or test-excavation.

2. A report on the result of the preliminary research shall be furnished to the National parks and Wildlife Service within three months of the expiry of the permit, or any renewal thereof.

3. This report shall include:

   - outline of the aims of the research;
   - a detailed description of the method of excavation/collection/recording andanalysis;
   - a complete list of all material recovered;
   - a detailed plan of sites excavated/collected including the location of all trenches, auger holes and spoil heaps;
   - National Parks and Wildlife Service site forms for all sites found. These must include 1:250,000 scale and either 1:25,000 or 1:100,000 scale map reference;
   - the report must include a summary of consultation undertaken with relevant Aboriginal Land Councils or relevant Aboriginal Community Groups.
   - the permit holder shall also furnish the National parks and Wildlife Service with a report written without archaeological terminology, which would be available to relevant Aboriginal Land Councils or relevant Aboriginal Community Groups.

4. All areas excavated are to be backfilled during the same field season, unless reasons acceptable to the Director are presented for a variance in this procedure.

5. Any Aboriginal relics recovered, being the property of the Crown, shall be deposited at The Australian Museum, or at another place, designated by the Museum, after these relics have been fully examined, or before a period of five years from the date of expiration of the permit or any renewal thereof, whichever occurs sooner.

6. Should any 'relic', defined under the Heritage Act of NSW be uncovered, then excavation or disturbance of that area is to stop immediately and the Heritage Council of NSW is to be informed in accordance with S.146 of the Heritage Act, 1977 (as amended).

Historical Archaeologists of the Heritage Council can be contacted on

(02) 266 7111
(02) 266 7265
(02) 266 7267
(02) 266 7248

'relic' is defined as any deposit, object of material evidence-

(a) which relates to the settlement of the area that comprises NSW, not being Aboriginal settlement; and

(b) which is 50 or more years old.

Appendix 3: AHIMS Site Cards



National Parks and Wildlife Service

BOX N189, GROSVENOR STREET POST OFFICE, SYDNEY, NSW 2000. TEL (02) 237 6500

Standard Site Recording Form

11-3-0016

MAP NAME	EDITION	SCALE	REFERENCE	HEAD OFFICE USE ONLY:
Inverell SH/56-5	1 Series 1501	1:250 000	LN 286 479	NWPS site no: [redacted]
Ashford 9138 I II & III	1	1:50 000	3/67/ LN 2864/4798	Site types: Open site File nos: Date 23/1/85 Filed by: [illegible]

Site name: Pindari Dam P/S.1.

Locality/property name:

Owner/Manager:

Address:

Local post office:

NPWS District:

Region: Northern

Reason for investigation (give R.O. instruction no. where applicable): Proposed extension of Pindari Dam.

Portion no:
Parish:

Other land category:
County:

Plan/sketch/section of site attached? Yes/No.
How many?

Air photo refs. (for stereo pair) Pindari Dam, April 1984 Run 3, 3385-121

Photos taken? Yes/No
How many attached? 6

How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff. (Draw diagram on separate sheet.) From Pindari Dam office, cross Severn R. below present Dam wall, follow first tributary entering from the west (below dam wall) upstream for about 500 m. The site extends for about 500 m further upstream on the south bank.

Other sites in locality? Yes/No.
Are sites in NPWS Register? Yes/No.

Site Types include: open sites - artefact scatters

Unregistered sites — plans for future recording? Yes/No. recorded with this

Have artefacts been removed from site? Yes/No/don't know. When?
By whom?

Deposited where?

Is site important to local Aborigines? Yes/No/don't know. See copy of Aboriginal Land Council Statement
Give contact(s) name(s) + address(es)

Contacted for this recording? Yes/No.
(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report). L. Haglund: Archaeological Survey of proposed Pindari Dam extension and associated works. Report to the WRC, July 1984 C-2217 C-829

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: Generally poor visibility; artefacts exposed by gullying erosion or erosion of thin topsoil over rock shelves.

Recommendations for management & protection (attach separate sheet if necessary): Set aside a major part of the site (esp. the western most parts) as not to be developed. Site tails off gradually eastwards, eastern most parts being seriously disturbed and eroded (transmission line route).

Site recorded by: Laila Haglund
Address/institution: 1 Cameron St Balmain 2041

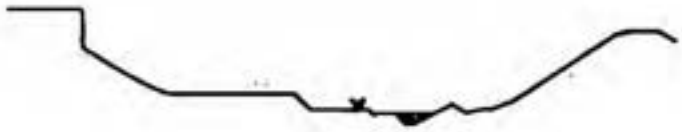
Date: 1984

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no:

1. Land form a. beach/hill slope/ridge top, etc: creek bank/hill slope b. site aspect: N + E c. slope: v. gentle

d. mark on diagram provided *or* on your own sketch the position of the site:



e. Describe briefly: on relatively flat parts of gully flow well above narrow gully with permanent fresh water in incised channel

f. Local rock type: porphyry g. Land use/effect: grazing — some surface erosion

2. Distance from drinking water: adjacent Source: small tributary

3. Resource Zone associated with site (estuarine, riverine, forest etc): Riverine/forest

4. Vegetation: Now cleared

5. Edible plants noted:

6. Faunal resources (include shellfish): See report

7. Other exploitable resources (river pebbles, ochre, etc):

Site type:

DESCRIPTION OF SITE & CONTENTS.

Note state of preservation of site & contents. Do **NOT** dig, disturb, damage site or contents.

See attached sheet for P/S.1.

CHECKLIST TO HELP:
length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.

DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types.

ART: area of surface decorated, motifs, colours, wet, dry pigment, technique of engraving, no. of figures, sizes, patination.

BURIALS: number & condition of bone, position, age, sex, associated artefacts.

TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth

QUARRIES: rock type, debris, recognisable artefacts, percentage quarried.

OTHER SITES EG. structures (fish traps, stone arrangements, bora rings, ma mias), mythological sites, rock holes, engraved groove channels, contact sites (missions massacres cemeteries) as appropriate

Attach sketches etc, eg. plan & section of shelter, show relation between site contents, indicate north, show scale.

Attach annotated photos (stereo where useful) showing scale, particularly for art sites

P/S.1: Surface scatter of stone artefacts (Figs.2,2a,14,18).

Location: On the right bank of a tributary entering the Severn River from the northwest below the present dam wall. A 66kV transmission line follows this bank, at the foot of the low ridge forming the southern flank of the valley enclosing the tributary. The site appears to extend between this line and the watercourse, from about one kilometre upstream and southeast towards the river.

Extent: The site appears to have a core area with more frequent artefact scatters. This extends for about 0.5km along the watercourse as a strip about 100m broad. The width may vary considerably. No artefacts were seen on the top of the creek bank, but the site may extend upslope under the almost unbroken grass cover above a fence line approximately parallel with the transmission line. Within this strip, surface visibility varies greatly. Exposed artefacts were seen in patches rarely exceeding 2 sq.m. in extent. The presence of occasional artefacts between these, and the topography and vegetation of the area, make it likely that further archaeological material is present below the surface. The exposures were therefore considered together as expressions of one major site with many separate activity areas. Occasional isolated artefacts were seen further downstream, between this site and site P/S.2.

Description: The visible northwest end of the site lies just below saddles in the two enclosing ridges, allowing easy access to their crests. At this point a low, almost level, rock outcrop provides a well-drained surface just above a water-hole in the tributary. Similar rocky areas and water-holes can be found further downstream. The rocky areas alternate with areas of sediment overlying rock shelf. Patches of surface erosion show some of these areas of sediment to be at least 30cm deep, but the depth of the A-horizon rarely exceeds 10cm. It was noted that artefacts were likely to occur wherever some 6-8cm of deposit had been removed. The archaeological horizon appears to be contained within the A-horizon. The core area of the site consists of a generally level terrace with a number of dry areas not affected by seepage from the slopes above. After rain there is seepage across all depressions in the terrace, and it is cut by occasional extensive scours from the stream channel which expose underlying rock. Southeast of the core area the ridge slope runs to the creek and most surfaces are affected by seepage which has exposed extensive areas of sloping rock shelf. The occasional artefacts seen in this part, between P/S.2 and the core area of P/S.1, are likely to have washed downslope.

The artefacts seen were made of mudstone, chert, other chalcedonic silicas, silcrete, milky and clear quartz.In some of the exposures seen, all the artefacts were made of one raw material, e.g. red silcrete or quartz, indicating that the artefacts were the result of one episode of flaking for each exposure. In others there was a wider range of raw materials. One example of each is illustrated in figure 18.

Artefact density varied; the highest seen was 9 artefacts in a pocket about a quarter of a square metre in extent, between rock shelves. They had probably washed into this, and the spread of eight artefacts of red silcrete on about four metres of narrow animal track, is probably more typical of the site.

Artefact types included a pyramidal core, flakes (generally rounded or oblong and of the size range illustrated), thin blades of trapezoidal or triangular section, flaked pieces and chips less than 10mm long. Apart from a backed margin in sample B, and a scraper, no secondary working was seen. An ovoid pebble, about 11cm long, with slight pitting at one end, was found on an erosion scour just south of the fence line; this is probably a hammerstone.

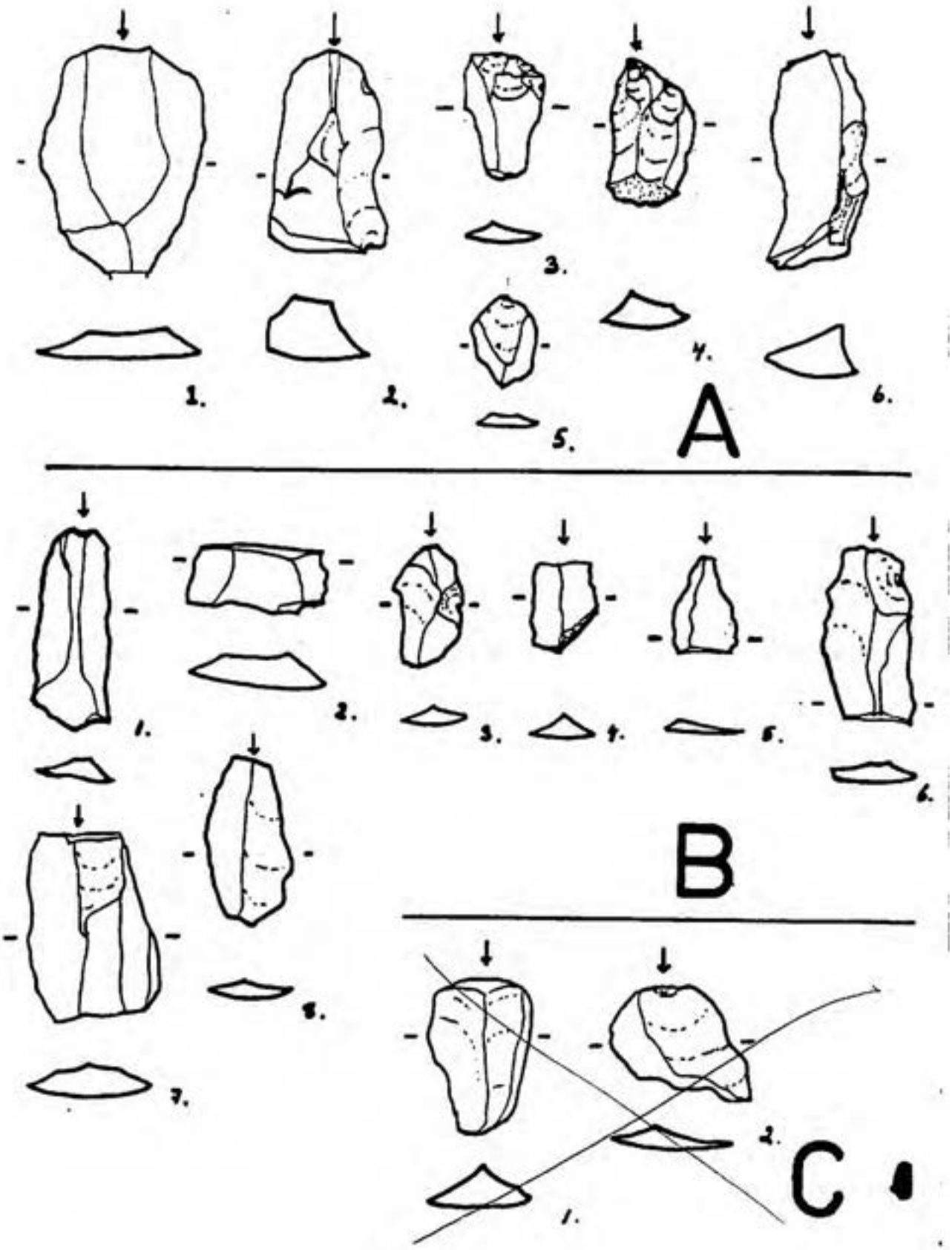
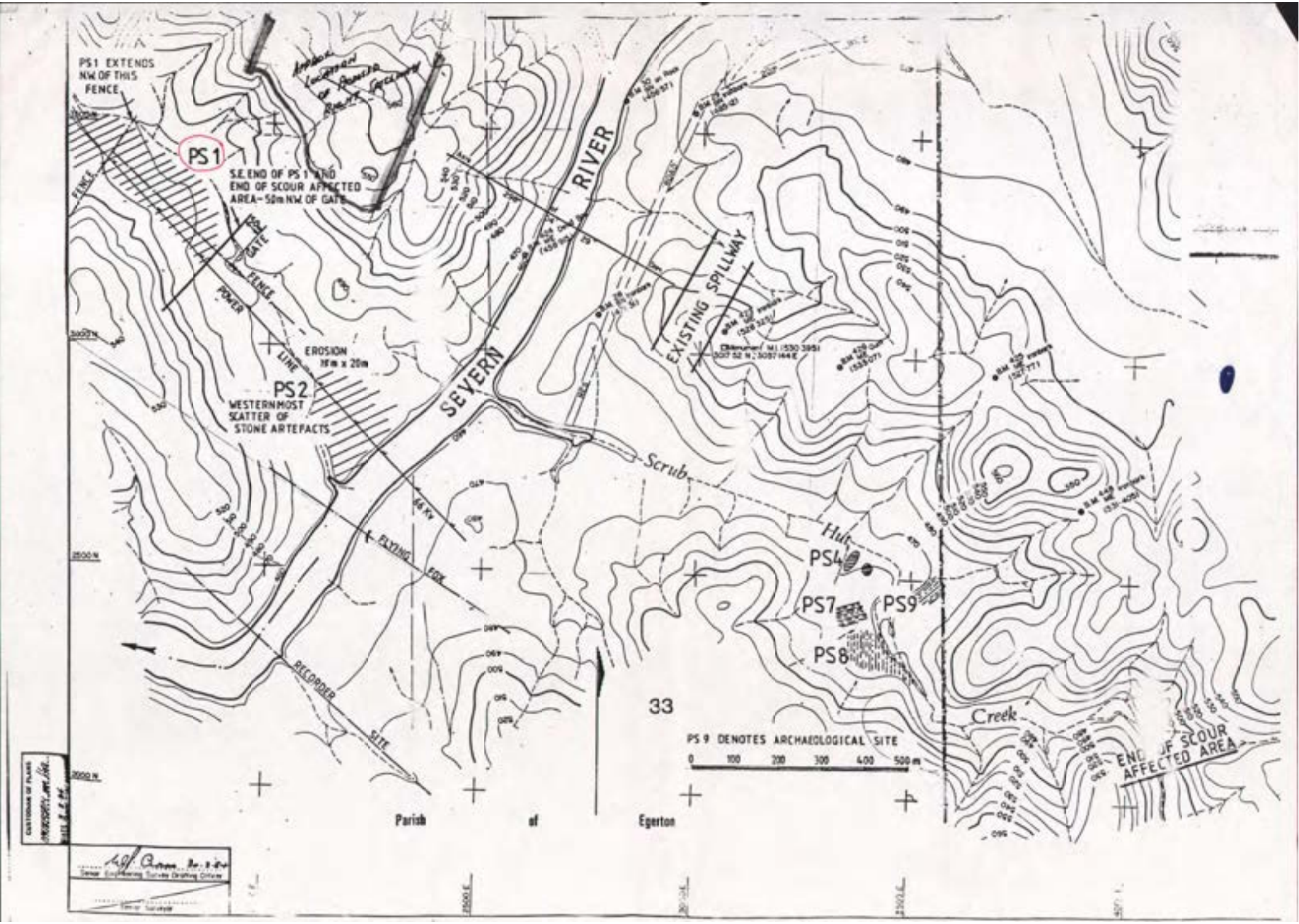


Fig.18 Site P/S.1, samples A and B, and two artefacts from site P/S.2 (= C).

mudstone = A.1-2, red agate(?) = A.3, chert = A.4-5, grey silcrete = A.6, C.1-2, red silcrete = B.1-8






PS1 EXTENDS NW OF THIS FENCE
PS1
S.E. END OF PS 1 AND END OF SCOUR AFFECTED AREA - 50m NW OF GATE
FENCE
POST
GATE
FENCE
POWER
LINE
EROSION
PS2
WESTERNMOST SCATTER OF STONE ARTEFACTS
SEVERN
RIVER
EXISTING SPILLWAY
Scrub
Hut
PS4
PS7
PS9
PS8
66 Kv
FLYING FOX
RECORDER SITE
Creek
END OF SCOUR AFFECTED AREA
33
PS 9 DENOTES ARCHAEOLOGICAL SITE
0 100 200 300 400 500 m
Parish of Egerton
2500 N
2000 N


STANDRE
HOGARTH
Pts 1
Pts 2
Pts 3
Pts 5
Pts 6
Pts 7
Pts 8
Pts 9

2

National Parks and Wildlife Service

BOX N189, GROSVENOR STREET POST OFFICE, SYDNEY, NSW 2000. TEL (02) 237 6500

Standard Site Recording Form

11-3-0017

MAP NAME	EDITION	SCALE	REFERENCE	HEAD OFFICE USE ONLY:
Inverell SH/56-5	Series 1501 ed. 1	1:250000	LN 290 474	NWPS site no: [redacted]
Ashford 9139-II & III	ed. 1	1:50 000	LN 3/2905 6V 4737	Site types: Open sites File nos: Date 23/1/85 Filed by: H

Site name: Pindari Dam p/s 2

Locality/property name:

Owner/Manager:

Address:

Local post office:

NPWS District:

Region: Northern

Reason for investigation (give R.G. instruction no. where applicable): Proposed extension of Pindari Dam

Portion no:

Parish:

Other land category:

County:

Plan/sketch/section of site attached? Yes/No

How many?

Air photo refs. (for stereo pair) Pindari Dam, April 1984, Run 3, 3385 - 121

Photos taken? Yes/No

How many attached? 4

How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff. (Draw diagram on separate sheet.) From Pindari Dam Office, cross to R. bank of Severn River below dam wall, go south to first tributary from the west, the site extends from the junction westwards.

Other sites in locality? Yes/No.

Are sites in NPWS Register? Yes/No.

Site Types include: Open sites / artefacts scatters.

Unregistered sites — plans for future recording? Yes/No. (with this)

Have artefacts been removed from site? Yes/No/don't know. When?

By whom?

Deposited where?

Is site important to local Aborigines? Yes/No/don't know. See copy of Aboriginal Land Council Statement

Give contact(s) name(s) + address(es)

Contacted for this recording? Yes/No.

(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report). L. Haglund: Arch. Survey of proposed Pindari Dam extension and associated works. Report to the WRC. July 1984

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: Very severely eroded and disturbed

Recommendations for management & protection (attach separate sheet if necessary): Some surface collection and test excavation prior to any interference.

Site recorded by: L. Haglund

Address/institution: 1 Cameron St

Date: 1984

3

National Parks and Wildlife Service

BOX N189, GROSVENOR STREET POST OFFICE, SYDNEY, NSW 2000. TEL (02) 237 6500

Standard Site Recording Form

11-3-0018

MAP NAME	EDITION	SCALE	REFERENCE	HEAD OFFICE USE ONLY:
Inverell SH/56-5	Series 1501 ed. 1	1:250 000	LN 309 481	NWPS site no: [redacted]
Aerial photo 9139 L II & III	ed. 1	1:50000	LN 3/3095 67/4815	Site types: Open site; File nos: ; Date 23/1/85; Filed by:

Site name: Pindari Dam lookout = P/S. 3
Locality/property name:
Local post office:
Owner/Manager:
Address:

DESTROYED

NPWS District:
Region: Northern

DRAFT

Reason for investigation (give R.O. Instruction no. where applicable): Proposed extension of Pindari Dam.

ISSUED

Portion no:	Other land category:	Plan/sketch/section of site attached? Yes/No
Parish:	County:	How many?
Air photo refs. (for stereo pair) Pindari Dam, April 1984, run 3, 3385 - 121		Photos taken? Yes/No How many attached? 1

How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff. (Draw diagram on separate sheet.) From Dam Site Office, follow Scenic Drive to Pindari (Apex) lookout. The site is on a northward promontory below the lookout.

Other sites in locality? Yes/No.
Are sites in NPWS Register? Yes/No.
Site Types include: Open sites - artefact scatters
Unregistered sites — plans for future recording? Yes/No (with this)

Have artefacts been removed from site? Yes/No/don't know. When?
By whom?
Deposited where?

Is site important to local Aborigines? Yes/No/don't know. See copy of Aboriginal Land Council Statement
Give contact(s) name(s) + address(es)

Contacted for this recording? Yes/No.
(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report). L. Haglund: Archaeological Survey of proposed Pindari Dam extension and associated works. Report to the WPC, July 1984

Checklist: surface visibility, damage/disturbance/ threat to site	Condition of site: Severely eroded and disturbed

Recommendations for management & protection (attach separate sheet if necessary): Should be tested for remnant of undisturbed deposit — probably all disturbed and eroded

Site recorded by: Laila Haglund
Address/institution: 1 Cameron St Balmain 2041
Date: 1984

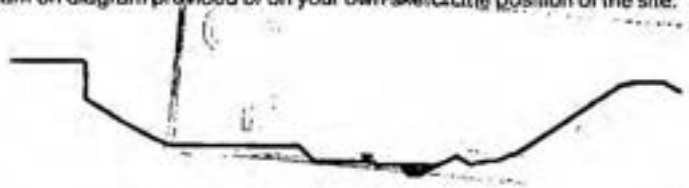
3

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no:

1. Land form a. beach/hill slope/ridge top, etc: b. site aspect: North c. slope: gently level

d. mark on diagram provided *or* on your own sketch the position of the site:



e. Describe briefly: on small, flat rise spur protruding into present dam

f. Local rock type: porphyry g. Land use/effect: cleared, picnic tables, track, toilets.

2. Distance from drinking water: adjacent now, (used in the past) Source: Pindari Dam

3. Resource Zone associated with site (estuarine, riverine, forest etc): forest / riverine

4. Vegetation: cleared

5. Edible plants noted:

6. Faunal resources (include shellfish): See report.

7. Other exploitable resources (river pebbles, ochre, etc):

Site type:

CHECKLIST TO HELP: length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.

DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types

ART: area of surface decorated, motifs, colours, wet, dry pigment, technique of engraving, no. of figures, sizes, patination

BURIALS: number & condition of bone, position, age, sex, associated artefacts

TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth

QUARRIES: rock type, debris, recognisable artefacts, percentage quarried.

OTHER SITES EG. structures (fish traps, stone arrangements, bora rings, mia mias), mythological sites, rock holes, engraved groove channels, contact sites (missions massacres cemeteries) as appropriate

DESCRIPTION OF SITE & CONTENTS.

P/S.3: Surface scatter of stone artefacts (Figs.2,15,19).

Location: On the low point extending northwards below Apex (Pindari) Lookout.

Extent: From just below the present public toilets, across the main access track and into the area cleared and set up as a public picnic area, a triangle of about 700 sq.m. The main artefact scatters occur over about a quarter of this.

Description: Towards the tip of the point much of the surface was apparently removed to create a level picnic area. Here a probable core and a chunky flake of grey mudstone were noted at the foot of a small rock outcrop.

Further south the track can be seen to cut some 30cm into the slope up to the toilets and the Lookout. The slope has been cleared to the level of the toilets. Below a thin surface layer of more humic soil, the deposit appears colluvial: pale, greyish brown with many angular rock fragments.

Paths and a rough vehicle track have been worn into the slope. The artefacts were seen on such erosion surfaces. They are sparsely scattered, the greatest density seen being four artefacts per square metre. Most artefacts were several metres apart. Fourteen artefacts were noted, but more are likely to be embedded in the deposit, though in low numbers. Most artefacts seen were made of a light grey, fine-grained silcrete, but a couple were of grey mudstone and a couple of quartz.

The artefacts included two multi-directional flake cores, pointed and oval flakes and thin blades. One flake can be classed as a chunky steepscraper (cf.Fig.19).

Attach sketches etc. eg. plan & section of shelter, show relation between site contents, indicate north, show scale.
Attach annotated photos (stereo where useful) showing scale, particularly for art sites.

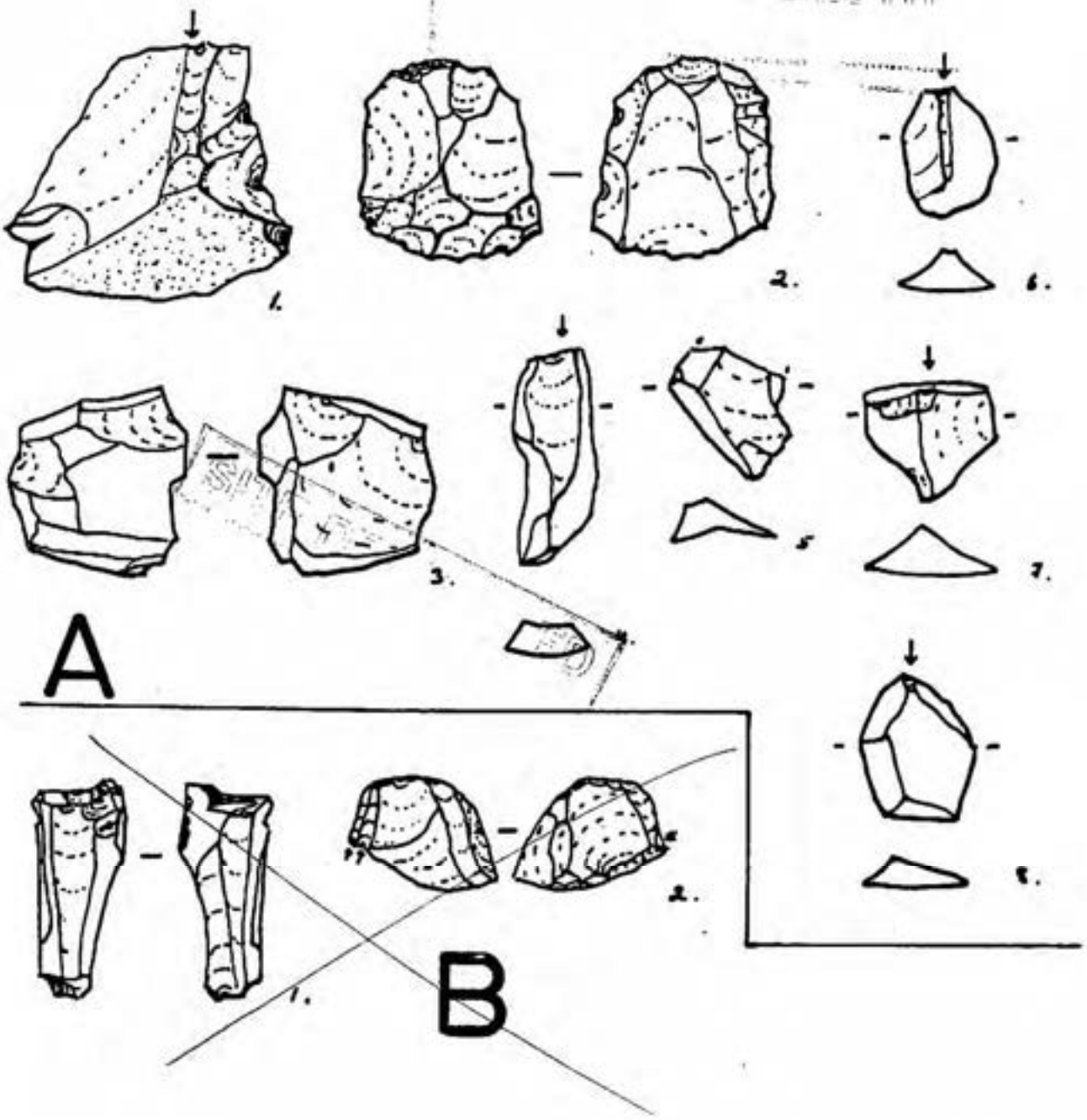


Fig.19 A = artefacts from site P/S.3, B= artefacts from P/S.5

A.1= flake from north of track, A.2= core/scraper, A.3= core, A.4-8= flakes and blades. A.2-8 from south of the track. A.6-8 plus a chip of quartz were within 1m^2 of surface.

mudstone= A.1, A.7 grey silcrete= A.2-6, A.8

B.1= blade core of grey mudstone, B.2= burin(?) of clear quartz.

NATIONAL PARKS AND WILDLIFE SERVICE

CONSENT TO DESTROY
SHFD 110001
SITE DESTROYED

NATIONAL PARKS AND WILDLIFE ACT 1974
SECTIONS 86, 87 AND 90

CONSENT AND PERMIT TO SALVAGE

CONSENT TO CARRY OUT THE DESTRUCTION OF AN ABORIGINAL RELIC/PLACE AND PERMIT TO COLLECT AND/OR EXCAVATE FOR THE PURPOSE OF SALVAGE

WHEREAS the Aboriginal relics described in Schedule "A" are situated upon the land described in Schedule "B", and constitute relics within the meaning of Section 90 of the National Parks and Wildlife Act 1974, and WHEREAS application has been made by:

Mr Mark Lau,

of:

Dept Water Resources
PO Box 3720
Parramatta NSW 2150

for CONSENT to destroy those relics in the course of:

enlargement of the Pindari Dam

NOW I, William J. Gillooly Director of National Parks and Wildlife, in pursuance of Section 90 of the said Act, and subject to the conditions hereunder set out DO HEREBY CONSENT to the destruction of the said relics by the said applicant, AND FURTHER, in accordance with the said Conditions and in pursuance of Section 87 of the said Act, I DO HEREBY PERMIT the salvage collection and/or excavation of the said relics from the aforesaid land, prior to destruction of the relics, by Dr. Laila Haglund the qualified person named in the said conditions.

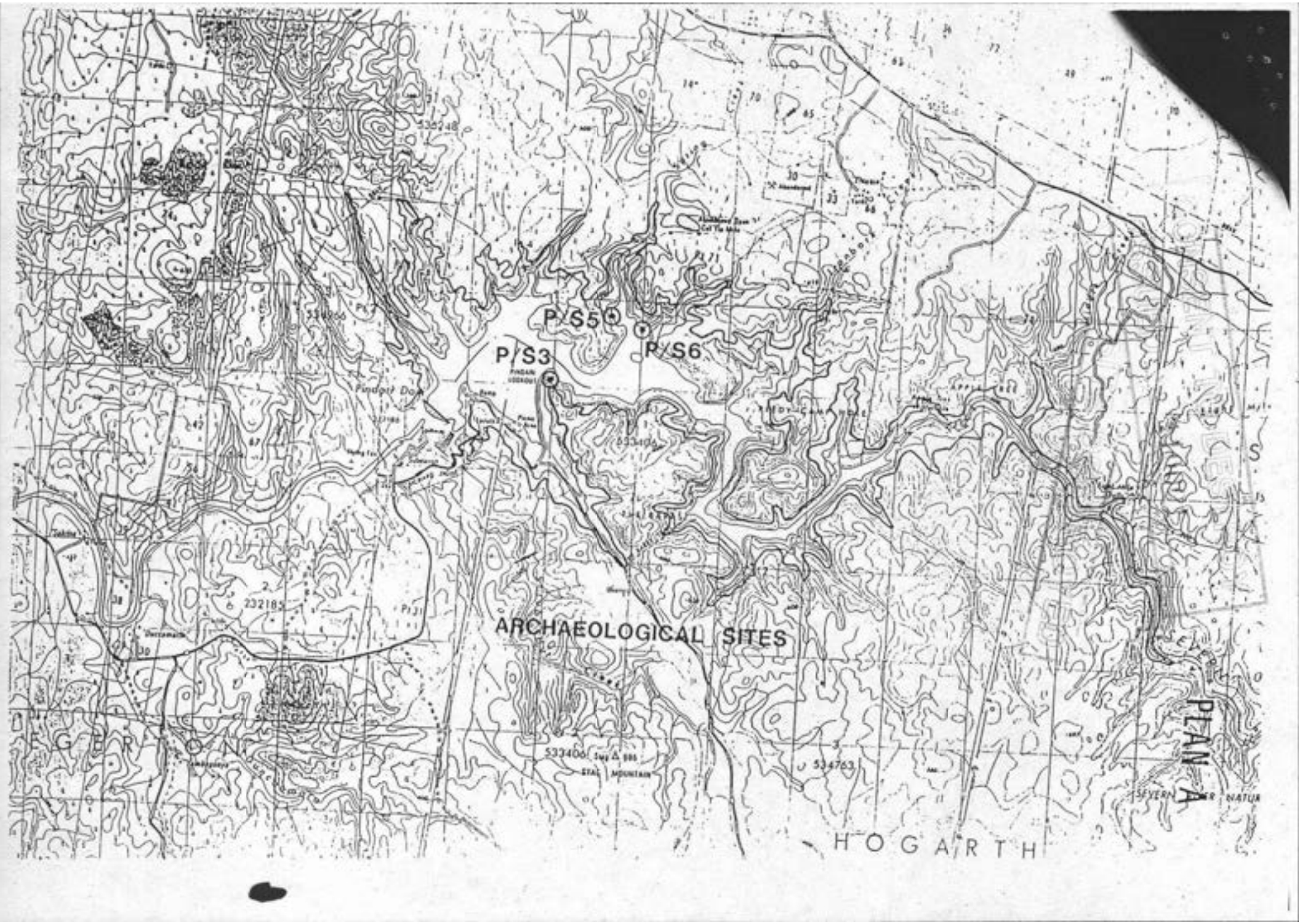
TERMS AND CONDITIONS OF THIS CONSENT

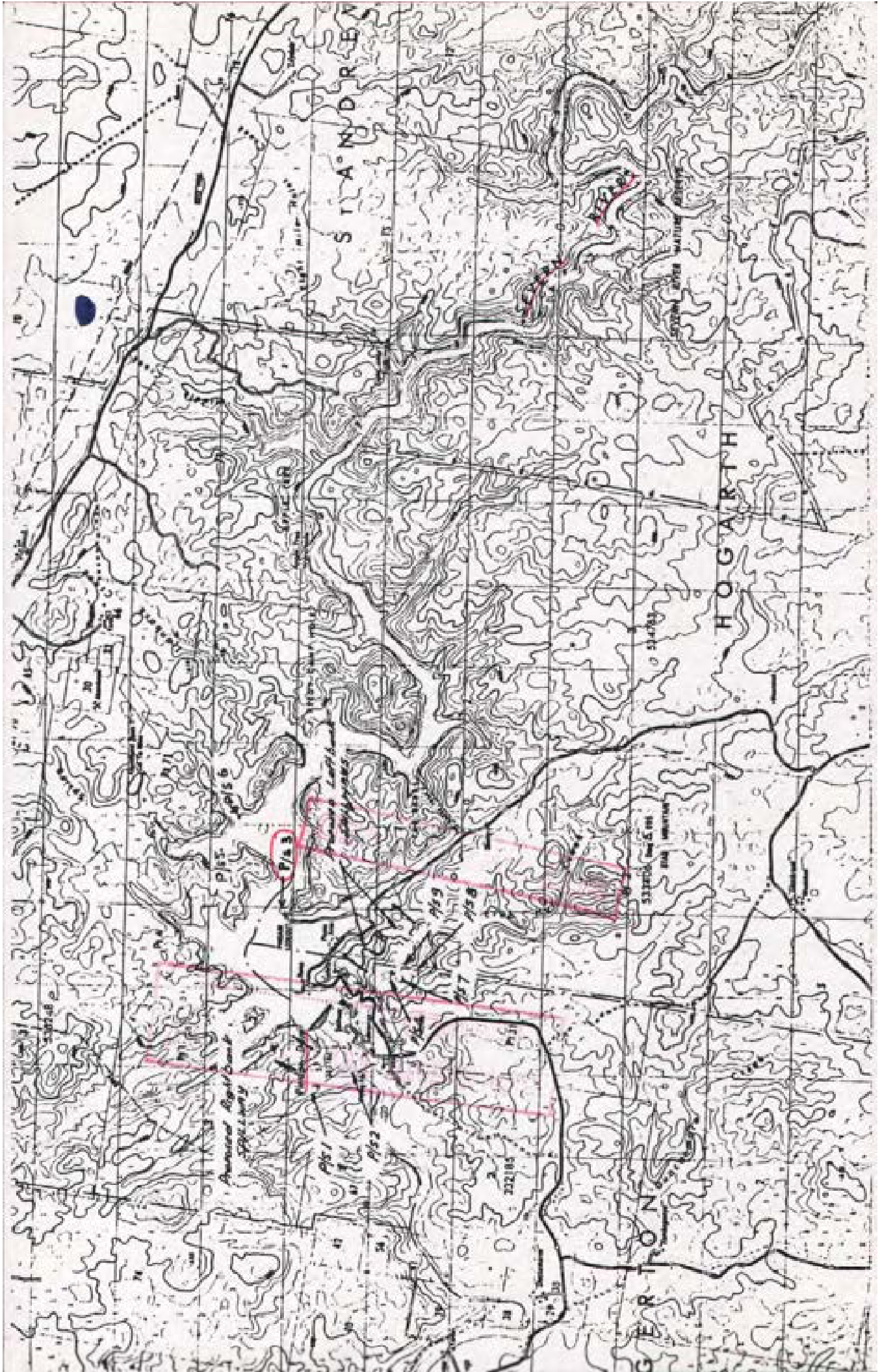
This Consent is issued subject to General Terms and Conditions covering all archaeological Permits and Consents, as well as the Specific Terms and Conditions pertaining to Consents to destroy Aboriginal relics all of which conditions are detailed in the attached pages.

DATED at Sydney this 25th day of October, 1991.

H. Clemens

for Director of National Parks and Wildlife


P/S5
P/S6
P/S3
ARCHAEOLOGICAL SITES
HOGARTH


STANDER
HOGARTH
P/s 3
P/s 9
P/s 7
P/s 1
P/s 2
N



CONSENT TO DESTROY
ISSUED 110001
SITE DESTROYED

SCHEDULE A:

Sites NPWS 11-3-17
NPWS 11-3-18
NPWS 11-3-20
NPWS 11-3-21

Isolated finds: IF 1 to 5, in Report NPWS C-829
(Dr. L. Haglund, 1984, p17).

Permit for the salvage (excavation/collection) to apply to sites NPWS 11-3-17 and 11-3-18

SCHEDULE B:

NPWS 11-3-17	32905 E	674737 N
NPWS 11-3-18	33095 E	674815 N
NPWS 11-3-20	33168 E	674888 N
NPWS 11-3-21	33207 E	674868 N

Isolated finds; within the Pindari Dam pool, as shown on attached map, edged in red.

SPECIAL CONDITIONS APPLYING TO CONSENT AND PERMIT TO SALVAGE

1. A specific objective of the salvage of sites 11-3-17 and 11-3-18, is to carry out an anlaysis of inter and intra site variability in this area. The sample recovered should reflect the requirements of statistical analysis appropriate to this objective.

2. A report of the excavation/collection will be submitted to the National Parks and Wildlife Service, not later than six months after the start of the work.

SPECIFIC CONDITIONS APPLYING TO CONSENT AND PERMIT TO SALVAGE

1. The Consent covers only those relics described in the instrument of Consent and in any Schedules thereto.

2. In the case of Consents granted to cover development activities, the Consent is granted to cover only those circumstances described in the Schedules, and subject to there not being discovered in the course of further operations, in the progress of that development requiring the Consent, any other relics which will be damaged or destroyed by the continuation of the operation. (Destruction of such relics would require the granting of a separate Consent).

3. The Consent is conditional upon all relevant development approvals having been obtained.

110001

4. Should the relics listed in Schedule 'A' above remain in existence two (2) years from the date of this document, the Consent shall be deemed to be void, and any further damage to the relics will require the preparaton of a new Consent document.

5. Prior to the Consent becoming effective, the relics described in the Schedules must be salvaged, following the guidelines attached. The salvage work is to be carried out by Dr. Laila Haglund, who is a qualified person, competent to undertake this work.

6. Any Aboriginal relics recovered, being the property of the Crown, shall be deposited at The Australian Museum, or at another place, designated by the Museum, after these relics have been fully examined, or before a period of two years from the date of expiration of the Permit or any renewal thereof, whichever occurs first.

7. Should any 'relic', defined under the Heritage Act of NSW be uncovered, then excavation or disturbance of that area is to stop immediately and the Heritage Council of NSW is to be informed in accordance with S.146 of the Heritage Act, 1977 (as amended).

Historic Archaeologists of the Heritage Council can be contacted on

(02) 266 7111
(02) 266 7265
(02) 266 7267
(02) 266 7248

'relic' is defined as any deposit, object or material evidence-

(a) which relates to the settlement of the area that comprises NSW, not being Aboriginal settlement; and

(b) which is 50 or more years old.

The holder of the Permit shall furnish the National Parks and Wildlife Service with a report at the completion of the salvage work or expiry of the Permit or any renewal thereof, or as specified in the guidelines, whichever occurs first. Such report shall include:

- a complete list of all material recovered;
- a detailed description of the methods of excavation/collection and analysis used;
- a detailed plan of the site, including the location of collection areas, all trenches, auger holes and spoil heaps;
- summary of consultation undertaken with relevant Local Aboriginal Land Councils or relevant Aboriginal Community Groups.

2

SITE POSITION & ENVIRONMENT | OFFICE USE ONLY: NPWS site no:

1. Land form a. beach/hill slope/ridge top, etc: Creek bank b. site aspect: S & E c. slope: gentle

d. mark on diagram provided or on your own sketch the position of the site:



e. Describe briefly: on junction of tributary and river

f. Local rock type: poor physy g. Land use/effect: grazing / severe erosion.

2. Distance from drinking water: adjacent Source: tributary + river

3. Resource Zone associated with site (estuarine, riverine, forest etc): riverine

4. Vegetation: see report. New clearance

5. Edible plants noted:

6. Faunal resources (include shellfish):

7. Other exploitable resources (river pebbles, ochre, etc):

CONSENT TO DESTROY ISSUED

Site type:

DESCRIPTION OF SITE & CONTENTS.

P/S.2: Surface scatter of stone artefacts (Figs.2,2a,18C,20).

Location: On the left bank of the same tributary as P/S.1, but further downstream. The westernmost exposure was noted close to the point where the 66kV transmission line crosses from the right to the left bank of the tributary.

Extent: The site appears to extend over the point formed between the tributary and the river, and below the 460m contour, that is over a triangle with a maximum extent of about two hectares.

Description: The surface area of the site has been cleared. A sparse scatter of artefacts, of various types of rock, was seen on denuded stretches along a slight crest in the centre of the triangle, below rock outcrops. The surface appears generally disturbed and severely eroded. The sediment cover appears to be thin over most of this triangle, patches of deeper deposit occurring to the sides of the crest.

In a major erosion scar, circa 15m by 20m in extent, flanking the creek close to the transmission line crossing, scatters of artefacts were seen eroding out of the sediments, indicating that further, but undisturbed, archaeological deposit can be found behind the erosion face. This was up to 0.4m high, showing a thin brown A-horizon above a greyish white B-horizon. The horizontal extent of the uneroded deposit is here probably only a few metres, judging from the angle of the rock slopes further back, and the artefact horizon probably lies within the A-horizon.

The scatters visible in the major scar were found as two patches, each with artefacts of one raw material. One had flakes and tiny chips of grey silcrete, the other a core, a blade and chips of brownish mudstone, indicating the presence of definite 'working floors' for the knapping of stone tools.

CHECKLIST TO HELP: length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.
DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types
ART: area of surface decorated, motifs, colours, wet, dry pigment, technique of engraving, no. of figures, sizes, patination.
BURIALS: number & condition of bone, position, age, sex, associated artefacts.
TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth
QUARRIES: rock type, debris, recognisable artefacts, percentage quarried.
OTHER SITES EG. structures (fish traps, stone arrangements, bora rings, mia mias), mythological sites, rock holes, engraved groove channels, contact sites (missions massacres cemeteries) as appropriate

Attach sketches etc, eg. plan & section of shelter, show relation between site contents, indicate north, show scale.
Attach annotated photos (stereo where useful) showing scale, particularly for art sites.

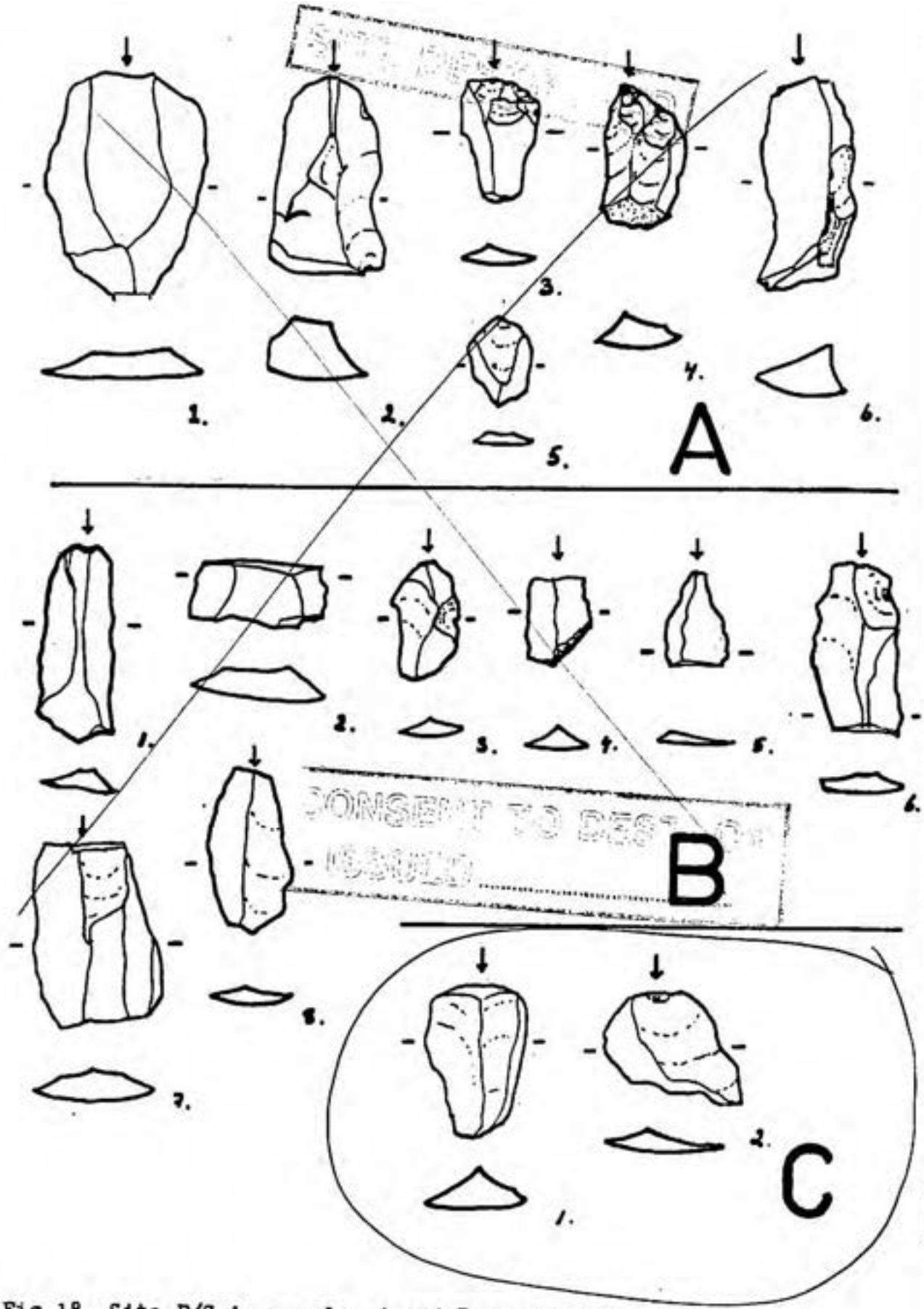
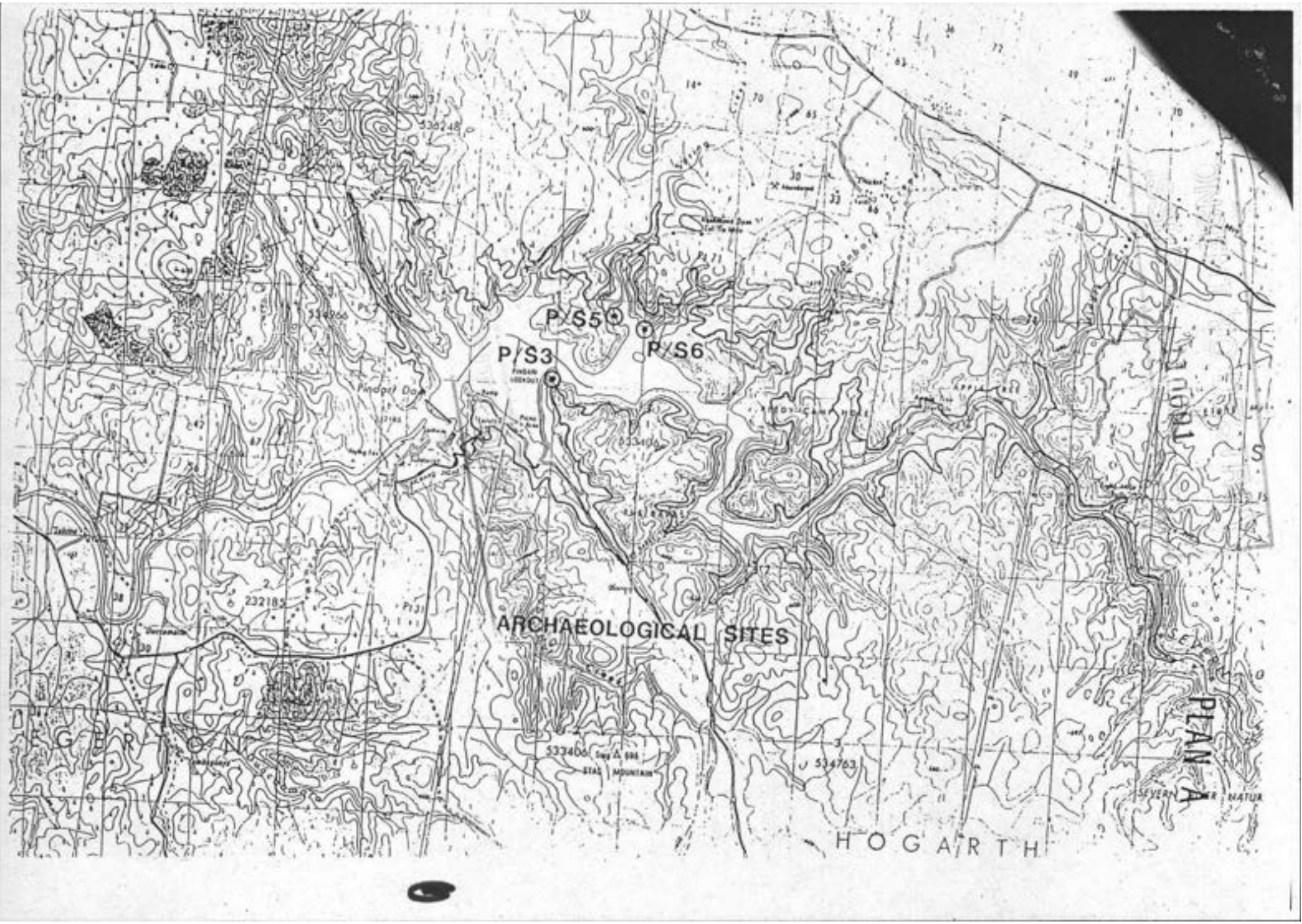


Fig.18 Site P/S.1, samples A and B, and two artefacts from site P/S.2 (= C).

mudstone = A.1-2, red agate(?) = A.3, chert = A.4-5, grey silcrete = A.6, C.1-2, red silcrete = B.1-8


P/S5
P/S6
P/S3
ARCHAEOLOGICAL SITES
HOGARTH
PLAN A

NATIONAL PARKS AND WILDLIFE SERVICE

110001

NATIONAL PARKS AND WILDLIFE ACT 1974
SECTIONS 86, 87 AND 90

CONSENT AND PERMIT TO SALVAGE

CONSENT TO CARRY OUT THE DESTRUCTION OF AN ABORIGINAL RELIC/PLACE AND PERMIT TO COLLECT AND/OR EXCAVATE FOR THE PURPOSE OF SALVAGE

WHEREAS the Aboriginal relics described in Schedule "A" are situated upon the land described in Schedule "B", and constitute relics within the meaning of Section 90 of the National Parks and Wildlife Act 1974, and WHEREAS application has been made by:

Mr Mark Lau,

of:

Dept Water Resources
PO Box 3720
Parramatta NSW 2150

for CONSENT to destroy those relics in the course of:

enlargement of the Pindari Dam

NOW I, William J. Gillooly Director of National Parks and Wildlife, in pursuance of Section 90 of the said Act, and subject to the conditions hereunder set out DO HEREBY CONSENT to the destruction of the said relics by the said applicant, AND FURTHER, in accordance with the said Conditions and in pursuance of Section 87 of the said Act, I DO HEREBY PERMIT the salvage collection and/or excavation of the said relics from the aforesaid land, prior to destruction of the relics, by Dr. Laila Haglund the qualified person named in the said conditions.

TERMS AND CONDITIONS OF THIS CONSENT

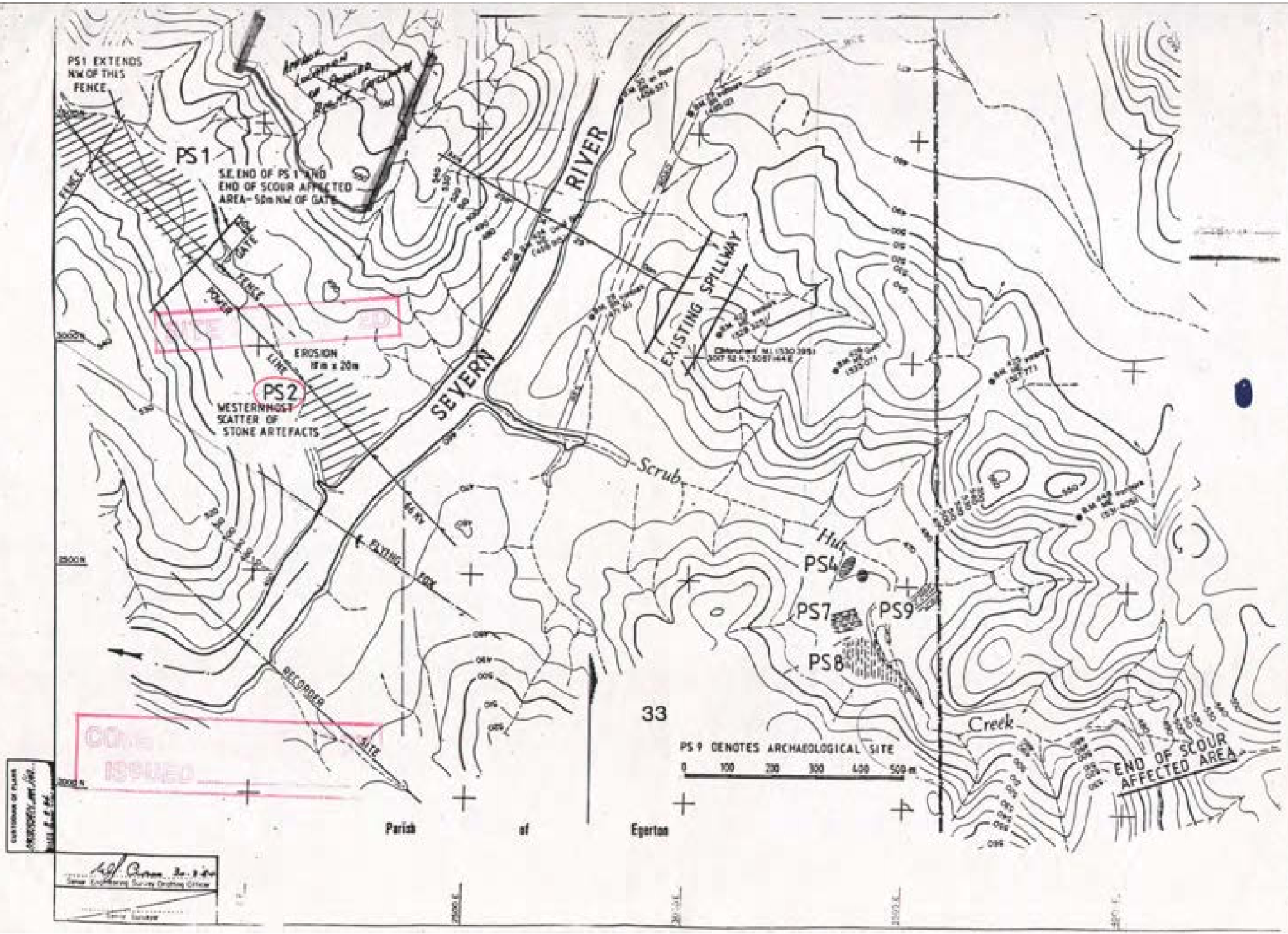
This Consent is issued subject to General Terms and Conditions covering all archaeological Permits and Consents, as well as the Specific Terms and Conditions pertaining to Consents to destroy Aboriginal relics all of which conditions are detailed in the attached peges.

DATED at Sydney this 25th day of October, 1991.

H. Clemens

for Director of National Parks and Wildlife


STANDRE
HOGARTH


PS1 EXTENDS NW OF THIS FENCE
PS1
S.E. END OF PS1 AND END OF SCOUR AFFECTED AREA - 50m NW OF GATE
FENCE
POST
GATE
POWER LINE
EROSION 10m x 20m
PS2
WESTERN MOST SCATTER OF STONE ARTEFACTS
SEVERN
RIVER
EXISTING SPILLWAY
Scrub
Hut
PS4
PS7
PS9
PS8
FLYING FOX
RECORDED SITE
33
Creek
END OF SCOUR AFFECTED AREA
PS 9 DENOTES ARCHAEOLOGICAL SITE
0 100 200 300 400 500 m
Parish of Egerton



National Parks and Wildlife Service

BOX N189, GROSVENOR STREET POST OFFICE, SYDNEY, NSW 2000. TEL (02) 237 6500

Standard Site Recording Form

11-3-0020

MAP NAME	EDITION	SCALE	REFERENCE	HEAD OFFICE USE ONLY:
Inverell SH/56-5	Series 1501 ed. 1	1:250,000	LN 316 489	NWPS site no: 11-3-20
Ashford 9139-II & III	ed. 1	1:50,000	LN S/3168 CV/4888	Site types: Open site File nos: Date 23/1/85 Filed by: K

Site name: Pindari Dam/PS6 Spring Creek

Locality/property name:

Owner/Manager:

Address:

SITE DESTROYED

Local post office:

NPWS District:

Region: Northern

Reason for investigation (give R.O. instruction no. where applicable): Proposed extension of Pindari Dam

Portion no:

Parish:

Other land category:

County:

Plan/sketch/section of site attached? Yes/No

How many?

Air photo refs. (for stereo pair) Pindari Dam, 1984 April, Run 3, 3385-121

Photos taken? Yes/No

How many attached? 6

How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff. (Draw diagram on separate sheet.) Office by Scenic Drive to Apex (Pindari) lookout, then by boat to mouth of Spring Creek, follow west bank upstream almost to narrowing of channel.

Other sites in locality? Yes/No.

Are sites in NPWS Register? Yes/No.

Site Types include: open sites - artefact scatters

Unregistered sites — plans for future recording? Yes/No. (with this)

Have artefacts been removed from site? Yes/No/don't know. When?

By whom?

Deposited where?

Is site important to local Aborigines? Yes/No/don't know. See copy of Aboriginal Land Council statement

Give contact(s) name(s) + address(es)

Contacted for this recording? Yes/No.

(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report): L. Haglund: Archaeological Survey of proposed Pindari Dam extension and associated works. Report to the WRC. July 1984.

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: Mostly drowned (if once more extensive).

Recommendations for management & protection (attach separate sheet if necessary): Very little site above water, very thin top soil — little arch. potential, no further action recommended.

Site recorded by: Laila Haglund

Date: 1984

Address/institution: 1 Cameron St. Balmain 2041

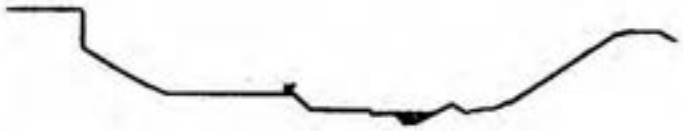
5

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no:

1. Land form a. beach/hill slope/ridge top, etc: flat topped minor spur b. site aspect: East c. slope: flat

d. mark on diagram provided *or* on your own sketch the position of the site: e. Describe briefly:



f. Local rock type: porphyry g. Land use/effect:

2. Distance from drinking water: adjacent now, formerly some 30-50 m away? Source: Pindari Dam

3. Resource Zone associated with site (estuarine, riverine, forest etc): Forest / river

4. Vegetation: See description

5. Edible plants noted:

6. Faunal resources (include shellfish):

7. Other exploitable resources (river pebbles, ochre, etc):

SITE DESTROYED

Site type:

CHECKLIST TO HELP: length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.

DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types

ART: area of surface decorated, motifs, colours, wet, dry pigment, technique of engraving, no. of figures, sizes, patination.

BURIALS: number & condition of bone, position, age, sex, associated artefacts.

TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth

QUARRIES: rock type, debris, recognisable artefacts, percentage quarried.

OTHER SITES EG. structures (fish traps, stone arrangements, bora rings, ma mias), mythological sites, rock holes, engraved groove channels, contact sites (missions massacres cemeteries) as appropriate

DESCRIPTION OF SITE & CONTENTS.

P/S.5: Surface scatter of stone artefacts (Figs.2,16,19B).

Location: South of the present mouth of Spring Creek, on the right bank, below a saddle in headland H.3b, on a small point extending eastwards. Half-drowned trees can be seen fringing the point up to about 30m out from the present shore line, indicating the former extent of this lobe.

Extent: Artefacts were found at about 7m, 11m and 24m in from the present point, in the central part of the triangle.

Description: The point forms a diffuse triangle extending some 25m into the dam. The surface is only just above maximum supply level. It is flat, in part exposed rock ledge, in part thin, gravelly soil. There is a sparse tree cover on and behind the site, including several tall ironbarks, young to mature box and some sparse but tall scrub. There is dense, low brush and sedges along the shore. The surface carries sparse grass, much leaf litter and patches of moss. There are stands of large grass trees on the slope behind the site and a pleasant meadow a little further to the northeast.

The artefacts found were a probable burin of clear quartz, a double-ended grey mudstone blade core with prepared platform and a broken and battered hammerstone. It is unlikely that many more artefacts occur in the shallow soil of the site; behind the site the ground is fairly damp. The site was interpreted as a resting place or lookout point set well above the former valley floor and probably on a route linking this with the valley to the west of headland H.3a,b.

CONSENT TO DESTROY ISSUED .....

Attach sketches etc. eg. plan & section of shelter, show relation between site contents, indicate north, show scale.
Attach annotated photos (stereo where useful) showing scale, particularly for art sites.

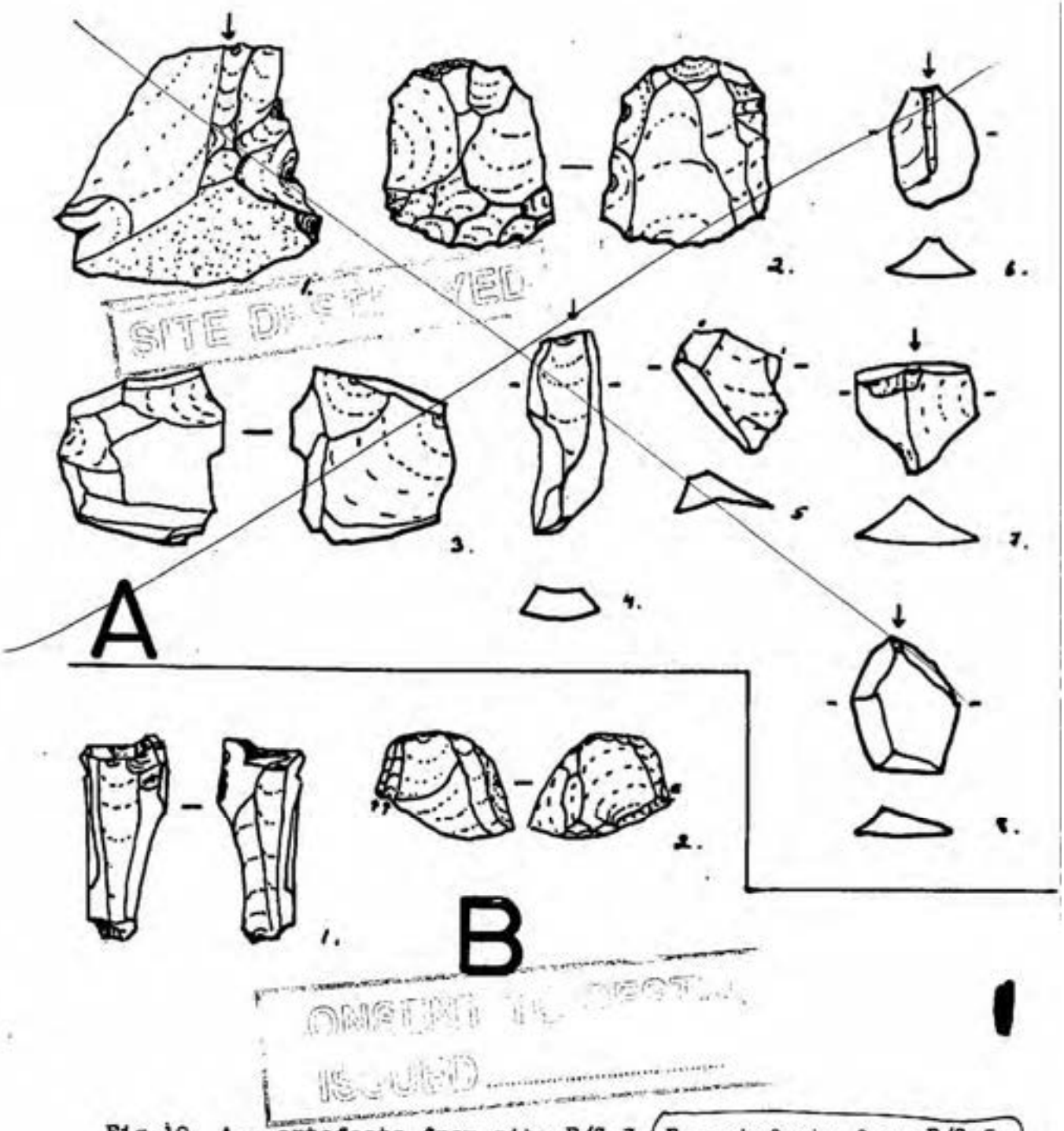


Fig.19 A = artefacts from site P/S.3, B= artefacts from P/S.5

A.1= flake from north of track, A.2= core/scraper, A.3= core, A.4-8= flakes and blades. A.2-8 from south of the track. A.6-8 plus a chip of quartz were within 1m^2 of surface.

mudstone= A.1, A.7 grey silcrete= A.2-6, A.8

B.1= blade core of grey mudstone, B.2= burin(?) of clear quartz.

NATIONAL PARKS AND WILDLIFE SERVICE

CONSENT TO DESTROY
ISSUED 11/08/91

NATIONAL PARKS AND WILDLIFE ACT 1974
SECTIONS 86, 87 AND 90

SITE DESTROYED

CONSENT AND PERMIT TO SALVAGE

CONSENT TO CARRY OUT THE DESTRUCTION OF AN ABORIGINAL RELIC/PLACE AND PERMIT TO COLLECT AND/OR EXCAVATE FOR THE PURPOSE OF SALVAGE

WHEREAS the Aboriginal relics described in Schedule "A" are situated upon the land described in Schedule "B", and constitute relics within the meaning of Section 90 of the National Parks and Wildlife Act 1974, and WHEREAS application has been made by:

Mr Mark Lau,

of:

Dept Water Resources
PO Box 3720
Parramatta NSW 2150

for CONSENT to destroy those relics in the course of:

enlargement of the Pindari Dam

NOW I, William J. Gillooly Director of National Parks and Wildlife, in pursuance of Section 90 of the said Act, and subject to the conditions hereunder set out DO HEREBY CONSENT to the destruction of the said relics by the said applicant, AND FURTHER, in accordance with the said Conditions and in pursuance of Section 87 of the said Act, I DO HEREBY PERMIT the salvage collection and/or excavation of the said relics from the aforesaid land, prior to destruction of the relics, by Dr. Laila Haglund the qualified person named in the said conditions.

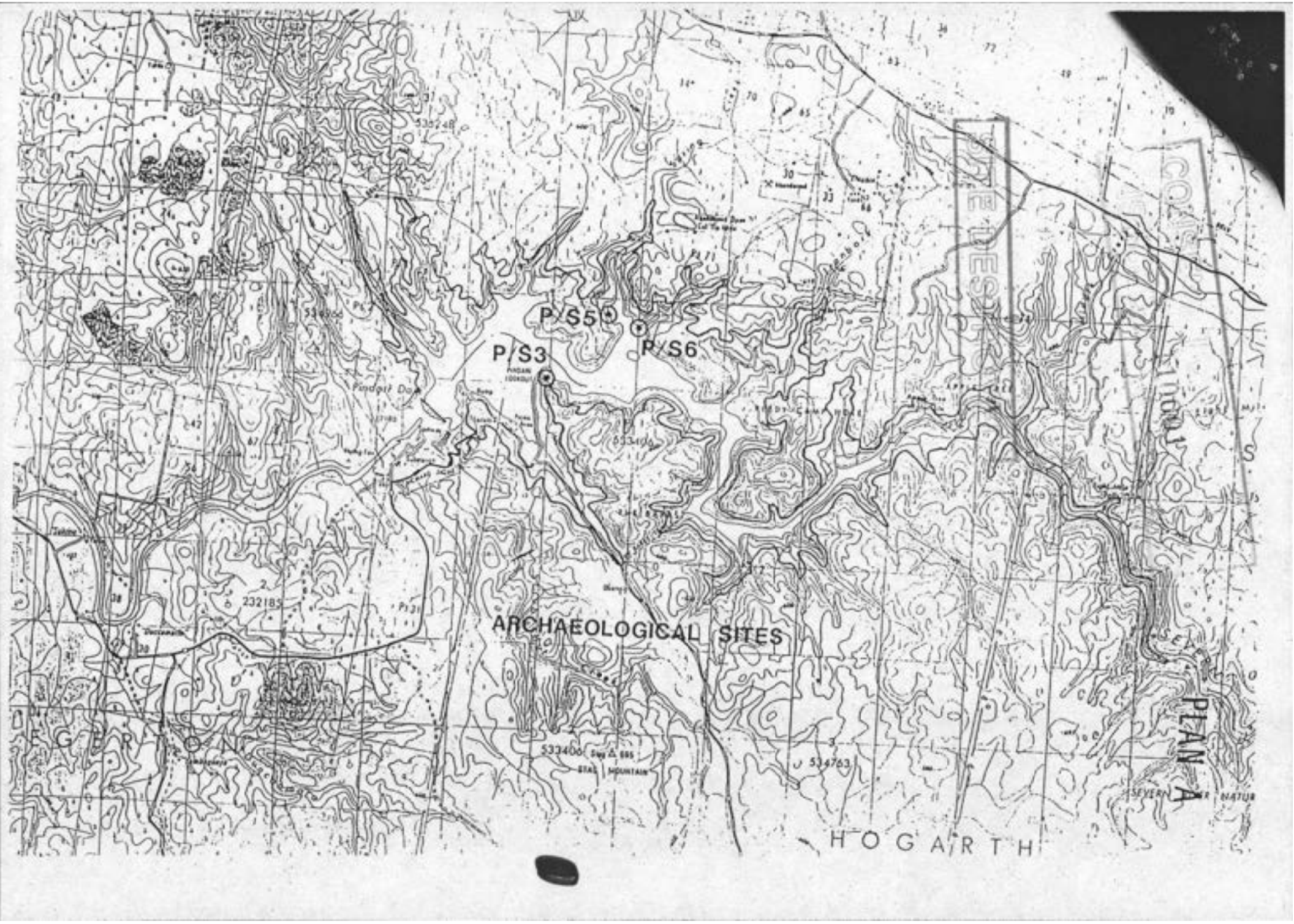
TERMS AND CONDITIONS OF THIS CONSENT

This Consent is issued subject to General Terms and Conditions covering all archaeological Permits and Consents, as well as the Specific Terms and Conditions pertaining to Consents to destroy Aboriginal relics all of which conditions are detailed in the attached pages.

DATED at Sydney this 25th day of October, 1991.

H. Clemens

for Director of National Parks and Wildlife


P/S5
P/S6
P/S3
ARCHAEOLOGICAL SITES
HOGARTH
PLAN A


STADDLE
HOGARTH

National Parks and Wildlife Service

BOX N189, GROSVENOR STREET POST OFFICE, SYDNEY, NSW 2000. TEL (02) 237 6500

Standard Site Recording Form

11-3-0021

MAP NAME	EDITION	SCALE	REFERENCE	HEAD OFFICE USE ONLY:
Inverell SH/56-5	Series 1501 ed. 1	1:250 000	LN3207486	NWPS site no: 11-3-21
Ashford 9139-II & III	ed. 1	1:50 000	LN3/3207/67/4868	Site types: Open site File nos: Date 23/1/85
		1:25K.	3/3207.67/4868	Filed by:

Site name: Pindari Dam / PS6 Spring Creek
Local post office:
Locality/property name:
Owner/Manager:
Address:

CONSENT TO DESTROY ISSUED

NPWS District:
Region:

Reason for investigation (give R.O. instruction no. where applicable): Proposed extension of Pindari Dam.

SITE DESTROYED

Portion no: Parish: Other land category: County:	Plan/sketch/section of site attached? Yes/No. How many?
Air photo refs. (for stereo pair) Pindari Dam, April 1984, run 3, 3385 - 121	Photos taken? Yes/No How many attached? 3

How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff. (Draw diagram on separate sheet.) From Pindari Dam Office, follow Scenic Drive to Apex lookout, continue by boat to mouth of Spring + unnamed creeks (north of small island). The site is on the eastern bank, just south of entrance to channel of unnamed creek.

Other sites in locality? Yes/No.
Are sites in NPWS Register? Yes/No.
Site Types include: open site - artefact scatters
Unregistered sites — plans for future recording? Yes/No (with this)

Have artefacts been removed from site? Yes/No/don't know. When?
By whom?
Deposited where?

Is site important to local Aborigines? Yes/No/don't know. See copy of Aboriginal Land Council statement
Give contact(s) name(s) + address(es)

Contacted for this recording? Yes/No.
(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report). L. Haglund: Archaeological Survey of proposed Pindari Dam extension and associated works. Report to WRC. July 1984. C-829.

Checklist: surface visibility, damage/disturbance/ threat to site	Condition of site: Heavily eroded, most parts now underwater. Little or no topsoil present, little archaeological potential.

Recommendations for management & protection (attach separate sheet if necessary): No further action recommended

Site recorded by: Laila Haglund
Address/institution: 1 Cameron St. Balmain NSW 2041
Date: 1984

6

SITE POSITION & ENVIRONMENT | OFFICE USE ONLY: NPWS site no:

1. Land form a. beach/hill slope/ridge top, etc: spur b. site aspect: west c. slope: flat

d. mark on diagram provided *or* on your own sketch the position of the site:



e. Describe briefly: flat top of what was once a small spur leading down to the creek

f. Local rock type: porphyry g. Land use/effect:

2. Distance from drinking water: nearby in the past adjacent river, Source: Pindari Dam

3. Resource Zone associated with site (estuarine, riverine, forest etc): River / forest

4. Vegetation: See below

5. Edible plants noted:

6. Faunal resources (include shellfish):

7. Other exploitable resources (river pebbles, ochre, etc):

CONSENT TO DESTROY ISSUED

Site type:

CHECKLIST TO HELP: length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.

DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types.

ART: area of surface decorated, motifs, colours, wet, dry pigment, technique of engraving, no. of figures, sizes, patination.

BURIALS: number & condition of bone, position, age, sex, associated artefacts.

TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth.

QUARRIES: rock type, debris, recognisable artefacts, percentage quarried.

OTHER SITES EG. structures (fish traps, stone arrangements, bora rings, mis mias), mythological sites, rock holes, engraved groove channels, contact sites (missions massacres cemeteries) as appropriate

DESCRIPTION OF SITE & CONTENTS.

P/S.6: Surface scatter of stone artefacts (Figs.2,17).

Location: East of the present mouth of Spring Creek, on a small point bounded by the main inlet to the southwest, the mouth of an unnamed creek to the northwest, and a series of rock ledges leading up to the ridge forming H.4 to the east.

Extent: The fairly level part forms a triangle about 40m at the base and extending some 30m out from the rugged slope. At the base there is a low, even rock ledge about 16m wide and 4-8m deep; beyond this the surface is fairly even, part rock ledge, part thin, rocky soil and little above present full supply level. Drowned trees around the point show that it was once the crest of a wider, gradual slope down to Spring Creek.

Description: The site is sparsely wooded with young box. There is no underbrush, only some scrub and sedges along the shore. Five artefacts were noted. Of these, a flake of milky quartz and a flaked piece of yellow quartzite were seen on the rock ledge at the back, the rest (three flakes of milky quartz, grey mudstone and banded chalcedonic silica) were lying on the thin soil in the southern central part of the point. It is unlikely that many more artefacts occur in the thin soil of the site. It was interpreted as similar in character to P/S.5.

Attach sketches etc, eg. plan & section of shelter, show relation between site contents, indicate north, show scale.
Attach annotated photos (stereo where useful) showing scale, particularly for art sites.

NATIONAL PARKS AND WILDLIFE SERVICE

CONSENT TO DESTRO
ISSUED 110001

SITE DESTROYED

NATIONAL PARKS AND WILDLIFE ACT 1974
SECTIONS 86, 87 AND 90

CONSENT AND PERMIT TO SALVAGE

CONSENT TO CARRY OUT THE DESTRUCTION OF AN ABORIGINAL RELIC/PLACE AND PERMIT TO COLLECT AND/OR EXCAVATE FOR THE PURPOSE OF SALVAGE

WHEREAS the Aboriginal relics described in Schedule "A" are situated upon the land described in Schedule "B", and constitute relics within the meaning of Section 90 of the National Parks and Wildlife Act 1974, and WHEREAS application has been made by:

Mr Mark Lau,

of:

Dept Water Resources
PO Box 3720
Parramatta NSW 2150

for CONSENT to destroy those relics in the course of:

enlargement of the Pindari Dam

NOW I, William J. Gillooly Director of National Parks and Wildlife, in pursuance of Section 90 of the said Act, and subject to the conditions hereunder set out DO HEREBY CONSENT to the destruction of the said relics by the said applicant, AND FURTHER, in accordance with the said Conditions and in pursuance of Section 87 of the said Act, I DO HEREBY PERMIT the salvage collection and/or excavation of the said relics from the aforesaid land, prior to destruction of the relics, by Dr. Laila Haglund the qualified person named in the said conditions.

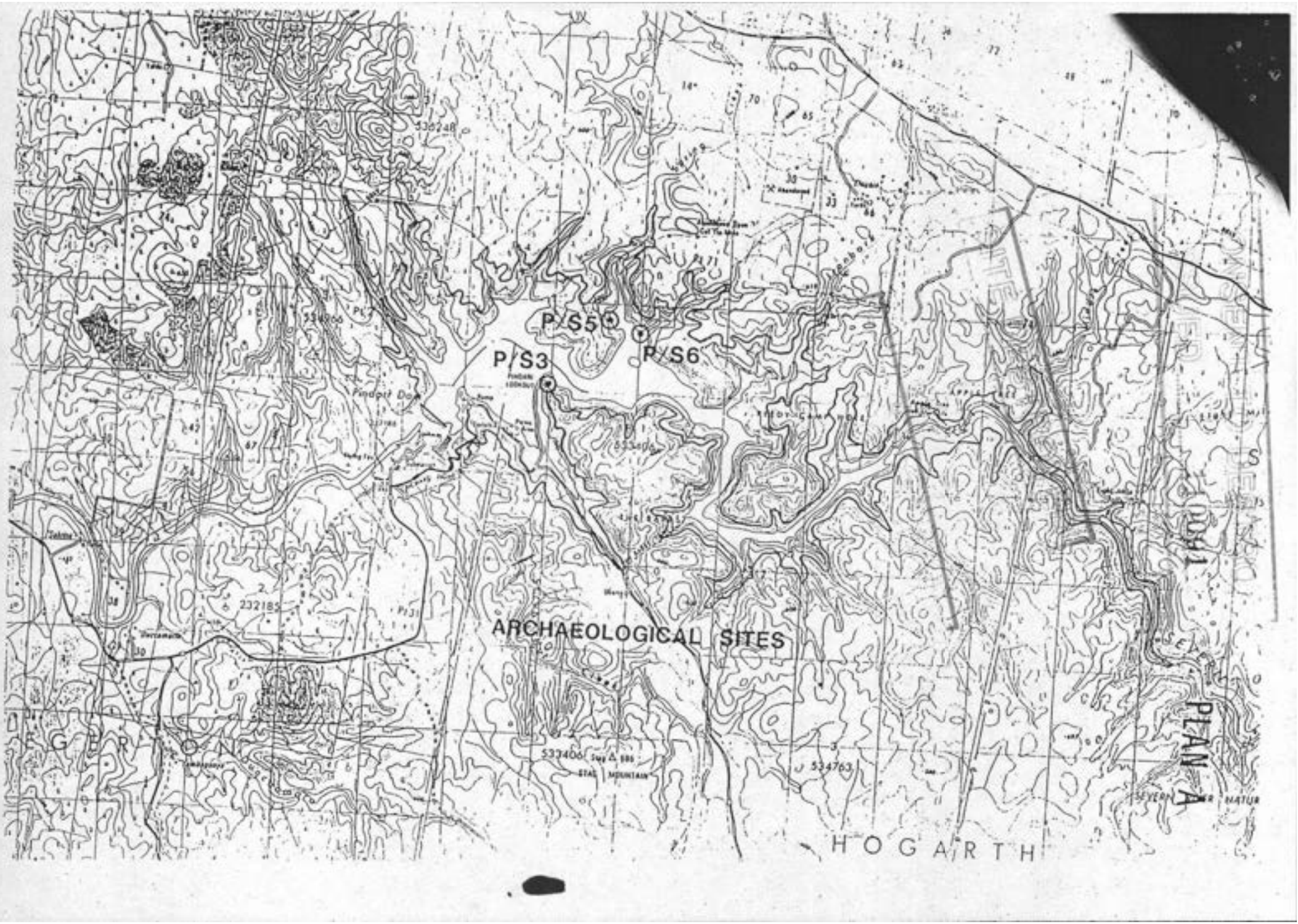
TERMS AND CONDITIONS OF THIS CONSENT

This Consent is issued subject to General Terms and Conditions covering all archaeological Permits and Consents, as well as the Specific Terms and Conditions pertaining to Consents to destroy Aboriginal relics all of which conditions are detailed in the attached pages.

DATED at Sydney this 25th day of October, 1971.

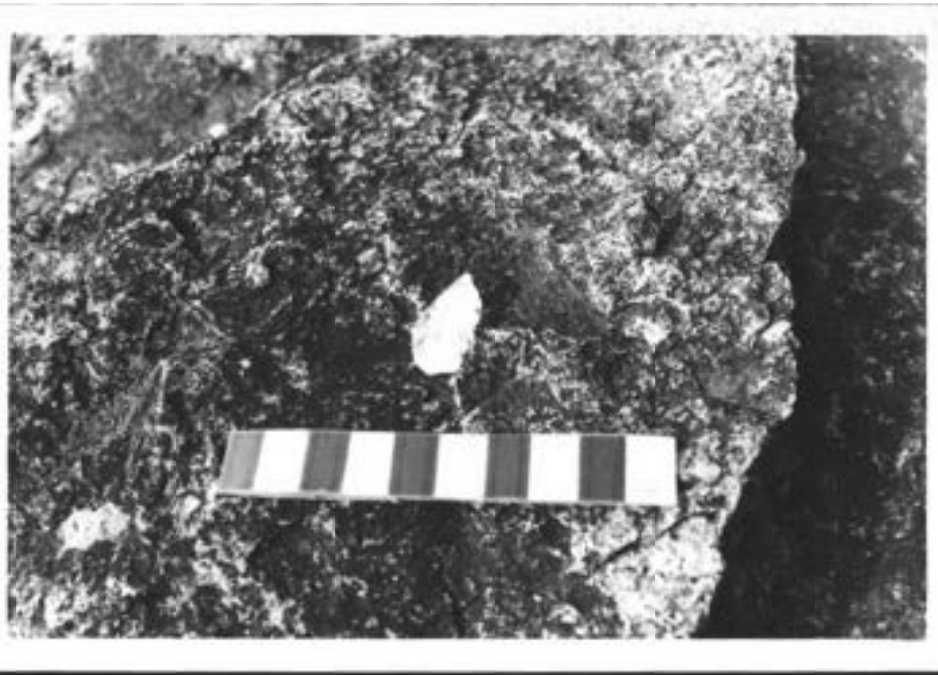
H. Clemens

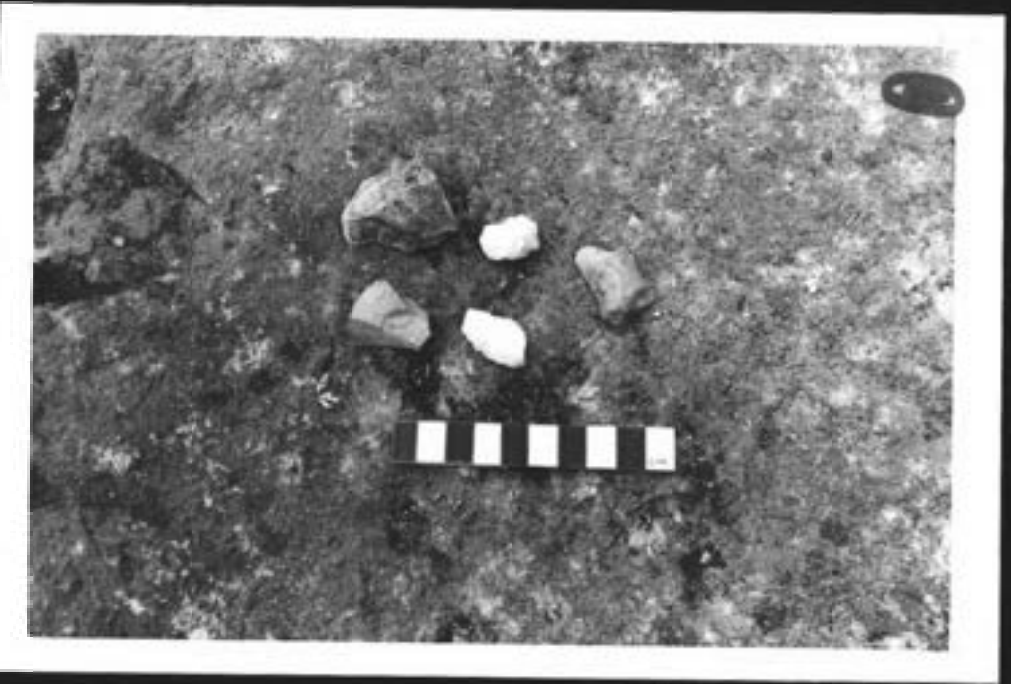
for Director of National Parks and Wildlife

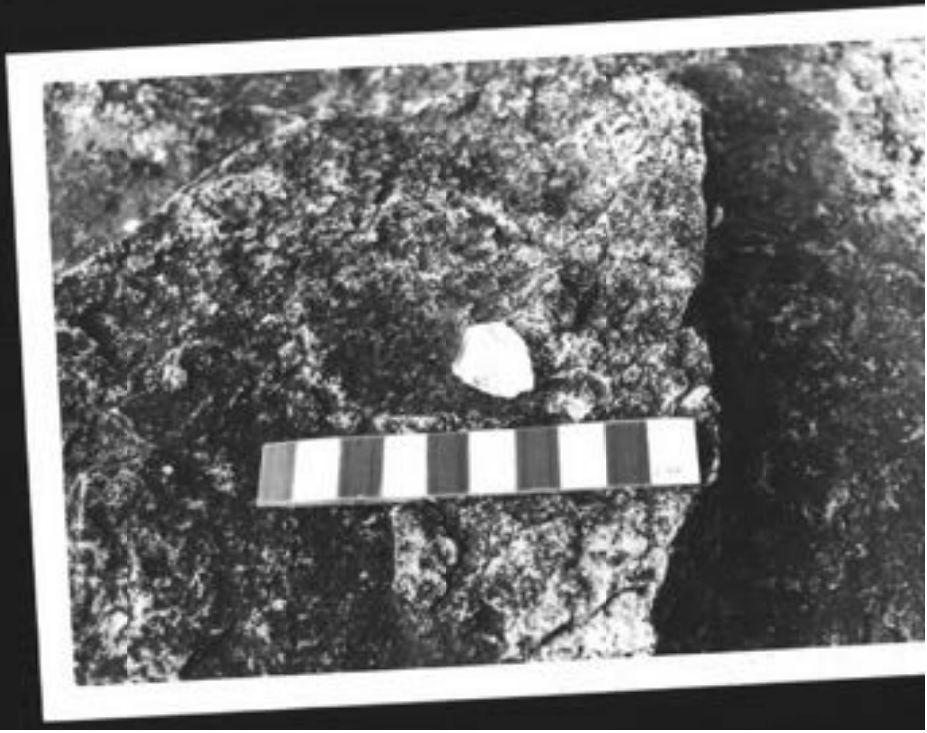

P/S5
P/S6
P/S3
ARCHAEOLOGICAL SITES
DEGRETON
HOGARTH
PLAN A


Proposed Right Bank Spillway
Proposed Left Bank Spillway
P/S 1
P/S 2
P/S 3
P/S 4
P/S 5
P/S 6
P/S 7
P/S 8
P/S 9
S T A N D R E
H O G A R T H
G E R T O N









Appendix 4: Native Title Tribunal Search results

From: Geospatial Search Requests
To: [redacted]

OFFICIAL

Your ref: *211 Finstan Dam DD 1\DP810544* **Our ref:** SR24/1280

Dear [redacted]

Thank you for your search request, please find your results below.

Search Results
The results provided are based on the information you supplied and are derived from a search of the following Tribunal databases:

0. Schedule of Native Title Determination Applications
1. Register of Native Title Claims
2. Native Title Determinations
3. Indigenous Land Use Agreements (Registered and notified)

Results for overlapping native title matters in NSW:

Feature ID	Tenure	Cadastre Data As At	Feature Area SqKm	Overlapping Native Title Feature
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

For more information about the Tribunal's registers or to search the registers yourself and obtain copies of relevant register extracts, please visit our website.

Information on native title claims and freehold land can also be found on the Tribunal's website here: Native title claims and freehold land .

Please note: There may be a delay between a native title determination application being lodged in the Federal Court and its transfer to the Tribunal. As a result, some native title determination applications recently filed with the Federal Court may not appear on the Tribunal's databases.

The search results are based on analysis against external boundaries of applications only. Native title applications commonly contain exclusions clauses which remove areas from within the external boundary. To determine whether the areas described are in fact subject to claim, you need to refer to the "Area covered by claim" section of the relevant Register Extract or Schedule Extract and any maps attached.

Search results and the existence of native title
Please note that the enclosed information from the Register of Native Title Claims and/or the Schedule of Applications is **not** confirmation of the existence of native title in this area. This cannot be confirmed until the Federal Court makes a determination that native title does or does not exist in relation to the area. Such determinations are registered on the National Native Title Register.

The Tribunal accepts no liability for reliance placed on enclosed information
The enclosed information has been provided in good faith. Use of this information is at your sole risk. The National Native Title Tribunal makes no representation, either express or implied, as to the accuracy or suitability of the information enclosed for any particular purpose and accepts no liability for use of the information or reliance placed on it.

If you have any further queries, please do not hesitate to contact us via GeospatialSearch@NNTT.gov.au

Regards;

Geospatial Searches
National Native Title Tribunal | Perth
Email: GeospatialSearch@nntt.gov.au | **www.nntt.gov.au**

From: [redacted]
Sent: Thursday, August 1, 2024 11:30 AM
To: Geospatial Search Requests <GeospatialSearch@NNTT.gov.au>
Subject: SR24/1280 - 211 Native Title Search

Caution: This is an external email. DO NOT click links or open attachments unless you recognise the sender and know the content is safe.

To whom it may concern,

Please find attached request for Spatial Search of Tribunal Registers

Kind Regards
[redacted]

Appendix 5: WaterNSW: Unexpected Finds Procedure

Discovery of Unexpected Aboriginal Objects Procedure

Purpose/Scope
This procedure is to manage the process of discovering, assessing and recording unexpected Aboriginal objects.

Aboriginal objects are physical evidence of the use of an area by Aboriginal people. They can also be referred to as 'Aboriginal sites', 'relics' or 'cultural material'.

Implementation officer	Environmental Services Manager
Relevant to	All staff and contractors that are undertaking works on WaterNSW land or for WaterNSW
Relevant documents	CD2015/40* - Heritage Action Management Plan CD2015/272* - Procedure for Part 5 Environmental Assessment Aboriginal cultural heritage consultation requirements for proponents 2010 (Published by OEH)
Relevant legislation	*National Parks and Wildlife Act 1974 (NPW Act)* *National Parks and Wildlife Regulation 2009* *Environmental Planning and Assessment Act 1979* *Aboriginal Lands Right Act 1983* *Native Title (New South Wales) Act 1994*

1. Procedure

While undertaking investigation, construction or maintenance works, Aboriginal objects may be discovered despite the requirement to screen and identify potential sites as a component of WaterNSW's Environmental Impact Assessment (EIA) process and procedure.

When a discovery of this type occurs, this procedure must be followed unless a procedure has been approved and is in place as part of the conditions of approval of a Project or specific Contractual obligations.

Heritage NSW provide the following information in relation to what classifies as Aboriginal objects:

"*Aboriginal objects are physical evidence of the use of an area by Aboriginal people. They can also be referred to as 'Aboriginal sites', 'relics' or 'cultural material'.*

Aboriginal objects include:

- *physical objects, such as stone tools, Aboriginal-built fences and stockyards, scarred trees and the remains of fringe camps*
- *material deposited on the land, such as middens*

- *the ancestral remains of Aboriginal people.*

Handicrafts made by Aboriginal people for sale are not 'Aboriginal objects' under the *National Parks and Wildlife Act 1974* (NPW Act).

The NPW Act protects Aboriginal objects and Aboriginal places in NSW. Under the NPW Act, it is an offence to do any of the following things without an exemption or defence provided for under the NPW Act (penalties apply):

- A person must not knowingly harm or desecrate an Aboriginal object.
- A person must not harm or desecrate an Aboriginal object or Aboriginal Place (strict liability).

Harm includes destroy, deface or damage of Aboriginal object or Aboriginal Place, and in relation to an object, move the object from the land on which it has been situated.

Under s.89A of the NPW Act a person who finds an Aboriginal object not already recorded on the Aboriginal Heritage Information Management System (AHIMS) is legally bound to notify Heritage NSW as soon as possible of the object's location. This will be done by the qualified archaeologist engaged by WaterNSW to assess the Aboriginal object or other persons as agreed by WaterNSW

1.1 Assessment and management of an unexpected Aboriginal Object

Should the following be identified during any works:

- an unexpected Aboriginal object (either above ground or archaeological), or
- any skeletal remains suspected of being human.

Works should cease immediately at the site and in the vicinity of the object. Do not further move or disturb the object and follow the procedure outlined in Figure 1.1.

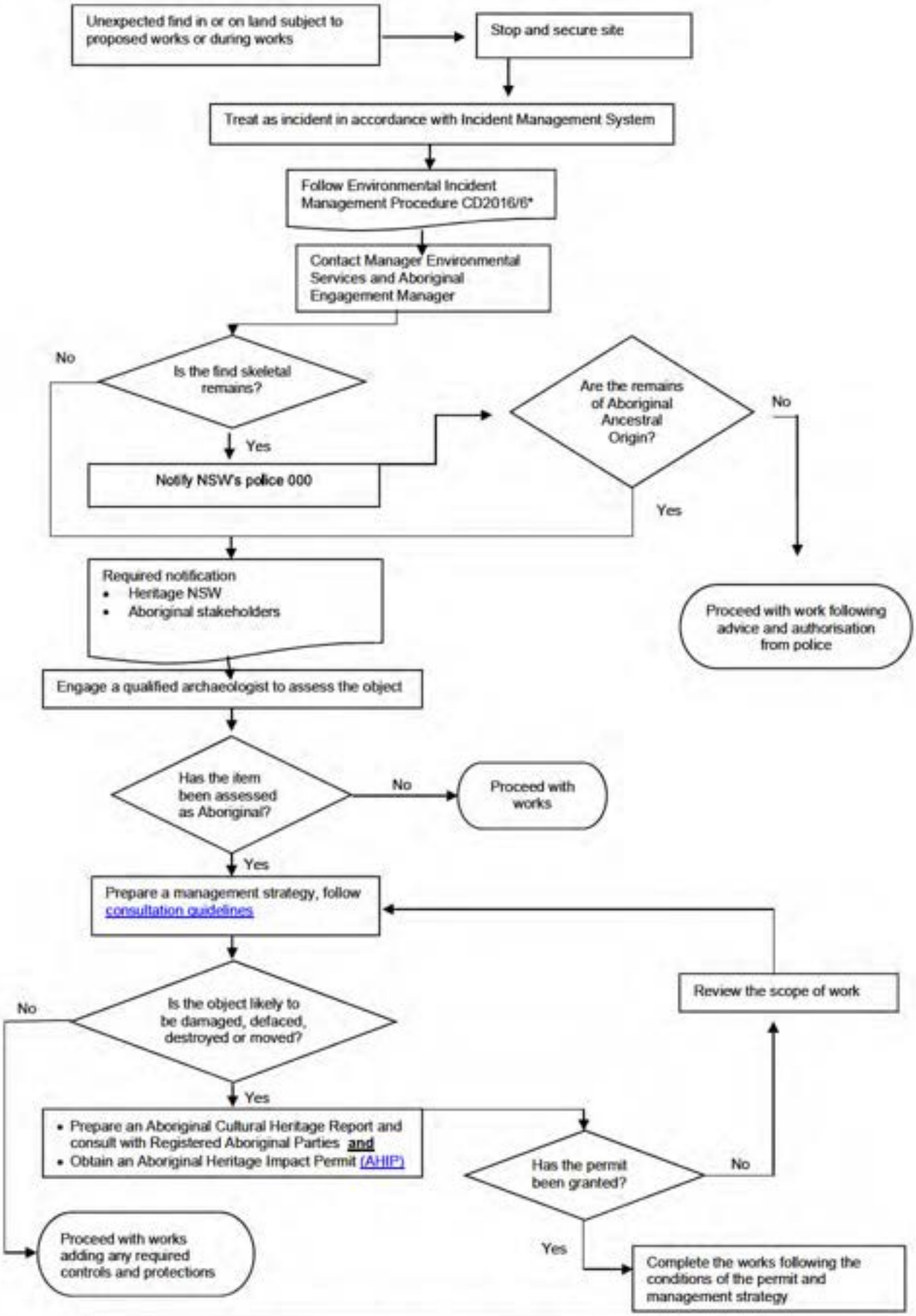
2. Monitoring, Evaluation and Review and Review History

Outcome: How does this procedure deliver against the purpose and scope?	
Monitoring	Application of procedure if unexpected Aboriginal object is discovered by WaterNSW staff or contractor during works
Evaluation and Review	Low Risk – 3 yearly
Review History	Minor change

3. Approval

JOSH ST CLAIR
Manager Health Safety and Environment

Figure 1.1: Discovery of an Unexpected Aboriginal Cultural Object Process



Appendix F

Statement of Heritage Impact



View east across the wall of Pindari Dam.

STATEMENT OF HERITAGE IMPACT

PINDARI DAM BUBBLE PLUME PROJECT

INVERELL SHIRE LOCAL GOVERNMENT AREA

FEBRUARY 2025

Report prepared by

OzArk Environment & Heritage

for WSP Australia Pty Ltd

on behalf of Water NSW

OzArk
Environment & Heritage

145 Wingewarra St
(PO Box 2069)
Dubbo NSW 2830

Phone: (02) 6882 0118
Fax: (02) 6882 0630
enquiry@ozarkehm.com.au
www.ozarkehm.com.au

This page has intentionally been left blank.

DOCUMENT CONTROLS

Proponent	Water NSW
Document Description	WSP Australia Pty Ltd
File Location	OzArk Job No.
Clients \ WSP Parsons Brinkerhoff \ Pindari Dam Plume Bubble_heritage_March 2024 \ SoHI	4147

Document Status: V3.1 FINAL	Date: 4 February 2025
Draft V1: OzArk internal edits	V1.0 EM author 28/6/24 V1.1: BC edit 13/10/24
Draft V2: OzArk and client edits	N/A
Final V3: Final document	V3.0 OzArk finalised 14/10/24 V3.1 OzArk edit 4/2/25

Prepared for	Prepared by
Alex Garrett Senior Environmental Scientist WSP Australia Pty Limited Level 2, 121 Marcus Street Canberra ACT 2601 0449 253 999 Alex.Garrett@wsp.com	Eleanore Martin Archaeologist OzArk Environment & Heritage 145 Wingewarra Street (PO Box 2069) Dubbo NSW 2830 02 6882 0118 eleanore@ozarkehm.com.au

COPYRIGHT

© OzArk Environment & Heritage 2025 and © WSP Australia Pty Ltd 2025 and Water NSW 2025

All intellectual property and copyright reserved.

Apart from any fair dealing for private study, research, criticism, or review, as permitted under the Copyright Act, 1968, no part of this report may be reproduced, transmitted, stored in a retrieval system, or adapted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise) without written permission.

Enquiries should be addressed to OzArk Environment & Heritage.

Acknowledgement

OzArk acknowledge the Traditional Custodians of the area on which this assessment took place and pay respect to their beliefs, cultural heritage, and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the Elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

EXECUTIVE SUMMARY

OzArk Environment & Heritage (OzArk) has been engaged by WSP Australia Pty Ltd (the client) on behalf of Water NSW (the proponent) to complete a Statement of Heritage Impact (SOHI) for The Pindari Dam Bubble Plume project (the proposal). The proposal is within the Inverell Shire Local Government Area. The SOHI is necessitated by items near the project being listed under Section 170 of the *Heritage Act 1977* on the Transport for NSW Heritage and Conservation Register.

An inspection of the proposed work area and adjacent heritage listed item was completed by OzArk Archaeologist, Eleanore Martin, on 21 May 2024.

Adjacent to the project area is an s170 registered item, Pindari Dam (item # 4550170), which is not listed as a heritage item on the State Heritage Register (SHR) or Inverell Shire Local Environmental Plan.

The proposed works involve the installation of pumps, power, and infrastructure to generate bubble plumes in the lower layers of the water catchment at Pindari dam. The bubble plumes will allow for the artificial destratification of the dam's water layers in an order to reduce algae blooms, resolve cold water pollution and increase water quality.

The assessment has concluded that the project will have no negative impacts on the heritage significance of Pindari Dam. The following recommendations are made to minimise the impacts to the heritage significance of the Dam:

1) As it is assessed the works will not adversely affect the heritage significance of the item, Council consent is not required. The *State Environmental Planning Policy (Transport and Infrastructure) 2021* (Section 2.11) also removes the obligation to consult with the Inverell Shire Council.

2) Although the risk of impacting significant archaeological remains has been assessed as low, the WaterNSW *Unanticipated Finds Protocol* must be followed if suspected significant historic artefacts are identified.

CONTENTS

EXECUTIVE SUMMARY III

1 INTRODUCTION 1

1.1 Brief description of the proposal 1

1.2 Assessment approach 2

1.3 Project area 2

1.4 Heritage items adjacent to the proposal 5

1.4.1 Pindari Dam 5

2 LEGISLATIVE REQUIREMENTS 10

2.1 Applicable Legislation 10

2.1.1 Heritage Act 1977 10

2.1.2 *Environmental Planning and Assessment Act 1979* 10

2.1.3 *Environment Protection and Biodiversity Conservation Act 1999* 10

2.1.4 Inverell Local Environmental Plan 2012 11

2.1.5 Inverell Development Control Plan 2013 11

2.1.6 *State Environmental Planning Policy (Transport and Infrastructure) 2021* 11

2.1.7 *Section 170 Heritage and Conservation Register* 11

2.1.8 Applicability to the proposal 12

3 HISTORICAL BACKGROUND 12

3.1 Brief History of the project area 12

4 SIGNIFICANCE ASSESSMENT 12

4.1 Statement of significance 12

4.2 Discussion 13

5 HERITAGE IMPACT ASSESSMENT 13

5.1 Proposed works 13

5.2 Archaeological Assessment 13

5.3 Impact assessment 16

5.3.1 Fabric and spatial arrangements 16

5.3.2 Settings, views, and vistas 16

5.3.3 Landscape 16

5.3.4 Use 17

5.3.5 Demolition 17

5.3.6 Curtilage 17

5.3.7 Moveable heritage 17

5.3.8 Aboriginal cultural heritage 17
5.3.9 Historical archaeology 18
5.3.10 Natural heritage 18
5.3.11 Conservation areas 18
5.3.12 Cumulative impacts 18
5.4 Considerations for specific works – works adjacent to a heritage item 18
6 SUMMARY AND RECOMMENDATIONS 19
6.1 Summary 19
6.2 Recommendations 19
REFERENCES 20

FIGURES

Figure 1-1: Map showing the location of the proposal. 1
Figure 1-2: Aerial showing the project area. 3
Figure 1-3: Project design with ecological study area overlay (as provided by WSP in October 2024). 4
Figure 1-4: View northwest across the concrete face of the dam wall from the publicly accessible area to the east. 6
Figure 1-5: View east across the top of the dam wall. 6
Figure 1-6: View east across the back of the dam wall. 7
Figure 1-7: View northwest across to the northern extent of the spillway 7
Figure 1-8: View south at the power station and flow release through the left abutment of the dam. 8
Figure 1-9: View south at part of the hydroelectricity station associated with Pindari Dam. 8
Figure 1-10: View south at the Severn River water release area. 9
Figure 1-11: View southeast at the concrete face of the dam wall and Lake Pindari 9
Figure 5-1: Historic and recent aerials with an overlay of the project area. 15
Figure 5-2: Parish maps with an overlay of the project area. 16

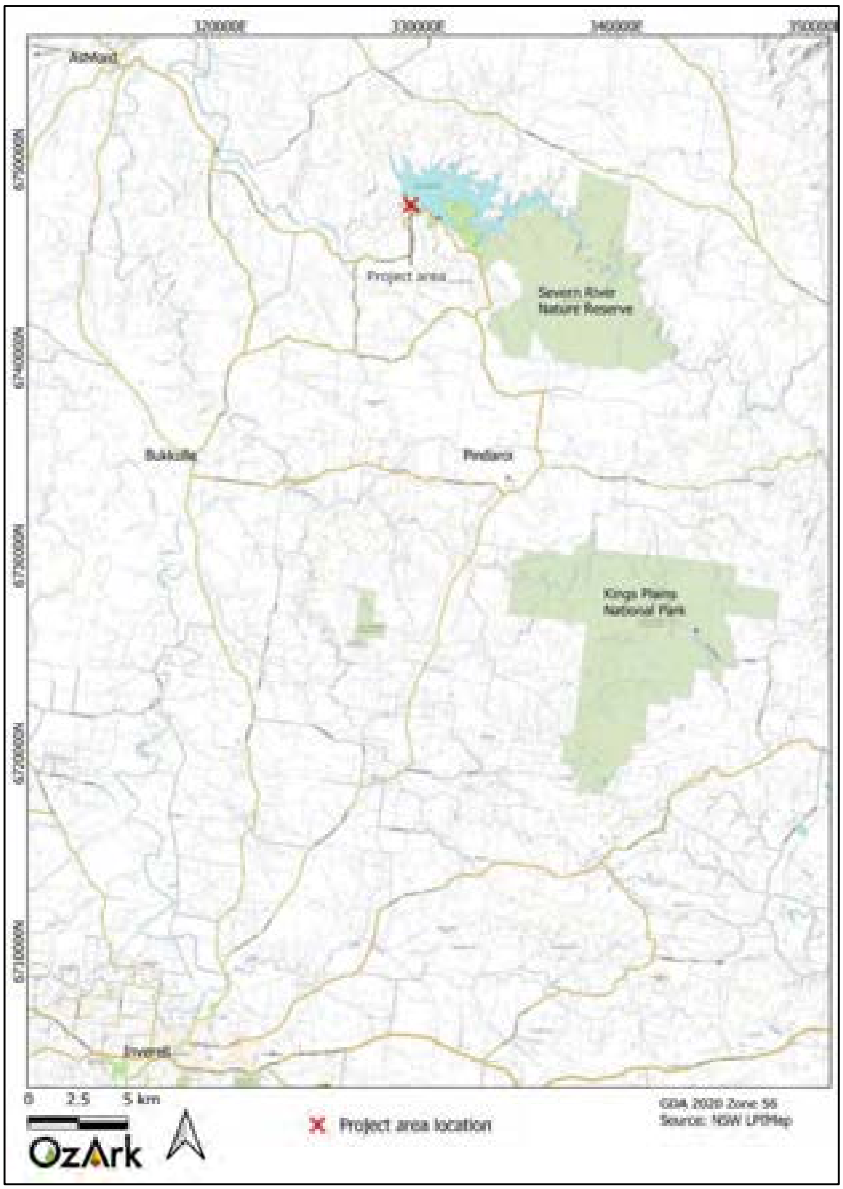
1 INTRODUCTION

1.1 BRIEF DESCRIPTION OF THE PROPOSAL

OzArk Environment & Heritage (OzArk) has been engaged by WSP Australia Pty Ltd (the client) on behalf of Water NSW (the proponent) to complete a Statement of Heritage Impact (SOHI) for The Pindari Dam Bubble Plume project (the project). The project is within the Inverell Shire Local Government Area (LGA). The SOHI is necessitated by items near the project being listed under Section 170 of the *Heritage Act 1977* (Heritage Act) on the Transport for NSW Heritage and Conservation Register.

An inspection of the proposed work area and adjacent heritage listed item was completed by OzArk Archaeologist, Eleanore Martin, on 21 May 2024.

Figure 1-1: Map showing the location of the proposal.



1.2 ASSESSMENT APPROACH

The SOHI will apply the *Guidelines for preparing a statement of heritage impact* (DPE 2023a). The International Council on Monuments and Sites' *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (Burra Charter), and the guide for *Assessing heritage significance. Guidelines for assessing places and objects against the Heritage Council of NSW criteria* (DPE 2023b).

1.3 PROJECT AREA

The project area, at the time of the heritage inspection, comprised an approximate 3.1 ha area of undulating terrain adjacent to the Pindari Dam wall, at Lot 1 DP232186 and Lot 31 DP914703, Pindaroi NSW (**Figure 1-2**).

Since the heritage inspection, the project's impact area has been finalised and includes sections of the northern spillway and the existing road east of the WaterNSW office which were not inspected (see **Figure 1-3**). Based on photographs and aerial imagery, the additional areas of impact do not appear to contain existing structures with heritage potential and as such, do not alter the findings of the report. As there is little variation to the findings of the report, the conceptual project area has been retained within figures throughout the report.

The project area is situated approximately 14.5 kilometres (km) northwest of Pindaroi, 16 km southeast of Ashford, and 44.6 km northeast of Inverell. It is noted the design of the project extends into Pindari Lake, however, sections within the lake will not be assessed in this report.

Figure 1-2: Aerial showing the project area.



Figure 1-3: Project design with ecological study area overlay (as provided by WSP in October 2024).



1.4 HERITAGE ITEMS ADJACENT TO THE PROPOSAL

Adjacent to the project area is Pindari Dam, item number 4550170 of the Water NSW Section 170 Heritage and Conservation Register (s170 Register).

1.4.1 Pindari Dam

The construction of Pindari Dam (the Dam) was first started in 1967 and was completed in 1969. The dam consisted of a rock fill wall reinforced with a concrete face and an unlined rock spillway with rock walls either side (see **Section 5.2**).

Modifications to the Dam started in 1992 and were completed in 1994. These modifications included expansions to the dam wall which incorporated the original spillway (**Figure 1-5** and **Figure 1-6**) and the establishment of a new unlined spillway on the northwest bank (**Figure 1-7**). The height of the dam wall was doubled from its original 45 meters (m) which increased the storage capacity of the dam to over eight times its original size. To support the new storage capacity, the dam embankment height was raised by 40 m. Additional works included the construction of a 5 m diversion tunnel through the left abutment (**Figure 1-8**), auxiliary outlet works, and the expansion of existing outlet works.

The Dam consists of a rock fill with reinforced concrete face wall (**Figure 1-5**) and an ungated unlined rock cut spillway (**Figure 1-7**). The Dam supports a maximum storage capacity of 312,000 megalitres and its main function is to supply regulated water flows for irrigation, stock, households, town, and industrial purposes along the Severn and MacIntyre Rivers upstream of the Dumaresq River Junction. In addition to its primary function, the Dam supplies water to streams serviced by the Boomi River Trust, supplements supply to NSW irrigators along the Border River, provides power to Ashford via a hydroelectricity station on land immediately south of the dam wall (**Figure 1-9**), and is a recreational area for the public.

The Dam is located on the Severn River (**Figure 1-10**). The Dam catchment zone, situated north of the dam wall, is known as Lake Pindari (also referred to as Lake Coulton; **Figure 1-11**). The catchment zone is fed by the Severn River and several named watercourses, including Springy Creek, Ironbark Creek, and Middle Creek.

Figure 1-4: View northwest across the concrete face of the dam wall from the publicly accessible area to the east.



Figure 1-5: View east across the top of the dam wall.



Figure 1-6: View east across the back of the dam wall.



Figure 1-7: View northwest across to the northern extent of the spillway.



Figure 1-8: View south at the power station and flow release through the left abutment of the dam.



Figure 1-9: View south at part of the hydroelectricity station associated with Pindari Dam.



Figure 1-10: View south at the Severn River water release area.



Figure 1-11: View southeast at the concrete face of the dam wall and Lake Pindari.



2 LEGISLATIVE REQUIREMENTS

2.1 APPLICABLE LEGISLATION

2.1.1 Heritage Act 1977

The Heritage Act is applicable to the current assessment. This Act established the Heritage Council of NSW (the Heritage Council). The Heritage Council's role is to advise the government on the protection of heritage assets, make listing recommendations to the Minister in relation to the SHR, and assess/approve/decline proposals involving modification to heritage items or places listed on the SHR. Most proposals involving modification are assessed under Section 60 of the Heritage Act.

Automatic protection is afforded to 'items' of state or local significance, where items mean a place, building, work, relic, moveable object, or precinct. 'Relics' are defined as 'any deposit or material evidence relating to the settlement of the area that comprised New South Wales, not being Aboriginal settlement, and which holds state or local significance'. Excavation of land on which it is known or where there is reasonable cause to suspect that 'items' will be exposed, moved, destroyed, discovered, or damaged is prohibited unless approved under an excavation permit.

2.1.2 Environmental Planning and Assessment Act 1979

The primary law regulating land use in NSW is the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Act is administered by the NSW Department of Planning, Housing and Infrastructure (DPHI). The Minister for Planning and Public Spaces is responsible for the Act.

The EP&A Act allows plans to be made to guide the process of development and to regulate competing land uses.

These are known as environmental planning instruments (EPIs).

The EP&A Act allows two types of EPIs to be made:

- Local Environmental Plans (LEPs)
- State environment planning policies (SEPPs).

2.1.3 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), administered by the Commonwealth Department of Climate Change, Energy, the Environment and Water, provides a framework to protect nationally significant flora, fauna, ecological communities, and heritage places. The EPBC Act establishes both a National Heritage List and Commonwealth Heritage List of protected places.

2.1.4 Inverell Local Environmental Plan 2012

Pindari Dam is not a listed item on the Inverell LEP 2012.

2.1.5 Inverell Development Control Plan 2013

As the project area is not situated within any of the five identified heritage conservation areas, the Inverell Development and Control Plan 2013 (IDCP) is not applicable to this project.

2.1.6 *State Environmental Planning Policy (Transport and Infrastructure) 2021*

The *State Environmental Planning Policy (Transport and Infrastructure) 2021* (Transport and Infrastructure SEPP) notes that works to a locally listed item or works occurring in a heritage conservation area that will create more than a minor or inconsequential impact must have the impact assessed and written notice provided to the relevant council.

Specifically, the requirement to notifying Councils 21 days prior to the commencement of works is set out in Section 2.11 of the Transport and Infrastructure SEPP:

> *Section 2.11: Consultation with councils—development with impacts on local heritage*
>
> *(1) This section applies to development carried out by or on behalf of a public authority if the development—*
>
> *(a) is likely to affect the heritage significance of a local heritage item, or of a heritage conservation area, that is not also a state heritage item, in a way that is more than minor or inconsequential*
>
> *(b) is development that this Chapter provides may be carried out without consent.*
>
> *(2) A public authority, or a person acting on behalf of a public authority, must not carry out development to which this section applies unless the authority or the person has—*
>
> *(a) had an assessment of the impact prepared*
>
> *(b) given written notice of the intention to carry out the development, with a copy of the assessment and a scope of works, to the council for the area in which the heritage item or heritage conservation area (or the relevant part of such an area) is located*
>
> *(c) taken into consideration any response to the notice that is received from the council within 21 days after the notice is given.*

2.1.7 Section 170 Heritage and Conservation Register

The s170 Register records heritage assets of NSW state government agencies and was established under the Heritage Act. NSW state government agencies have a responsibility to ensure that items listed on their s170 Registers are 'maintained with due diligence'.

Government agencies are required to give 14-days' notice to the Heritage Council under s170A(1) before removing an item from the Register, transferring ownership of an item, or demolishing an item.

2.1.8 Applicability to the proposal

- There are no heritage 'matters of national environmental significance' in the project area that would require referral to the minister under the EPBC Act.
- The works will be approved under Part 5 of the EP&A Act.
- Any significant heritage values associated with Pindari Dam that may be within the project area are protected under the Heritage Act.
- Pindari Dam, which is situated in landforms adjacent to the project area, is listed on the WaterNSW s170 Register (within the State Heritage Inventory [SHI]) although has been recommended for removal from the SHI.

3 HISTORICAL BACKGROUND

3.1 BRIEF HISTORY OF THE PROJECT AREA

John Oxley first explored the lower Inverell region in 1818 (Haglund 1984). The land north of Oxley's expedition was later explored by Allan Cunningham in 1827 (Wiedemann 1981). Cunningham's expedition formed part of an exploration into the land north of Oxley's (1818) line in attempt to establish an inland route from Scone to Moreton Bay (Wiedemann 1981: 17). According to Cunningham's journals, the exploration party passed over the Severn River, which flows through the current project area, near Ashford on July 4th. Cunningham was not impressed with the Ashford area as it had poor soils for agricultural development and lacked water availability (Wiedemann 1981: 19).

Little information is publicly available regarding the history of project area and the only accessible information is contained within the s170 Register item listing. According to the listing, Pindari Dam was established on land used as an early pastoral run, one of which was named Pindari, meaning 'high rock'. Records indicate that the area was used as pastoral/grazing lands until the dam was built in the mid to late 1960s.

4 SIGNIFICANCE ASSESSMENT

4.1 STATEMENT OF SIGNIFICANCE

Pindari Dam has been assessed as significant due to its contribution to the community of Inverell in the form of providing employment opportunity, for its social and recreational uses, for revitalising the local economy, supplying the agricultural industry with a reliable water source, and

for its connection to a select group of farmers who were involved in partially funding past expansion works. The dam's seamless concrete facing to minimise leakage was an innovative design unique to the Pindari Dam's construction, and as such was attributed some research significance from a design perspective. It is noted that the dam was recommended for removal from the s170 Register.

The dam has minor significance at a local level.

4.2 DISCUSSION

The statement of significance completed for Pindari Dam identifies the architectural merits, aesthetic values, and economic and social contribution as the significant heritage elements of the heritage item, as well as the historic association with a small selection of un-named local farmers.

The dam also has contributary value as a major water storage and supply facility for both NSW and south-east Queensland.

5 HERITAGE IMPACT ASSESSMENT

5.1 PROPOSED WORKS

The proposed works involve the installation of pumps, power, and infrastructure to generate bubble plumes in the lower layers of the water catchment at Pindari dam. The bubble plumes will allow for the artificial destratification of the dam's water layers in an order to reduce algae blooms, resolve cold water pollution and increase water quality.

The project is located on landforms adjacent to the existing dam wall at Pindari Dam, Ashford NSW (**Figure 1-2**). The proposed works will not impact any existing structures, including the dam and power generating facilities, however, may partially impact associated roads. Aside from the dam itself, the remaining structures do not appear to have historical, social, aesthetic, or scientific values, although they do support the function and maintenance of the dam.

5.2 ARCHAEOLOGICAL ASSESSMENT

The land on which the bubble plume infrastructure is proposed to be built comprises of undulating terrain with artificial terracing in the north, steep slopes in the centre, and river flats in the south. The project area intersects the Severn River in the south and is situated in landforms adjacent to Scrub Hut Creek. Existing structures within the project area consist of two sealed vehicle tracks, the Pindari hydro-power station and associated water release channel and infrastructure, and infrastructure associated with the storage facility. Most of the existing buildings and structures are situated in the southern half of the project area.

Historical imagery from 1990 compared to an aerial from 1993 and recent aerial imagery indicates that there has been significant modification to the dam and surrounding landforms, including the

project area (**Figure 5-1**). The imagery demonstrates an intensification of water management operations and land use within the project area and surrounds between 1990 and 1993. Between 1993 and recent aerials, it appears that little variation to the land use or appearance has been altered, except on the steep slope landforms where vegetation has been allowed to regrow (**Figure 5-1**).

Maps of the County of Arrawatta Central and Eastern Regions suggest that the project area was situated across the junction between Egerton, Lockerby and Hogarth parishes (**Figure 5-2**). The Parish maps suggest that the catchment area of the dam was partially situated in an area intended for mining purposes, as notified on 28th October 1908. However, the project area and dam wall were situated on a separate lot which was intersected by three unnamed watercourses and utilised for an undocumented purpose. The parish maps are detailed and indicate the presence of structures (where present). In relation to the project area, the parish maps suggest that no historic structure was present.

There is no evidence to suggest the existence of a previous substantial structure within the project area. Therefore, there is low potential for archaeological features or deposits relating to any former structures.

Figure 5-1: Historic and recent aerials with an overlay of the project area.

	1990 aerial showing the original dam constructed in 1969 with an overlay of the project area.
	1993 aerial showing the construction phase of the dam expansion works with an overlay of the project area.
	2024 aerial of Pindari Dam with an overlay of the project area.

Figure 5-2: Parish maps with an overlay of the project area.



5.3 IMPACT ASSESSMENT

The following section addresses the matters for consideration outlined in the SoHI guidelines (DCCEEW 2023).

5.3.1 Fabric and spatial arrangements

The proposed works will not directly impact the existing Pindari Dam and as such there is no risk of harm to the fabric or heritage value of the item.

5.3.2 Settings, views, and vistas

The project is situated on restricted access land owned by WaterNSW adjacent to Pindari Dam wall and used to monitor and maintain the dam water levels. The dam wall is visible from multiple locations around the edge of Pindari Lake, however, the project area itself can only be viewed in entirety from the top of the dam wall at the eastern-most extent.

5.3.3 Landscape

There will be a localised impact to landscape features directly associated with the dam wall. This will likely include the removal and trimming of extant vegetation.

5.3.4 Use

The project will not alter the structure of Pindari Dam and aims at improving its function by increasing the quality of its output through minor alterations within the water catchment zone. The proposed works are situated on land owned and maintained by Water NSW which are not publicly accessible and as such the proposed works are unlikely to inhibit the public enjoyment of the space. As such, the long-term community use of the landscape will remain unchanged.

5.3.5 Demolition

The project does not involve demolition, partial or whole, of any structures and as such this matter of consideration is not applicable.

5.3.6 Curtilage

The project will not impact existing structures or heritage items, however, will impact several clusters of vegetation on the slope landform and spillway. The vegetation dominantly comprises of small trees, with some mid-level shrubs on the steep slope landform associated with the dam wall. The trees are primarily regrowth vegetation, as evidenced by their absence from the historic aerial from 1990 (see **Figure 5-1**) when the stone quarry and dam expansion works were occurring. However, a small cluster of extant vegetation, including mature grass trees, remain on the upper slope landform in the centre of the project area. The project will potentially impact this small patch of extant vegetation.

It is noted that most of the natural landscape, except the steep slope landform, within the project area has been irreversibly altered through artificial levelling, terracing, and channelling associated with the function of the dam wall.

Overall, the project will not impact the historical or built landscape of Pindari Dam, however, will impact small portions of the natural landscape of the project area.

5.3.7 Moveable heritage

No items of moveable are listed in association with heritage were identified within the project area during the visual inspection and as such this matter of consideration is not applicable.

5.3.8 Aboriginal cultural heritage

There are no known Aboriginal objects or previously recorded Aboriginal sites situated in the project area (Haglund 1984; OzArk 2024). Furthermore, Haglund completed an Aboriginal heritage assessment of the project area in 1984, and it was determined that due to the steep topography and degree of modification to soils within the project area, the potential for archaeological material to be identified was low. A visual inspection conducted by OzArk Archaeologist, Eleanore Martin, on 21 May 2024 confirmed that no Aboriginal objects were

present and similarly assessed that the project area was unlikely to contain archaeological material (OzArk 2024).

5.3.9 Historical archaeology

The project area has been subject to a variety of landscaping activities. These landscaping activities include vegetation clearing, artificial terracing to develop a spillway in the north, stone quarrying on the hill crest, the interruption of the Severn River in the south through the construction of the dam, the establishment of a channel to release water from the dam back into the Severn River and levelling the south. Due to these disruptions to the natural landscape, the original soils have been entirely removed or replaced by introduced materials. As such, there is very low potential for subsurface archaeological material to be present within the project area.

5.3.10 Natural heritage

Pindari Dam is not listed as a place containing natural heritage values and as such this matter of consideration is not applicable.

5.3.11 Conservation areas

The Inverell Shire DCP (2013) does not list Pindari dam as a conservation area and as such this matter of consideration is not applicable.

5.3.12 Cumulative impacts

There will be no cumulative impacts as the value and function of Pindari Dam as a water storage facility will be maintained and improved by the project.

5.4 CONSIDERATIONS FOR SPECIFIC WORKS – WORKS ADJACENT TO A HERITAGE ITEM

Will the proposed works affect the heritage significance of the adjacent heritage item or the heritage conservation area?

The heritage significance of the dam is primarily attributed to its function as a water storage facility, which fuels its economic value and provides the area with water security, and for its monetary connection to a small collection of local farmers. As the wall of the dam will not be impacted by the project, the connection to local farmers will remain intact and unchanged. As for its function as a water storage facility, the project aims to resolve environmental issues associated with the dam and improve water quality. The project will therefore improve the function of the dam and as a result add to its perceived value. This suggests that the proposed works are compliant with Article 22 of the *Burra Charter* (*Australia* ICOMOS 2013).

Will the proposed works affect views to, and from, the heritage item? If yes, how will the impact be mitigated?

The proposed works will not interact with the dam wall itself and therefore will not directly impact the aesthetics of the structure. However, the project will likely be visible from the publicly accessible side of the dam wall (the east) and will be viewed in association with the structure. Currently, from the east bank a road and spillway are visible where the project will be situated. As such, the proposed works are not likely to detract from, or contribute to, the current visual landscape.

Will the proposed works impact on the integrity or the streetscape of the heritage conservation area?

As discussed above, the project will be visible by the public, however, is situated on a heavily modified landform with no obvious visual appeal. As such the project is unlikely to contribute or detract from the visual landscape and will not obscure the view of the heritage item.

6 SUMMARY AND RECOMMENDATIONS

6.1 SUMMARY

The project will be completed in land adjacent to Pindari Dam which is a heritage item of local significance listed on the Water NSW Section 170 Heritage and Conservation Register. The project area contains facilities and structures associated with the dam which are not listed as heritage items but are integral to the function and therefore value of the item. Pindari Dam is not an SHR or LEP as an item of heritage significance.

The project will involve the installation of pumps, power and infrastructure to generate bubble plumes. The project will not alter the dam itself and will improve the overall function of the structure by reducing environmental pollutants and improving water quality. The project will not harm the heritage values of the item which are attached to the 1994 extensions of the dam wall.

6.2 RECOMMENDATIONS

The assessment has concluded that the project will have no negative impacts on the heritage significance of Pindari Dam. The following recommendations are made to minimise the impacts to the heritage significance of the Dam:

1) As it is assessed the works will not adversely affect the heritage significance of the item, Council consent is not required. The *State Environmental Planning Policy (Transport and Infrastructure) 2021* (Section 2.11) also removes the obligation to consult with the Inverell Shire Council.
2) Although the risk of impacting significant archaeological remains has been assessed as low, the WaterNSW *Unanticipated Finds Protocol* must be followed if suspected significant historic artefacts are identified.

REFERENCES

Burra Charter — *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*. International Council on Monuments and Sites. 2013.

DPE 2023a — *Guidelines for preparing a statement of heritage impact.* Department of Planning and Environment. 2023.

DPE 2023b — *Assessing heritage significance. Guidelines for assessing places and objects against the Heritage Council of NSW criteria*. Department of Planning and Environment. 2023.

Haglund 1984 — Haglund, L. 1984. *Archaeological survey of the proposed Pindari Dam extension and associated works*. Report to: Water Resources Commission of New South Wales.

Horton 1996 — Horton, D. 1996. *The AIATIS Map of Indigenous Australia*. The Australian Institute for Aboriginal and Torres Strait Islander Studies, Canberra.

Tindale 1974 — Tindale, N. 1974, *Aboriginal Tribes of Australia: Their Terrain, Environmental Controls, Distribution, Limits, and Proper Names*, Australian National University Press, Canberra.

Wiedemann 1981 — Wiedemann, E. 1981. *World of its own: Inverell's early years, 1827-1920*. Devill Publicity Inverell, NSW.

Appendix G

WaterNSW Unexpected Aboriginal Objects Procedure

Discovery of Unexpected Aboriginal Objects Procedure

Purpose/Scope
This procedure is to manage the process of discovering, assessing and recording unexpected Aboriginal objects.

Aboriginal objects are physical evidence of the use of an area by Aboriginal people. They can also be referred to as 'Aboriginal sites', 'relics' or 'cultural material'.

Implementation officer	Environmental Services Manager
Relevant to	All staff and contractors that are undertaking works on WaterNSW land or for WaterNSW
Relevant documents	CD2015/40* - Heritage Action Management Plan CD2015/272* - Procedure for Part 5 Environmental Assessment Aboriginal cultural heritage consultation requirements for proponents 2010 (Published by OEH)
Relevant legislation	*National Parks and Wildlife Act 1974 (NPW Act)* *National Parks and Wildlife Regulation 2009* *Environmental Planning and Assessment Act 1979* *Aboriginal Lands Right Act 1983* *Native Title (New South Wales) Act 1994*

1. Procedure

While undertaking investigation, construction or maintenance works, Aboriginal objects may be discovered despite the requirement to screen and identify potential sites as a component of WaterNSW's Environmental Impact Assessment (EIA) process and procedure.

When a discovery of this type occurs, this procedure must be followed unless a procedure has been approved and is in place as part of the conditions of approval of a Project or specific Contractual obligations.

Heritage NSW provide the following information in relation to what classifies as Aboriginal objects:

"*Aboriginal objects are physical evidence of the use of an area by Aboriginal people. They can also be referred to as 'Aboriginal sites', 'relics' or 'cultural material'.*

Aboriginal objects include:

- *physical objects, such as stone tools, Aboriginal-built fences and stockyards, scarred trees and the remains of fringe camps*
- *material deposited on the land, such as middens*

- *the ancestral remains of Aboriginal people.*

Handicrafts made by Aboriginal people for sale are not 'Aboriginal objects' under the *National Parks and Wildlife Act 1974* (NPW Act).

The NPW Act protects Aboriginal objects and Aboriginal places in NSW. Under the NPW Act, it is an offence to do any of the following things without an exemption or defence provided for under the NPW Act (penalties apply):

- A person must not knowingly harm or desecrate an Aboriginal object.
- A person must not harm or desecrate an Aboriginal object or Aboriginal Place (strict liability).

Harm includes destroy, deface or damage of Aboriginal object or Aboriginal Place, and in relation to an object, move the object from the land on which it has been situated.

Under s.89A of the NPW Act a person who finds an Aboriginal object not already recorded on the Aboriginal Heritage Information Management System (AHIMS) is legally bound to notify Heritage NSW as soon as possible of the object's location. This will be done by the qualified archaeologist engaged by WaterNSW to assess the Aboriginal object or other persons as agreed by WaterNSW

1.1 Assessment and management of an unexpected Aboriginal Object

Should the following be identified during any works:

- an unexpected Aboriginal object (either above ground or archaeological), or
- any skeletal remains suspected of being human.

Works should cease immediately at the site and in the vicinity of the object. Do not further move or disturb the object and follow the procedure outlined in Figure 1.1.

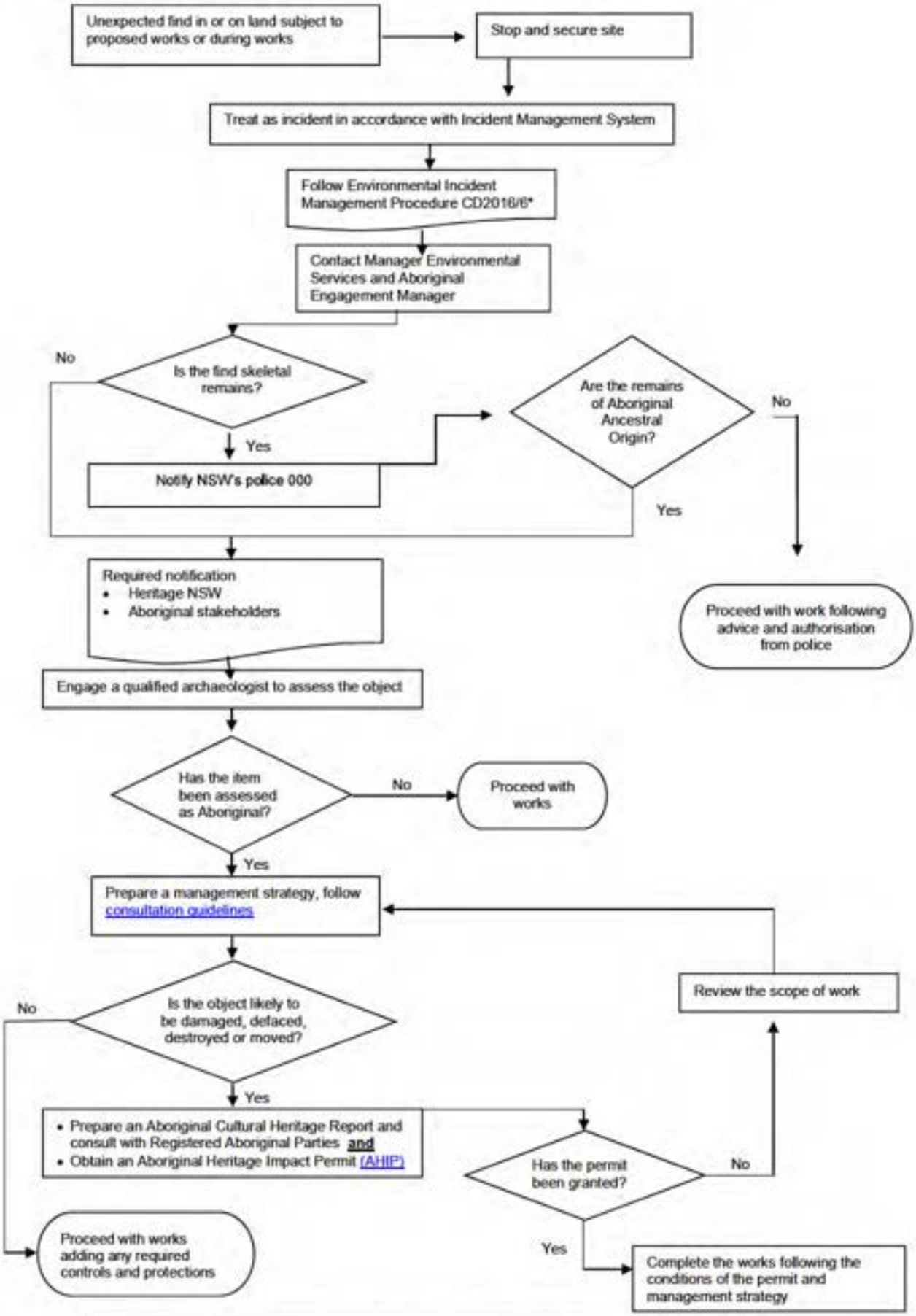
2. Monitoring, Evaluation and Review and Review History

Outcome: How does this procedure deliver against the purpose and scope?	
Monitoring	Application of procedure if unexpected Aboriginal object is discovered by WaterNSW staff or contractor during works
Evaluation and Review	Low Risk – 3 yearly
Review History	Minor change

3. Approval

JOSH ST CLAIR
Manager Health Safety and Environment

Figure 1.1: Discovery of an Unexpected Aboriginal Cultural Object Process



Appendix H

Transport for NSW Construction and Maintenance Noise Estimator Tool

Transport for NSW

Distanced Based Assessment (Construction Scenario)

Steps for Screening Assessment:

1. Schedule noisy works or actual in standard hours where possible or before 10pm and implement Standard Mitigations.
2. Select the representative noise area category. The excluded Initial Representative Noise Criteria, provides a number of examples to help select the noise area category.
3. Select the scenario. If not found in simplesearch.pdf, refer to 'Source Limit' and select a representative scenario with similar plant combinations.
4. Is there line of sight to receiver? Select the appropriate scenario from the drop down list.

Identify and implement standard mitigation measures where feasible and reasonable, including any standing requirements as part of the standard mitigation measures by changing the selection in the 'Is there line of sight to receiver' dropdown box. Solid barrier can be in the form of hoist building, solid construction hoarding, acoustic curtain, timber lapped and capped fence, shipping container, site office, etc. Please note that pegboards and mesh are not considered to be a form of solid barrier and any gaps would compromise the acoustic integrity of the solid barrier.

5. Determine if there are any receivers (both residential and non-residential) present within the affected distance for each relevant time period (Consider background noise assessments to check assumptions in Step #2.1).

(a) there are many affected residents and the impact duration at any one resident is more than 3 weeks, or

(b) there are a few affected receivers and the impact duration at any one receiver is more than 6 weeks.

Note this consideration need to be given to the construction staging plan when determining impact durations.

7. Identify if there are any receivers within the additional mitigation measures distances and identify feasible and reasonable measures at each receiver.

8. Where night works are involved, identify sleep disturbance affection distance.

9. Document the outcomes of these steps.

(Note that sensitive noise management levels for active recreation businesses not identified in the Construction and Maintenance Noise Estimator should be investigated on a project-by-

Abbreviation	Measure
N	Hoarding/s
SN	Specific scaffolding/s
PC	Phone calls
IB	Individual briefings
RO	Respite offer
R1	Respite period 1
R2	Respite period 2
DR	Direct (DR) / Indirect
AA	Alternative accommodation
V	Verification

Note that spot check verification of noise levels and individual briefings are not required for projects with less than 3 weeks impact duration

Noise area category		R1
RBL or Lowest Background level (dBA90)	Day	50
	Evening	41
	Night	40
Leq(15minute) Noise Management Level (dBA)	Day (OOHW)	60
	Evening	51
	Night	50
Scenario		Crossing plant
Is there line of sight to receiver?		Yes

Residential receiver

		Affected distance (m)	Leq(15minute) noise level above background (dB)											Leq(15minute) 75 dB(A) or greater (highly affected)			Sleep disturbance Lmax 65 dB(A)
			0 to 10 dB(A) Noticeable			10 to 20 dB(A) Clearly audible			20 to 30 dB(A) Moderately intrusive			> 30 dB(A) Highly intrusive						
			Measures	Within distance (m)	Mitigation level (dBA)	Measures	Within distance (m)	Mitigation level (dBA)	Measures	Within distance (m)	Mitigation level (dBA)	Measures	Within distance (m)	Mitigation level (dBA)	Measures	Within distance (m)	Mitigation level (dBA)	Affected distance (m)
Undeveloped green fields, rural areas with isolated dwellings	Day	706						N	330	50	N	110	40	N, PC, RO	50	75	
	Day (OOHW)	1010			N, R1, DR	700	40	N, R1, DR	330	50	N, R1, DR, PC, SN	110	40	N, PC, RO	50	75	
	Evening	1010			N, R1, DR	700	40	N, R1, DR	330	50	N, R1, DR, PC, SN	110	40	N, PC, RO	50	75	
	Night	1010	N	1010	30	N, RO, DR	700	40	N, PC, SN, R2, DR	330	50	AA, N, PC, SN, RO, DR	110	40	N, PC, RO	50	75	170
	Highly Affected	30													N, PC, RO	30	75	
Developed settlements (urban and suburban)	Day	830						N	420	50	N	150	40	N, PC, RO	50	75	
	Day (OOHW)	1300			N, R1, DR	830	40	N, R1, DR	420	50	N, R1, DR, PC, SN	150	40	N, PC, RO	50	75	
	Evening	1300			N, R1, DR	830	40	N, R1, DR	420	50	N, R1, DR, PC, SN	150	40	N, PC, RO	50	75	
	Night	1300	N	1300	30	N, RO, DR	830	40	N, PC, SN, RO, DR	420	50	AA, N, PC, SN, RO, DR	150	40	N, PC, RO	50	75	200
	Highly Affected	30													N, PC, RO	30	75	
Propagation across a valley / over water	Day	1340						N	670	50	N	220	40	N, PC, RO	50	75	
	Day (OOHW)	1900			N, R1, DR	1310	40	N, R1, DR	775	50	N, R1, DR, PC, SN	230	40	N, PC, RO	50	75	
	Evening	1900			N, R1, DR	1310	40	N, R1, DR	775	50	N, R1, DR, PC, SN	230	40	N, PC, RO	50	75	
	Night	1900	N	1900	30	N, RO, DR	1310	40	N, PC, SN, RO, DR	775	50	AA, N, PC, SN, RO, DR	230	40	N, PC, RO	50	75	350
	Highly Affected	30													N, PC, RO	30	75	

Non-residential receiver
Undeveloped green fields, rural areas with isolated dwellings

	Standard hours			Leq(15minute) noise level above RBL						Leq(15minute) 75 dB(A) or greater (highly affected)		
	Period	RBL	Affected distance (m)	0 to 10 dB(A)			10 to 20 dB(A)					
				Measure	Within distance (m)	Mitigation level (dBA)	Measure	Within distance (m)	Mitigation level (dBA)	Measure	Within distance (m)	Mitigation level (dBA)
Classroom at schools and other educational institutions	Day	50	230				N	105	65	N, PC, RO	50	75
Hospital wards and operating theatres	Day	45	110							N, PC, RO	50	75
Place of worship	Day	50	230				N	105	65	N, PC, RO	50	75
Active recreation	Day	50	105							N, PC, RO	50	75
Passive recreation	Day	40	150				N	60	70	N, PC, RO	50	75
Industrial premise	Day	70	30							N, PC, RO	50	75
Offices, retail outlets	Day	70	30							N, PC, RO	50	75

	OOHW			Leq(15minute) noise level above RBL												
	Period	RBL	Affected distance (m)	0 to 10 dB(A)			10 to 20 dB(A)			20 to 30 dB(A)			> 30 dB(A)			
				Measure	Within distance (m)	Mitigation level (dBA)	Measure	Within distance (m)	Mitigation level (dBA)	Measure	Within distance (m)	Mitigation level (dBA)	Measure	Within distance (m)	Mitigation level (dBA)	
Hospital wards and operating theatres	Evening	45	110				N, R1, DR	60	70	N, R1, DR	17	60	AA, N, PC, SN, RO, DR	5	60	
	Night	40	120	N	120	60	N, RO, NR	60	70	N, PC, SN, RO, DR	17	60	AA, N, PC, SN, RO, DR	5	60	
Place of worship	Evening	50	230				N, R1, DR	105	60	N, R1, DR	60	70	N, R1, DR, PC, SN	17	60	
	Night	50	230	N	230	60	N, RO, NR	105	60	N, PC, SN, RO, DR	60	70	AA, N, PC, SN, RO, DR	17	60	
Active recreation	Evening	45	105				N, R1, DR	60	70	N, R1, DR	17	60	N, R1, DR, PC, SN	5	60	
Passive recreation	Evening	40	150				N, R1, DR	105	65	N, R1, DR	30	75	N, R1, DR, PC, SN	8	65	
Industrial premise	Evening	70	30				N, R1, DR	17	60	N, R1, DR	5	60	N, R1, DR, PC, SN	2	100	
Offices, retail outlets	Night	70	30	N	30	70	N, RO, NR	17	60	N, PC, SN, RO, DR	5	60	AA, N, PC, SN, RO, DR	2	100	
	Evening	70	60				N, R1, DR	30	75	N, R1, DR	9	60	N, R1, DR, PC, SN	3	95	
	Night	70	60	N	60	70	N, RO, NR	30	75	N, PC, SN, RO, DR	9	60	AA, N, PC, SN, RO, DR	3	95	

Non-residential receiver
Developed settlements (urban and suburban)

	Standard hours			Leq(15minute) noise level above RBL						Leq(15minute) 75 dB(A) or greater (highly affected)		
	Period	RBL	Affected distance (m)	0 to 10 dB(A)			10 to 20 dB(A)					
				Measure	Within distance (m)	Mitigation level (dBA)	Measure	Within distance (m)	Mitigation level (dBA)	Measure	Within distance (m)	Mitigation level (dBA)
Classroom at schools and other educational institutions	Day	50	260				N	115	65	N, PC, RO	50	75
Hospital wards and operating theatres	Day	45	110							N, PC, RO	50	75
Place of worship	Day	50	260				N	115	65	N, PC, RO	50	75
Active recreation	Day	45	110							N, PC, RO	50	75
Passive recreation	Day	40	160				N	70	70	N, PC, RO	50	75
Industrial premise	Day	70	30							N, PC, RO	50	75
Offices, retail outlets	Day	70	70							N, PC, RO	50	75

		DCNR														
				+5 dB(A)			5 to 10 dB(A)			10 to 20 dB(A)			> 20 dB(A)			
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	60	110				N, R1, DR	70	70	N, R2, DR	80	80	N, R1, DR, PC, SN	8	80
	Night	60	110	N	110	63	N, R2, NR	70	70	N, PC, SN, R2, DR	80	80	AA, N, PC, SN, R2, DR	8	80
Place of worship	Evening	60	240				N, R1, DR	160	70	N, R2, DR	80	80	N, R1, DR, PC, SN	10	80
	Night	60	240	N	240	63	N, R2, NR	160	70	N, PC, SN, R2, DR	80	80	AA, N, PC, SN, R2, DR	10	80
Active recreation	Evening	65	110				N, R1, DR	70	70	N, R2, DR	80	80	N, R1, DR, PC, SN	8	80
Passive recreation	Evening	60	130				N, R1, DR	110	70	N, R2, DR	80	80	N, R1, DR, PC, SN	11	80
Industrial premise	Evening	75	30				N, R1, DR	30	70	N, R2, DR	80	80	N, R1, DR, PC, SN	7	80
	Night	75	30	N	30	73	N, R2, NR	30	70	N, PC, SN, R2, DR	80	80	AA, N, PC, SN, R2, DR	7	80
Offices, retail outlets	Evening	70	70				N, R1, DR	70	70	N, R2, DR	80	80	N, R1, DR, PC, SN	8	80
	Night	70	70	N	70	70	N, R2, NR	70	70	N, PC, SN, R2, DR	80	80	AA, N, PC, SN, R2, DR	8	80

Nonresidential receiver
Propagation across a valley / over water

	Standard hours										
				+10 dB(A)			10 to 20 dB(A)			LAeq(15minute) 75 dB(A) or greater (highly affected)		
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	310				N	110	60	N, PC, R2	35	75
Hospital wards and operating theatres	Day	60	130							N, PC, R2	35	75
Place of worship	Day	60	310				N	110	60	N, PC, R2	35	75
Active recreation	Day	65	130							N, PC, R2	35	75
Passive recreation	Day	60	230				N	70	70	N, PC, R2	35	75
Industrial premise	Day	75	30							N, PC, R2	35	75
Offices, retail outlets	Day	70	80							N, PC, R2	35	75

		DCNR														
				+5 dB(A)			5 to 10 dB(A)			10 to 20 dB(A)			> 20 dB(A)			
	Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	60	130				N, R1, DR	80	70	N, R2, DR	90	80	N, R1, DR, PC, SN	8	80
	Night	60	130	N	130	63	N, R2, NR	80	70	N, PC, SN, R2, DR	90	80	AA, N, PC, SN, R2, DR	8	80
Place of worship	Evening	60	270				N, R1, DR	200	70	N, R2, DR	90	80	N, R1, DR, PC, SN	10	80
	Night	60	270	N	270	63	N, R2, NR	200	70	N, PC, SN, R2, DR	90	80	AA, N, PC, SN, R2, DR	10	80
Active recreation	Evening	65	130				N, R1, DR	80	70	N, R2, DR	90	80	N, R1, DR, PC, SN	8	80
Passive recreation	Evening	60	130				N, R1, DR	110	70	N, R2, DR	90	80	N, R1, DR, PC, SN	11	80
Industrial premise	Evening	75	30				N, R1, DR	30	70	N, R2, DR	90	80	N, R1, DR, PC, SN	7	80
	Night	75	30	N	30	73	N, R2, NR	30	70	N, PC, SN, R2, DR	90	80	AA, N, PC, SN, R2, DR	7	80
Offices, retail outlets	Evening	70	80				N, R1, DR	70	70	N, R2, DR	90	80	N, R1, DR, PC, SN	8	80
	Night	70	80	N	80	73	N, R2, NR	70	70	N, PC, SN, R2, DR	90	80	AA, N, PC, SN, R2, DR	8	80

Appendix I

Operational Noise Impact Assessment

Pindari Bubble Plume Destratification

Operational Noise Impact Assessment

Prepared for
WaterNSW

November 2024



D2023-59507_Operational Noise Impact Assessment_Rev4

ASSETREADY
A WSP & SMEC Joint Venture

Document control

Project name	Pindari Bubble Plume Destratification
Document title	Operational Noise Impact Assessment
Prepared for	WaterNSW
Service Order number	D2023-59507_Operational Noise Impact Assessment_Rev4

Revision history

Rev	Date	Details
1	23/08/2024	Draft
2	27/09/2024	Issue
3	18/10/2024	Issue
4	29/11/2024	Issue

	Name	Date	Signature
Prepared by:	Matthew Bechara	29/11/2024	M Bechara
Reviewed by:	Chris Field	29/11/2024	Chris Field
Approved by:	Chris Field	29/11/2024	Chris Field

ASSETReady Contact Details

Address	WSP Australia Pty Limited, Level 27, 680 George Street, Sydney, 2000, Australia
Telephone	0434 252 043
Email	Ryan.Beheshti@wsp.com

Table of Contents

Executive summary iii

1 Introduction 1

1.1 Acoustic objectives 2

1.2 Reference project documentation 2

2 Existing noise environment 3

2.1 Receivers 3

3 Environmental Noise Criteria 5

3.1 NSW Noise Policy for Industry 5

3.1.1 Time periods 5
3.1.2 Project Intrusiveness Noise Levels 5
3.1.3 Project Amenity Noise Levels 6
3.1.4 Project noise trigger level 7
3.1.5 Maximum noise level event assessment and sleep disturbance 7
3.1.6 Meteorological conditions 7

4 Operational noise assessment 9

4.1 Assessment methodology 9

4.1.1 Scenarios assessed 9
4.1.2 3D noise model 9
4.1.3 Corrections for annoying noise characteristics 10
4.1.4 Sound Power Levels (SWL) 10

4.2 Predicted operational noise levels 11

5 Conclusion 13

List of tables

Table 2.1 Identified receivers 3
Table 3.1 NSW NPfI Time Periods 5
Table 3.2 Established Project Intrusiveness Noise Level, residential receivers only 5
Table 3.3 Established Project Amenity Noise Level 6
Table 3.4 Summary of Project Noise Trigger Levels (PNTL) 7
Table 3.5 Maximum noise level event screening criteria 7
Table 3.6 Meteorological parameters assessed. 8
Table 4.1 Scenarios assessed for operational noise modelling 9
Table 4.2 Key parameters used for operational noise modelling 9
Table 4.3 Key parameters used for operational noise modelling 10

Table 4.4 Predicted operational noise levels and assessment – Unmitigated levels at noise sensitive receivers 12

List of figures

Figure 1-1 Pindari Dam Location 1
Figure 2.1 Receiver Map 4

List of appendices

Appendix A Operational Noise Contours

Executive summary

AssetReady was engaged by WaterNSW to conduct a noise assessment for the proposed operation of compressor units at Pindari Dam, located in northern New South Wales. The compressor units will be used to support a trial cold water destratification system at Lake Pindari using bubble plumes principles, to protect downstream fish stocks and improve water quality of the lake. The assessment focused on evaluating the potential noise impacts of placing two compressor units at the base of the dam. This evaluation was conducted at the request of WaterNSW.

The noise assessment aimed to identify the relevant legislative requirements, assess the potential noise impacts on sensitive receivers, and propose mitigation measures if necessary. Due to the absence of direct noise measurements, the assumed rating background noise level (RBL) was established based on the NSW Noise Policy for Industry (NPfI) (NSW EPA 2017) guidelines.

Key findings include:

- The noise impact was assessed using a three-dimensional computer noise model under various scenarios, including different meteorological conditions and dam water levels.
- Compliance with the NPfI noise criteria was predicted for the compressor location for all time periods (day, evening, and night) at all identified receivers, including residential areas, a campground, and commercial sites.
- No further noise management or mitigation measures were required based on the proposed design, as predicted noise levels were within the acceptable limits.

1 Introduction

AssetReady were engaged by WaterNSW to conduct a noise assessment to consider the potential operational impacts of two compressor units at Pindari dam. The compressor units will be used to support to support a trial cold water destratification system at Lake Pindari using bubble plumes principles to protect downstream fish stocks and improve water quality of the lake (Project).

Pindari Dam is situated on the Severn River about 22 kilometres upstream of Ashford (Figure 1.1) and 80 kilometres north-east of Inverell near the NSW-Queensland border. The dam is about 650 kilometres north-west of Sydney. Pindari Dam supplies regulated flows for irrigation, stock and domestic use, town water supplies and industrial use along the Severn and Macintyre rivers upstream of the Dumaresq River junction.

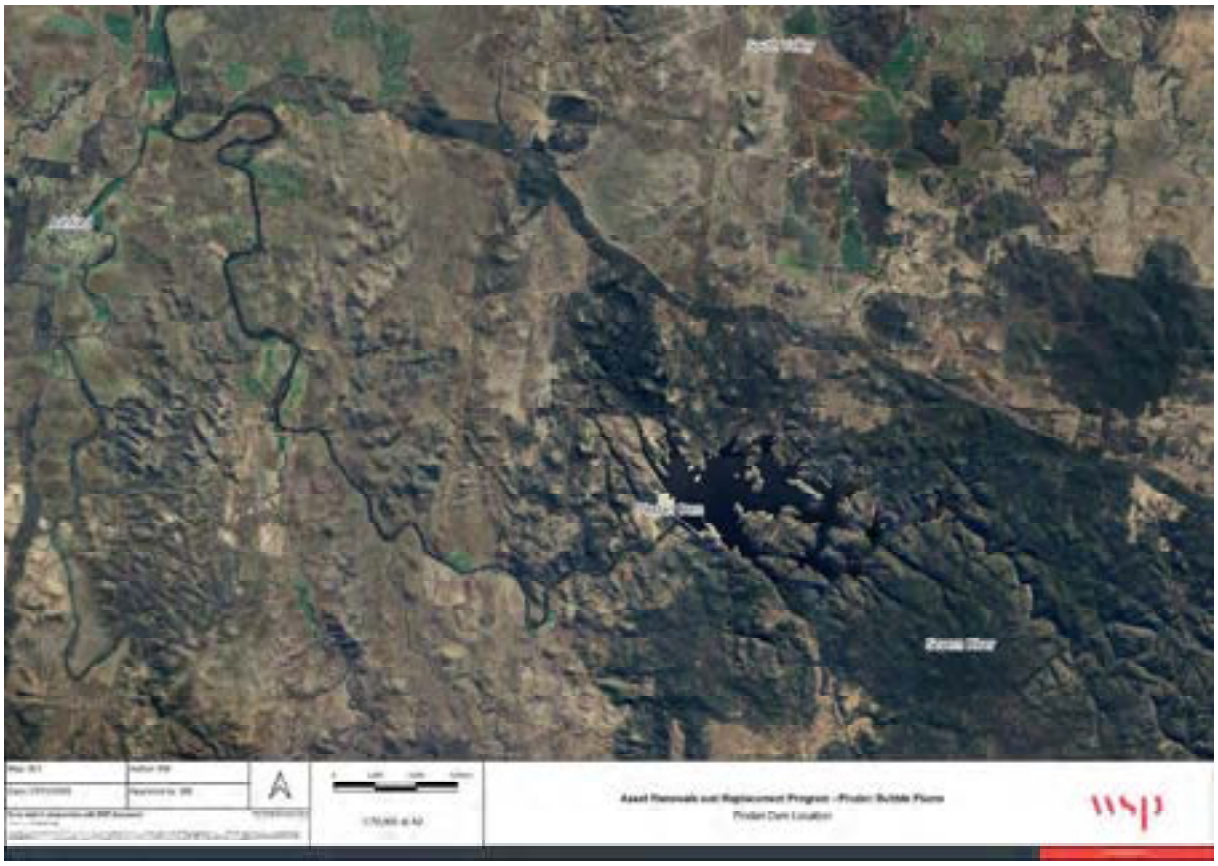


Figure 1-1 Pindari Dam Location

This assessment looks at the potential noise impacts from two compressors (model: Atlas Copco ZT315 VSD-10.4) located at the base of the dam. The assessment is to determine the potential noise impacts from the operation of the Project on the nearest sensitive receivers.

This document outlines relevant noise legislation, the existing noise environment, methodology, findings of the investigations and comparison of compressor options.

1.1 Acoustic objectives

This noise impact assessment (NIA) has been developed to assess potential impacts from the Project relating to environmental noise. It aims to achieve the following:

- Identify the relevant legislative requirements.
- Identify potential sensitive receivers in the vicinity of the Project.
- Identify potential noise impacts associated with operation of the Project.
- Outline systems and management measures to reduce or eliminate identified noise impacts.

1.2 Reference project documentation

Acoustic criteria and design recommendations in this report are based on the following project documentation:

- Civil and Building Services drawings, revision D, issued by ASSETREADY on 30/09/2024
- Detailed Design Report, (D2023_59507)-DEL-RPT-001 A, revision A, issued by ASSETREADY

Reference standards, policies and guidelines:

- *NSW EPA Noise Policy for Industry 2017* (NPfI)

2 Existing noise environment

Pindari Dam is located in a rural area of northern NSW. Since background noise measurements have not been conducted to determine the prevailing noise environment, the NSW Noise Policy for Industry (NPfI) (NSW EPA 2017)has been referenced to establish the assumed rating background noise level (RBL) for the project, as outlined in Table 2.1 of the NPfI. Refer to Section 3.1 of this document for further details.

2.1 Receivers

A primary aerial identification of noise sensitive receivers within 2 km of the Project has been carried out finding four potential residential receiver locations and five non-residential receiver locations. Two of the four residential receivers are understood to be WaterNSW office buildings and have been assessed as a residence to cover worst case scenario.

The identified receivers are presented in Table 2.1 and represented graphically in Figure 2.1.

Table 2.1 Identified receivers

ID	Receiver type	Noise sensitive	Address
R01	Residential	Yes	1626 Pindari Dam Rd, Pindaroi NSW 2361
R02	Residential/Office(3)	Yes	1627 Pindari Dam Rd, Pindaroi NSW 2361
R03	Residential/Office(3)	Yes	1629 Pindari Dam Rd, Pindaroi NSW 2361
R04	Residential	Yes	1986 Pindari Dam Rd, Pindaroi NSW 2361
R05	Shed (1)	No	1986 Pindari Dam Rd, Pindaroi NSW 2361
R06	Shed (1)	No	1986 Pindari Dam Rd, Pindaroi NSW 2361
R07	Passive recreation	Yes	Pindari Boat Camp Recreation Area
R08	Passive recreation	Yes	Pindari Dam Camping Ground, Pindaroi NSW 2361
R09	Commercial(2)	Yes	Pindari Dam Rd, Pindaroi

(1) Shed deemed not suitable for occupation and is therefore deemed to not be a noise sensitive receiver.

(2) Understood to be WaterNSW asset.

(3) Understood to be WaterNSW office building. Assessed as a residence to cover worst case scenario.



Figure 2.1 Receiver Map

3 Environmental Noise Criteria

The following sections present the applicability and derivation of environmental noise limits for the project.

3.1 NSW Noise Policy for Industry

Noise emissions from the Project to surrounding noise sensitive areas are required to comply with the requirements of the NSW Noise Policy for Industry 2017 (NPfI) (NSW EPA 2017).

The assessment procedure for industrial noise sources has two components:

- Project Noise Trigger Level, which considers the most stringent of the project intrusiveness and amenity noise levels
  - where the Project Noise Trigger Level is exceeded, it would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures
- Maximum noise level event, which considers the potential for sleep disturbance at residences
  - where the maximum noise level event screening criteria is exceeded, a detailed assessment should be undertaken which covers the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period/

3.1.1 Time periods

Time periods defined by the NSW NPfI are presented in Table 3.1.

Table 3.1 NSW NPfI Time Periods

NSW NPfI Time Period	Time
Day	7am to 6pm Monday to Saturday 8am to 6pm Sundays and public holidays
Evening	6pm to 10pm all days
Night	All other times

3.1.2 Project Intrusiveness Noise Levels

The project's intrusiveness noise level has been determined based on the minimum assumed rating background noise level (RBL) as specified in Table 2.1 of the NSW NPfI, in accordance with Section 2.3 of the NSW NPfI and is summarised as:

Leq (15 minute) ≤ Rating Background Level (L90) + 5 dBA

The established project intrusiveness noise levels are presented in Table 3.2.

Table 3.2 Established Project Intrusiveness Noise Level, residential receivers only

Receiver Location	Time Period	RBL dBA	Project Intrusiveness Noise Level (RBL + 5dB) dBA $L_{eq(15min)}$

R1-R4	Day	35(1)	**40**
	Evening	30(1)	**35**
	Night	30(1)	**35**

(1) Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and public holidays; evening: the period from 6 pm to 10 pm; night: the remaining periods. In accordance with NPfI, where the measured rating background level is less than 30 dBA for the evening and night periods, it is set to 30 dBA. When it is found to be less than 35 dBA for the day period, it is set to 35 dBA.

3.1.3 *Project Amenity Noise Levels*

To limit continuing increases in ambient noise levels (i.e. background noise level creep), the maximum amenity noise level within an area from industrial noise sources should not normally exceed the amenity noise levels prescribed in the NSW NPfI. The recommended amenity noise levels represent the objective for total industrial noise from all sources at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location, defined as the recommended noise levels listed below (Table 2.2 of NPI) minus 5 dBA.

The amenity criteria have been established at the identified receivers based on their typical designation of 'rural residential' land use at receivers. The established amenity criteria applicable to the project are presented in Table 3.3.

Table 3.3 Established Project Amenity Noise Level

Receiver Location	Type of Receiver	Recommended amenity noise level (ANL) dBA $L_{eq\ period}$	Project amenity noise level correction dBA $L_{eq\ period}$	Project amenity noise level (ANL -5dB) dBA $L_{eq\ period}$	$L_{eq\ period}$ to $L_{eq\ 15\ min}$(3) Correction dBA	Project Adjusted ANL dBA $L_{eq\ 15\ min}$(3)		
						Day	Evening	Night
R1-R4	Residential (rural)	Day: 50 Evening: 45 Night: 40	-5	Day: 45 Evening: 40 Night: 35	+3	**48**	**43**	**38**
R9	Commercial	65	-5	60	+3	**63**	**63**	**63**
R7, R8	Passive Recreation	50	-5	45	+3	**48**	**48**	**48**

1) Day: the period from 7:00 am to 6:00 pm Monday to Saturday; or 8:00 am to 6:00 pm on Sundays and public holidays; Evening: the period from 6:00 pm to 10:00pm; Night: the remaining periods.
2) Amenity levels only apply during times of use for non-residential receivers
3) To standardise the time periods for the intrusiveness and amenity noise levels, this policy assumes that the $L_{Aeq,15min}$ will be taken to be equal to the $L_{Aeq\ period}$ +3 decibels (dB)

3.1.4 Project noise trigger level

In assessing the noise impact of the Project on surrounding residential receivers, both the intrusiveness and amenity criterion are considered and the limiting criteria set as the Project Noise Trigger Levels (PNTL).

In accordance with Section 2.2 of the NSW NPfI, the project noise trigger levels and limits are expressed as $L_{Aeq,15min}$, for the nominated receiver types. The PNTL is the lower (most stringent) value of the intrusiveness (Table 3.2)and amenity noise levels (Table 3.3).A summary of all relevant criteria is presented in Table 3.4.

Table 3.4 Summary of Project Noise Trigger Levels (PNTL)

Receiver Location	Assessment/ Receiver type	Project noise trigger levels dBA $L_{eq\ 15\text{-}min}$		
		Day[1]	Evening[1]	Night[1]
R1-R4	*Intrusiveness*	*40*	*35*	*35*
	Amenity	*48*	*43*	*38*
	PNTL -Residential	**40**	**35**	**35**
R9	Commercial	**63**	**63**	**63**
R7, R8	Passive Recreation	**48**	**48**	**48**

1) Day: the period from 7:00 am to 6:00 pm Monday to Saturday; or 8:00 am to 6:00 pm on Sundays and public holidays; Evening: the period from 6:00 pm to 10:00pm; Night: the remaining periods.
2) For non-residential receivers, PNTL levels only apply during the operating hours of the receiver.

3.1.5 Maximum noise level event assessment and sleep disturbance

The potential for operational noise impacts resulting from transient maximum noise level events and sleep disturbance during the night-time period is detailed in the NPfI. Maximum noise impacts may cause awakening events, while maintained elevated levels of noise may reduce the quality of sleep. As such, the sleep disturbance criteria are presented in two forms as follows:

- $L_{Aeq,15min}$ 40 dB or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- L_{AFmax} 52 dB or the prevailing RBL plus 15 dB, whichever is the greater.

Table 3.5 summarises the maximum noise level event screening criteria for the proposed development.

Table 3.5 Maximum noise level event screening criteria

Receiver Location	Night time RBL	$L_{Aeq,\ 15\ minute}$ dB Criteria (Sleep disturbance)	L_{AFmax} dB Criteria (Awakening)
R1-R4	30 dB	40 $L_{eq,\ 15\ minute}$ dB	52 L_{AFmax} dB

As the noise sources for this assessment do not have impulsive or significant time varying characteristics, it is expected that the project noise trigger level $L_{Aeq,15min}$ criteria will be the most stringent, refer to Table 3.4, however the L_{AFmax} criteria in Table 3.5 would still be applicable.

3.1.6 Meteorological conditions

Meteorological conditions applied by AssetReady are summarised in Table 3.6. These are based on the standard and noise-enhancing meteorological conditions outlined in Fact Sheet D of the NSW NPfI.

Table 3.6 Meteorological parameters assessed.

Period	Description	Temp, °C	Humidity, %	Wind velocity, m/s	Wind direction	Air pressure, mbar	Pasquill stability class
Standard	Stability categories A-D with wind speed up to 0.5 m/s at 10 m Average Ground Level (AGL)	10°C	70%	0.5	Source to receiver	1013.3	D
Noise enhancing (Night)	Stability categories A-D with light wind (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL	10°C		2			F

4 Operational noise assessment

The assessment has been based on the conservative assumption that two compressors will operate at 100% capacity at all times (24-hour operation). As such, the project will need to demonstrate that it is able to comply with the most stringent criteria (night time). The following sections outline the assessment methodology and results of the operational noise assessment.

4.1 Assessment methodology

4.1.1 *Scenarios assessed*

The scenarios presented in Table 4.1 were assessed in a 3D computer noise model. The primary objective of the scenarios tested was to review the noise impact to nearest noise sensitive receivers at the proposed compressor location. Additionally, the scenarios tested incorporated both meteorological conditions presented in Table 3.6 to account for a range of potential situations.

Table 4.1 Scenarios assessed for operational noise modelling

Scenario	Noise Source[1]	Meteorological conditions[2]
1a	Two compressors operating simultaneously at the Compressor location.	Standard conditions
1b		Noise enhancing night time conditions

(1) Refer to Figure 2.1 for compressor location.

(2) Refer to Table 3.6 for details.

4.1.2 *3D noise model*

A 3D computer noise model was created to predict the operational noise impact for all scenarios of the Project. Key parameters used in establishment across all noise model predictions are summarised Table 4.2.

Table 4.2 Key parameters used for operational noise modelling

Item	Description
Software	SoundPLAN 8.2
Standard	CONCAWE (noise propagation model available in SoundPLAN 8.2). This propagation model include consideration of: — Locations of noise sources and receivers — Geometrical spread of noise (divergence) — Atmospheric absorption — Ground effects — Screening from barriers and topographical features — Reflections from surfaces — Meteorological conditions.

Item	Description
Meteorological conditions	In line with the noise enhancing night time conditions outlined in Table 3.6.
3-dimensional ground topography data	Elevation around the Project site is based on provided groundworks design from the Client. For all other areas, 1-metre elevation lines from Geoscience Australia's website ELVIS (Elevation Information System) was used.
Ground absorption	The following ground absorption factors have been applied: — 0.0 for water — 0.3 for dam wall — 0.5 for ground (0=hard ground, 1=soft ground)
Receivers	Point receivers at 1.5 m above ground level have been used.
Site layout	As illustrated in Figure 2.1
Noise sources	Outlined in Section 4.1.4.

4.1.3 Corrections for annoying noise characteristics

The predicted spectral data at each receiver was assessed for tonal and low-frequency characteristics in line with criteria outlined in Fact Sheet C of NSW NPfI. If detected, the predicted operational noise levels in Section 5.1.1.5 have been adjusted with applicable correction factor.

4.1.4 Sound Power Levels (SWL)

The key noise emitting components associated with the Project and their noise emission are outlined in Table 4.3.

Sound power levels are based on specifications provided by the suppliers: Atlas Copco's ZT315VSD Air Cooled Oil-Free. The data provided by the supplier is the sound pressure level at 1 m from the compressor. The noise modelling carried out had the housing of the compressors as an industrial building source. As such, the sound power levels have been predicted based on the compressor housing dimensions and the sound pressure levels provided by the supplier. The compressor housing has been modelled with a conservative assumption of all sides open to the environment with a metal deck roof.

Table 4.3 Key parameters used for operational noise modelling

Equipment	Make	SPL at 1 m, dBA (1)	SWL per unit, dBA (2)	Noise source height above ground level, m
Compressor	Atlas Copco ZT315 VSD-10.4	78 $L_{eq,15min}$	91 $L_{eq,15min}$ (front & back) 92 $L_{eq,15min}$ (sides) 77 $L_{eq,15min}$ (roof)	0.0 to 3.0 (3)

(1) Sound pressure level provided by Atlas Copco ZT315VSD specification

(2) When units are operating at full (100%) fan speed.

(3) Modelled as industrial buildings with area sources located at openings.

(4) Spectral data for the transformer unit is based on empirical data.

4.2 Predicted operational noise levels

A summary of the predicted noise levels without any noise mitigation measures in place at each receiver is provided in Table 4.4. Noise contours are presented in Appendix A for the compressor location with worst case noise enhancing meteorological conditions. .The modelling results show:

- Compliance with requirements outlined in Section 3 is predicted for day, evening and night time periods at all receivers. In addition, the screening noise criteria for sleep disturbance is also not expected to be triggered.
- Higher noise levels predicted at receivers to the southeast of the compressor location (R1 to R8) .
- No further noise management or mitigation measures are required.

Table 4.4 Predicted operational noise levels and assessment – Unmitigated levels at noise sensitive receivers

ID	Address	Predicted Noise Levels Day/Eve/Night, Scenario, dBA $L_{eq,15min}$		Criteria, dBA $L_{eq,15min}$			Complies
		1a	1b	Day	Eve	Night	
R1	1626 Pindari Dam Rd, Pindaroi NSW 2361	21	24	40	35	35	Yes
R2	1627 Pindari Dam Rd, Pindaroi NSW 2361	14	17	40	35	35	Yes
R3	1629 Pindari Dam Rd, Pindaroi NSW 2361	<10	15	40	35	35	Yes
R4	1986 Pindari Dam Rd, Pindaroi NSW 2361	<10	<10	40	35	35	Yes
R5	1986 Pindari Dam Rd, Pindaroi NSW 2361	<10	<10	40	35	35	Yes
R6	1986 Pindari Dam Rd, Pindaroi NSW 2361	<10	<10	40	35	35	Yes
R7	Pindari Boat Camp Recreation Area	11	11	48	48	48	Yes
R8	Pindari Dam Camping Ground, Pindaroi NSW 2361	<10	<10	48	48	48	Yes
R9	Pindari Dam Rd, Pindaroi	52	53	63	63	63	Yes

(1) No corrections for annoying noise characteristics were required

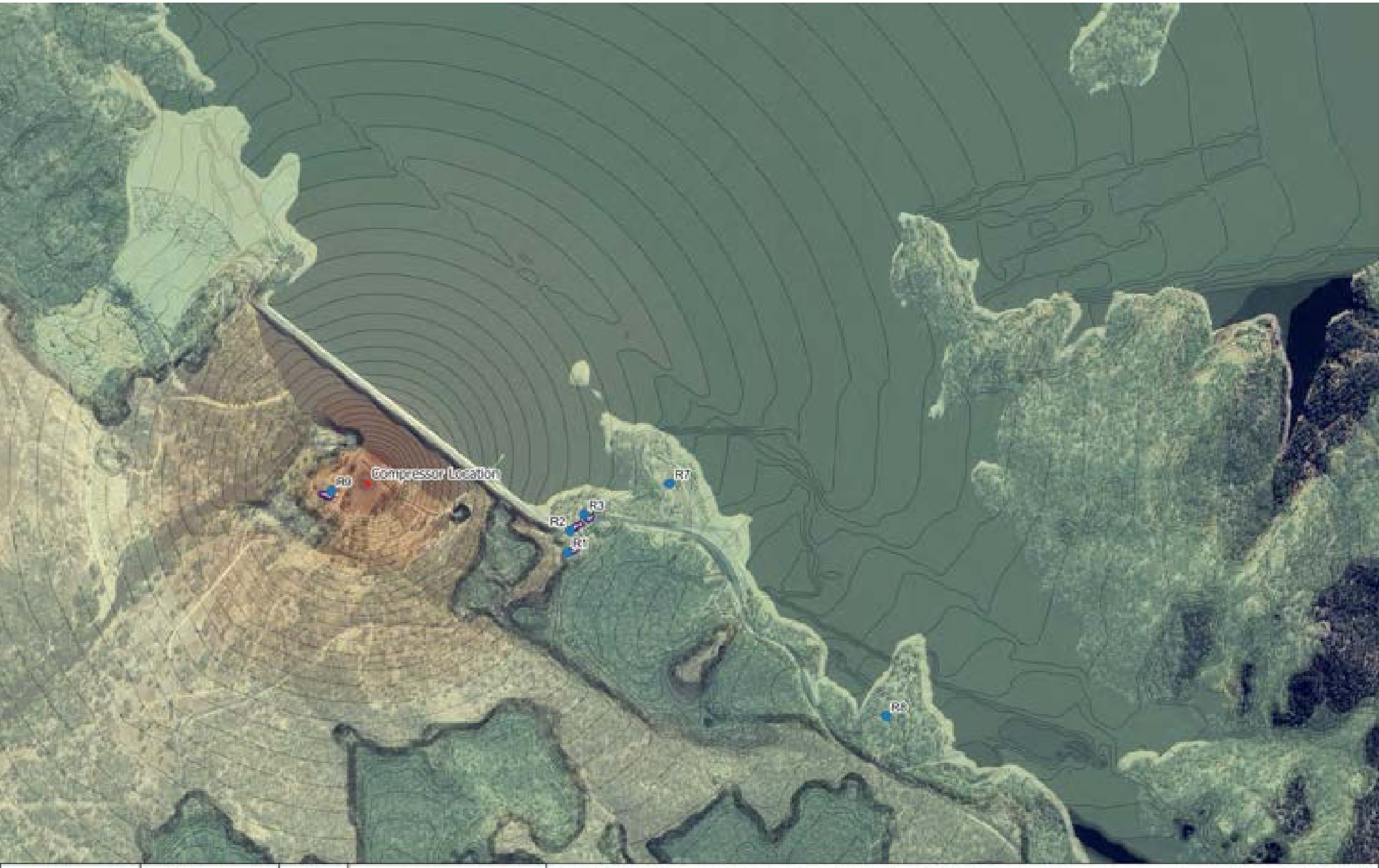
5 Conclusion

The operational noise impact assessment for the Project has demonstrated that the proposed compressor location is a viable option for installation, with no significant noise impacts on the surrounding environment. The assessment, conducted in line with the NPfI (NSW EPA 2017) and other relevant standards, shows that noise levels at all sensitive receivers, including residential areas, recreational sites, and offices, are predicted to comply with the established noise criteria under various operational scenarios. The predicted worst case external noise impacts from the Project to the WaterNSW offices (Table 2.1) are predicted to be 15-17dBA, which is well below the external noise limit of 63dBA.

The operational noise assessment, which included modelling under various meteorological conditions, confirms that the proposed compressor location will remain within the permissible noise limits across all time periods (day, evening, and night). Therefore, no additional noise mitigation measures are necessary, with minimal noise impact on the surrounding community and environment.

Appendix A

Operational Noise Contours



Map: 003	Author: GL
Date: 28/11/2024	Approved by: MB

To be read in conjunction with WSP document: PR122845-ACO-001

1:8,000 at A3

Legend

- Receivers
- Buildings
- Compressors

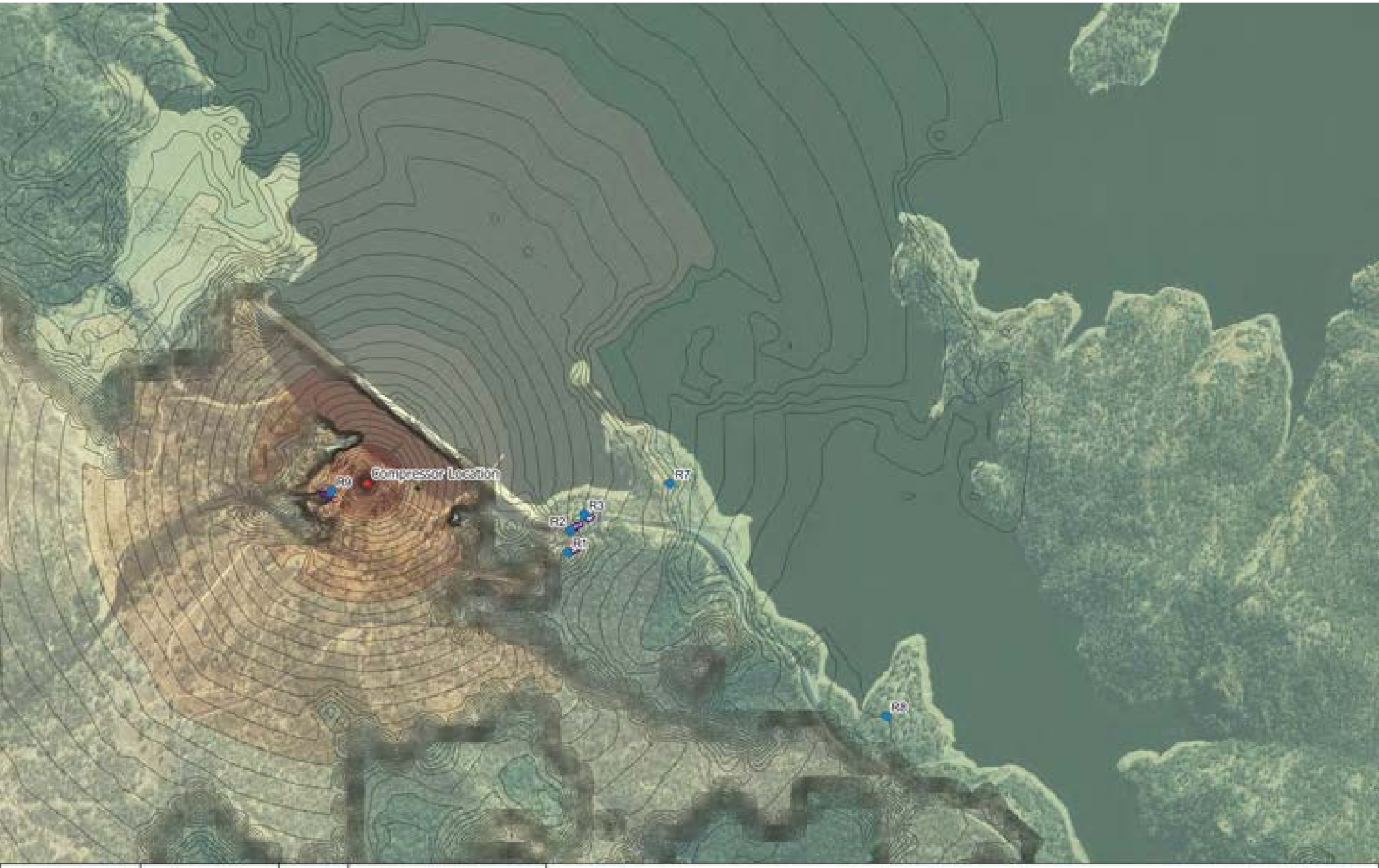
Noise level, dBA Leq period

0 - 10	20 - 30	40 - 50	60 - 70
10 - 20	30 - 40	50 - 60	70 - 73

Asset Renewals and Replacement Program - Pindari Bubble Plume

Operational Noise Contours

Scenario 1a



Map: 003	Author: KM
Date: 24/10/2024	Approved by: MB

To be read in conjunction with WSP document PR122648-ACO-001

1:8,000 at A3

Legend

- Receivers
- Buildings
- Compressors

Noise level, dBA Leq period

0 - 10	20 - 30	40 - 50	60 - 70
10 - 20	30 - 40	50 - 60	70 - 73

Asset Renewals and Replacement Program - Pindari Bubble Plume

Operational Noise Contours

Scenario 1b

Appendix J

Issue for Tender design drawings

GENERAL NOTES:

1. ALL DESIGN, MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE WATER SERVICES ASSOCIATION OF AUSTRALIA SPECIFICATIONS, THE LATEST EDITIONS OF RELEVANT AUSTRALIAN STANDARDS, BUILDING CODE OF AUSTRALIA, WaterNSW TECHNICAL STANDARDS AND TECHNICAL GUIDELINES, UNLESS OTHERWISE STATED.
2. THE STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE SPECIFICATION AND OTHER ASSOCIATED DRAWINGS, AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED BY THE WaterNSW REPRESENTATIVE DURING THE COURSE OF THE DESIGN AND CONSTRUCTION CONTRACT.
3. THE CONTRACTOR SHALL PROTECT THE WORK AREA PRIOR TO COMMENCEMENT OF WORK TO IDENTIFY ANY SET HAZARDS AND MAKE SAFE OR REMOVE ANY HAZARDS IDENTIFIED.
4. THE STRUCTURE SHALL BE MAINTAINED IN A STABLE CONDITION AND NO PART SHALL BE OVERSTRESSED DURING CONSTRUCTION PHASES.
5. THE STRUCTURE HAS BEEN DESIGNED ON THE BASIS OF RETURN TO SERVICE CODE PACKAGING IN ITS COMPLETED FORM, THE CONTRACTOR SHALL AT ALL TIMES DURING CONSTRUCTION, PROVIDE ADEQUATE PROPS, FRAMEWORK, FALSE WORK, GUYS, ETC, TO PROTECT THE WORK.
6. ORDERING MATERIALS SHALL NOT BE STARTED ON STRUCTURAL ELEMENTS WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
7. SHOP DRAWINGS SHALL BE PREPARED FOR ALL WORKS.
8. ALL LEVELS AND DIMENSIONS RELEVANT TO SETTING OUT SHOWN ON THE DRAWINGS SHALL BE CONFIRMED AND VERIFIED ON SITE PRIOR TO FABRICATION AND INSTALLATION.
9. REFER DRAINAGE INFORMATION NOTES ON DWG P1001-1201.
10. DIMENSIONS OF PROPRIETARY ITEMS DOES NOT INDICATE EXCLUSIVE PREFERENCE, BUT INDICATES THE REQUIRED PROPERTIES OF THE ITEM, SIMILAR ALTERNATIVES HAVING THE REQUIRED PROPERTIES MAY BE OFFERED FOR APPROVAL INSTALL PROPRIETARY ITEMS IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS.
11. SETTING OUT DIMENSIONS AND SIZES OF STRUCTURAL MEMBERS SHALL NOT BE DETERMINED BY SCALING OF THE STRUCTURAL DRAWINGS.
12. ELIMINATION OF SURFACES IS THE RESPONSIBILITY OF THE CONTRACTOR TO CONFIRM ON SITE PRIOR TO THE COMMENCEMENT OF WORKS.
13. ALL DIMENSIONS SHOWN ARE IN MILLIMETRES (MM).
14. ANY DISCREPANCIES BETWEEN DRAWINGS SHALL BE NOTIFIED TO THE ENGINEER FOR CLARIFICATION BEFORE PROCEEDING WITH WORKS.
15. CLEAN UP AFTER COMPLETING WORKS AND REMOVE ALL WASTE FROM SITE.

DESIGN BASIS:

1. REFER DOCUMENT [illegible] VERSION OF THE PROJECT SPECIFIC RELIABILITY ASSESSMENT REPORT "BUBBLE_PLUME.pdf" + RPT-REP FOR THE DESIGN BASIS.

STAINLESS STEEL NOTES:

1. ALL STAINLESS STEEL SHALL COMPLY WITH THE REQUIREMENTS OF AS/NZS 4673:2001/AMD1, ASTM A276/A276M AND ISO 9445, AS APPROPRIATE, AND SHALL BE GRADE 316L UNLESS NOTED OTHERWISE.
2. ALL STAINLESS STEEL BOLTS AND THREADED RODS SHALL BE GRADE 316, A4-70 AND SHALL BE COATED WITH MOLYCOTE 1000 OR APPROVED EQUIVALENT PRIOR TO INSTALLATION, AND SHALL BE PROVIDED WITH STAINLESS STEEL NUTS AND STAINLESS STEEL WASHERS. ALL STAINLESS NUTS SHALL BE PROVIDED WITH A NYLOCK UNDER THE NUT AND BOLT HEAD.
3. WELDS TO BE CLASS SA ASME STAINLESS STEEL, WELD SURFACE FINISH GRADE 3 OR A ELECTRODES TO BE STAINLESS 316L, PRE-APPROVED TO AS/NZS1554.
4. UNDERCUT STAINLESS STEEL INCLUDING FASTENERS, SHALL BE CLEANED IN ACCORDANCE WITH ASTM A380 AND THEN PASSIVATED TO ASTM A249 WHERE THE WORK LAYER HAS BEEN DAMAGED DURING FABRICATION OR CONSTRUCTION BY WELDING, WELDING SPATTERS, SPARKS ON THE LINE, CUTS INTERNAL AND EXTERNAL TORCH SURFACES SHALL BE PASSIVATED.
5. STAINLESS STEEL MATERIALS SHALL NOT BE STORED WITH CARBON STEEL, TOOLS USED FOR CARBON STEEL SHALL NOT BE USED ON STAINLESS OR ALLOYABLE STAINLESS STEEL COMPONENTS, WHERE AREA FOR STAINLESS STEEL SHALL BE SEPARATED FROM THOSE WHERE CARBON STEEL IS PERMISSIBLE TO AVOID CONTAMINATION BY PARTICLES OR RUSTS.
6. STAINLESS STEEL SHALL BE MARKED USING STEELOG FREE PENS ONLY.
7. STAINLESS STEEL SHALL BE WRAPPED OR OTHERWISE PROTECTED DURING TRANSPORT TO AVOID CONTAMINATION BY FOREIGN PARTICLES, IF A PLASTIC COATING IS USED ALL TRACES OF ADHESIVE SHALL BE REMOVED ON REMOVAL OF THE PLASTIC.

STRUCTURAL STEELWORK NOTES:

1. ALL DESIGN, WORKMANSHIP AND MATERIAL SELECTION SHALL BE IN ACCORDANCE WITH ADOPTED AS, AUSTRALIAN TECHNICAL STANDARDS AND SPECIFICATIONS.
2. THE CONSTRUCTION CATEGORY SHALL BE CC3 FOR ALL STEEL ELEMENTS, IN ACCORDANCE WITH AS/NZS 1554 PART 1.
3. STRUCTURAL STEEL SHALL BE AS FOLLOWS, UNO:
   a. HOT ROLLED STEEL MEMBERS, BAR, RC, PFC AND ANGLES: AS/NZS 3678, GRADE 300
   b. HOT ROLLED STEEL PLATES: AS/NZS 3678 GRADE 300
4. CONTRACTOR SHALL SUPPLY MILL CERTIFICATES FOR ALL STRUCTURAL STEEL COMPONENTS.
5. ALL EXPOSED AREAS ARE TO BE CONSIDERED SAFE EDGES AND ROUNDED SMOOTH.
6. UNLESS SHOWN OTHERWISE, STANDARD CONNECTION DETAILS SHALL CONFORM WITH AS/NZS STANDARDIZED STRUCTURAL CONNECTIONS.
7. NO WELDS SHALL BE PERMITTED WITHOUT PRIOR WRITTEN APPROVAL OF THE ENGINEER.
8. UNLESS SHOWN OTHERWISE, STRUCTURAL MEMBERS AT CONNECTIONS SHALL BE CONCENTRIC.
9. WHERE MEMBERS SHOWN ON THE STRUCTURAL DRAWINGS ARE TO BE BENT, CURVED OR ROLLED, THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE METHODS REQUIRED TO ACHIEVE THE REQUIRED SHAPES WITHOUT EXCESSIVE DISTORTION OF THE MEMBERS.
10. STEEL BEAMS ARE TO BE FABRICATED WITH THE MATERIAL LARGEST FACING UP.
11. ALL EXCAVATION IN CONTACT WITH THE GROUND SHALL BE PAINTED WITH TWO COATS OF APPROVED BITUMINOUS PAINT, EXTENDED TO 50mm ABOVE FINISHED SURFACE LEVEL.
12. BEFORE COMMENCING FABRICATION, THE CONTRACTOR SHALL SUBMIT COPIES OF THE SHOP DRAWINGS TO THE RELEVANT WaterNSW REPRESENTATIVE FOR REVIEW, REVIEW SHALL NOT INCLUDE CHECKING OF DIMENSIONS.
13. LOAD INDICATING WASHERS SHALL BE USED TO VERIFY TIGHTENING OF BOLTS IN "N" CONNECTIONS, TORQUE WRENCHES SHALL NOT BE USED. A HARDENED WASHER SHALL BE USED UNDER THE BOLT HEAD OF THE NUT WHICHEVER IS ROTATED. THE USE OF FULLY TENSIONED BOLTS IS PROHIBITED.
14. ALL STEELWORK SHALL BE [illegible]

WELDING NOTES:

1. ALL WELDS TO BE [illegible]
2. WELDING SHALL BE CATEGORY SP, WITH EVERY CATTERMOLE CAMP, UNO WITH AS/NZS 1554.1, JOINTS SHALL BE AS APPROPRIATE.
3. ALL CLEAT AND STIFFENER PLATES TO BE MINIMUM 10mm THICK UNO.
4. WELD DESIGNATION
   a. SP/PB = COMPLETE JOINT WELD
   b. SP/PB = COMPLETE PENETRATION BUTT WELD
5. ALL STITCHING TO BE SHOP WELDED UNO.
6. ALL SHARP EDGES ON STEELWORK SHALL BE GRAMMED PRIOR TO WELDING.
7. ALL WELD SPATTER TO BE CAREFULLY REMOVED FROM STAINLESS STEEL COMPONENTS PRIOR TO PASSIVATION.
8. ALL STAINLESS STEEL PLATES WORK AND WELDS SHALL BE FULLY PASSIVATED AFTER MANUFACTURE, PROCEDURES USED FOR CLEANING AND PASSIVATION OF ALL STAINLESS STEEL COMPONENTS AND PREPARATION SHALL CONFORM TO ASTM A380 STANDARD, UNLESS NOTED OTHERWISE.

CORROSION PROTECTION NOTES:

1. ALL STRUCTURAL MILD STEEL WORK EXCLUDING HARDWARE, COMPONENTS SHALL BE HOT DIP GALVANISED TO SHARK VERSION 2012 RETIGHTENED BY AS/NZS 2312 IN ACCORDANCE WITH AS/NZS 4680 AND AS/NZS 4791 (OR APPROPRIATE, ALL FASTENERS, COMPONENTS SHALL BE HOT DIP GALVANISED TO GRADE VERSION).
2. TESTING AND TOLERANCES OF ZITS FOR GALVANISING REQUIREMENTS TO VERSION AND VERSION SHALL BE UNDERTAKEN.
3. ALL STEEL MEMBERS TO BE FREE OF ANY CONTAMINATION AND PICKLING EFFECTS.
4. PROTECTIVE COATINGS TO BE APPLIED AFTER ALL FABRICATION IS COMPLETED.
5. SUITABLE DETAILS BELOW GALVANISED PROTECTION SCHEME WHERE DISSIMILAR METALS/MATERIALS ARE IN CONTACT.
6. ALL NUTS, BOLTS AND WASHERS ARE STAINLESS STEEL MINIMUM A4-70 TO BS 7760 AND BOLTED WITH APPROPRIATE INSULATION, REFER TO "BOLTED CONNECTION NOTES" FOR DETAILS.
7. ALL DAMAGED PROTECTIVE COATINGS SHALL BE REPAIRED OR MADE AS PER AS/NZS 4680, AS APPROPRIATE.
8. ALL GUARDRAILS, STANDARDS AND KICK PLATES SHALL BE HOT DIP GALVANISED AFTER FABRICATION.
9. SUPERIMPOSED GALVANISING VALUES SHALL BE PROVIDED FOR BLEED AND DRAINAGE OF GALVANISING FLUID IN ACCORDANCE WITH THE GALVANIZERS ASSOCIATION OF AUSTRALIA "SYSTEM GUIDELINE FOR HOT DIP GALVANIZING-A BEST PRACTICE FOR VENTING AND DRAINING". HOLES SHALL NOT BE PROVIDED ON TOP OR HEAD-TOP SURFACES, INCLUDING CLOSED SHAPES OR RUNNING TUBING, WHERE USERS ALLOW THE PASSAGE OF DAMAGES, ANY SUCH HOLES DEEMED NECESSARY FOR EFFECTIVE GALVANISING SHALL BE FILLED PRIOR TO DELIVERY TO SITE.

BOLTED CONNECTION NOTES:

1. BOLTS FOR CONNECTIONS ARE AS FOLLOWS:

MATERIAL/TYPE/LOCATION OF ELEMENTS CONNECTED	BOLT PROPERTIES
[illegible]	[illegible]
[illegible]	[illegible]

2. A MINIMUM OF 2 HOLES TO ENSURE MINIMUM EDGE DISTANCE AND TO PREVENT ECCENTRICITY, WASHER PLATES SHALL BE USED AT EACH CONNECTION, UNLESS OTHERWISE NOTED.
3. WHERE BOLTS ARE A DISSIMILAR METAL TO THE CONNECTION ELEMENTS, ELECTRICALLY INSULATED WASHERS SHALL BE SUPPLIED AND INSTALLED AS FOLLOWS: ELECTRICALLY INSULATED WASHERS SHALL BE PROVIDED BETWEEN THE STAINLESS STEEL WASHER AND ANY DISSIMILAR METAL, REFER TO "BOLTED CONNECTIONS NOTES".
4. CHEMICAL ANCHORS SHALL BE MINIMUM M16 WITH A MINIMUM 125mm EMBEDMENT DEPTH UNO.
5. WHERE CONCRETE ELEMENTS ARE LESS THAN 125mm THICK, ANCHORS SHALL BE THROUGH BOLTED AND THE USE OF CHEMICAL ANCHORS IS NOT PERMITTED.
6. EXISTING CONCRETE SHALL BE CHISELLED APPROPRIATELY, TAP AND ENSURE SOUND TO ENSURE GOOD QUALITY CONCRETE PRIOR TO DRILLING OF ANCHORS, IF CONCRETE CRACKING OR SPALLING IS OBSERVED, CONSULT WITH DESIGN ENGINEER OR WaterNSW REPRESENTATIVE AND CLARIFY BEST METHODS AS SPECIFIED.
7. PULL OUT TESTING OF CHEMICAL ANCHORS MAY ALSO BE REQUIRED BY CONSTRUCTION CONSULTANT AS DIRECTED TO BE CONFIRMED BY WaterNSW REPRESENTATIVE, ONE PER TEST LOAD (BATCH), IF NOT SPECIFIED ON THE DRAWINGS.
8. GIANT LEVELLING BASE PLATES MINIMUM 15mm OF APPROVED NON-SHRINK CEMENTITIOUS GROUT (HIGH STRENGTH WATER SUPPORTING MECHANICAL EQUIPMENT) WITH A MINIMUM CHARACTERISTIC COMPRESSIVE STRENGTH OF 50MPA AT 28 DAYS.

CONCRETE NOTES:

1. ALL CONCRETE STRUCTURES, CONCRETE WORK, MATERIALS, PLACEMENT, WORKMANSHIP AND TESTING, SHALL BE IN ACCORDANCE WITH THE SPECIFICATION WaterNSW "GENERAL SPECIFICATION FOR CONCRETE WORKS", AND CURRENT EDITION OF AS3600 AND AS 3706, ASSUMED, ESPECIALLY WHERE ALL SUBORDINATE CODES REFERENCED BY AS 3600, AUSTRALIA, AS/NZS AS 1379 AND AS 3706, AS APPROPRIATE.
2. BEFORE COMMENCING OPERATIONS, LABORATORY TESTING AND PREPARE TRIAL MIXES TO DEMONSTRATE COMPLIANCE WITH THE PERFORMANCE REQUIREMENTS OF THE CONCRETE TO THE SATISFACTION OF THE ENGINEER, OBTAIN APPROVAL OF SUITABLE MIX SPECIFICATIONS, WHERE SHALL AT ALL TIMES BE ADHERED TO FOR LOAD PLACEMENT OF THE CONCRETE WORKS TO WHICH THE APPROVED MIX APPLIES, OR PREVIOUS RELEVANT MIX DOCUMENTATION.
3. ALL CONCRETE QUALITY CONTROL SHALL BE IN ACCORDANCE WITH WaterNSW "GENERAL SPECIFICATION FOR CONCRETE WORKS".

CONCRETE NOTES CONTINUED:

4. REFER TO TABLE BELOW FOR MINIMUM CONCRETE COVERS (B=SEV CONCRETE TO REINFORCEMENT):

CONCRETE PROPERTY	STRUCTURE ELEMENT
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

5. REFER TO BELOW FOR MINIMUM CONCRETE COVERS (B=SEV CONCRETE TO REINFORCEMENT):

FOR PERMANENTLY SUBMERGED = 50mm
EXTERNAL SURFACE IN CONTACT WITH SOIL = 75mm
EXPOSED AGAINST GROUND (WET) SOIL = 75mm
EXPOSED AGAINST GROUND (DRY) SOIL = 50mm

6. FREE DROPPING OF CONCRETE FROM A HEIGHT GREATER THAN 500mm SHALL NOT BE PERMITTED.
7. CONCRETE SHALL NOT BE PLACED BEFORE THE RECEIVED CONCRETE LEVEL.
8. UNLESS NOTED OTHERWISE, STRIPPING OF FORMWORK SHALL BE IN ACCORDANCE WITH AS3600 AND WaterNSW "GENERAL SPECIFICATION FOR CONCRETE WORKS" STANDARDS.
9. CONCRETE SHALL BE COMPACTED WITH SUITABLE MECHANICAL VIBRATORS.
10. CONCRETE SHALL BE PLACED IN ONE CONTINUOUS POURING OPERATION BETWEEN SPECIFIED CONSTRUCTION JOINTS.
11. ANY ADDITIONAL CONSTRUCTION JOINTS NOT INDICATED BY THE ENGINEER, OR SHOWN ON THE DETAILED DESIGN DRAWINGS, SHALL BE SUBMITTED FOR APPROVAL PRIOR TO COMMENCEMENT OF WORKS, THE CONTRACTOR SHALL SUBMIT PROPOSED LOCATIONS FOR ALL PLANE JOINTS, AS WELL AS THE SCHEDULE AND TIMING OF POURS.
12. ALL CONSTRUCTION JOINTS SHALL BE SCARIFIED AND THOROUGHLY CLEANED OF LOOSE MATERIAL BEFORE PLACING FRESH CONCRETE, WHERE JOINTS ARE TO BE SAW CUT, CUTTING SHALL TAKE PLACE WITHIN 4 TO 6 HOURS OF CONCRETE PLACEMENT.
13. ANY ADMIXTURES SHALL BE CHLORIDE FREE, SHALL COMPLY WITH AS1478, SHALL BE USED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS AND THE RATIOS AND THE DOSAGES OF 25% OF THE ADMIXTURES SHALL FORM PART OF THE APPROVED MIX'S SPECIFICATIONS.
14. CALCIUM CHLORIDE ADMIXTURES SHALL NOT BE USED IN CONCRETE WITHOUT PRIOR APPROVAL OF THE ENGINEER.
15. USE OF CONCRETE ELEMENTS TO NOT INCLUDE THICKNESS OF APPROX FINISHES.
16. THE CONTRACTOR SHALL ARRANGE FOR THE ENGINEER TO INSPECT ALL REINFORCEMENT PRIOR TO PLACEMENT OF CONCRETE POURS AND ORDERING OF CONCRETE, AND MUST OBTAIN APPROVAL PRIOR TO POURING CONCRETE.
17. MINOR CONCRETE VARIANTS TO AS 3600 AND AS SHOWN BELOW:

CHANGES SURFACE CRACK:
(a) EXPOSED SURFACES EXPOSED TO CLASS A AND — CLAUSE 2.10 AS 3600
(b) MINOR VARIANTS = 0.005 X 10.05 MM

ACCEPTABLE SURFACE CRACK:
(a) WATER RETAINING STRUCTURES: CRACK CONTROL CRACK
(b) OTHER STRUCTURES: MINOR PLANT CRACK

CONCRETE NOTES CONTINUED:

18. CONCRETE CURING AND PROTECTION SHALL BE IN ACCORDANCE WITH WaterNSW "GENERAL SPECIFICATION FOR CONCRETE WORKS", AS NOTED THE PROJECT SPECIFICATION AND TO THE APPROVAL OF THE ENGINEER.
19. AFTER THE COMMENCEMENT OF WORKS, FORMS SHALL BE KEPT IN PLACE FOR A MINIMUM OF 1 DAYS, AFTER STRIPPING, THE WALLS SHALL BE KEPT MOIST BY AN APPROVED PROCEDURE WHICH SHALL INCLUDE (BUT NOT LIMITED TO) CURING WITH MOISTURE PROOF MEMBRANES, OR BY THE APPLICATION OF SOME ACCEPTABLE WATERPROOFING SYSTEM FOR A MINIMUM PERIOD OF 3 FURTHER 10 DAYS.
20. CURING OF ALL OTHER ELEMENTS RECEIVES SHALL'S SHALL COMMENCE AS SOON AS THE EXPOSED SURFACE OF CONCRETE HAS HARDENED, TO PREVENT DAMAGE BUT IN NO CASE LATER THAN 2 HOURS AFTER THE FINISHING OPERATION HAS BEEN COMPLETED.
21. CURING MUST BE CARRIED TO THE APPROPRIATE SECTION IN THE GENERAL CONDITIONS OF THE PROJECT SPECIFICATIONS REGARDING CONCRETING IN HOT WEATHER.
22. PROVIDE 50mm POLYFOAM BARRIER (POLYSTYRENE OR APPROVED EQUIVALENT) TO THE UNDERSIDE OF FLOOR SLABS, FOOTINGS AND SOIL RETAINING SURFACES OF WALLS.
23. ALL EXPOSED CORNERS OF CONCRETE SHALL HAVE A 15X15 CHAMFER UNLESS NOTED OTHERWISE ON DRAWINGS.
24. CONCRETE CURING SHALL TO BE NOTED UNLESS NOTED OTHERWISE.
25. CONCRETE REPAIRS SHALL BE IN ACCORDANCE WITH WaterNSW "GENERAL SPECIFICATION FOR CONCRETE WORKS".

PRECAST CONCRETE

1. REFER TO ARCHITECTURAL DRAWINGS FOR ARCHITECTURAL FEATURES, SHAPES, SCALE, TEXTURES OR EXPOSED FACES, ETC, AND DETAILS OF OTHER PROPRIETARY ITEMS.
2. FOR PRECAST ELEMENTS MINIMUM COVER IS GIVEN TO REINFORCEMENT = 40mm
3. ALL FITMENTS AND CAST IN ITEMS SHALL BE HOT-DIP GALVANIZED OR STAINLESS NOT TO AS 4680 AND THE PROJECT SPECIFICATION. UNLESS SHOWN OTHERWISE.
4. THE FINAL LIFTING ARRANGEMENTS ARE TO BE COMPLETED BY THE PRECAST CONTRACTOR AS REQUIRED BY THE STRUCTURAL DRAWINGS.
5. REFER TO STRUCTURAL DRAWINGS FOR LOCATION AND DIMENSIONS OF ALL PENETRATIONS AND CAST-IN ELEMENTS.
6. PENETRATIONS FOR SERVICES SHALL BE NEAT CORNER CUTS, YOU WORK SHALL NOT BE PERMITTED FOR PENETRATIONS WITHOUT PRIOR APPROVAL.
7. PANELS HAVE BEEN DESIGNED FOR "IN-SERVICE" CONDITIONS, THE CONTRACTOR SHALL ENSURE THAT PANEL CONCRETE STRESSES THROUGHOUT ALL STAGES OF HANDLING INCLUDING LIFTING, STACKING, TRANSPORT AND ERECTION WILL NOT EXCEED CRACKING, SUPPLEMENTING BY A CHARTERED ENGINEER EXPERIENCED IN THIS TYPE OF WORK SHALL COMPLY WITH THE REQUIREMENTS OF ALL WHS/ AND ALL SAFE, COMPLETIONS AND DETAILS OR CONTRACTORS DRAWINGS SHALL INCLUDE LOCATION WORK AND SIZE OF INSERTS AND TESTED PROVEN CAPACITY OF LIFTING INSERTS.

REINFORCEMENT NOTES:

1. REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY AND MAY NECESSARILY BE TRUE PROJECTION.
2. REINFORCEMENT SHALL BE IN ACCORDANCE WITH AS/NZS 4671, THE NOMINED MANUFACTURER FOLLOWING THE BAR SYMBOLS REPRESENTS THE NOMINAL BAR DIAMETER IN MM.
3. ALL HOOKS AND BENDS SHALL BE IN ACCORDANCE WITH AS3600 UNLESS OTHERWISE STATED.
4. ALL REINFORCEMENT SHALL BE SECURELY TIED AT ALL LAPS AND INTERSECTIONS WITH A 1.25mm DIAMETER BLACK ANNEALED WIRE.
5. ALL REINFORCEMENT LAP LENGTHS SHALL BE AS FOLLOWS UNLESS NOTED OTHERWISE.

LAP LENGTHS AND SPACING IN TERMS OF BAR DIAMETERS (mm)			
BAR TYPE AND GRADE	CONCRETE GRADE	MINIMUM BAR SPACING (mm)	OTHER REQUIRED
		[illegible]	

6. WHERE TWO DIFFERENT DIAMETER BARS ARE LAPPED, THE LAP LENGTH SHALL EQUAL THE LARGER BAR DIAMETER.
7. REINFORCEMENT FRAME SHALL BE SUPPORTED IN FLAT SHEETS ONLY.
8. CHAIR LAPS SHALL BE AS PER AS3600 CLAUSE 13.11 (C), THE 3 REINFORCE TRANSVERSE WIRES MUST OVERLAP, STAGGER FRAME SPACES TO ENSURE NO MORE THAN THREE FRAME THICKNESS AT ONE POINT, AND MINIMUM CONCRETE COVER IS MAINTAINED WHERE FRAME SPACES OCCUR.
9. CORNER SLAB REINFORCEMENT SHALL BE FIRMLY SUPPORTED ON CONCRETE CHAIRS AT 600mm CENTRES MAXIMUM, BOTH WAYS.
10. SLAB BEAM LOCATIONS SHALL BE SECURED TO A MINIMUM EACH CORNER OF THE LOCATING.
11. LONGITUDINAL BEAM REINFORCEMENT SHALL BE SECURED BY SPACERS OR TIES AT BY MORE THAN 500mm INTERVALS.
12. THE FOLLOWING ABBREVIATIONS APPLY TO THE LOCATION AND LAYERS OF REINFORCEMENT BARS.

BF = EACH FACE	H = HORIZONTAL
T = TOP FACE	V = VERTICAL
B = BOTTOM FACE	EW = EACH WAY
C = CENTRALLY PLACED	LW = LENGTH WORKS

13. SPLICE REINFORCEMENT ONLY AT LOCATIONS SHOWN ON THE DRAWINGS, OR AS APPROVED BY THE ENGINEER.
14. WELDING OF REINFORCEMENT IS ONLY PERMITTED WHERE SHOWN ON THE DRAWINGS OR OTHERWISE APPROVED BY THE ENGINEER, WHERE WELDING OF REINFORCEMENT IS APPROVED IT SHALL BE CARRIED OUT IN ACCORDANCE WITH AS3600.

SECURITY CLASS:	[illegible]									
CONFIDENTIALITY:	HIGHER									
DISCIPLINE:	STRUCTURAL									
DRAWING TYPE:	GENERAL NOTES									
DRAWING SCALE:	NON-DIMENSIONAL									
PLOT DATE:	[illegible]									

ASSETREADY

C	[illegible]	[illegible]	[illegible]	[illegible]	DRAWN	[illegible]	SCALES	1:1	SHEET SIZE	A1
B	[illegible]	[illegible]	[illegible]	[illegible]	CHECKED	[illegible]				
A	[illegible]	[illegible]	[illegible]	[illegible]			FILE No.	[illegible]	REPORT No.	[illegible]
REVISIONS	DETAILS OF AMENDMENT	[illegible]	[illegible]	[illegible]	SUBMITTED	[illegible]	OVERALL HEIGHT	[illegible]	SUBSTRUCTURE No.	[illegible]

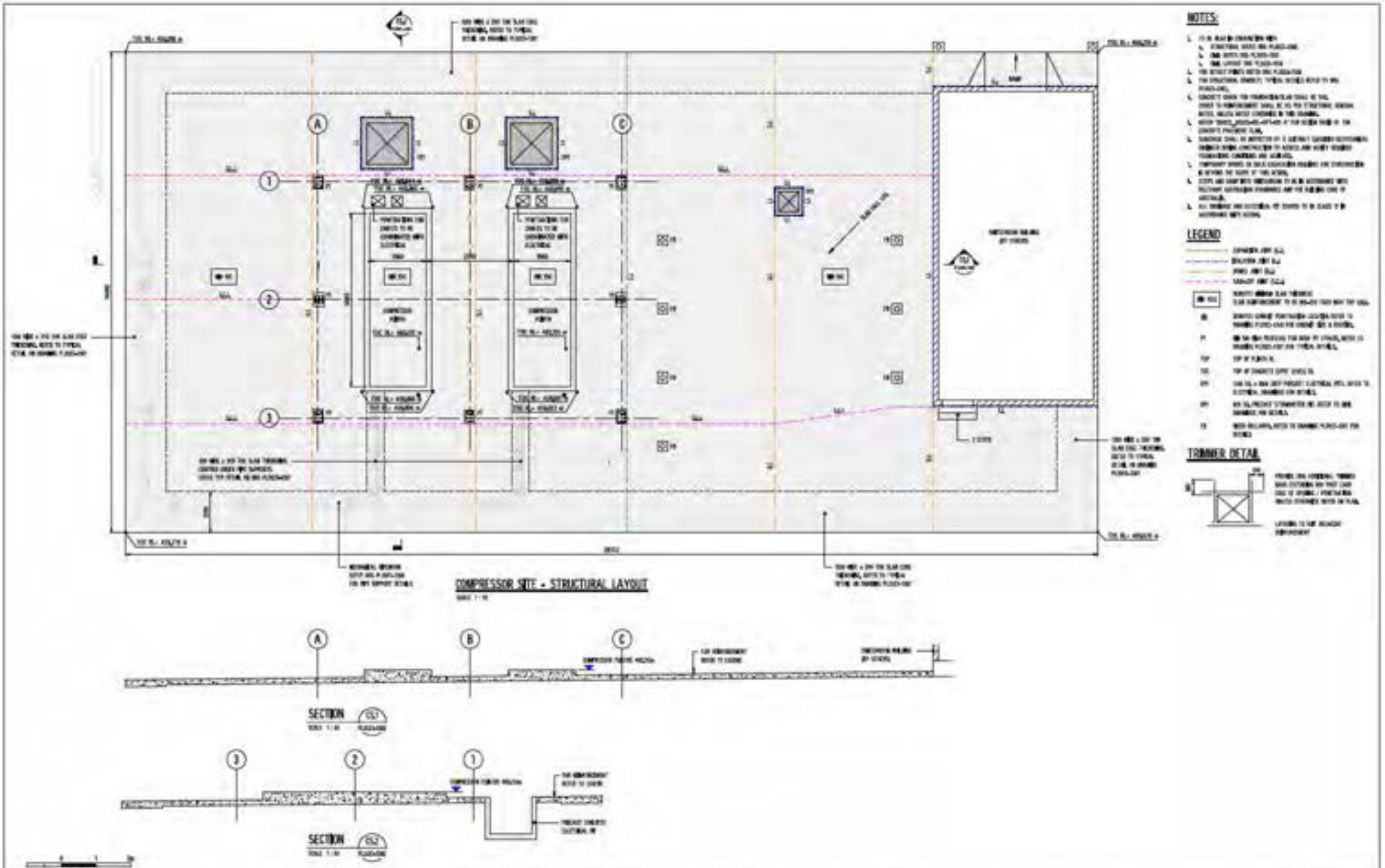
WaterNSW

COPYRIGHT RESERVED
This document is the property of Water NSW. It must not be copied without their written consent and is not to be used for any purpose other than that for which it was supplied. It must not be loaned to any third party.

PINDARI BUBBLE PLUME

BUBBLE PLUME DESTRATIFICATION SYSTEM
STRUCTURAL NOTES

PLAN No.	PL2023-1380
SHEET No.	TBC



FACILITY NAME	PINDARI BUBBLE PLUME
LOCATION (MAP)	MOREE
DESIGNED BY	STRUCTURAL
DRAWING TYPE	PLAN LAYOUT
DRAWING STATUS	50% DESIGN RELEASE
PLOT DATE	17/04/2023 2:30:59 PM

ASSETREADY

C	50% DESIGN RELEASE	WJ	17/04/23
B	50% DESIGN RELEASE	WH	04/04/23
A	50% DESIGN RELEASE	AG	27/03/23
0	50% DESIGN RELEASE	AG	24/03/23
REVISION	DETAILS OF AMENDMENT	CHKD	DATE

DRAWN: GEORGE
FILE: PLOT.DWG
DESIGNED: GEORGE
PLOTTED: 24/03/2023
CHECKED:

SCALES: AS SHOWN
PLOT No.: 1:50
SHEET SIZE: A1
REPORT No.: N/A
DWELL KEMP
PLOTTED:
JOB/PROJECT No.: CW2049882

WaterNSW

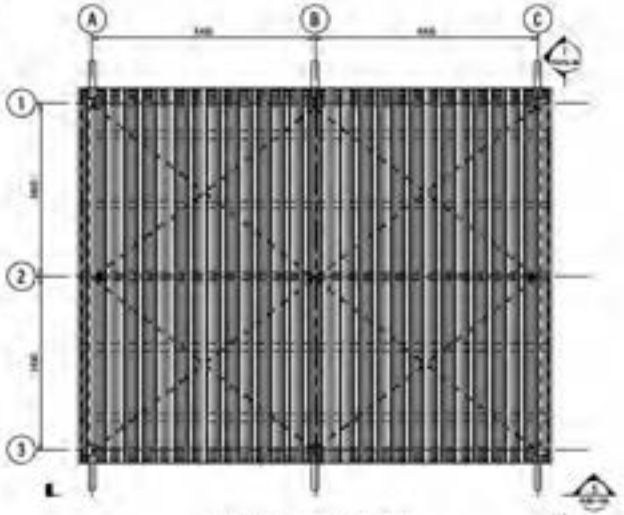
COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on demand. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI BUBBLE PLUME

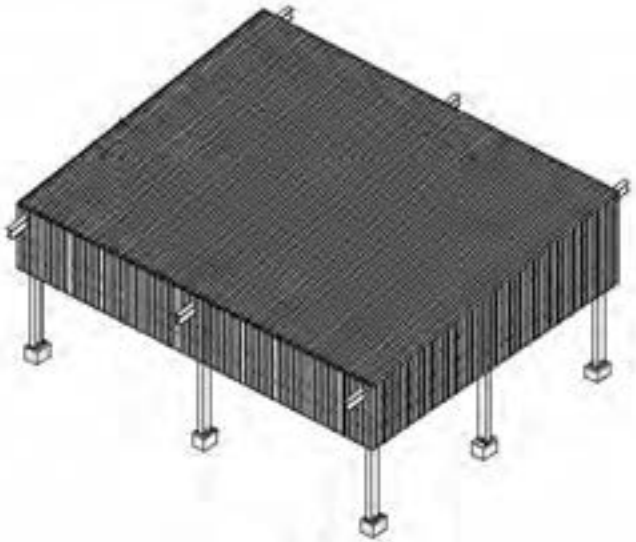
BUBBLE PLUME DESTRATIFICATION SYSTEM
COMPRESSOR SETF
STRUCTURAL LAYOUT

REV	PLAN No.
D	PL2023-1382
C	
B	
A	

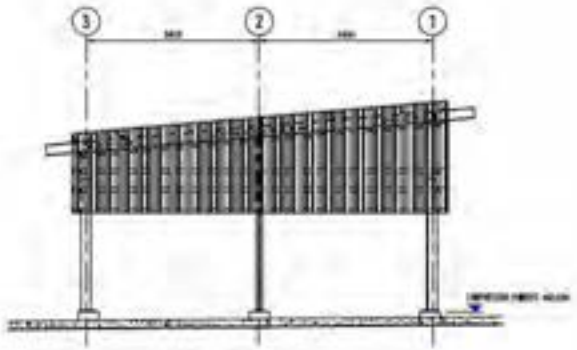
SHEET 1 OF 1



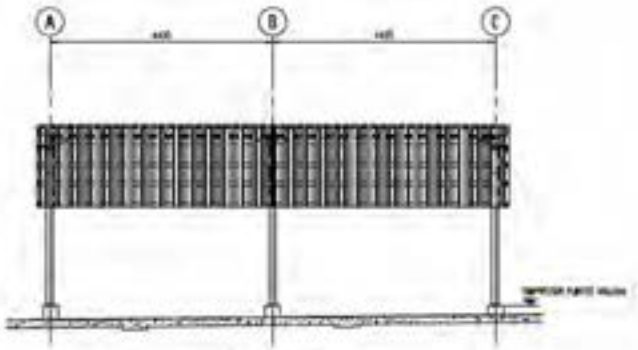
GENERAL ARRANGEMENT PLAN



ISOMETRIC VIEW



ELEVATION



ELEVATION

ASSETREADY

WaterNSW

PINDARI BUBBLE PLUME

BUBBLE PLUME DESTRATIFICATION SYSTEM

COMPRESSOR SET-

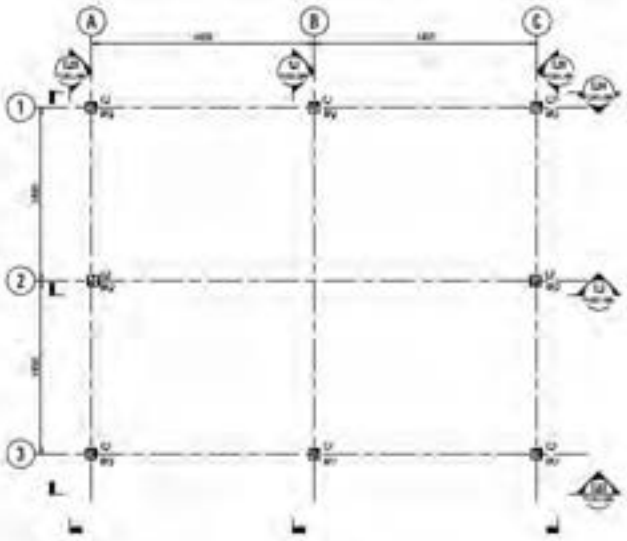
COMPRESSOR CANOPY GENERAL ARRANGEMENT

PL2023-1383

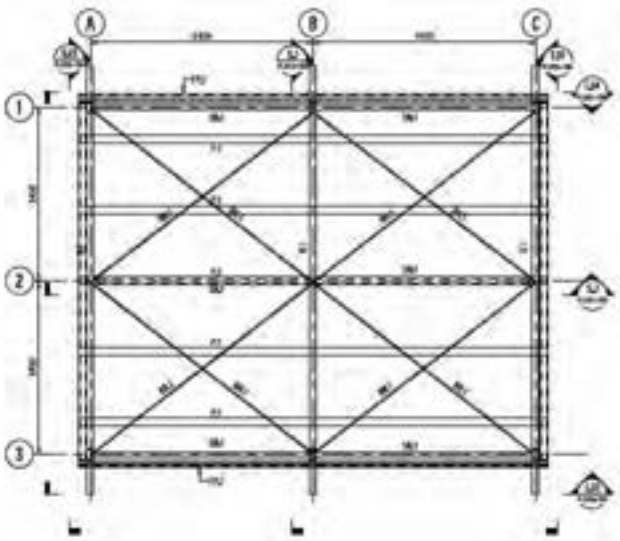
NOTES:

1. [illegible]

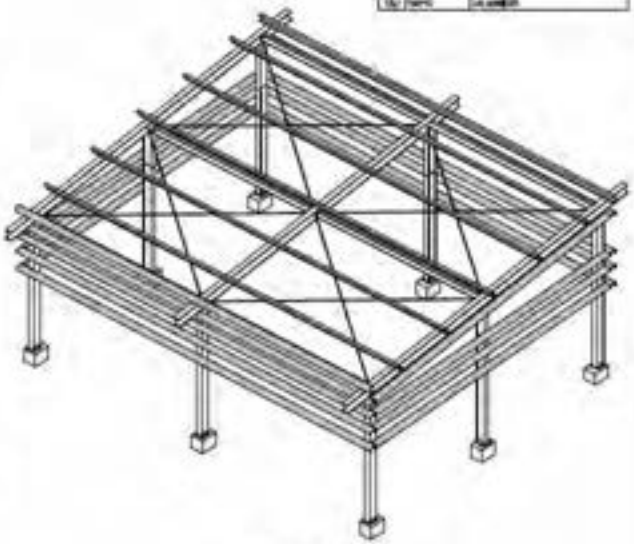
FRAMING SCHEDULE		
REF.	DESCRIPTION	COMMENTS
[illegible]		



COLUMN PLAN



ROOF PLAN



ISOMETRIC VIEW

FACILITY NAME: PINDARI DAM								
LOCATION (HOST): WEMBO								
DESCRIPTION: STRUCTURAL								
DRAWING TYPE: PLAN LAYOUT								
DRAWING STATUS: 50% DESIGN RELEASE								
PLOT DATE: 22/01/2025 12:02:45 PM								

ASSETREADY

NOTES:

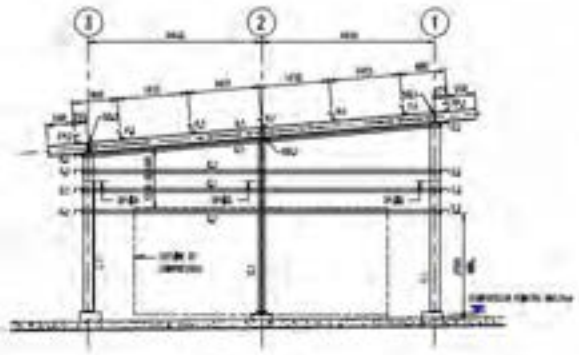
1.

a.

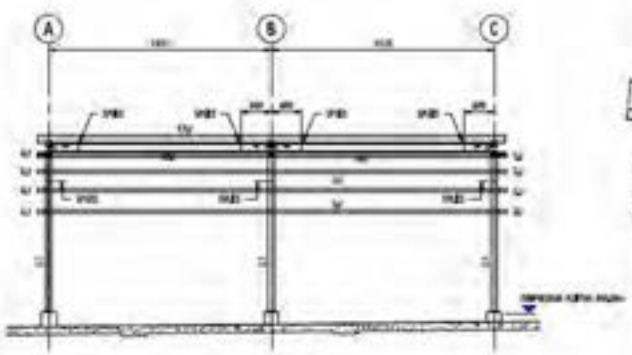
b.

c.

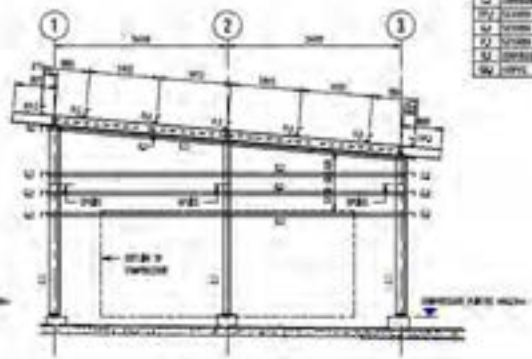
FRAMING SCHEDULE		
REF.	DESCRIPTION	COMMENTS



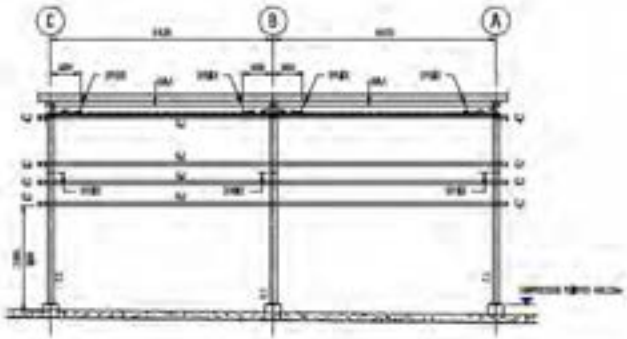
ELEVATION



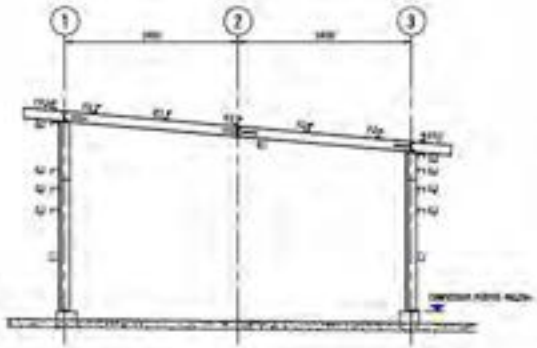
ELEVATION



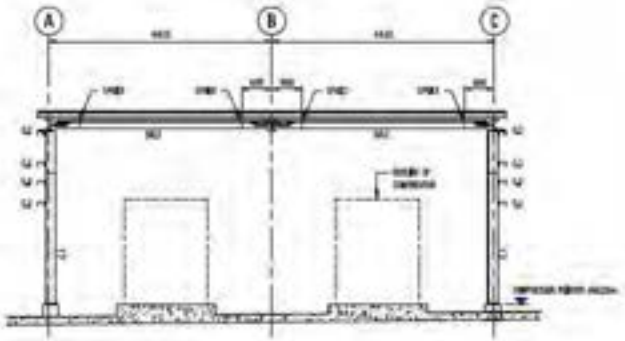
ELEVATION



ELEVATION



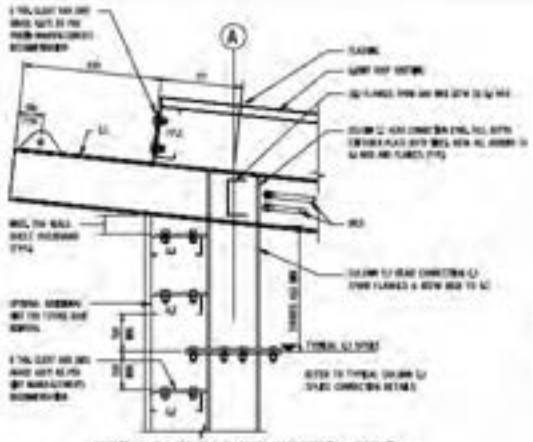
SECTION



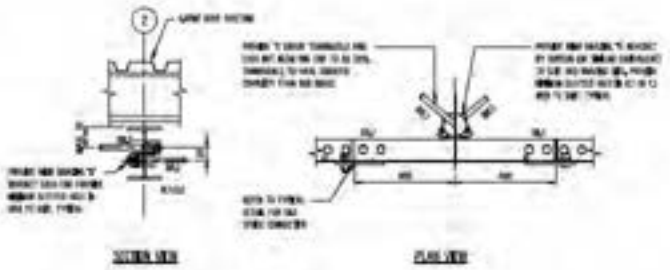
SECTION

FACILITY NAME:	PINDARI BUBBLE PLUME										
CONTRACT NO.:	4500000										
DISCIPLINE:	STRUCTURAL										
DRAWING TYPE:	PLAN LAYOUT										
DRAWING STATUS:	90% DESIGN ISSUE										
PLOT DATE:	22/01/2025 12:02:36 PM										

ASSETREADY



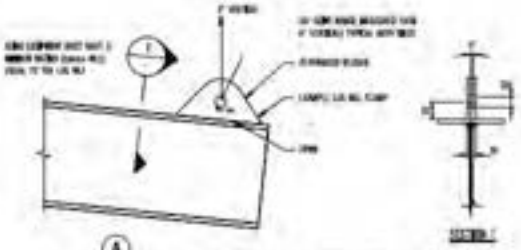
TYPICAL CJ TO RJ EAVES CONNECTION DETAIL



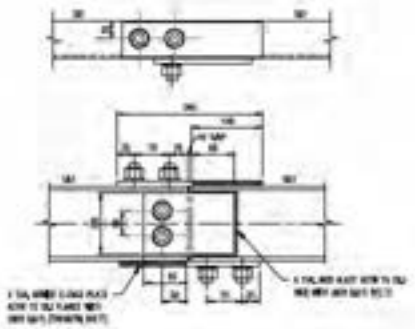
TYPICAL ROD BRACING DETAILS



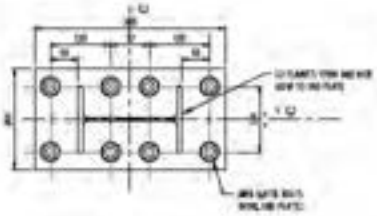
TYPICAL SBJ TO RJ CONNECTION DETAIL



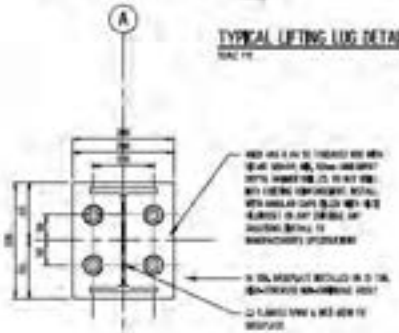
TYPICAL LIFTING LUG DETAILS



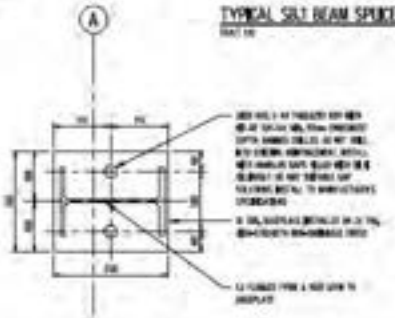
TYPICAL SBJ BEAM SPLICE DETAIL



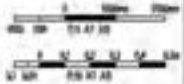
TYPICAL CJ COLUMN SPLICE DETAIL



BASEPLATE TYPE BP1



BASEPLATE TYPE BP2



ASSETREADY

WaterNSW

PINDARI BUBBLE PLUME

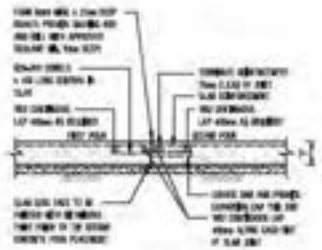
BUBBLE PLUME DESTRATIFICATION SYSTEM

COMPRESSOR SETS

COMPRESSOR CANOPY DETAILS

PL2023-1386

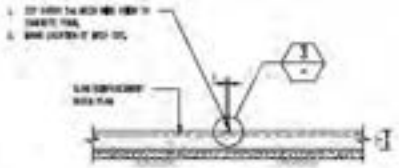
NOTES:



DENOTED AS SJ1 ON SLAB PLAN

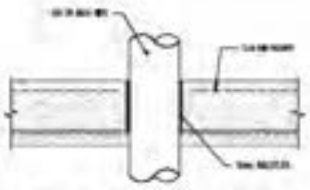
NOTE:

CONSTRUCTION JOINT DETAIL

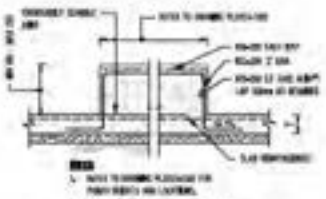


DENOTED AS SJ2 ON SLAB PLAN

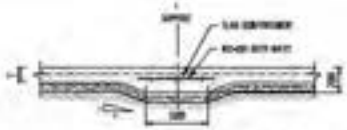
SLAB ON GROUND SAWCUT JOINT DETAIL



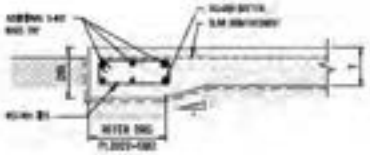
SLAB PENETRATION TYPICAL DETAIL



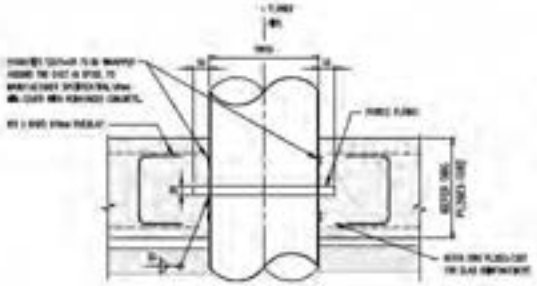
TYPICAL PLINTH DETAIL



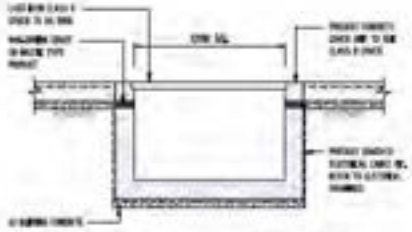
THICKENING UNDER PIPE SUPPORT



TYPICAL SLAB EDGE THICKENING

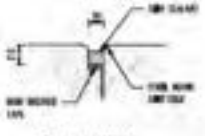


PUDDLE FLANGE DETAILS

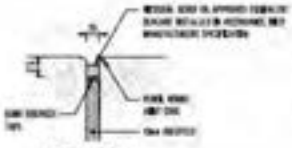


1200 SQ. ELECTRICAL PIT TYPICAL DETAIL

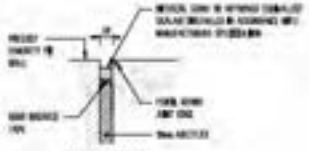
DRAINAGE PIT SIMILAR



DETAIL 1



DETAIL 2

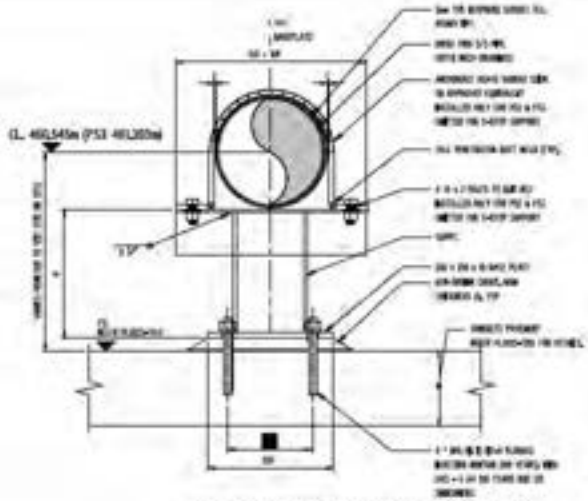


DETAIL 3

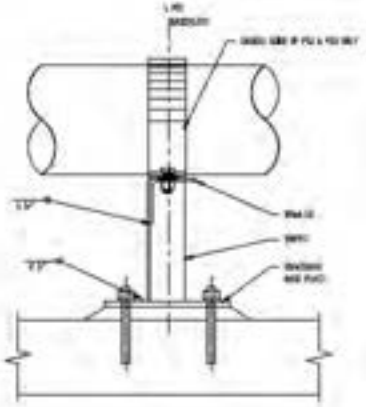
SEALANT DETAILS



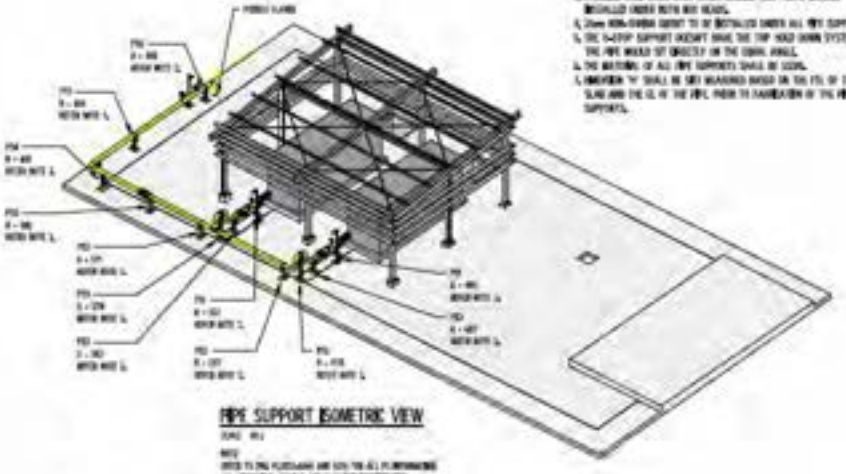
FACILITY NAME: PINDARI CREEK LOCATION (NEAR): WEMPA DESIGNED: STRUCTURAL DRAWING TYPE: GENERAL NOTES DRAWING STATUS: 90% DESIGN REVIEW PLOT DATE: 17/04/2024 2:51:46 PM	ASSETREADY					DRAWN: BH CHECKED: DAVID BARCLAY APPROVED: P. BERGITH	PROJECTS: PINDARI CREEK TITLE No.: TBC CONSULTANT: POWERCOM	SHEET SIZE: A1 REPORT No.: N/A ASSET PROJECT No.: CW51999882	WaterNSW COPYRIGHT RESERVED This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on demand. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.	PINDARI BUBBLE PLUME BUBBLE PLUME DESTRATIFICATION SYSTEM COMPRESSOR SITE REINFORCED CONCRETE - TYPICAL DETAILS	REV.	PLAN No. PL2023-1387 SHEET NO. TBC
		C	90% DESIGN REVIEW ISSUE	MH	16/02/24						C	
		B	90% DESIGN REVIEW ISSUE	MH	22/08/24						B	
		A	90% DESIGN REVIEW ISSUE	MH	22/12/23						A	
		REVISION No.	DETAILS OF AMENDMENT	DRAWN	DATE							



PIPE SUPPORT (PS2, PS3 & PS4/V-STOP) DETAILS

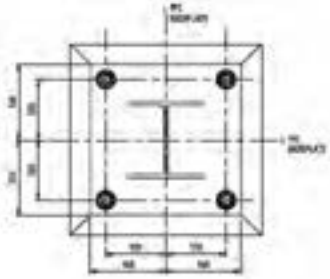


PIPE SUPPORT (PS2, PS3 & PS4/V-STOP) ELEVATION

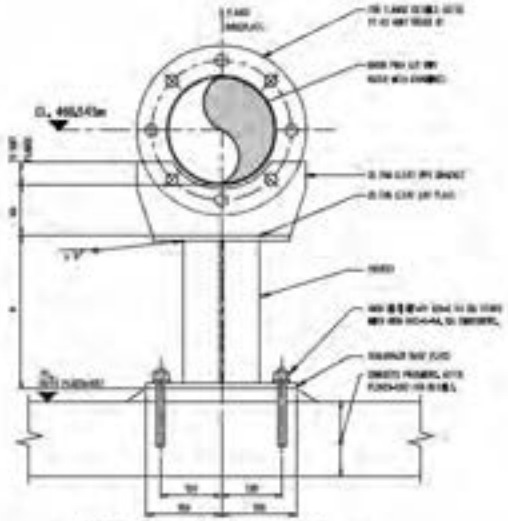


PIPE SUPPORT ISOMETRIC VIEW

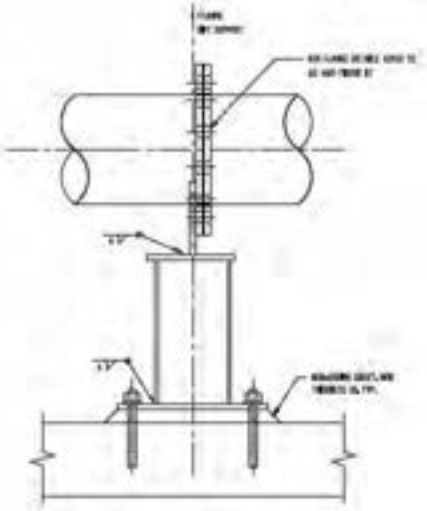
NOTES



TYPICAL PIPE SUPPORT BASEPLATE DETAILS



PIPE SUPPORT (PS1/ANCHOR) DETAILS



PIPE SUPPORT (PS1/ANCHOR) SIDE ELEVATION

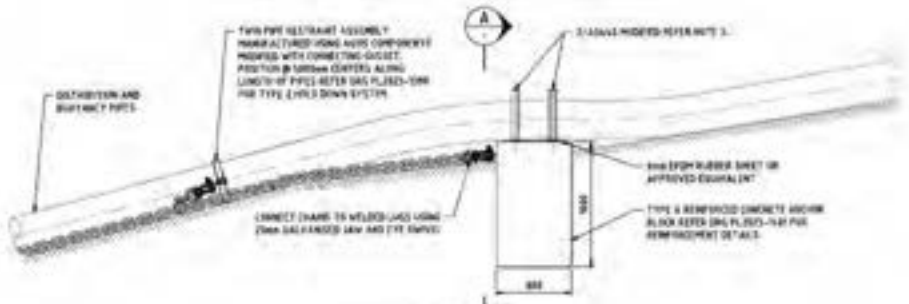
FACILITY NAME:	PINDARI DAM	ASSETREADY						WaterNSW	PINDARI BUBBLE PLUME
LOCATION UNIT:	INVERELL								BUBBLE PLUME DESTRATIFICATION SYSTEM
DISCIPLINE:	STRUCTURAL								COMPRESSOR SITE
DRAWING TYPE:	DETAILS								ABOVE GROUND PIPE SUPPORTS
DRAWING STATUS:	WITH DESIGN ISSUE								
PLOT DATE:	22/01/2026 10:50:46 PM								

D	WITH DESIGN ISSUE	RH	14/01/26						
C	WITH DESIGN ISSUE	AG	24/09/25						
B	WITH DESIGN ISSUE	AG	24/07/25						
A	WITH DESIGN ISSUE	AG	30/05/25						
REVISION	DETAILS OF AMENDMENT	CHKD	DATE						

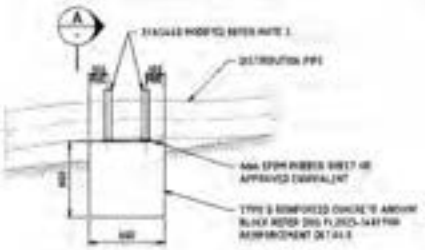
DRAWN:	DESIGN:	SCALES:	SHEET SIZE:		
TGB, ROBERTS		AS SHOWN	A1		
CHECKED:	ENGINEER:	TSC	REPORT No.		
TGB, ROBERTS		DWG			
CHKD: KSAP		APPROJECT No.			
POSITION:					

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without their written consent and must be returned on demand. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PLAN No.	PLAN No.
A	PL2023-1390
B	WAD / RT
C	
D	
E	TBC



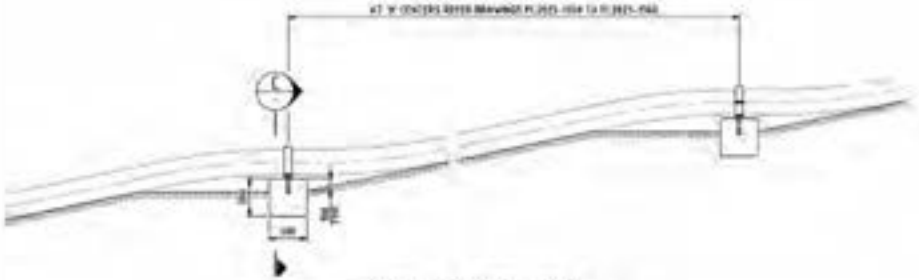
ANCHOR BLOCK – TYPE A



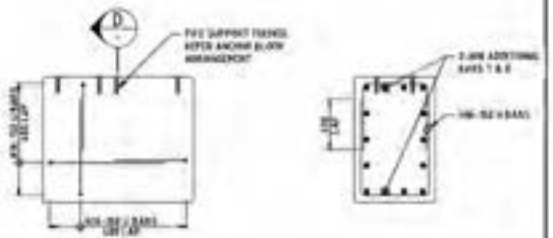
ANCHOR BLOCK – TYPE B

NOTES:

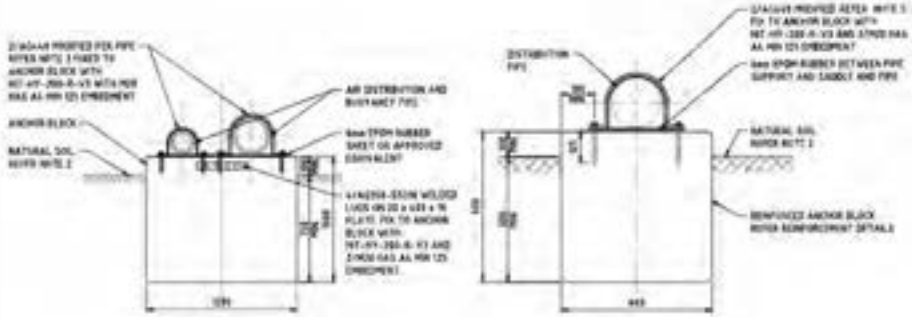
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH
   a. STRUCTURAL NOTES DRG PL2023-1300,
   b. CIVIL NOTES DRG PL2023-1910,
   c. CIVIL LAYOUT DRG PL2023-1003
2. ASSUMED ALLOWABLE HORIZONTAL BEARING PRESSURE OF UNDISTURBED NATURAL SOIL >250kpa. SITE CONDITIONS TO BE CONFIRMED BY SUITABLE QUALIFIED GEOTECHNICAL ENGINEER. REFER GEOTECHNICAL REPORT PE203643-WSP-LYPS-000-REP-001 FOR GENERAL SITE INFORMATION
3. "ANCHORAGE" TYPE CLAMPS AND FITTINGS ARE SPECIFIED AND ARE TO BE MODIFIED TO SUIT HDPE PIPE OD. APPROVED EQUIVALENT MAY BE USED. ALL CLAMPS TO BE INSULATED. ALL CONCRETE INSERTS, CLAMPS AND FIXINGS TO BE STAINLESS STEEL 316 GRADE
4. ALL BOLTS IN CONTACT WITH DISSIMILAR METAL PIPES INCORPORATE NYLON BUSHES AND WASHERS.
5. ALL WELD SHALL BE 6MM FILLET WELD ALL ROUND U.N.O.
6. U/G BOLT LENGTHS SO THAT PROJECTION BEYOND NUT IS AT LEAST TWO FULL THREADS AND NOT MORE THAN 10mm.



TYPICAL PIPE SUPPORT PS 6



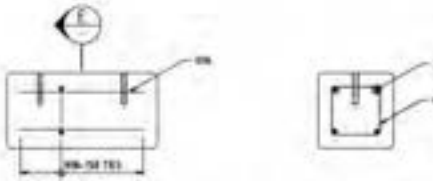
TYPICAL ANCHOR BLOCK – REINFORCEMENT DETAIL SECTION D



SECTION A

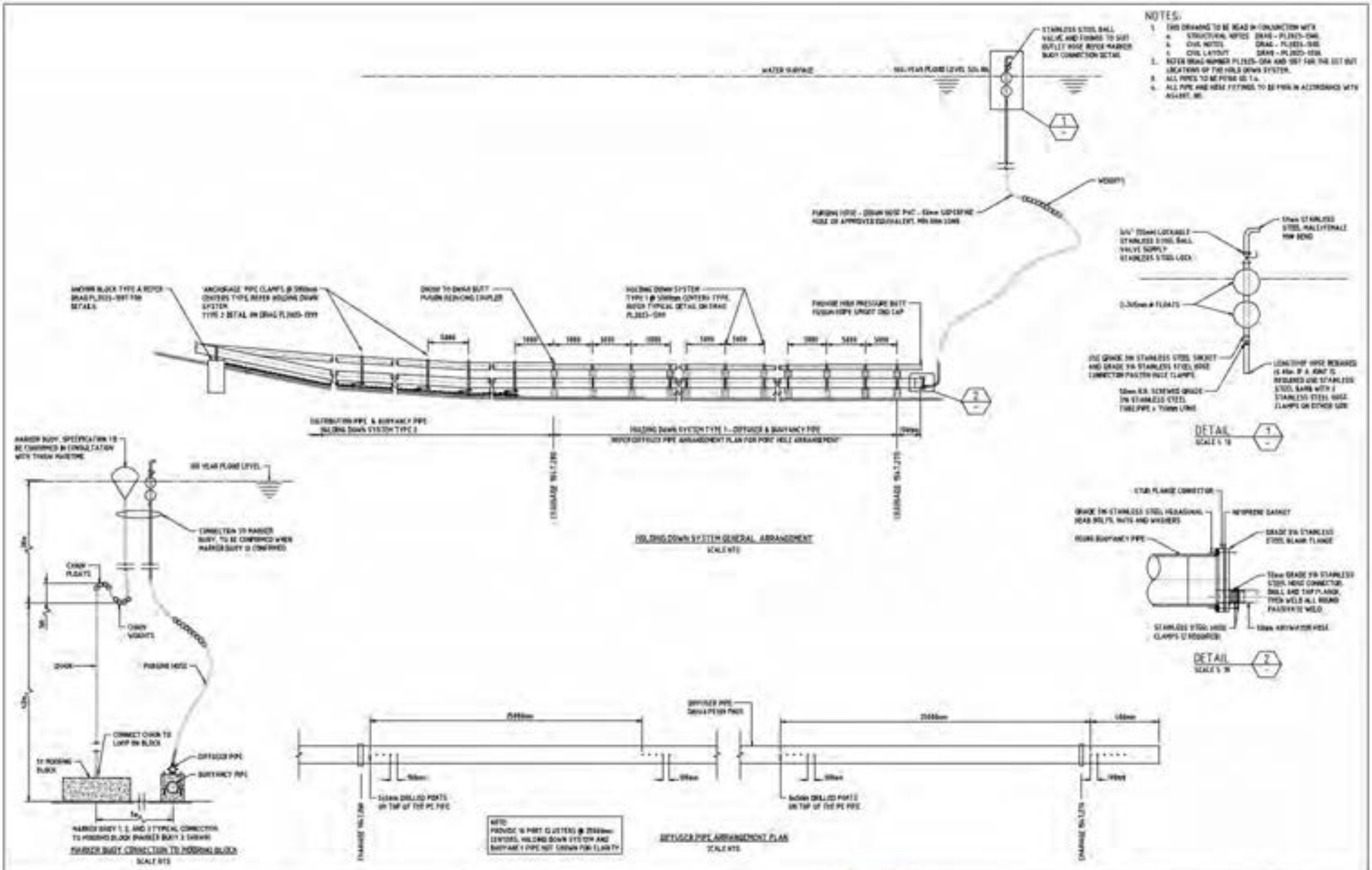
SECTION B

SECTION C



PIPE SUPPORT TYPE PS6 – REINFORCEMENT DETAIL SECTION E

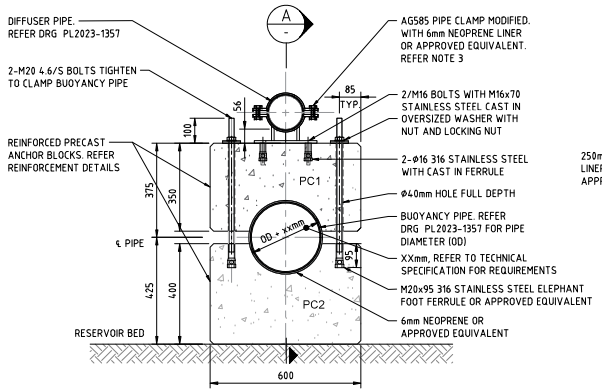
FACILITY NAME: PINDARI DAM									
CONTRACT CODE: TBC									
DISCIPLINE: STRUCTURAL									
DRAWING TYPE: DETAIL DRAWING									
DRAWING STATUS: WITH DESIGN ISSUE									
PLOT DATE: 27/07/2023 3:48:08 PM									
ASSETREADY									
	D	WITH DESIGN ISSUE	RJH	31/01/23					
	A	WITH DESIGN ISSUE	RJH	31/10/22					
	REVISION	DETAILS OF AMENDMENT	CHKD	DATE					
DRAWN: RJH 31/10/22									
DESIGNED: RJH 31/10/22									
CHECKED: RJH 31/10/22									
APPROVED: RJH 31/10/22									



PROJECT NAME:	PINDARI DAM										
LOCATION CODE:	TBC										
DISCIPLINE:	STRUCTURAL										
DRAWING TYPE:	DETAIL DRAWING										
DRAWING CATEGORY:	GEN-TOWN-WALLS										
YEAR (2023):	[PHASE][AREA]-PM										
ASSETREADY											
D	ADDITIONAL DETAILS	KJL	24/10/23	DRAWN:	D.FUSS	SCALES:	AS SHOWN	SHEET SIZE:	A1	WaterNSW	PINDARI DAM BUBBLE PLUME DESTRATIFICATION SYSTEM DIFFUSER PIPE + HOLDDOWN SYSTEM GENERAL ARRANGEMENT	PL2023-1398
C	ADDITIONAL DETAILS	KJL	19/10/23									
B	ADDITIONAL DETAILS	KJL	04/10/23	APPROVED:	D.HANSEN	FILE NAME:	.DWG	REFERENCE:				
A	ADDITIONAL DETAILS	KJL	22/09/23	CHECKED:	D.FUSS							
ISSUE/DATE	DETAILS OF AMENDMENT	CHK'D	CK'D					ASSETREADY NO.				
												TBC

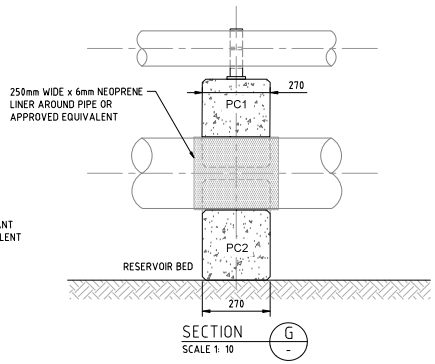
NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH
   a. STRUCTURAL NOTES DRG - PL2023-1380,
   b. CIVIL NOTES DRG - PL2023-1355
   c. CIVIL LAYOUT DRG - PL2023-1356.
2. REFER DRG NUMBER PL2023-1357 FOR THE SET OUT LOCATIONS OF THE TYPE OF SUPPORTS (TYPE 1 - 3).
3. "ANCHORAGE" CLAMPS AND FITTINGS ARE SPECIFIED AND ARE TO BE MODIFIED TO SUIT HDPE PIPE OD AND CHANGED FIXING POSITIONS TO SUIT. APPROVED EQUIVALENT MAY BE USED.
4. ALL CONCRETE INSERTS, CLAMPS AND FIXINGS TO BE STAINLESS STEEL 316 UNO.
5. 20mm GALVANISED CHAIN BASED ON "BULLIVANTS" WCRL-200G, WEIGHT 8.13kg/m OR APPROVED EQUIVALENT.
6. ALL HOLD-DOWN WEIGHT BLOCKS SHALL BE PRECAST.
7. ALL BOLTS IN CONTACT WITH DISSIMILAR MATERIAL MUST INCORPORATE NYLON BUSHES AND WASHERS.



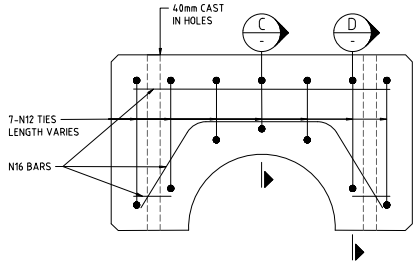
HOLDING DOWN SYSTEM TYPE 1

SCALE 1:10



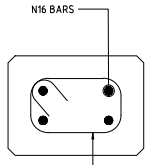
SECTION G

SCALE 1: 10



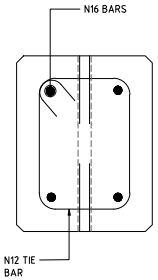
PC1 REINFORCEMENT DETAIL

SCALE 1:5



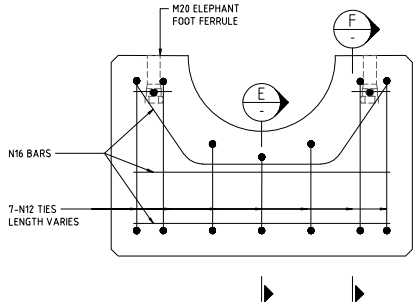
SECTION C

SCALE 1: 5



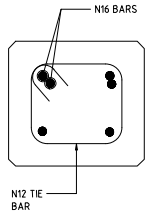
SECTION D

SCALE 1: 5



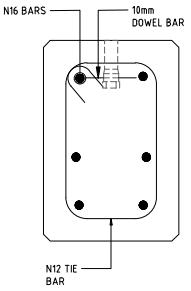
PC2 REINFORCEMENT DETAIL

SCALE 1:5



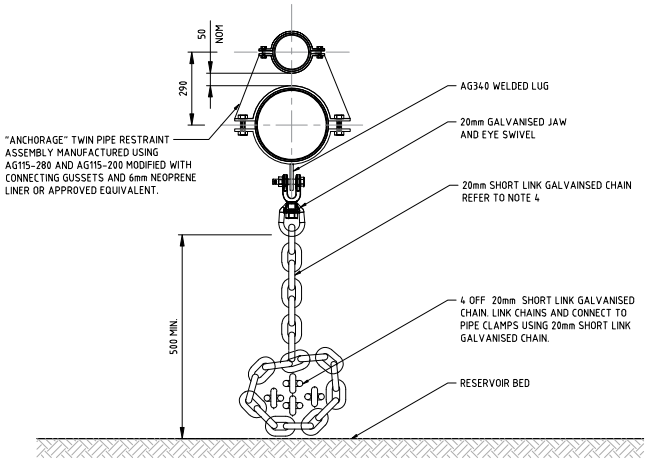
SECTION E

SCALE 1: 5



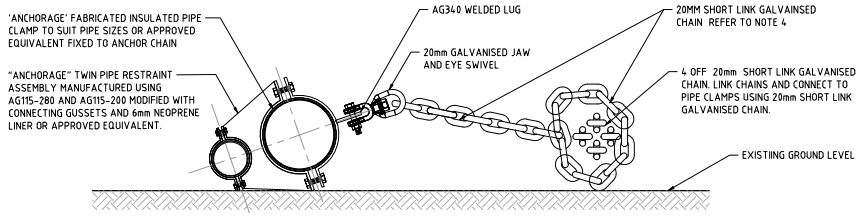
SECTION F

SCALE 1: 5



HOLDING DOWN SYSTEM - TYPE 2 (BELOW WATER LEVEL)

SCALE 1:10



HOLDING DOWN SYSTEM - TYPE 3 (NO WATER)

SCALE 1:10

PRECAST ELEMENT	APPROX WEIGHT(kg)
PC 1	136
PC 2	156

0 0.2 0.4 0.6 0.8 1.0 METRES

SCALE 1:10

0 0.1 0.2 0.3 0.4 5.0 METRES

SCALE 1:5

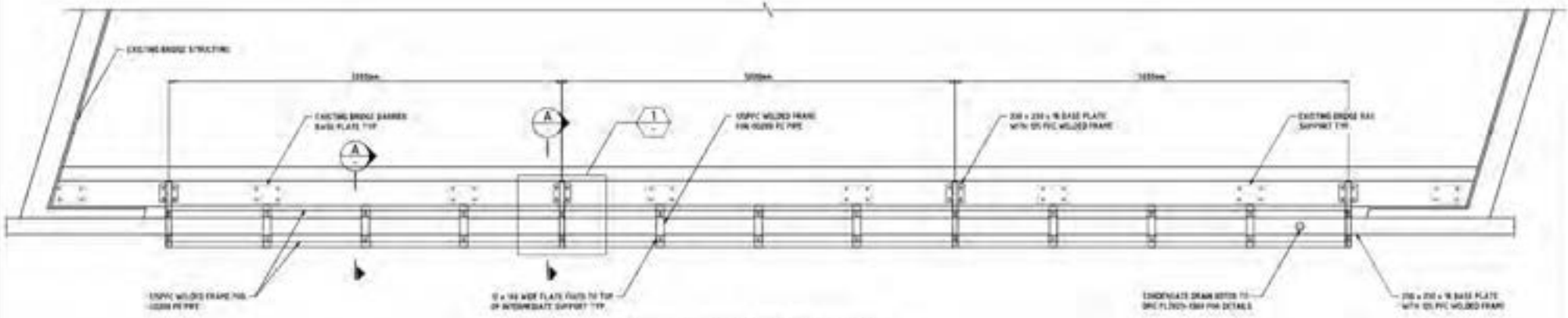
FACILITY NAME:	PINDARI DAM					DRAWN 06/09/24 A. SOLOMON	SCALES AS SHOWN	SHEET SIZE A1
LOCATION CODE:								
DISCIPLINE:	STRUCTURAL					DESIGNED 6/09/24 R. HANSEN	FILE NO. N/A	REPORT NO. N/A
DRAWING TYPE:	DETAIL DRAWING	B	90% DESIGN RE-ISSUE	R.H.	31/01/25			
DRAWING STATUS:	90% DESIGN ISSUE	A	90% DESIGN ISSUE	R.B.	6/09/24	CHECKED 6/09/24	R. BEHESHTI	JOB/PROJECT NO. D2023/158945
PLOT DATE:	21/01/2025 3:56:21 PM	REVISION	DETAILS OF AMENDMENT	CHK'D	DATE	N. TAYLOR/R. BEHESHTI	PROJECT MANAGER	

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

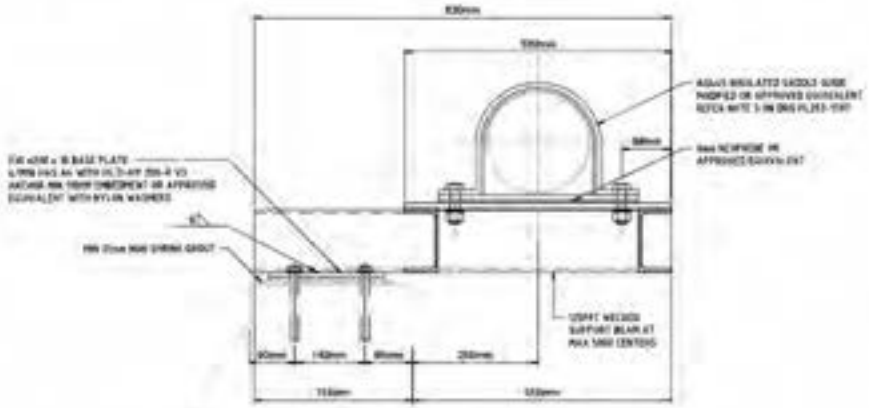
BUBBLE PLUME DESTRATIFICATION SYSTEM
DIFFUSER PIPE - HOLDDOWN SYSTEM
TYPICAL DETAIL

REV.	PLAN No.
	PL2023-1399
	SHEET 2
B	
A	



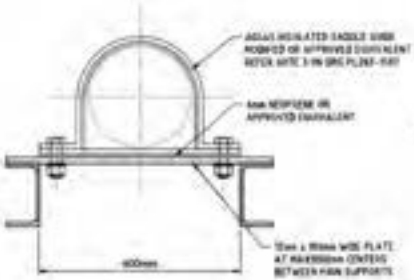
PLAN - PIPE SUPPORT ON EXISTING BRIDGE

SCALE 1:25



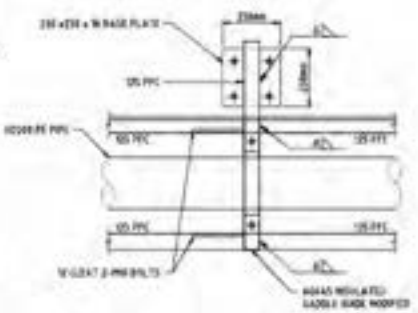
SECTION A

SCALE 1:5



SECTION B

SCALE 1:5



DETAIL 1

SCALE 1:10

NOTES:

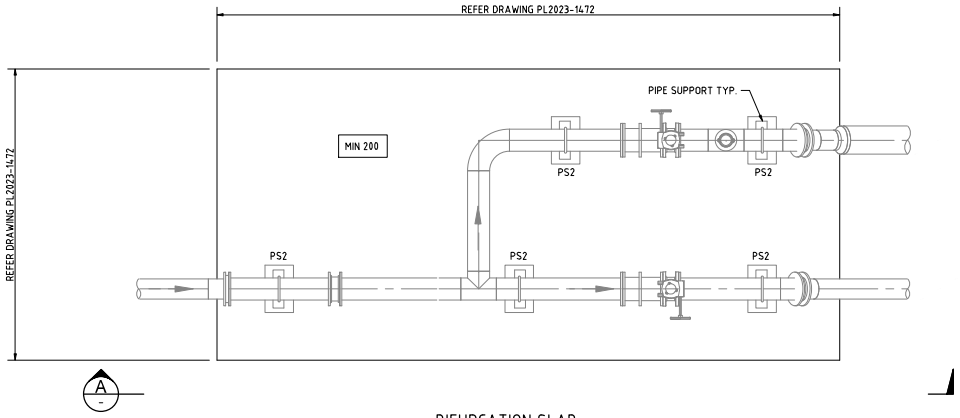
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH
   a. STRUCTURAL NOTES DRG - PL2023-1048
   b. CIVIL NOTES DRG - PL2023-1050
   c. CIVIL LAYOUT DRG - PL2023-1004

PROJECT NAME: PINDARI DAM	ASSETREADY				DRAWN: C. HAIDH	SCALE: AS SHOWN	SHEET SIZE: A1	WaterNSW	PINDARI DAM
LOCATION:					SUBMITTED: N. HANSEN	FILE NO.: 126	REPORT NO.: N/A	COPYRIGHT RESERVED	BUBBLE PLUME DESTRATIFICATION SYSTEM
DISCIPLINE: STRUCTURAL					CHECKED:	TENDER:	ASSET PROJECT NO.: CW051048	This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.	DIFFUSER PIPE + HOLDDOWN SYSTEM
DRAWING TYPE: DETAIL DRAWING					N. HANSEN				GENERAL ARRANGEMENT
DRAWING STATUS:									
PLOT DATE:									

REV	DESCRIPTION OF ISSUE	PLOT	DATE
A	ISSUE FOR DESIGN ISSUE		
B	DETAILS OF AMENDMENT	CHKD	DATE

REV	PLAN No.
	PL2023-1400
	SHEET 1
A	

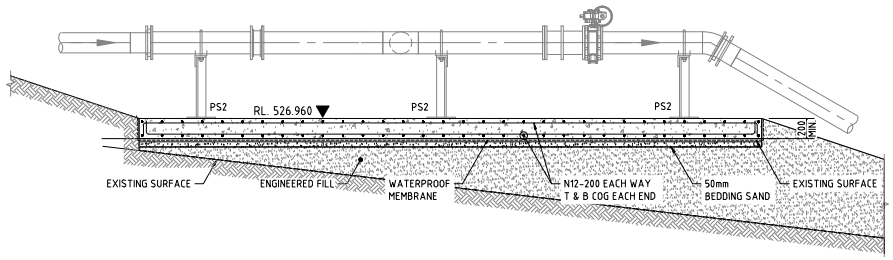
NOTES:
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH
   a. STRUCTURAL NOTES DRG PL2023-1380
   b. CIVIL NOTES DRG PL2023-1355
   c. CIVIL LAYOUT DRG PL2023-1367
2. FOR ENGINEERED FILL DETAILS. REFER TO EARTHWORKS NOTES ON DRG PL2023-1355.
3. FOR PIPE DETAILS REFER TO DRG PL2023-1472
4. FOR PIPE SUPPORT DETAILS REFER TO DRG 1390
5. ALL BOLTS IN CONTACT WITH DISSIMILAR METAL MUST INCORPORATE NYLON BUSHES AND WASHERS.
6. USE BOLT LENGTHS SO THAT PROJECTION BEYOND NUT IS AT LEASE TWO FULL THREADS AND NOT MORE THAN 15mm.



BIFURCATION SLAB

SCALE 1:25

SLAB REINFORCEMENT TO BE N16-200 EACH WAY, TOP & BOTTOM U.N.O.



SECTION A

SCALE 1 : 25

0 500 1000 1500 2000 2500 MILLIMETRES

SCALE 1:25

FACILITY NAME:	PINDARI DAM
LOCATION CODE:	WDBPIN
DISCIPLINE:	STRUCTURAL
DRAWING TYPE:	DETAIL DRAWING
DRAWING STATUS:	90% DESIGN ISSUE
PLOT DATE:	21/01/2025 3:59:49 PM

ASSETREADY

REVISION	DETAILS OF AMENDMENT	CHK'D	DATE
A	ISSUE FOR TENDER	R.H.	31/01/25

DRAWN	31/01/25	SCALES	SHEET SIZE
C. HARDY		AS SHOWN	A1
DESIGNED	31/01/25	FILE NO.	REPORT NO.
R. HANSEN		N/A	N/A
CHECKED	31/01/25	N. TAYLOR	JOB/PROJECT NO.
K. WOOD		PROJECT MANAGER	D2023/158944

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
BIFURATION SLAB & PIPE SUPPORT
TYPICAL DETAILS

REV.	PLAN No.
A	PL2023-1401
	SHEET 1

PINDARI DAM
BUBBLE PLUME DESTRATIFICATION SYSTEM



LOCALITY PLAN
SCALE 1:10000

0 500 1000 2000 3000 4000 METRES
SCALE 1:10000

CIVIL DRAWINGS

PL2023-1354	COVER SHEET AND DRAWING LIST
PL2023-1355	GENERAL NOTES AND LEGEND
PL2023-1356	KEY SHEET LAYOUT PLAN
PL2023-1357	SITE LONGITUDINAL SECTION
PL2023-1358	COMPRESSOR SITE GENERAL ARRANGEMENT
PL2023-1359	DISTRIBUTION PIPE PLAN AND LONGITUDINAL SECTION - SHEET 1 OF 4
PL2023-1360	DISTRIBUTION PIPE PLAN AND LONGITUDINAL SECTION - SHEET 2 OF 4
PL2023-1361	DISTRIBUTION PIPE PLAN AND LONGITUDINAL SECTION - SHEET 3 OF 4
PL2023-1362	DISTRIBUTION PIPE PLAN AND LONGITUDINAL SECTION - SHEET 4 OF 4
PL2023-1363	ACCESS TRACK LONG SECTION
PL2023-1364	ACCESS TRACK CROSS SECTIONS - SHEET 1 OF 4
PL2023-1365	ACCESS TRACK CROSS SECTIONS - SHEET 2 OF 4
PL2023-1366	ACCESS TRACK CROSS SECTIONS - SHEET 3 OF 4
PL2023-1367	ACCESS TRACK CROSS SECTIONS - SHEET 4 OF 4
PL2023-1368	VEHICLE TURNING MOVEMENT PATH
PL2023-1369	SITE DRAINAGE PLAN
PL2023-1370	TYPICAL DETAILS - SHEET 1 OF 2
PL2023-1371	TYPICAL DETAILS - SHEET 2 OF 2
PL2023-1372	PAVEMENT AND TRENCH DETAILS
PL2023-1373	DRAINAGE DETAILS
PL2023-1374	COMMS CABLING GENERAL ARRANGEMENT

STRUCTURAL DRAWINGS

PL2023-1380	STRUCTURAL NOTES
PL2023-1381	COMPRESSOR SITE - STRUCTURAL LAYOUT
PL2023-1382	COMPRESSOR SITE - REINFORCED CONCRETE - TYPICAL DETAILS SHEET 1 OF 2
PL2023-1383	COMPRESSOR SITE - REINFORCED CONCRETE - TYPICAL DETAILS SHEET 2 OF 2
PL2023-1384	COMPRESSOR SITE - ABOVE GROUND PIPE SUPPORTS
PL2023-1385	MISCELLANEOUS DETAILS - PIPE SUPPORT
PL2023-1386	HOLD DOWN SYSTEM - DIFFUSER PIPE GENERAL ARRANGEMENT
PL2023-1389	HOLD DOWN SYSTEM - TYPICAL DETAILS

MECHANICAL DRAWINGS

PL2023-1449	MECHANICAL PIPEWORK PLAN
PL2023-1470	MECHANICAL PIPEWORK SECTIONS
PL2023-1471	MECHANICAL PIPEWORK ISOMETRIC
PL2023-1472	PIPELINE BIFURCATION
PL2023-1473	PIPETSS & INSTRUMENTATION DIAGRAM

ESSENTIAL ENERGYS DRAWINGS

SCH-868889	HC HV OH MAINS & ESTABLISH PAD MOUNT SUBSTATION PINDARI DAM

STANDARD DRAWINGS

PL2319-10263	WATERSW FENCING - CHAIN LINK FENCE 1.8 AND GATE 6A TYPE 2.1-8/8-1 STRAIGHT POSTS
PL2319-10264	WATERSW FENCING - CHAIN LINK FENCE 1.8 AND GATE 6A TYPE 2.1-8/8-1 CRANKED POSTS

E&I DRAWINGS

P_2023-1405	COVER PAGE
P_2023-1406	ELECTRICAL DRAWING INDEX
P_2023-1408	SYMBOLS AND LEGENDS
P_2023-1407	SYMBOLS AND LEGENDS CONTINUED
P_2023-1408	MAIN SWITCHBOARD SCADXXXX - SUPPLIED POWER SYSTEM DIAGRAM
P_2023-1409	MAIN SWITCHBOARD SCADXXXX - SINGLE LINE DIAGRAM
P_2023-1410	MAIN SWITCHBOARD SCADXXXX - SINGLE LINE DIAGRAM (CONTINUED)
P_2023-1411	LIGHT AND POWER DB DBLXXXX - SINGLE LINE DIAGRAM
P_2023-1412	METERING ISOLATOR 1 - SCHEMATIC DIAGRAM
P_2023-1413	MAINS INCOMER 1 - SCHEMATIC DIAGRAM
P_2023-1414	GENERATOR INCOMER 1 - SCHEMATIC DIAGRAM
P_2023-1415	POWER METER AND SURGE DIVERTER 1 - SCHEMATIC DIAGRAM
P_2023-1416	METERING ISOLATOR 2 - SCHEMATIC DIAGRAM
P_2023-1417	MAINS INCOMER 2 - SCHEMATIC DIAGRAM
P_2023-1418	GENERATOR INCOMER 2 - SCHEMATIC DIAGRAM
P_2023-1419	POWER METER AND SURGE DIVERTER 2 - SCHEMATIC DIAGRAM
P_2023-1420	OUTGOING FEEDERS - SCHEMATIC DIAGRAM
P_2023-1421	BUS TIE - SCHEMATIC DIAGRAM
P_2023-1422	LATCH STOP RELAY - SCHEMATIC DIAGRAM
P_2023-1423	REMOTE CONTROL PANELS 1 AND 2 - SCHEMATIC DIAGRAM
P_2023-1425	ESSENTIAL 24 VDC UPS AND POWER SUPPLIES - SCHEMATIC DIAGRAM
P_2023-1427	NETWORK ARCHITECTURE - DIAGRAM
P_2023-1428	PLC P_FXXXX - POWER DISTRIBUTION BOARD SCHEMATIC
P_2023-1429	PLC P_FXXXX - ETHERNET SWITCH SCHEMATIC
P_2023-1430	PLC P_FXXXX - HMI SCHEMATIC DIAGRAM
P_2023-1431	PLC P_FXXXX - RACK, POWER, COMS, AND I/ARD ALLOCATION SCHEMATIC
P_2023-1432	PLC P_FXXXX RACK 0 SLOT 2 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1433	PLC P_FXXXX RACK 0 SLOT 2 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1434	PLC P_FXXXX RACK 0 SLOT 3 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1435	PLC P_FXXXX RACK 0 SLOT 3 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1436	PLC P_FXXXX RACK 0 SLOT 4 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1437	PLC P_FXXXX RACK 0 SLOT 4 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1438	PLC P_FXXXX RACK 0 SLOT 5 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1439	PLC P_FXXXX RACK 0 SLOT 5 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1440	PLC P_FXXXX RACK 0 SLOT 6 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1441	PLC P_FXXXX RACK 0 SLOT 6 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1442	PLC P_FXXXX RACK 0 SLOT 7 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1443	PLC P_FXXXX RACK 0 SLOT 8 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1444	PLC P_FXXXX RACK 0 SLOT 9 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1445	PLC P_FXXXX RACK 0 SLOT 10 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1446	PLC P_FXXXX RACK 0 SLOT 11 - DIGITAL INPUT CARD SCHEMATIC
P_2023-1447	COMPRESSOR 1 OUTLET PRESSURE TRANSMITTER PTXxxxx - LOOP DIAGRAM
P_2023-1448	STATION OUTLET HEADER PRESSURE TRANSMITTER PTXxxxx - LOOP DIAGRAM
P_2023-1449	STATION INTLET HEADER FLOW TRANSMITTER FTXxxxx - LOOP DIAGRAM
P_2023-1450	COMPRESSOR 2 INTLET PRESSURE TRANSMITTER PTXxxxx - LOOP DIAGRAM
P_2023-1451	STATION INTLET AIR TEMPERATURE TRANSMITTER TTXxxxx - LOOP DIAGRAM
P_2023-1452	COMPRESSOR 1 CMPxxx1 DIGITAL INPUTS - LOOP DIAGRAM
P_2023-1453	COMPRESSOR 1 CMPxxx2 SAFETY AND DIGITAL OUTPUTS - LOOP DIAGRAM
P_2023-1454	COMPRESSOR 2 CMPxxx2 DIGITAL INPUTS - LOOP DIAGRAM
P_2023-1455	COMPRESSOR 2 CMPxxx2 SAFETY AND DIGITAL OUTPUTS - LOOP DIAGRAM
P_2023-1460	CABLE - BLOCK DIAGRAM
P_2023-1461	TEMPORARY GENERATOR CONNECTION PANELS & STAND - GENERAL ARRANGEMENT
P_2023-1462	MAIN SWITCHBOARD SCADXXXX - GENERAL ARRANGEMENT
P_2023-1463	ELECTRICAL KIOSK - GENERAL ARRANGEMENT
P_2023-1464	PLPXXXX PLC PANEL - GENERAL ARRANGEMENT
P_2023-1465	ELPXXXX 24 VDC POWER SUPPLIES AND UPS/BATTERY PANEL - GENERAL ARRANGEMENT
P_2023-1466	ELECTRICAL EQUIPMENT, CABLE ROUTE & EARTHING - SITE LAYOUT DRAWING
P_2023-1467	CONDUIT TRENCH SECTION VIEWS - DETAILS
P_2023-1468	TYPICAL EARTHING DETAILS

FACILITY NAME: PINDARI DAM	ASSETREADY	E	ISSUE FOR TENDER	N.L.	31/07/25	DRAWN: [illegible]	SCALES: AS SHOWN
LOCATION CODE: XXXPIN		D	40% DESIGN RE-ISSUE	N.L.	18/10/24	DESIGNED: [illegible]	FILE NO.: N/A
DISCIPLINE: CIVIL		C	90% DESIGN RE-ISSUE	N.L.	30/09/24	NJMILTON	
DRAWING TYPE: TITLE PAGE		B	90% DESIGN RE-ISSUE	N.L.	23/05/24	CHECKED: [illegible]	N/A USE
DRAWING STATUS: IFT ISSUE		A	60% DESIGN ISSUE	N.L.	22/12/23	N/A USE	PROJECT MANAGER
PLOT DATE: 23/07/2025 1:19:02 PM		REVISION	DETAILS OF AMENDMENT	CHKD.	DATE		

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM
BUBBLE PLUME DESTRATIFICATION SYSTEM
COVER SHEET AND DRAWING LIST

REV.	PLAN No.
E	PL2023-1354
D	SHEET 1
C	
B	
A	

GENERAL NOTES

G1. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE LATEST EDITION OF THE FOLLOWING:
- WSAA MANUAL FOR SELECTION AND APPLICATION OF PROTECTIVE COATINGS WSA 201
- WSA 104–2007 INDUSTRY STANDARD FOR CONCRETE SPIGOT CLASS.
- WSA 03 – WATER SUPPLY CODE OF AUSTRALIA
- COMMISSIONING – TRANSITIONING ASSETS INTO OPERATION
- ALL OTHER WRITTEN SPECIFICATIONS AS AND WHEN ISSUED DURING THE COURSE OF THE CONTRACT.

G2. FOR STRUCTURAL NOTES REFER TO DRG PL2023-1360 FOR ELECTRICAL NOTES REFER TO DRG PL2023-1439.

G3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN OF ANY TEMPORARY WORKS.

G4. WHERE PROPRIETARY ITEMS HAVE BEEN SPECIFIED, A SUITABLE EQUIVALENT MAY BE USED IF APPROVED BY WNSW. PROPRIETARY ITEMS SHALL BE INSTALLED STRICTLY IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

G5. THE DESIGN IS NOT SUITABLE FOR UNSTABLE GROUND, CONTAMINATED GROUND, SOFT SOILS OR MINE SUBSIDENCE AREAS.

G6. ALL LEVELS ARE IN METRES AND ALL DIMENSIONS ARE IN MILLIMETRES U.N.O. DIMENSIONS SHALL NOT BE OBTAINED BY SCALING THE DRAWINGS. DIMENSIONS SHOWN ON THE DRAWINGS SHALL BE VERIFIED BEFORE CONSTRUCTION COMMENCES. REPORT ANY DISCREPANCY TO THE SUPERINTENDENT BEFORE PROCEEDING WITH THE WORK.

G7. DATA: ALL CO-ORDINATES ARE BASED ON GDA2020 – MGA ZONE 56. ALL LEVELS ARE TO AUSTRALIAN HEIGHT DATUM (AHD).

G8. TOPOGRAPHICAL AND EXISTING GROUND INFORMATION SUPPLIED BY WNSW.

G9. THE CONTRACTOR SHALL MAINTAIN AND SUPPLY DETAILED RECORDS OF ALL MATERIALS USED AT THE SITE AND CONSTRUCTION ACTIVITIES.

G10. A SUITABLY QUALIFIED AND EXPERIENCED GEOTECHNICAL ENGINEER SHALL BE ENGAGED AND HAVE SITE PRESENCE AT APPROPRIATE CONSTRUCTION STAGES TO SET OUT WORKS AND VERIFY COMPLIANCE WITH DESIGN REQUIREMENTS.

G11. REFER TO PLAN / SECTIONS FOR INDICATIVE LOCATIONS AND EXTENTS OF PROPOSED WORKS. ACTUAL LOCATIONS AND EXTENTS TO BE CONFIRMED ONSITE BY THE GEOTECHNICAL ENGINEER.

G12. THE CONTRACTOR SHALL PROVIDE APPROPRIATE TEMPORARY SAFETY FENCES OR BARRIERS TO ENSURE THAT REMOVED MATERIAL, CONSTRUCTION PLANT OR SIMILAR ITEMS DURING THE WORKS ARE CONTAINED WITHIN THE DESIGNATED WORK AREA.

G13. THE CONTRACTOR SHALL PROVIDE APPROPRIATE ENVIRONMENTAL CONTROLS TO ENSURE ALL WORKS ARE CONFINED WITHIN THE DESIGNATED WORK AREA AND DO NOT CONTAMINATE EXISTING INFRASTRUCTURE, FAUNA OR FLORA.

G14. EXISTING UTILITIES AND SERVICE LOCATIONS, INCLUDING CULVERTS TO BE CONFIRMED BY THE CONTRACTOR PRIOR TO THE COMMENCEMENT OF WORKS.

G15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE TO THE EXISTING ROADWAY CAUSED BY THE CONSTRUCTION ACTIVITIES. ANY DAMAGE SHALL BE REINSTATED / REPLACED TO MATCH PRE EXISTING CONDITION TO THE SATISFACTION OF THE PRINCIPAL.

G16. THE CONTRACTOR SHALL REPORT ANY DISCREPANCIES, OMISSIONS OR ERRORS TO THE PRINCIPAL FOR CLARIFICATION BEFORE PROCEEDING WITH THE WORKS.

G17. ALL WORKS TO BE CONSTRUCTED AND TESTED IN ACCORDANCE WITH THE WNSW STANDARDS. A COPY OF THESE STANDARDS ARE TO BE KEPT ON SITE AT ALL TIMES.

G18. ALL CONDITIONS WITHIN THE REF AND ENVIRONMENTAL MANAGEMENT PLANS ARE TO BE MET. THE CONTRACTOR IS TO HAVE A COPY OF THE REF ON SITE AT ALL TIMES.

G19. ALL LEVELS ELECTRONICALLY GENERATED NO LEVEL BOOK AVAILABLE.

G20. THE MINIMUM NUMBER OF FIELD COMPACTION TESTS REQUIRED TO SATISFY THE DRAINAGE CODE OF AUSTRALIA ARE:
PIPE CROSSPOINT ZONE: 4
TRENCH FILL ZONE – NON TRAFFICABLE: NIL
TRENCH FILL ZONE – TRAFFICABLE: TO BE BACKFILLED WITH 20:1 STABILISED SAND
MAINTENANCE STRUCTURES: NIL

G21. PRIOR TO ANY EXCAVATION, THE CONSTRUCTOR MUST HAVE A CURRENT COPY OF THE DIAL UNDERGROUND SERVICE REPORTS, WHICH ARE TO BE READ IN CONJUNCTION WITH THIS PLAN.

G22. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE AUSTRALIAN STANDARDS, THE BY-LAWS AND ORDINANCES OF THE RELEVANT BUILDING AUTHORITY.

G23. MECHANICAL AND ELECTRICAL EQUIPMENT SUPPORTS, ANCHORAGES, OPENINGS, RECESSES AND REVEALS NOT SHOWN ON THE DRAWINGS BUT REQUIRED FOR THIS CONTRACT ARE TO BE PROVIDED PRIOR TO CASTING OF CONCRETE.

G24. ALL DIMENSIONS AND REDUCED LEVELS FOR NEW WORKS CONNECTING TO EXISTING WORKS TO BE VERIFIED BY SITE MEASUREMENT PRIOR TO CONSTRUCTION AND ADJUSTED WHERE NECESSARY TO SUIT EXISTING DETAILS, AS APPROVED OR DIRECTED BY THE DESIGN MANAGER.

G25. GROUTING SHALL BE PROVIDED UNDER ALL EQUIPMENT AND SUPPORTS WHEN MOUNTED ON A CONCRETE BASE OR PLINTH AND WHERE FASTENED TO CONCRETE WALL, COLUMN AND FLOORS. FOR DETAILS REFER TO WNSW STANDARDS.

G26. RESTORE SITE TO ORIGINAL CONDITION ON COMPLETION OF THE WORKS.

G27. STAINLESS STEEL ASSET LABELS SHALL BE PROVIDED FOR NEW VALVES & EQUIPMENT INSTALLED UNDER THIS CONTRACT. FOR DETAILS REFER TO WNSW STANDARDS.

PIPEWORK

P1. PROPRIETARY ITEMS AND EQUIPMENT ARE TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S REQUIREMENTS AND RECOMMENDATIONS.

P2. ALL PIPEWORK SHALL BE DESIGNED IN ACCORDANCE WITH AS/NZS 3500 AND OTHER WATER NSW SPECIFICATIONS. ALL PIPEWORK SHALL CONFORM TO APPROPRIATE AUSTRALIAN STANDARDS, MEAN LAWS OF PRACTICE AND WATER NSW TECHNICAL SPECIFICATIONS.

P3. DRAWS ARE TO BE PROVIDED AT LOW POINTS IN THE PIPE RUN.

P4. FLANGES SHALL COMPLY WITH AS/NZS 4087 PN16 UNO WHERE CONNECTION TO OTHER FLANGE TYPES / SUPPLIER EQUIPMENT IS REQUIRED. ALL FLANGES SHALL BE THE FLANGE STANDARD AND RATING STAMPED ON THE RIM OF THE FLANGE.

P5. FLANGE GASKETS FOR COMPRESSED AIR SERVICE SHALL BE SUNBRIDGE ELASTOMERIC INSERTION TYPE.

P6. ALL STAINLESS STEEL SCHEDULE PIPE SHALL COMPLY WITH AS/NZS 4041 BUTT WELDED FITTINGS SHALL COMPLY WITH AS/NZS 1528.

P7. ALL FASTENERS AND WASHERS ARE METRIC AND STAINLESS STEEL GRADE 316 UNO. ALL THREADS SHALL BE THOROUGHLY COATED WITH NON-CORROSIVE ANTI-SEIZE COMPOUND PRIOR TO ASSEMBLY.

PIPEWORK (CONTINUED)

P8. INSULATION WASHERS AND BOLT SLEEVES SHALL BE INSTALLED BETWEEN ALL DISSIMILAR METALS AT FLANGED JOINTS AND OTHER LOCATIONS.

P9. ALL STAINLESS STEEL PIPEWORK WELDS SHALL BE FULL PENETRATION BUTT WELDS IN ACCORDANCE WITH AS1554.6. WELDING TO BE CARRIED OUT USING APPROVED WELDING TECHNIQUES AND APPROPRIATE FILLER RODS/WIRES. WELDS MUST BE CHEMICALLY CLEANED, PICKLED AND FULLY PASSIVATED IN ACCORDANCE WITH ASTM A380.

P10. BUTTERFLY VALVES SHALL BE RESILIENT SEATED AND SUITABLE FOR MINIMUM PN12/500 RATING OF 1MPA. VALVES SHALL BE BI-DIRECTIONAL AND CAPABLE OF OPENING AND CLOSING AGAINST FULL VARIATIONS OF NO AND DESIGN EMERGENCY VELOCITY AS SPECIFIED. VALVE SHALL HAVE A LOCKABLE HANDLE.

P11. ALL VALVES SHALL BE IN ACCORDANCE WITH WATER NSW TECHNICAL SPECIFICATIONS.

P12. PROTECTIVE COATINGS SHALL BE IN ACCORDANCE WITH ZINTEK IN WNSW-PTC-05-001 PROTECTIVE COATINGS TECHNICAL SPECIFICATION.

TESTING

T1. ALL INSPECTION AND TESTING APPLICABLE IN THE VARIOUS SPECIFICATIONS LISTED IN NOTE G1 SHALL BE UNDERTAKEN.

EARTHWORKS

E01. THE UNCONTROLLED FILL AT THE SITE IS NOT SUITABLE AS SUBGRADE MATERIAL FOR PAVEMENTS OR STRUCTURAL ELEMENTS. TO ACHIEVE THE DESIGN SUBGRADE CALIFORNIA BEARING RATIO OF 5%, THE EXISTING FILL IS TO BE EXCAVATED TO TOP OF UNIT 2 RESIDUAL SOIL AND REPLACED WITH ENGINEERED GRANULAR FILL PLACED AND COMPACTED UNDER LEVEL 1 SUPERVISION BY A SUITABLY EXPERIENCED GEOTECHNICAL PRACTITIONER IN ACCORDANCE WITH AS 3798 – "GUIDELINES ON EARTHWORKS FOR COMMERCIAL AND RESIDENTIAL DEVELOPMENTS". THE EXCAVATION SHALL BE TO BE INSPECTED BY A SUITABLY EXPERIENCED GEOTECHNICAL ENGINEER PRIOR TO FILL PLACEMENT.

E02. FILL TO BE PLACED IN 300mm LOOSE LAYERS AND COMPACTED TO MIN 95% OF TOTAL DENSITY INDEX. TESTING TO BE CARRIED OUT USING NUCLEAR DENSITY METER IN ACCORDANCE WITH AS 1289.5.8.1 AT A MINIMUM RATE IN ACCORDANCE WITH TABLE A1 OF AS 3798. THE EXISTING FILL MAY BE SUITABLE FOR RE-USE, SUBJECT TO ADDITIONAL LABORATORY TESTING.

E03. REPLACEMENT FILL SHALL SATISFY THE REQUIREMENTS OF CLASS 3Q FILL SET OUT IN SECTION 3 OF NEW SOUTH WALES ROADS & TRANSPORTATION DIRECTORATE, 2018 "SPECIFICATION FOR SUPPLY OF RECYCLED MATERIAL FOR PAVEMENTS, CAP FINISHES AND DRAINAGE".

E04. GROUND CONDITIONS CONSIDERED IN DESIGN SHALL BE VERIFIED ON SITE BY A SUITABLY QUALIFIED AND EXPERIENCED GEOTECHNICAL ENGINEER DURING CONSTRUCTION IN ACCORDANCE WITH WNSW STANDARDS.

E05. EXPECTED GROUND CONDITIONS AT EACH STRUCTURE SHALL MEET THE MINIMUM REQUIREMENTS SPECIFIED BELOW. BEFORE EXCAVATION BEGINS, THE CONTRACTOR SHALL CONFIRM THAT THE ACTUAL GROUND CONDITIONS ENCOUNTERED MEET OR EXCEED THESE ASSUMPTIONS. IF ANY DISCREPANCIES ARE IDENTIFIED, THE CONTRACTOR SHALL NOTIFY THE PRINCIPAL IMMEDIATELY AND HOLD WORKS PENDING REVIEW AND DIRECTION.

STRUCTURE	SOIL/ROCK LAYER AND CONSISTENCY	MINIMUM STRENGTH	MINIMUM DENSITY/ RELATIVE TESTING	REQUIRED TESTING DEPTH	MINIMUM ALLOWABLE / BEARING CAPACITY
FENCE POST FOOTING	UNIT 2 MATERIAL (RESIDUAL SOIL) / ENGINEERED FILL	UNDRAINED SHEAR STRENGTH, S_u = 50kPa	DCP = 3 BLOWS/150mm	MINIMUM 1m BELOW BASE OF FOOTING	VERTICAL BEARING CAPACITY = 250kPa
CONFIRMATION & INFRASTRUCTURE SLAB	ENGINEERED FILL	UNDRAINED SHEAR STRENGTH, S_u = 50kPa	DCP = 3 BLOWS/150mm	MINIMUM 1m BELOW BASE OF FOOTING	VERTICAL BEARING CAPACITY = 250kPa
BARRIER BOLLARDS	UNIT 1 MATERIAL (WEATHERED) EXTREMELY WEATHERED	UNDRAINED SHEAR STRENGTH, S_u = 30kPa	DCP = 3 BLOWS/150mm	MINIMUM 1m BELOW BASE OF FOOTING	VERTICAL BEARING CAPACITY = 150kPa
FENCE BOLLARDS	UNIT 1 MATERIAL (WEATHERED) EXTREMELY WEATHERED	UNDRAINED SHEAR STRENGTH, S_u = 50kPa	DCP = 3 BLOWS/150mm	MINIMUM 1m BELOW BASE OF FOOTING	VERTICAL BEARING CAPACITY = 150kPa

ELECTRICAL CONDUIT INSTALLATION

E1. ALL ELECTRICAL CONDUITS SHALL BE SEALED USING "DUCT SEAL PUTTY" SUPPLIED BY DAINTON INDUSTRIES OR "DYTAN ATUM PASTE ST" SUPPLIED BY UNIVERSAL CORROSION COATINGS (UCC).

E2. ALL CONDUITS ENTERING STRUCTURES WHERE BENDING OF THE CABLES CAN OCCUR ARE TO BE FITTED WITH BELLMOUTHS.

SAFETY IN DESIGN

SD1. ALL DRAWINGS MUST BE READ IN CONJUNCTION WITH THE PROJECT SAFETY IN DESIGN REGISTER INCLUDED WITH THE DESIGN REPORT (REF TBC) WHICH IDENTIFIES DESIGN RELATED HEALTH AND SAFETY HAZARDS ASSOCIATED WITH THE PROPOSED DESIGN, CONSTRUCTION AND OPERATION AND PROPOSED AND ADOPTED CONTROL MEASURES.

DRAINAGE

D1. ALL SWALES SHALL BE LINED WITH A TYPE MAT OR SIMILAR SOIL STABILISATION AND WEED SUPPRESSION GEOTEXTILE MAT AND SPRAYED WITH GRASS.

D2. ALL DRAINAGE INLET PITS SHALL BE PRECAST REINFORCED CONCRETE WITH RAISED (NOT DIPPED) GALVANISED GRATE IN ACCORDANCE WITH WPE STANDARD DRAWING REEF-3A.

D3. SWALES SHALL ACHIEVE A MINIMUM GRADE OF 0.5% UNLESS STATED OTHERWISE ON THE DRAWINGS.

HERITAGE AND ENVIRONMENT

HE1. HERITAGE ITEMS MAY BE LOCATED WITHIN THE WORK ZONE, THE CONTRACTOR SHALL CONSIDER THE PRESENCE OF HERITAGE ITEMS IN LINE WITH THE REF.

HE2. KEY FISH HABITAT REPORTED AREAS HAVE BEEN IDENTIFIED WITHIN THE WORK ZONE. THE CONTRACTOR SHALL CONSIDER THE PRESENCE OF WHEN IN THE CZPR.

HE3. SENSITIVE ENVIRONMENTS OR THREATENED FLORA OR FAUNA POPULATIONS MAY BE LOCATED WITHIN THE WORK ZONE. THE CONTRACTOR SHALL CONSIDER THE PRESENCE OF ENVIRONMENTAL ITEMS IN LINE WITH THE REF.

LEGEND

EXISTING

- EDGE OF DAM WALL
- EDGE OF DRY AREA
- EDGE OF VEGETATION
- EDGE OF WATER AREA
- EDGE OF ROADWAY
- EDGE OF CONCRETE
- GUARDRAIL
- STRUCTURE
- ABERRATION
- CONTOUR
- TEXT
- EXISTING PILLAR CENTRELINE
- EXISTING FENCE CENTRELINE
- DRAINAGE PIPE AND HEADWALL

NEW

- DESIGN PILLAR CENTRELINE
- DESIGN FENCE CENTRELINE
- 11 kV ELECTRICAL CABLE
- EDGE OF EXCLUSION ZONE
- ROAD
- TOP OF BANK
- ZONE BOUNDARY
- DRY DOCK AIR PIPE

SURFACE KEY LEGEND

- NEW ASPHALT PAVEMENT
- NEW CONCRETE PAVEMENT
- NEW 150mm GRAVEL SITE SELECT, 75mm DEEP WITH WEED MAT UNDER
- EXCLUSION ZONE
- NEW GRASS PLANTING AND EXTENT OF DAC

VALLEY NAME:	PINDARI DAM						
LOCATION CODE:	WDAPIN						
DISCIPLINE:	CIVIL						
DRAWING TYPE:	GENERAL NOTES						
DRAWING ACRONYM:	BT SINGLE						
PLOT DATE:	[illegible] 4:26:09 PM						
	ASSETREADY	E	[illegible] FOR TENDER	N.A.	[illegible]	DRAWN: [illegible]	SCALE: NTS
		D	[illegible]	N.A.	[illegible]	CHECKED: [illegible]	FILE No.:
		C	[illegible]	N.A.	[illegible]	APPROVED: [illegible]	[illegible]
		B	[illegible]	N.A.	[illegible]		
		A	[illegible]	N.A.	[illegible]		
		REVISION	DETAILS OF AMENDMENT	CHKD.	DATE		

WaterNSW

COPYRIGHT RESERVED

This drawing is the property of Water NSW. It must not be copied without prior written permission and must not be reproduced in any way. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM

GENERAL NOTES AND LEGEND

REVS.	PLAN No.
B	PL2023-1355
C	
D	
E	
F	



SITE PLAN

MTS

FACILITY NAME	PINDARI DAM			
LOCATION CODE	WDDPDN			
DISCIPLINE	CIVIL			
DRAWING TYPE	GENERAL ARRANGEMENT			
DRAWING STATUS	IFT ISSUE			
PLOT DATE	05/05/2026 1:20:15 PM			

ASSETREADY

E	ISSUE FOR TENDER	N.L.	31/01/26
D	90% DESIGN RE-ISSUE	R.B.	18/12/24
C	90% DESIGN RE-ISSUE	R.B.	30/09/24
B	90% DESIGN RE-ISSUE	R.B.	23/05/24
A	90% DESIGN ISSUE	R.B.	23/12/23
REVISION	DETAILS OF AMENDMENT	CHKD	DATE

DRAWN	PERSON	SCALES	SHEET SIZE
N.MALTON		MTS	A1
DESIGNED	PERSON	FILE NO'S	REPORT NO'S
N.MALTON		N/A	N/A
CHECKED	PERSON	N.TAYLOR	JOB/PROJECT NO's
N.TAYLOR		PROJECT MANAGER	CD23/13644

WaterNSW

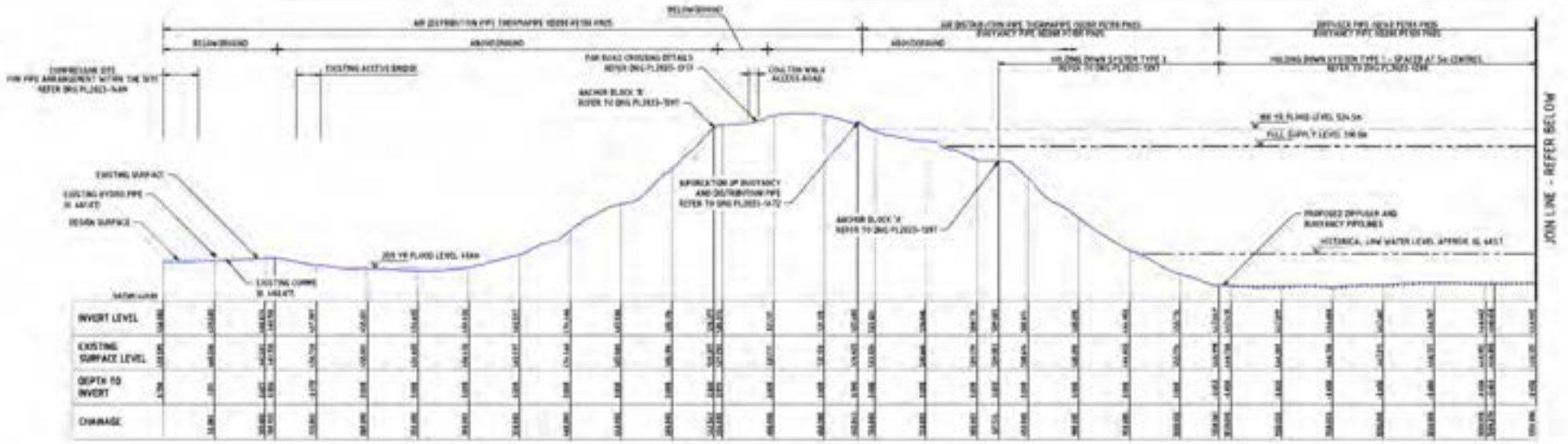
COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM

KEY SHEET LAYOUT PLAN

REVs	PLAN No.
E	PL2023-1356
D	SHEET 1
C	
B	
A	



DISTRIBUTION, DIFFUSER AND BOUYANCY PIPES LONGITUDINAL SECTION

HORIZONTAL SCALE 1:2000, VERTICAL SCALE 1:200



BOUYANCY AND DIFFUSER PIPES LONGITUDINAL SECTION

HORIZONTAL SCALE 1:2000, VERTICAL SCALE 1:200

LEGEND





ASSETREADY

WaterNSW

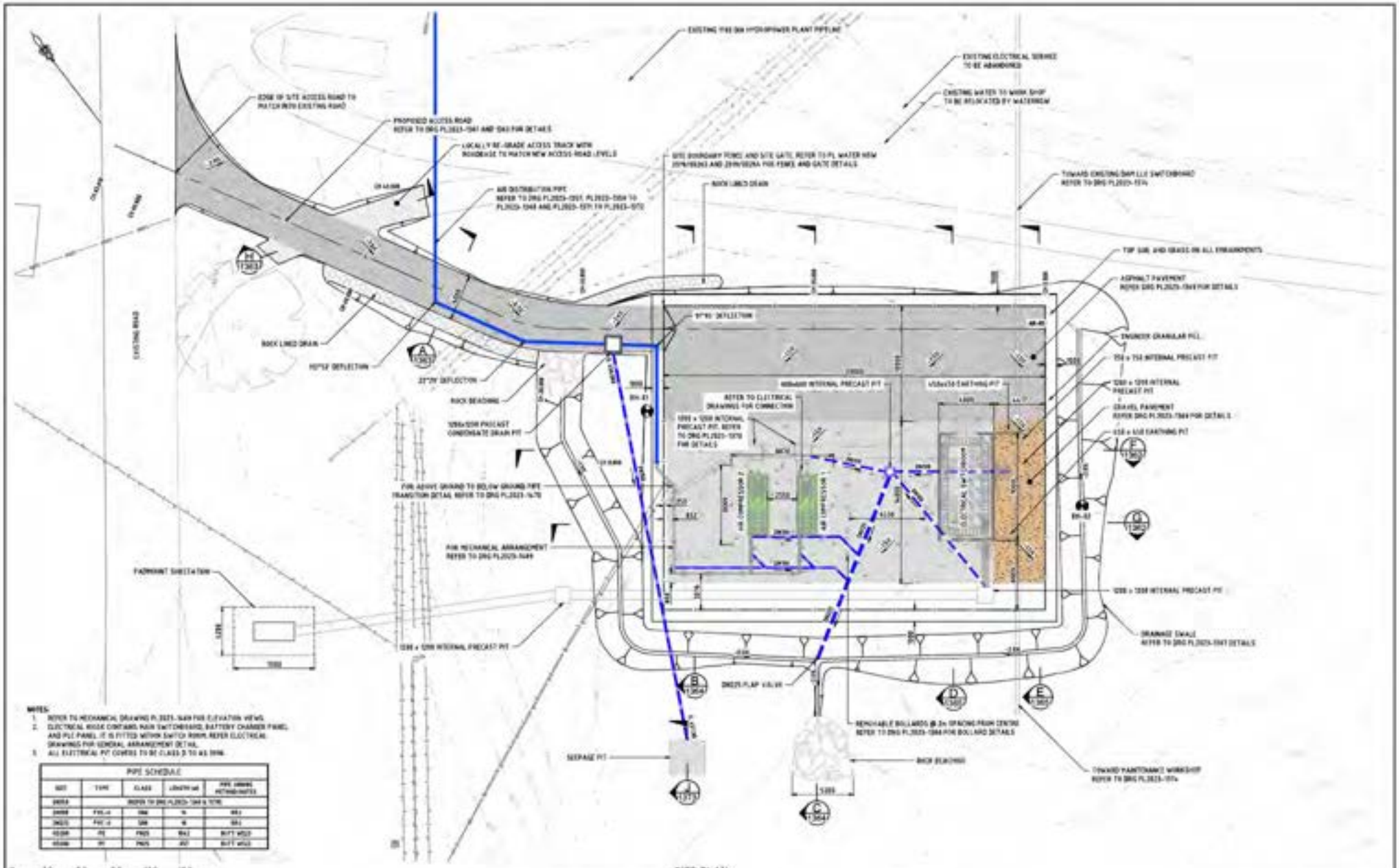
COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must not be issued or released. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM

DISTRIBUTION AND DIFFUSER PIPE LONGITUDINAL SECTION AND HOLDDOWN SYSTEM

PL2023-1357



NOTES:
1. REFER TO MECHANICAL DRAWING PL2023-1049 FOR ELEVATION VIEWS.
2. ELECTRICAL KIOSK CONTAINS MAIN SWITCHBOARD, BATTERY CHARGER PANEL AND PLC PANEL. IT IS FITTED WITHIN SWITCH ROOM. REFER ELECTRICAL DRAWINGS FOR GENERAL ARRANGEMENT DETAIL.
3. ALL ELECTRICAL PIT COVERS TO BE CLASS D TO AS 3996.

PIPE SCHEDULE

SET	TYPE	CLASS	LENGTH (m)	PIPE JOINING METHOD/NOTES
[illegible]	REFER TO DRG PL2023-1044 & 1070			
[illegible]	PVC-U	SN8	6	SEAL
[illegible]	PVC-U	SN8	6	SEAL
[illegible]	PE	PN25	80.2	BUTT WELD
[illegible]	PE	PN25	20.7	BUTT WELD

0 3.0 6.0 9.0 12.0 15.0 METRES
SCALE 1:150

SITE PLAN
SCALE 1:150

E	ISSUE FOR TENDER	N.A.	24/07/25
D	90% TENDER RE-ISSUE	N.A.	18/10/24
C	90% TENDER RE-ISSUE	N.A.	30/09/24
B	90% TENDER RE-ISSUE	N.A.	23/08/24
A	50% TENDER ISSUE	N.A.	22/07/24
REVISION	DETAILS OF AMENDMENT	CHKD.	DATE

DRAWN: [illegible] | SCALE: AS SHOWN | SHEET SIZE: A1
DESIGNED: [illegible] | FILE NO.: 126 | REPORT NO.: N/A
CHECKED: [illegible] | PROJECT MANAGER: N.J.WILSON | JOB/PROJECT NO.: D23/109644

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

ASSETREADY

FACILITY NAME: PINDARI DAM
LOCATION CODE: WSPDN
DISCIPLINE: CIVIL
DRAWING TYPE: GENERAL ARRANGEMENT
DRAWING STATUS: IFT (ISSUE)
PLOT DATE: 23/07/2025 4:28:05 PM

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
COMPRESSOR SITE GENERAL ARRANGEMENT

REV.	PLAN No.
E	PL2023-1358
D	SHEET 6
C	
B	
A	



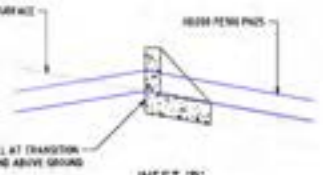
PLAN
SCALE: 1:500

LEGEND:
- PROPOSED PIPELINE
- DESIGN SURFACE
- EXISTING SURFACE
- [illegible]

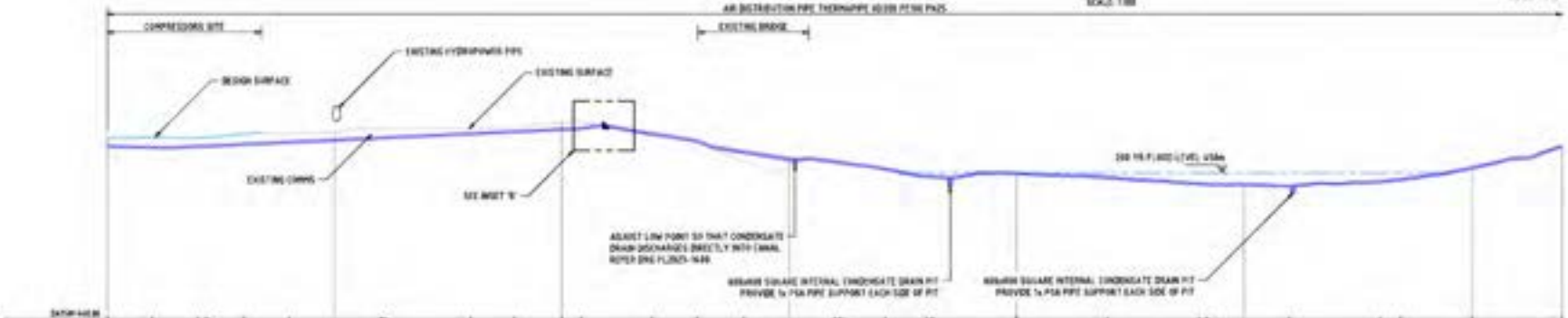
NOTES:
1. WHERE NO DEFLECTIONS ARE SPECIFIED, DEFLECT PIPE ON CURVE TO SUIT ALIGNMENT.



INSET A
SCALE: 1:500



INSET 'B'
SCALE: 1:100



LONGITUDINAL SECTION - CH0.000-CH320.00
HORIZONTAL SCALE 1:500, VERTICAL SCALE 1:250

FACILITY NAME	PINDARI DAM		
LOCATION CODE	PDRPN		
DISCIPLINE	CIVIL		
DRAWING TYPE	LONGITUDINAL SECTION		
DRAWING STATUS	IFT ISSUE		
PLOT DATE	03/05/2023 8:51:04 PM		

ASSETREADY

REV	DESCRIPTION	CHKD	DATE
E	ISSUE FOR TENDER	N.S.	31/07/23
D	95% DESIGN RE-ISSUE	R.J.L.	18/10/22
C	95% DESIGN RE-ISSUE	R.J.L.	30/09/22
B	95% DESIGN RE-ISSUE	R.J.L.	23/05/22
A	50% DESIGN ISSUE	R.J.L.	31/01/22

DRAWN	R.WILSON	SCALES	AS SHOWN
DESIGNED	R.WILSON	FILE NO.	N/A
CHECKED	R.WILSON	PROJECT MANAGER	N/A
SHEET SIZE	A1	REPORT NO.	N/A
JOB/PROJECT NO.	CP2021/10644		

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
DISTRIBUTION PIPE PLAN AND LONGITUDINAL SECTION
SHEET 1 OF 4

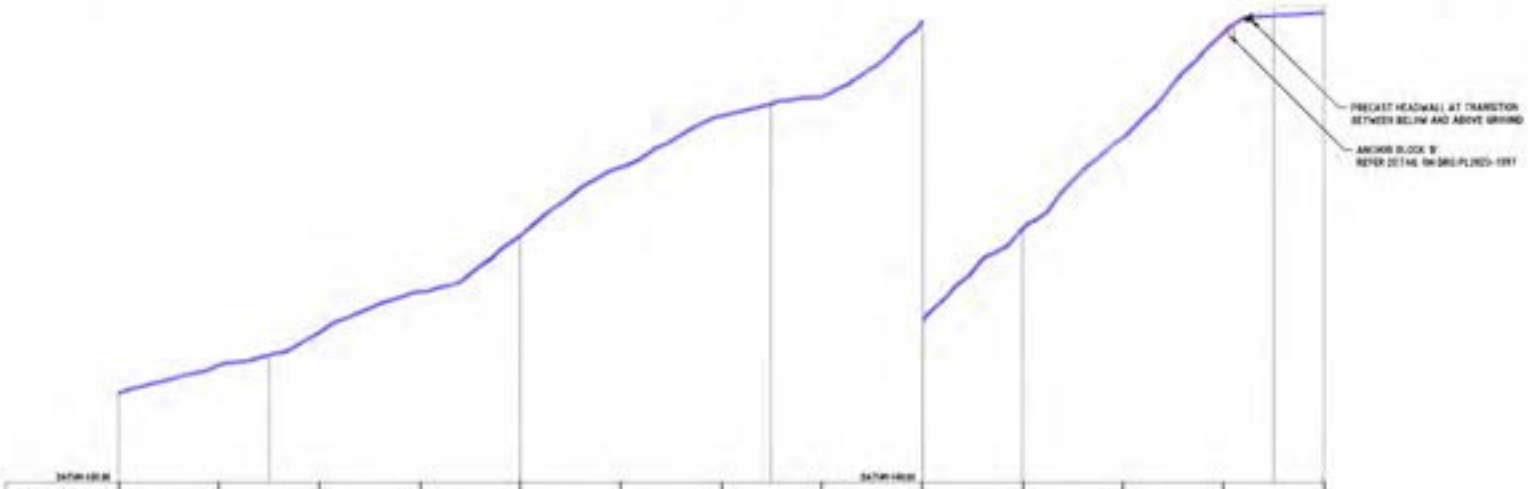
REV	PLAN No.
E	PL2023-1359
D	
C	
B	
A	

SHEET 1



PLAN

SCALE 1:500



INVERT LEVEL	
EXISTING SURFACE LEVEL	
DEPTH TO INVERT	
CHAINAGE	

LONGITUDINAL SECTION - CH320-CH560

HORIZONTAL SCALE 1:500, VERTICAL SCALE 1:250

LEGEND

PROPOSED PIPELINE

EXISTING SURFACE

NOTES:

1. WHERE 90 DEFLECTIONS ARE SPECIFIED, DEFLECT PIPE ON CURVE TO SUIT ALIGNMENT.

SCALE 1:500

SCALE 1:250

FACILITY NAME:	PINDARI DAM		
LOCATION CODE:	INDARI		
DISCIPLINE:	CIVIL		
DRAWING TYPE:	LONGITUDINAL SECTION		
DRAWING STATUS:	3RD ISSUE		
PLOT DATE:	03/05/2024 1:06:14 PM		

ASSETREADY

E	ISSUE FOR TENDER	N.L.	03/05/24
D	90% DESIGN RE-ISSUE	R.W.	18/10/23
C	90% DESIGN RE-ISSUE	R.W.	30/09/23
B	90% DESIGN RE-ISSUE	R.W.	23/08/23
A	90% DESIGN ISSUE	R.W.	22/12/22
REVISION	DETAILS OF AMENDMENT	CHKD.	DATE

DRAWN	P.WILSON	SCALES	AS SHOWN
	N.MALTON	FILE NO.	N/A
DESIGNED	P.WILSON		
	N.MALTON		N/A
CHECKED	P.WILSON		
	N.TAYLOR	PROJECT MANAGER	

SHEET SIZE	A1
REPORT NO.	N/A
JOB/PROJECT NO.	C0023/10644

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM

DISTRIBUTION PIPE PLAN AND LONGITUDINAL SECTION

SHEET 2 OF 4

REVN.	PLAN No.
B	PL2023-1360
C	SHEET 7
D	
E	

PL2023-1360

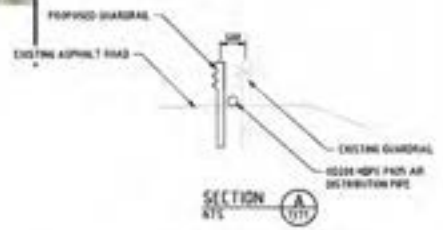
SHEET 7



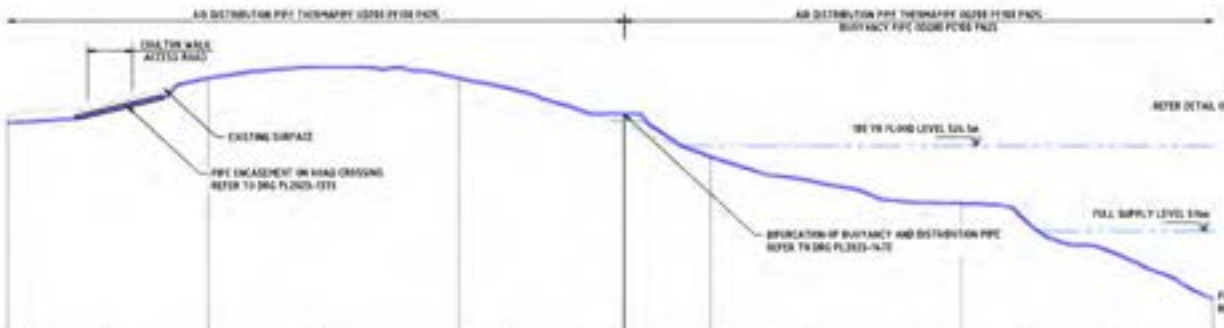
PLAN
SCALE 1:500

LEGEND:
- PROPOSED PIPELINE
- DESIGN SURFACE
- EXISTING SURFACE

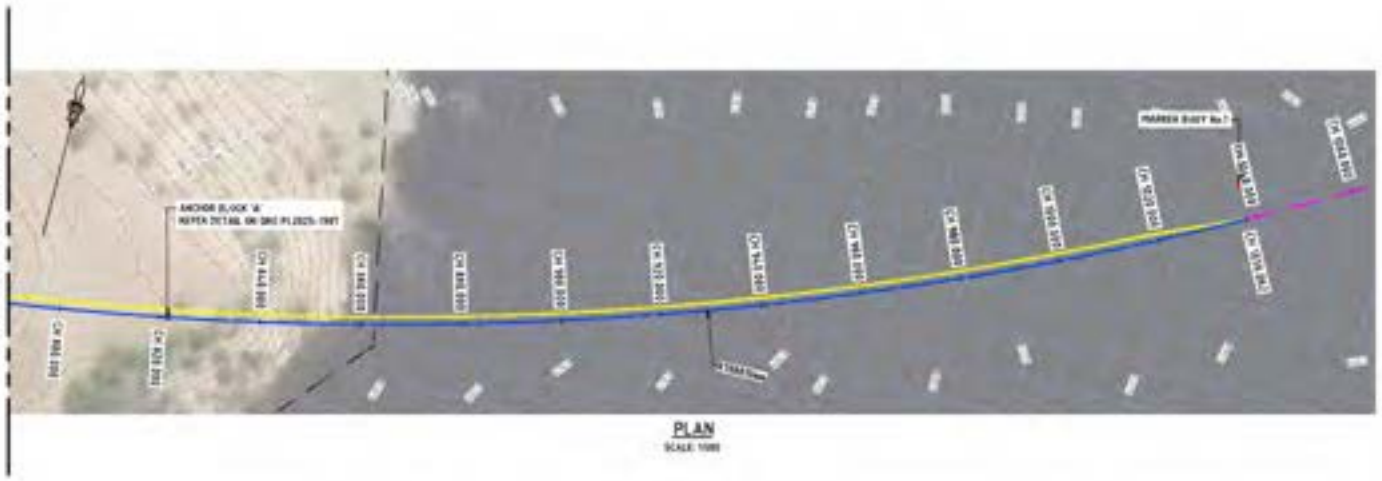
NOTES:
1. WHERE 9M DEFLECTIONS ARE SPECIFIED, DEFLECT PIPE ON CURVE TO SUIT ALIGNMENT



SECTION A
NTS



| | | |



PLAN
SCALE 1:500

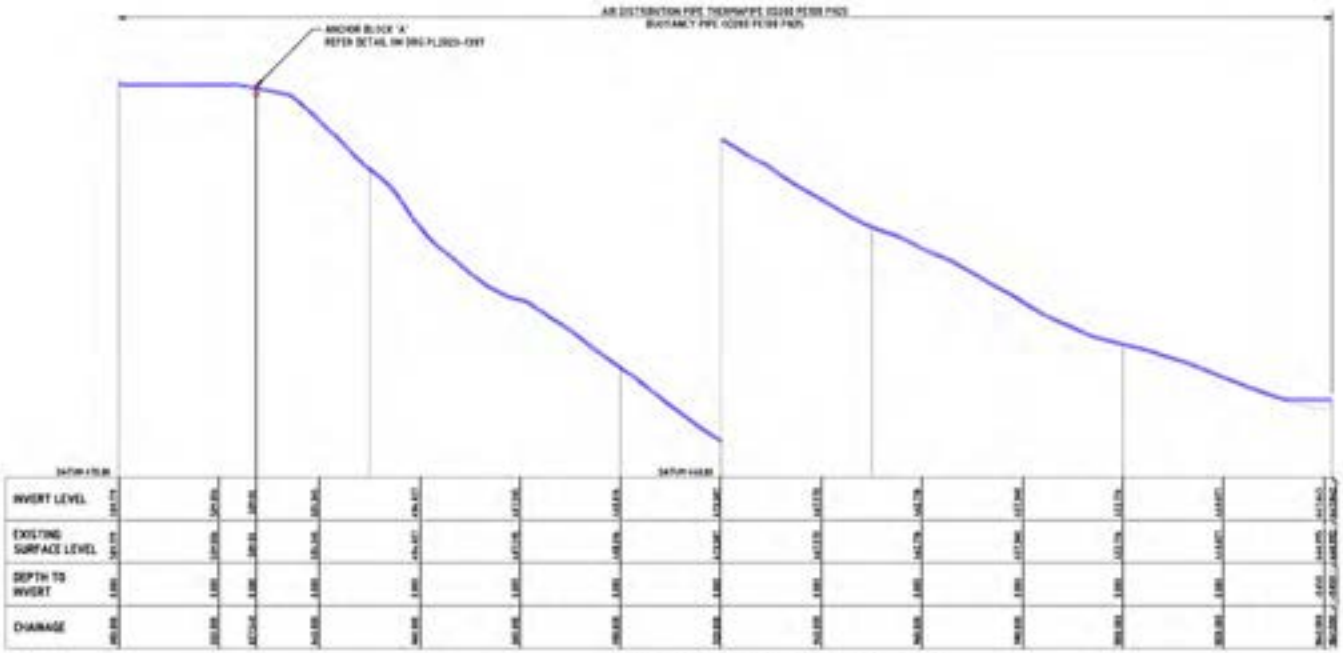
LEGEND:

PROPOSED PIPELINE

EXISTING SURFACE

NOTES:

1. WHERE 90 DEFLECTIONS ARE SPECIFIED, DEFLECT PIPE ON CURVE TO SUIT ALIGNMENT.



LONGITUDINAL SECTION - CH800-CH1034.822
HORIZONTAL SCALE 1:500, VERTICAL SCALE 1:250

0 10 20 30 40 50 METRES
SCALE 1:500

0 5 10 15 20 25 METRES
SCALE 1:250

FACILITY NAME	PINDARI DAM	ASSETREADY				DRAWN	SCALES	SHEET SIZE
LOCATION CODE	WD0PIN					NUMLTON	AS SHOWN	A1
DISCIPLINE	CIVIL					DESIGNED	FILE NO.	REPORT NO.
DRAWING TYPE	LONGITUDINAL SECTION					NUMLTON	N/A	N/A
DRAWING STATUS	IFT ISSUE					CHECKED		JOB/PROJECT NO.
PLOT DATE	03/04/2025 1:06:08 PM					N.J.WILLOR	N.J.WILLOR	CE031/0644
			C	ISSUE FOR TENDER	N.J.	01/01/25	PROJECT MANAGER	
			B	90% DESIGN REVISED	N.J.	19/12/24		
			A	90% DESIGN REVISED	N.J.	04/09/24		
			REVISION	DETAILS OF AMENDMENT	CHKD.	DATE		

WaterNSW

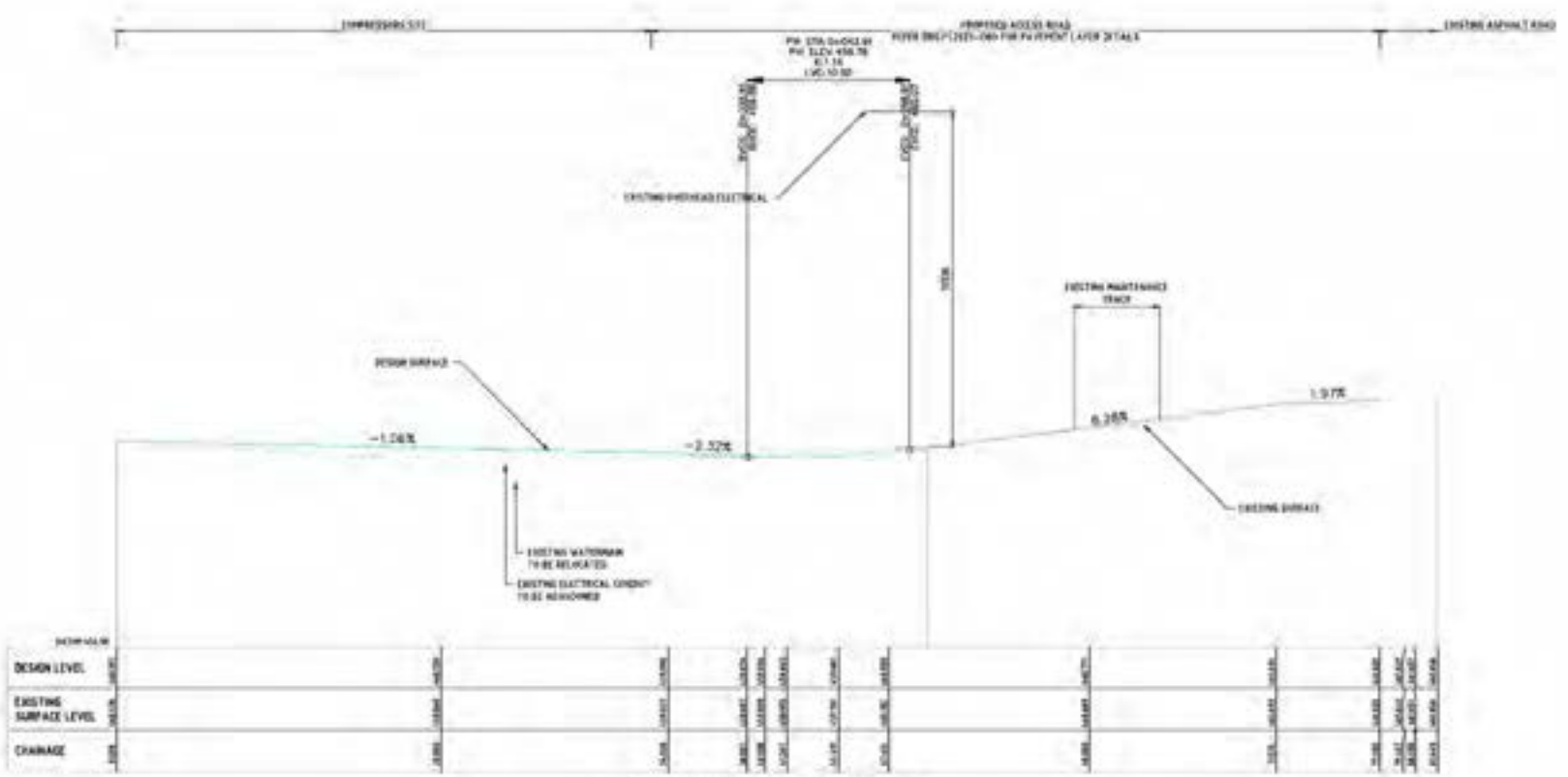
COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
DISTRIBUTION PIPE PLAN AND LONGITUDINAL SECTION
SHEET 4 OF 4

REVN.	PLAN No.
	PL2023-1372
C	SHEET 4
B	
A	

LEGEND



LONGITUDINAL SECTION – ACCESS ROAD

HORIZONTAL SCALE 1:200, VERTICAL SCALE 1:200

SCALE 1:100

SCALE 1:200

ASSETREADY

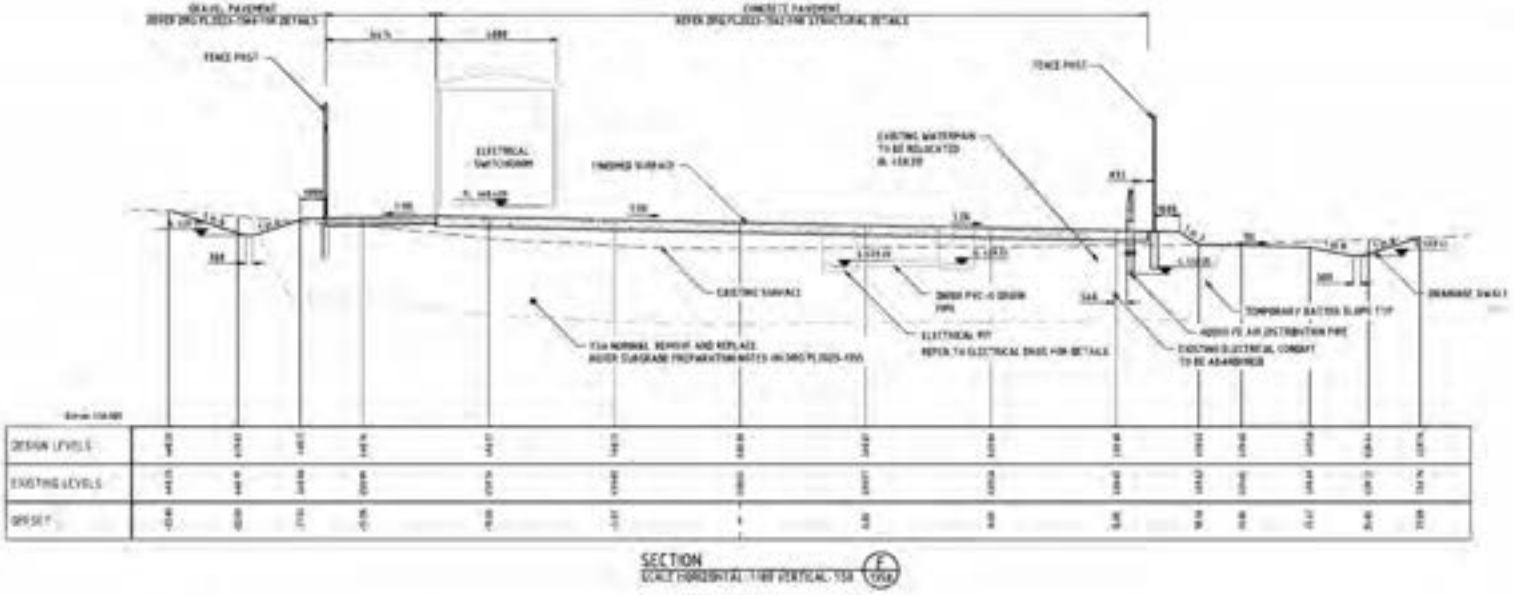
WaterNSW

PINDARI DAM

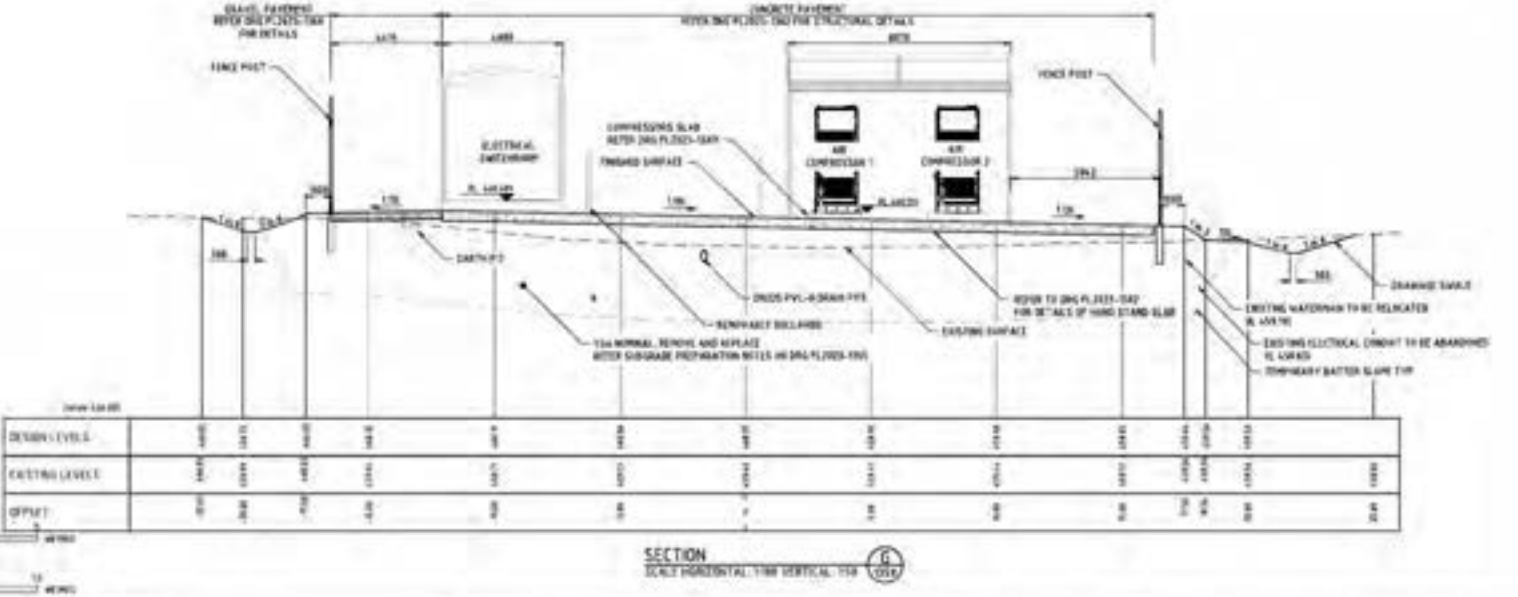
BUBBLE PLUME DESTRATIFICATION SYSTEM

ACCESS TRACK | DAM2 SECTION

PL2023-1361



SECTION
SCALE HORIZONTAL 1:100 VERTICAL 1:50 (F)



SECTION
SCALE HORIZONTAL 1:100 VERTICAL 1:50 (G)

SCALE 1:50

SCALE 1:100

FACILITY NAME	PINDARI DAM		
LOCATION CODE	WDPDN		
DISCIPLINE	CIVIL		
DRAWING TYPE	CROSS SECTION		
DRAWING STATUS	IFT ISSUE		
PLOT DATE	[illegible]		

ASSETREADY

NO.	DESCRIPTION	DRAWN	DATE
E	ISSUE FOR TENDER	N.A.	
D	[illegible]	N.A.	
C	[illegible]	N.A.	
B	[illegible]	N.A.	
A	[illegible]	N.A.	
REVISION	DETAILS OF AMENDMENT	DWG	DATE

DRAWN	N.SKELTON	SCALES AS SHOWN	SHEET SIZE A1
DESIGNED	N.SKELTON	FILE NO. 129	REPORT NO. N/A
CHECKED	N.TAYLOR	N.TAYLOR PROJECT MANAGER	ASSETREADY JOB NO. CW2019044

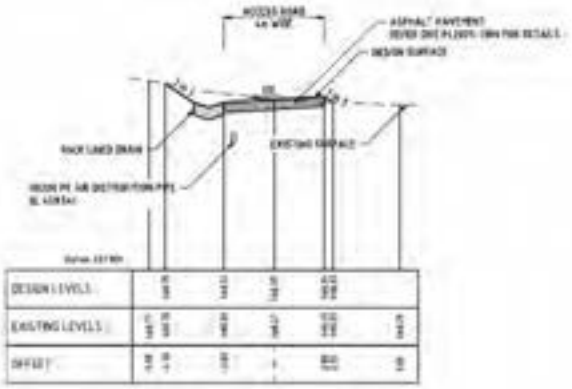
WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must not be issued to any third parties. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

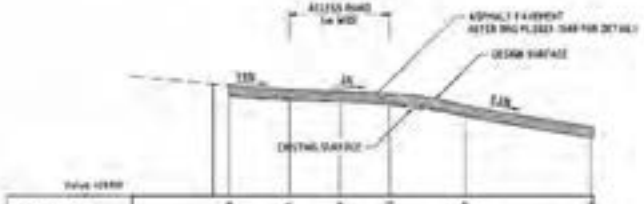
BUBBLE PLUME DESTRATIFICATION SYSTEM
SITE SECTIONS
SHEET 1 OF 4

NO.	PLAN No.
E	PL2023-1362
D	SHEET 11
C	
B	
A	



DESIGN LEVEL					
EXISTING LEVEL					
OFFSET					

SECTION
SCALE HORIZONTAL 1:100 VERTICAL 1:50 (A)



DESIGN LEVEL					
EXISTING LEVEL					
OFFSET					

SECTION
SCALE HORIZONTAL 1:100 VERTICAL 1:50 (H)

SCALE 1:100

SCALE 1:100

PROJECT NAME	PINDARI DAM						
LOCATION CODE	NOMPA						
DISCIPLINE	CIVIL						
DRAWING TYPE	CROSS SECTION						
DRAWING STATUS	IFT (ISSUE)						
PLOT DATE	23/01/2025 3:49:48 PM						

ASSETREADY

E	ISSUED FOR TENDER	N.C.	31/01/25
D	40% DESIGN RE-ISSUE	R.A.	18/12/24
C	40% DESIGN RE-ISSUE	R.A.	20/09/24
B	40% DESIGN RE-ISSUE	R.A.	12/03/24
A	40% DESIGN ISSUE	R.A.	22/11/23
REVISION	DETAILS OF AMENDMENT	CHKD.	DATE

DRAWN	PRINCIPAL	SCALES	SHEET SIZE
N.MALIK		AS SHOWN	A1
DESIGNED	PRINCIPAL	FILE NO.	REPORT NO.
N.MALIK		126	N/A
CHECKED	PRINCIPAL	N.J.WILLIS	ASSETREADY JOB NO.
N.J.WILLIS		PROJECT MANAGER	CW2019/044

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and it must not be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

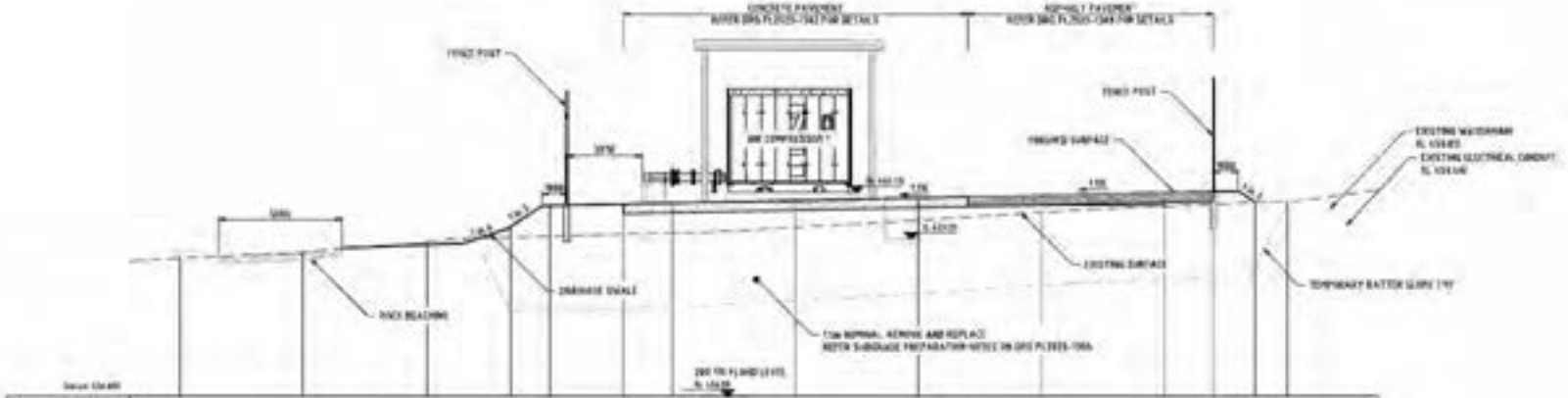
PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
SITE SECTIONS
SHEET 2 OF 4

REV.	PLAN No.
E	PL2023-1363
D	
C	
B	
A	



SECTION
SCALE: HORIZONTAL 1:100 VERTICAL 1:50 (B)



SECTION
SCALE: HORIZONTAL 1:100 VERTICAL 1:50 (C)

SCALE 1:50
SCALE 1:100

ASSETREADY

E	ISSUE FOR TENDER	N.R.	31/01/25
D	40% DESIGN RE-ISSUE	N.R.	18/12/24
C	40% DESIGN RE-ISSUE	N.R.	20/09/24
B	40% DESIGN RE-ISSUE	N.R.	23/08/24
A	40% DESIGN ISSUE	N.R.	02/07/24
NUMBER	DETAILS OF AMENDMENT	DRAFT	DATE

DRAWN: NAME
SCALE: AS SHOWN
SHEET SIZE: A1
DESIGNED: NAME
FILE NO.: 126
REPORT NO.: N/A
CHECKED: NAME
N/A SCALE
ASSET PROJECT NO.: CW2070844
PROJECT MANAGER

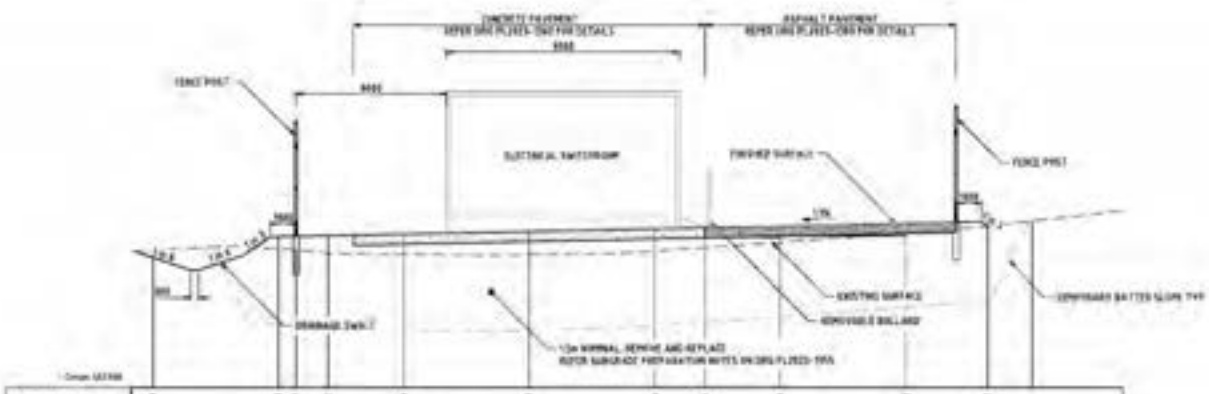
WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and shall be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
SITE SECTIONS
SHEET 3 OF 4

PL2023-1364



SECTION
SCALE HORIZONTAL 1:100 VERTICAL 1:50 (D) (1:50 A1)



SECTION
SCALE HORIZONTAL 1:100 VERTICAL 1:50 (E) (1:50 A1)

0 1 2 3 4 5 METRES
SCALE 1:100

0 2 4 6 8 10 12 METRES
SCALE 1:100

FACILITY NAME	PINDARI DAM		
LOCATION CODE	NOPIN		
DISCIPLINE	CIVIL		
DRAWING TYPE	CROSS SECTION		
DRAWING STATUS	IFT (ISSUE)		
PLOT DATE	[illegible]		

ASSETREADY

E	ISSUE FOR TENDER	N.A.	[illegible]
D	[illegible]	N.A.	[illegible]
C	[illegible]	N.A.	[illegible]
B	[illegible]	N.A.	[illegible]
A	[illegible]	N.A.	[illegible]
REVISION	DETAILS OF AMENDMENT	CHKD.	DATE

DRAWN	[illegible]	SCALES	SHEET SIZE
DESIGNED	[illegible]	FILE NO.	REPORT NO.
CHECKED	[illegible]		AGRIPROJECT NO.
PROJECT MANAGER			

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must not be used for any purpose. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
SITE SECTIONS
SHEET 4 OF 4

REV.	PLAN No.
E	PL2023-1365
D	SHEET No.
C	
B	
A	



VEHICLE TURNING PATH

SCALE 1:150

FACILITY NAME	PINDARI DAM		E	ISSUE FOR TENDER	N/L	310125
LOCATION CODE	4530PIN		D	95% DESIGN RE-ISSUE	N/L	181024
DISCIPLINE	CIVIL		C	95% DESIGN RE-ISSUE	N/L	300924
DRAWING TYPE	DETAIL		B	95% DESIGN RE-ISSUE	N/L	230924
DRAWING STATUS	IFT ISSUE		A	50% DESIGN ISSUE	N/A	220325
PLOT DATE	26/03/2025 10:23:15 AM		REVISION	DETAILS OF AMENDMENT	CHKD	DATE

ASSETREADY

DRAWN SHEVON NUMALTON
DESIGNED SHEVON NUMALTON
CHECKED SHEVON N/WILLIAM
PROJECT MANAGER N/WILLIAM
SCALES AS SHOWN
FILE NO. N/A
ASSETREADY NO. D2025/15644
SHEET SIZE A1
REPORT NO. N/A

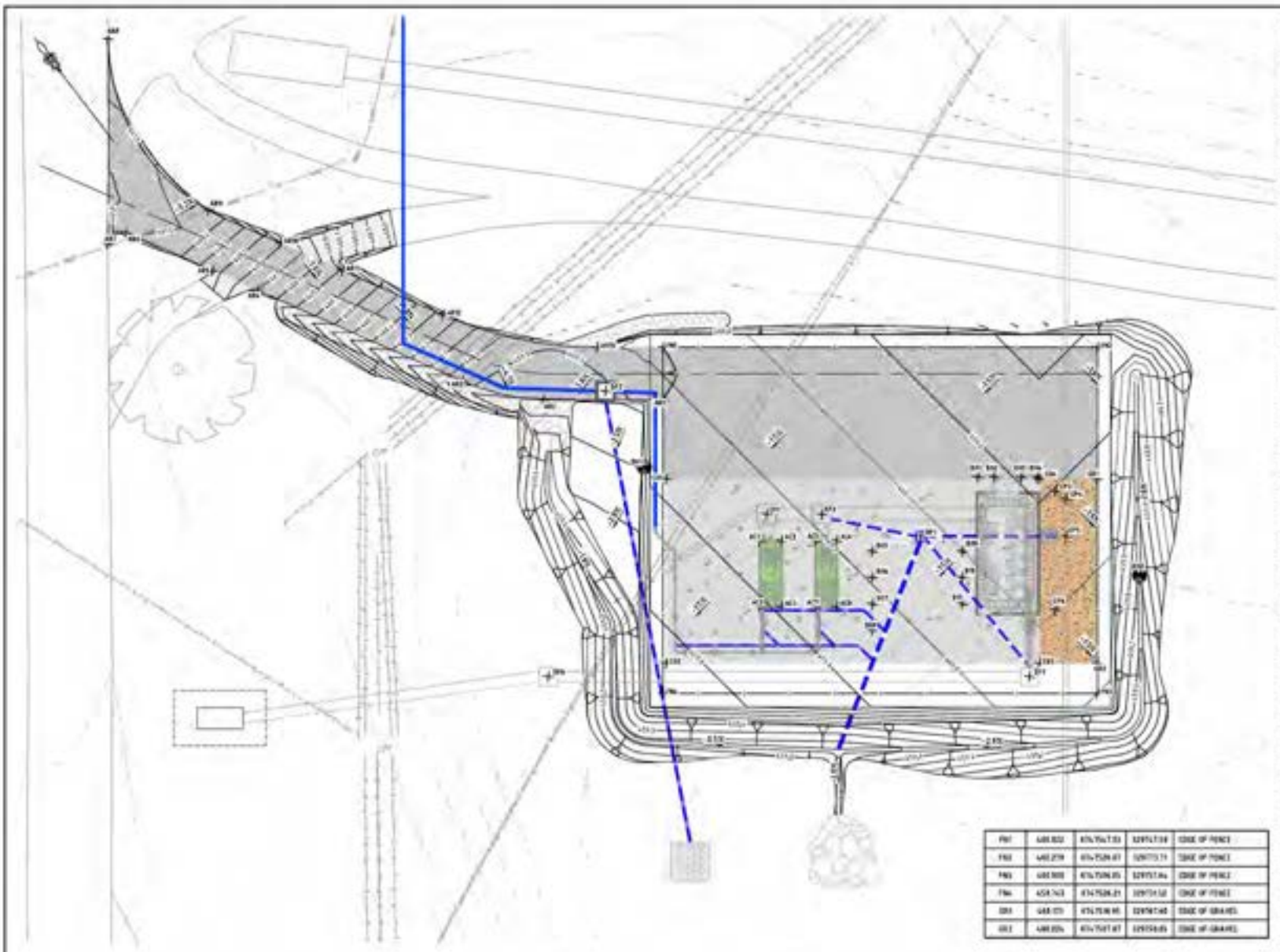
WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
VEHICLE TURNING MOVEMENT PATH

REVN	PLAN No.
D	PL2023-1366
C	SHEET 10
B	
A	



SITE PLAN
SCALE 1:150

SETOUT POINT TABLE

POINT NUMBER	RL in AHD	NORTHING	EASTING	DESCRIPTION
AC1	459.964	674,7330.97	329,744.43	AIR COMPRESSOR 2
AC2	459.942	674,7329.99	329,745.75	AIR COMPRESSOR 2
AC3	459.891	674,7326.92	329,743.35	AIR COMPRESSOR 2
AC4	459.909	674,7325.97	329,744.67	AIR COMPRESSOR 2
AC5	459.909	674,7328.34	329,741.76	AIR COMPRESSOR 1
AC6	460.007	674,7327.52	329,740.69	AIR COMPRESSOR 1
AC7	459.908	674,7324.35	329,744.89	AIR COMPRESSOR 1
AC8	459.953	674,7323.33	329,743.58	AIR COMPRESSOR 1
AR1	459.988	674,754.3.87	329,743.76	EDGE OF ACCESS ROAD
AR2	459.799	674,754.4.13	329,737.96	EDGE OF ACCESS ROAD
AR3	459.963	674,755.4.33	329,733.96	EDGE OF ACCESS ROAD
AR4	460.998	674,7544.24	329,735.68	EDGE OF ACCESS ROAD
AR5	461.230	674,7570.58	329,726.87	EDGE OF ACCESS ROAD
AR6	461.533	674,7576.98	329,728.66	EDGE OF ACCESS ROAD
AR7	461.876	674,7578.88	329,729.01	EDGE OF ACCESS ROAD
AR8	461.647	674,7591.06	329,726.55	EDGE OF ACCESS ROAD
AR9	461.420	674,7578.38	329,720.86	EDGE OF ACCESS ROAD
AR10	461.95	674,7591.9	329,729.42	EDGE OF ACCESS ROAD
AR11	460.700	674,7566.55	329,733.69	EDGE OF ACCESS ROAD
AR12	460.294	674,7564.22	329,735.61	EDGE OF ACCESS ROAD
AR13	459.957	674,7558.59	329,743.63	EDGE OF ACCESS ROAD
BI1	459.963	674,7529.37	329,741.95	BILLIARD
BI2	460.599	674,7528.49	329,736.73	BILLIARD
BI3	460.578	674,7529.31	329,734.98	BILLIARD
BI4	460.657	674,7527.73	329,733.66	BILLIARD
BH1	459.705	674,754.8.64	329,748.98	BOREHOLE 1
BH2	459.772	674,7571.21	329,730.66	BOREHOLE 2
BI01	460.772	674,7529.91	329,748.51	BILLIARD
BI02	460.784	674,7529.68	329,761.47	BILLIARD
BI03	460.207	674,7522.68	329,763.13	BILLIARD
BI04	460.378	674,7521.66	329,764.24	BILLIARD
BI05	460.227	674,7525.26	329,758.72	BILLIARD
BI06	460.096	674,7529.68	329,749.58	BILLIARD
BI07	459.984	674,7521.90	329,744.27	BILLIARD
CE1	460.211	674,7549.13	329,755.55	EDGE OF CONCRETE
CE2	459.979	674,7538.86	329,741.48	EDGE OF CONCRETE
CE3	459.778	674,7527.66	329,731.12	EDGE OF CONCRETE
CE4	460.219	674,752.9.81	329,764.15	EDGE OF CONCRETE
DP1	460.519	674,7523.37	329,754.32	DRAIN PIT
DP2	459.572	674,754.7.86	329,742.16	CONDENSATE DRAIN PIT
EP1	459.972	674,7532.28	329,744.89	ELECTRICAL PIT
EP2	460.876	674,7529.62	329,749.41	ELECTRICAL PIT
EP3	460.787	674,7526.17	329,744.52	EARTHING PIT
EP4	460.182	674,7549.21	329,764.88	ELECTRICAL PIT
EP5	460.152	674,7536.97	329,743.06	ELECTRICAL PIT
EP6	460.181	674,7530.84	329,729.02	EARTHING PIT
EP7	460.032	674,7538.24	329,754.35	ELECTRICAL PIT
EP8	8.888	674,7532.34	329,725.42	ELECTRICAL PIT

FN1	460.832	674,754.7.53	329,717.59	EDGE OF FENCE
FN2	460.279	674,7529.47	329,773.71	EDGE OF FENCE
FN3	460.900	674,7536.05	329,757.84	EDGE OF FENCE
FN4	459.743	674,7526.21	329,751.52	EDGE OF FENCE
GR1	460.171	674,7536.95	329,767.45	EDGE OF GRAVEL
GR2	460.854	674,7547.67	329,756.85	EDGE OF GRAVEL

FACILITY NAME:	PINDARI DAM	ASSETREADY	E	ISSUE FOR TENDER	N.A.	04/11/25	DRAWN: FINCUT SCALES: AS SHOWN SHEET SIZE: A1
LOCATION CODE:	WDRPN		D	40% TENDER REVISION	N.A.	18/10/24	DESIGNED: RAMJTON CHECKED: RAMJTON FILE NO.: N/A PROJECT NO.: CB23/10644
DISCIPLINE:	CIVIL		C	90% TENDER REVISION	N.A.	30/09/24	
DRAWING TYPE:	DETAIL		B	90% TENDER ISSUE	N.A.	23/10/24	
DRAWING STATUS:	FOR ISSUE		A	50% TENDER ISSUE	N.A.	02/10/24	
PLOT DATE:	03/11/2025 11:53:27 PM		REVISION	DETAILS OF AMENDMENT	CHKD	DATE	

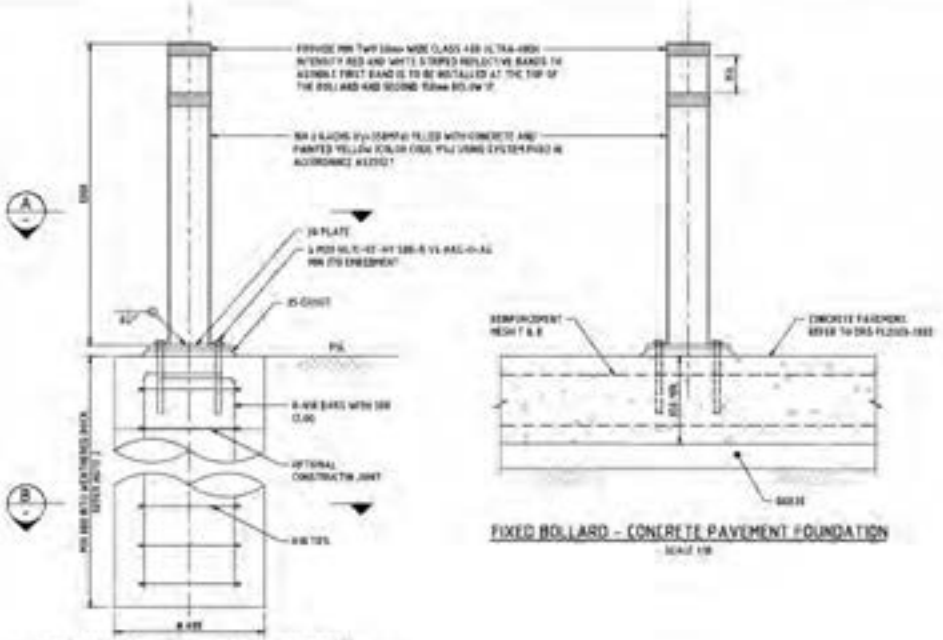
WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
SITE DRAINAGE AND SETOUT PLAN

PL2023-1367
SHEET 1A



FIXED BOLLARD – BORED PILE FOUNDATION

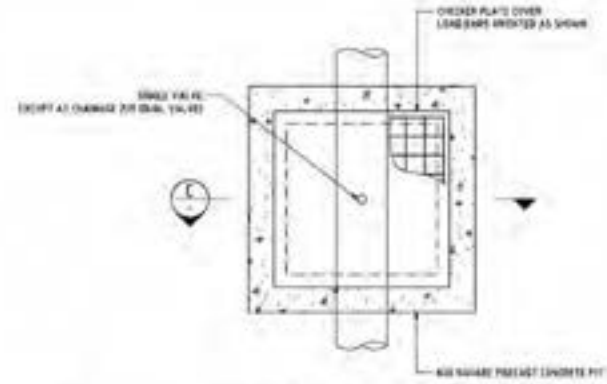
SCALE 1:10

FIXED BOLLARD – CONCRETE PAVEMENT FOUNDATION

SCALE 1:10

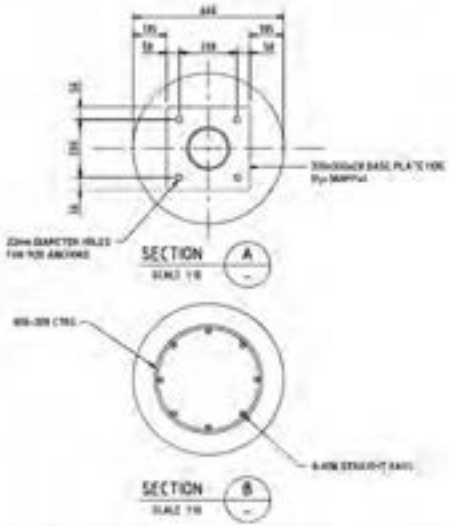
NOTES:

1. TO BE READ IN CONJUNCTION WITH:
   a. STRUCTURAL NOTES DRG PL2023-1360
   b. CIVIL NOTES DRG PL2023-1355
   c. CIVIL LAYOUT DRG PL2023-1358
2. CONCRETE GRADE 32MPa
3. CLEAR COVER OF REINFORCEMENT FOR BOLLARD FOOTING = 75mm
4. ASSUMED ALLOWABLE BEARING PRESSURE OF UNDISTURBED NATURAL SOIL 200 kpa. SITE CONDITIONS TO BE CONFIRMED BY SUITABLE QUALIFIED GEOTECHNICAL ENGINEER BEFORE GEOTECHNICAL REPORT PL2023-1-WSP-CPD-000-REP-0001 FOR GENERAL SITE INFORMATION



CONDENSATE DRAIN – PLAN

SCALE 1:10

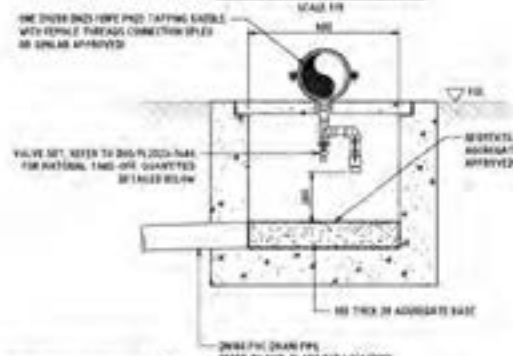


SECTION A

SCALE 1:10

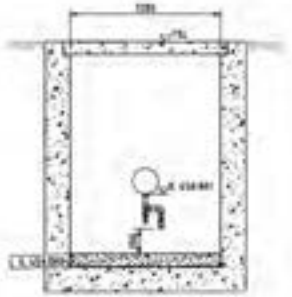
SECTION B

SCALE 1:10



DRAIN VALVE QUANTITIES	
VALVE SET	QUANTITY
1	
2	
3	
4	

CONDENSATE DRAIN DETAIL
ABOVEGROUND PIPE ARRANGEMENT



CONDENSATE DRAIN DETAIL
BELOWGROUND PIPE ARRANGEMENT

SECTION C

SCALE 1:10

SCALE 1:100

SCALE 1:10

E	ISSUED FOR TENDER	N.T.	31/01/25		
D	40% DESIGN RE-ISSUED	R.A.	18/12/24		
C	40% DESIGN RE-ISSUED	R.A.	20/09/24		
B	40% DESIGN RE-ISSUED	R.A.	23/07/24		
A	40% DESIGN ISSUE	R.A.	12/07/24		
REVISION	DETAILS OF AMENDMENT	DRAFT	DATE		

DRAWN: N.MALLEN
DESIGNED: N.MALLEN
CHECKED: N.MALLEN
SCALES: AS SHOWN
FILE NO.: 126
PROJECT MANAGER:
SHEET SIZE: A1
REPORT NO.:
ASSET PROJECT NO.: CW2078944

ASSETREADY

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must not be used for any purpose. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

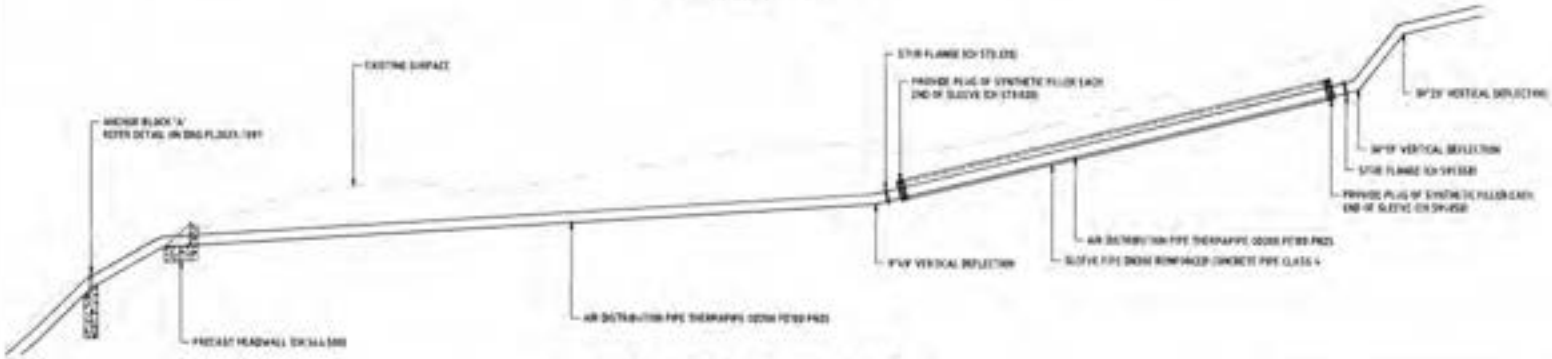
PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
FIXED BOLLARD DETAILS
SHEET 1 OF 2

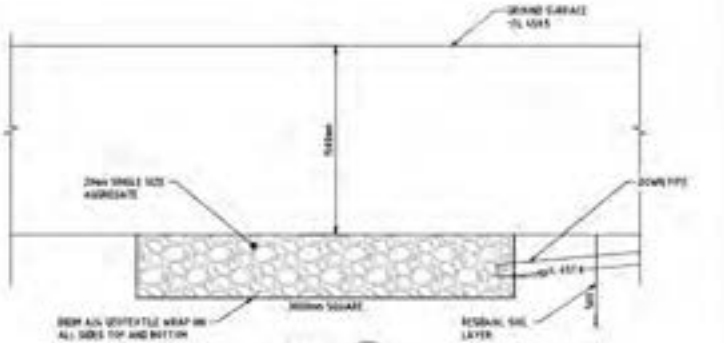
REV.	PLAN No.
E	PL2023-1368
D	
C	
B	
A	



ROAD CROSSING - PLAN
SCALE 1:100



ROAD CROSSING - LONGITUDINAL SECTION
HORIZONTAL SCALE 1:100, VERTICAL SCALE 1:50



SECTION J
SCALE 1:20

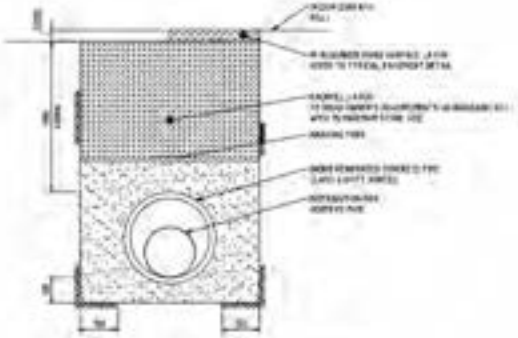
SCALE 1:100

SCALE 1:50

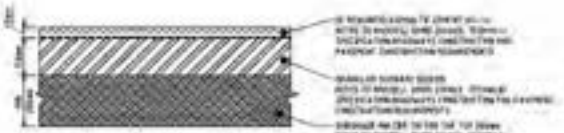
FACILITY NAME: PINDARI DAM LOCATION CODE: WDMPN DISCIPLINE: CIVIL DRAWING TYPE: DETAIL DRAWING STATUS: IFT (ISSUE) PLOT DATE: 23/07/2025 9:54:48 PM	ASSETREADY					DRAWN: PRIYUT NUKULCHAI DESIGNED: SHEKHAR NUKULCHAI CHECKED: PRIYUT NUKULCHAI N/A N/A JOHN PROJECT MANAGER	SCALES: HORIZONTAL AS SHOWN FILE NO.: N/A N/A N/A JOHN PROJECT MANAGER	SHEET SIZE: A1 REPORT NO.: N/A ADAPTIQUEST NO.: D2023/35644	WaterNSW COPYRIGHT RESERVED This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.	PINDARI DAM BUBBLE PLUME DESTRATIFICATION SYSTEM TYPICAL DETAILS SHEET 2 OF 2	REVS: PL2023-1373 SHEET NO.
		A	ISSUE FOR TENDER	N.L.	04/07/25						
		REVISION	DETAILS OF AMENDMENT	CHKD	DATE						

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH WATER SUPPLY CODE OF AUSTRALIA WSA-03-2011 - SYDNEY WATER EDITION, SYDNEY WATER TECHNICAL SPECIFICATION – CIVIL, WSA-03 WAT-1035 TO 1052, AND AS/NZS 2566.1 AND 2566.2.
2. FOR FULL BORED PIPE WORK NOTES REFER TO DRAWING PL2023-1353.
3. BEDDING – SPECIAL BEDDING SHALL BE SPECIFIED TO SUIT THE CONDITIONS OF THE TRENCH FLOOR, I.E.
   - IRREGULAR OUTCROPS OF ROCK
   - STEP OF >300Ø's
   - UNCONTROLLED DIGGING WHERE HAS DISTURBED THE FLOOR OF THE TRENCH
4. PLACEMENT OF CROSSPIPE, TRENCH FILL & COMPACTION TO MEET THE REQUIREMENTS OF AS/NZS 2566.1 & AS/NZS 2566.2
5. EXCAVATE OR COMPACT TRENCH FLOOR TO PROVIDE A FLAT FIRM BASE TO SUPPORT BEDDING MATERIAL AND MINIMIZE PIPELINE SETTLEMENT. WHEN EXCAVATED REPLACE WITH GRANULAR MATERIAL AS SPECIFIED FOR BEDDING
6. ENSURE THAT BEDDING IS DEEP ENOUGH THAT PIPE BARE PROJECTIONS DO NOT TOUCH TRENCH FLOOR
7. DETECTABLE WARNING TAPE SHALL BE PROVIDED EITHER ABOVE THE CROSSPIPE ZONE OR 150mm BELOW THE ITEL WHICHEVER IS CLOSE TO THE ITEL
8. KEEP 1200 OF TRENCH VERTICAL TO AT LEAST 150mm ABOVE THE PIPE SOFFIT
9. CENTRE LINE INFORMATION INDICATE EXCAVATION WORKS (BULK AND TRENCH) ARE LIKELY WITHIN NEXT 1000 LENGTH RUN.



DISTRIBUTION PIPELINE ROAD CROSSING DETAIL



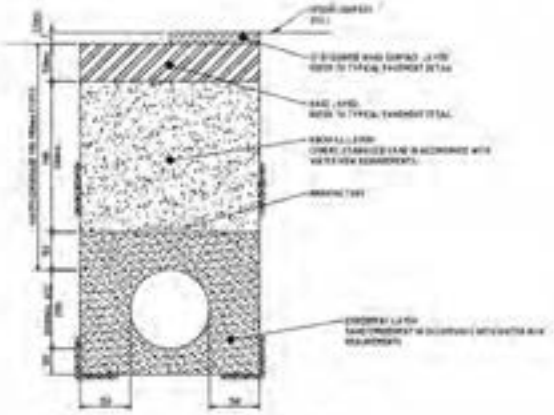
TYPICAL ASPHALT PAVEMENT DETAIL



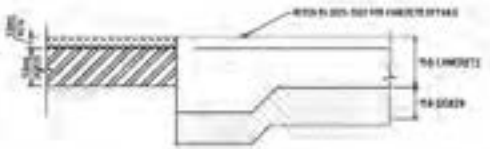
TYPICAL PAVEMENT DETAIL NON-TRAFFICABLE



TOPSOIL DETAIL

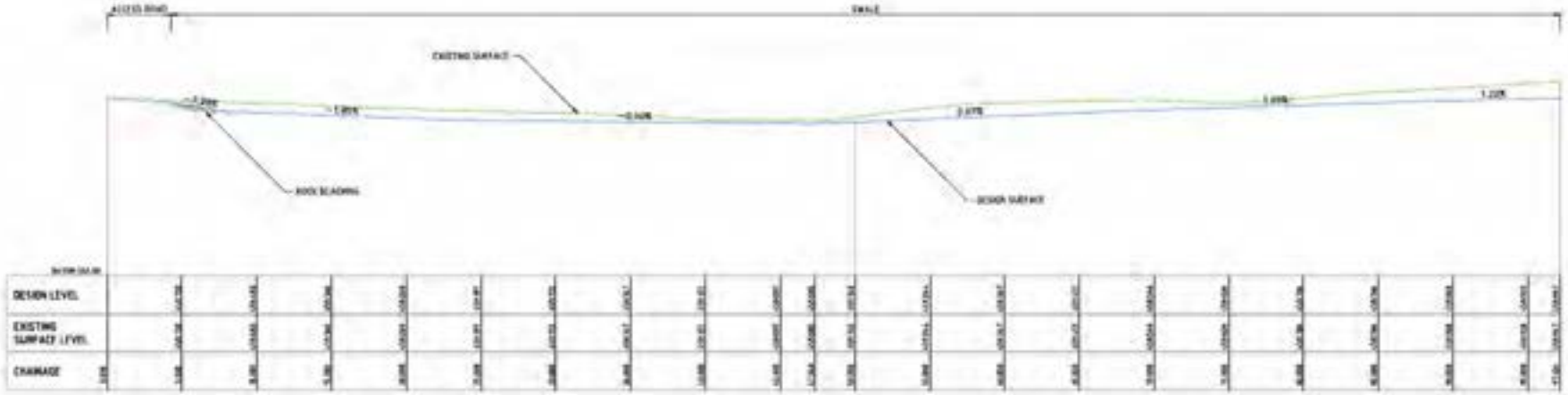


TYPICAL PIPELINE TRENCH DETAIL - TYPE 2
CEMENT STABILISED/TRAFFICABLE



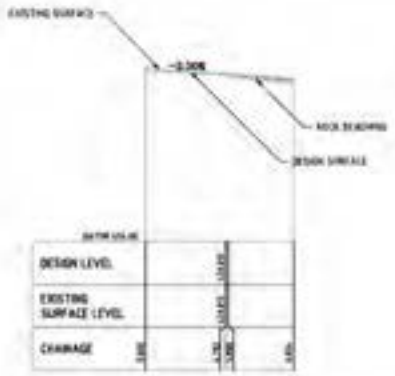
CONCRETE PAVEMENT - ASPHALT PAVEMENT INTERFACE

ASSET NAME: PINDARI DAM	ASSETREADY						WaterNSW	PINDARI DAM	PL2023-1369
LOCATION/ASSET: PDMPH								BUBBLE PLUME DESTRATIFICATION SYSTEM	
DISCIPLINE: CIVIL								PAVEMENT AND TRENCH DETAILS	
DRAWING TYPE: DETAIL									
DRAWING CONTENT: PT BRIDGE									
PLOT DATE: 29/10/2024 11:01 AM									



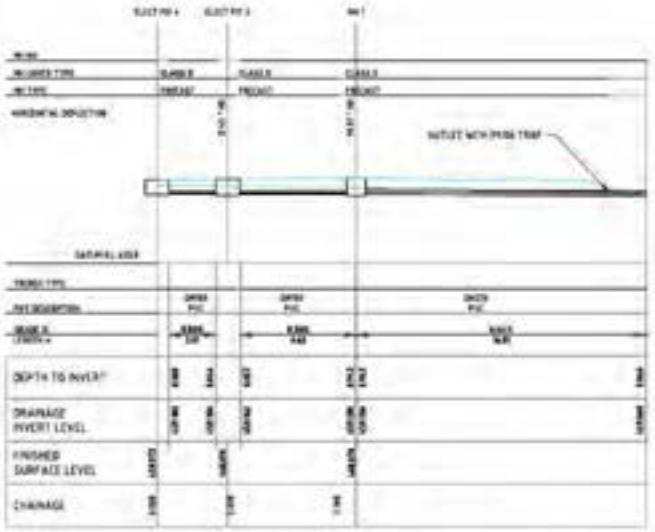
SW-01 LONGITUDINAL SECTION

SCALE 1:100 H 1:50 V



SW-02 LONGITUDINAL SECTION

SCALE 1:100 H 1:50 V



KIOSK AND PIT DRAINAGE LONGITUDINAL SECTION

SCALE 1:100 H 1:50 V

SCALE 1:100

SCALE 1:50

FACILITY NAME	PINDARI DAM	ASSETREADY						WaterNSW	PINDARI DAM
LOCATION CODE	XXXPIN								BUBBLE PLUME DESTRATIFICATION SYSTEM
DISCIPLINE	CIVIL								DRAINAGE LONGITUDINAL SECTION
DRAWING TYPE	LONGITUDINAL SECTION								
DRAWING STATUS	IFT ISSUE								
PLOT DATE	25/10/2023 10:23:16 AM								

NO.	DESCRIPTION	DES.	DATE
D	ISSUE FOR TENDER	N.L.	31/07/23
C	40% DESIGN REVISED	N.A.	18/12/23
B	40% DESIGN REVISED	N.A.	23/08/24
A	40% DESIGN ISSUE	N.A.	22/02/24
REVISION	DETAILS OF AMENDMENT	CHKD	DATE

DRAWN	SHAILIN	SCALES	SHEET SIZE: A1
DESIGNED	SHAILIN	FILE NO.: 126	REPORT NO.: N/A
CHECKED	PARKER	N/A WORK PACKAGE MANAGER	JOB/PROJECT NO.: D2023/0044

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

NO.	PLAN No.
C	PL2023-1370
D	SHEET 10
E	
F	
G	



NOTES:

1. INCLUDE 2 DEDICATED COMMS CONDUITS (1 SPARE) BETWEEN THE NEW SWITCHROOM AND THE EXISTING COMMUNICATIONS PIT A WHICH IS ADJACENT THE HOT ENTRY.
2. INSTALL A NEW 24 PORT LC PIGTAIL IN A NEW POWDER COATED MILD STEEL COMMS CABINET WITHIN THE HIGH LEVEL OUTLET CONTROL ROOM.
3. INSTALL A NEW 24 PORT LC PIGTAIL IN A NEW COMMS CABINET WITHIN THE OFFICE.
4. INSTALL A NEW 12C SINGLE MODE OS2 FIBRE FROM THE NEW SWITCHROOM PIGTAIL TO THE NEW PIGTAIL IN THE HIGH LEVEL OUTLET WORKS CONTROL ROOM (~438m), VIA NEW AND EXISTING CONDUITS.
5. INSTALL A NEW 12C SINGLE MODE OS2 FIBRE FROM THE NEW COMMS CABINET WITHIN THE HIGH LEVEL OUTLET CONTROL ROOM TO THE OFFICE (~438m, VIA THE EXISTING CONDUIT AND PIT SYSTEM.
6. REFER TO TYPICAL NETWORK ARCHITECTURE DIAGRAM PL2023-1659 FOR MORE DETAILS.

PLAN
SCALE 1:500

INSET 'A'
SCALE 1:100

FACILITY NAME	PINDARI DAM										
LOCATION CODE	WDPPN										
DISCIPLINE	CIVIL										
DRAWING TYPE	PLAN										
DRAWING STATUS	IFT ISSUE										
PLOT DATE	03/04/2026 1:48:05 PM										
ASSETREADY											
		A	ISSUE FOR TENDER	N.T.	31/01/26						
		REVISION	DETAILS OF AMENDMENT	CHKD	DATE						

DRAWN	SVEN LEE	SCALE	SHEET SIZE
	N.HAMILTON	AS SHOWN	A1
DESIGNED	SVEN LEE	FILE NO.	REPORT NO.
	N.HAMILTON	N/A	N/A
CHECKED	SVEN LEE	N.J.TAYLOR	JOB/PROJECT NO.
	N.J.TAYLOR	PROJECT MANAGER	0222/135644

WaterNSW

COPYRIGHT RESERVED
This drawing is the property of Water NSW. It must not be copied without prior written consent and must be returned on request. The information shown on it is to be regarded as confidential and must not be disclosed to any third party.

PINDARI DAM

BUBBLE PLUME DESTRATIFICATION SYSTEM
COMMS CABLING GENERAL ARRANGEMENT

REV.	PLAN No.
	PL2023-1374
	SHEET 2
A	

Appendix K

NSW Office of Environment and Heritage (DCCEEW) Consultation

Your ref: Email dated 26/10/2024
Our ref: DOC24/844873-3

WSP Australia Pty Ltd
Level 2, 121 Marcus Clarke Street
CANBERRA ACT 2601

Attention: Ms Cleo Courtney

Dear Ms Courtney

Re: Request for input to Planning Secretary's Environmental Assessment Requirements - Review of Environmental Factors – Pindari Bubble Plume Project

Thank you for your email dated 15 October 2024 about the proposed bubble plume system at Pindari Dam, seeking input to the Planning Secretary's Environmental Assessment Requirements (SEARs) from the Biodiversity, Conservation and Science Group (BCS) of the NSW Department of Climate Change, Energy, the Environment and Water for the preparation of a Review of Environmental Factors (REF). I appreciate the opportunity to provide advice.

We note the project will be assessed in accordance with Part 5 Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The environmental assessment requirements provided by BCS for the REF are limited to biodiversity, NPWS estate, flooding, and coastal processes and associated hazards.

BCS anticipates the REF will be sufficiently comprehensive to enable unambiguous assessment of all direct and indirect impacts of the proposed activity.

In particular, we expect the REF will consider all impacts on biodiversity, particularly on threatened species and ecological communities known or likely to occur on the subject land, including but not limited to:

- Rodd's star hair (*Astrotricha roddii*)
- Pindari wattle (*Acacia acrionastes*)
- Macnutt's wattle (*Acacia macnuttiana*)
- white-crowned snake (*Cacophis harriettae*)
- blue-billed duck (*Oxyura australis*)
- white-bellied sea-eagle (*Haliaeetus leucogaster*)
- little eagle (*Hieraaetus morphnoides*)
- south-eastern glossy black-cockatoo (*Calyptorhynchus lathami lathami*)
- little lorikeet (*Glossopsitta pusilla*)
- swift parrot (*Lathamus discolor*)
- turquoise parrot (*Neophema pulchella*)
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)
- speckled warbler (*Chthonicola sagittata*)
- regent honeyeater (*Anthochaera phrygia*)

- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)
- varied sittella (*Daphoenositta chrysoptera*)
- dusky woodswallow (*Artamus cyanopterus cyanopterus*)
- south-eastern hooded robin (*Melanodryas cucullata cucullata*)
- diamond firetail (*Stagonopleura guttata*)
- spotted-tailed quoll (*Dasyurus maculatus*)
- koala (*Phascolarctos cinereus*)
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions
- Howell Shrublands in the New England Tableland and Nandewar Bioregions

We consider this information is necessary to assess the REF for the proposed activity.

The full list of our requirements that may need to be addressed in the REF is provided in **Attachment 1**. In preparing the REF, the proponent can refer to the relevant guidance material in **Attachment 2.**

If you have any further questions about this issue, please contact Mr Gene Mason, Senior Conservation Planning Officer North East, BCS, on 8289 6315 or at gene.mason@environment.nsw.gov.au.

Yours sincerely



DIMITRI YOUNG
Senior Team Leader Planning North East
Biodiversity, Conservation and Science

11 November 2024

Enclosures:
Attachment 1 - DCCEEW BCS Recommended EARs - REF – Pindari Bubble Plume Project
Attachment 2 - REF Guidance Material

Attachment 1

NSW Department of Climate Change, Energy, the Environment and Water

Biodiversity, Conservation and Science Group

Environmental Assessment Requirements (EARs)

Review of Environmental Factors

Pindari Bubble Plume Project

TABLE OF CONTENTS

A The Proposed Activity 2

B Environmental Impacts of the Proposed Activity 2

C Biodiversity 3

D NPWS Estate 5

F Flooding, Coastal Processes and Associated Hazards 6

G Cumulative Impacts 6

A. The Proposed Activity

1. The Review of Environmental Factors (REF) should fully and clearly describe the proposed activity, including any environmental impact mitigation measures, and identify all the processes and activities intended for the site during the life of the proposed activity, including, where relevant:

    a. the location of the proposed activity and details of the surrounding environment

    b. appropriate land use zoning

    c. the size and type of the proposed activity and its operation

    d. the proposed layout of the site

    e. the staging and timing of the proposed activity

    f. the proposed activity's relationship to any other proposal

    g. all equipment proposed for use at the site

    h. chemicals, including fuel, used on the site and proposed methods for the transportation storage, use and emergency management

    i. waste generation, storage and disposal

    j. the anticipated environment impacts of the proposed activity, both direct and indirect

    k. a plan showing the distribution of any threatened flora or fauna species and the vegetation communities on or adjacent to the subject site, and the extent of vegetation proposed to be cleared

    l. ownership details of any residence and/or land likely to be affected by the proposed activity

    m. maps/diagrams showing the location of residences and properties likely to be affected and other industrial developments, conservation areas, wetlands, etc. in the locality that may be affected by the proposed activity

    n. methods to mitigate any expected environmental impacts of the proposed activity

    o. the anticipated level of performance in meeting required environmental standards.

B. Environmental Impacts of the Proposed Activity

1. Impacts related to Biodiversity, NPWS Estate, Acid Sulfate Soils, Flooding, Coastal Processes and Associated Hazards, and Cumulative Impacts, should be assessed, quantified, and reported on in the REF, as required.

2. The REF should address the specific requirements outlined under each heading below, where necessary, and assess impacts in accordance with the relevant guidelines mentioned. A full list of guidelines is at **Attachment 2**.

C. Biodiversity

1. The REF must assess the impacts of the proposed activity on biodiversity values to determine if the proposed activity is "likely to significantly affect threatened species" for the purposes of Section 7.8 of the *Biodiversity Conservation Act 2016* (BC Act) as follows:

   A. The REF must demonstrate whether the proposed activity is to be carried out in a declared area of outstanding biodiversity value.

   B. If the proposed activity is not carried out in a declared area of outstanding biodiversity value, then the REF must document *the test for determining whether proposed development or activity is likely to significantly affect threatened species or ecological communities* as outlined in Section 7.3 of the BC Act, by preparing an ecological assessment that should include:

      I. A field survey of the site of the proposed activity conducted and documented in accordance with relevant guidelines, including:

         a. *Field survey methods for environmental consultants and surveyors when assessing proposed developments or other activities on sites containing threatened species* (OEH undated) https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/field-survey-method-guidelines.pdf

         b. *NSW Survey Guide for Threatened Frogs (DPIE 2020)* https://www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-survey-guide-for-threatened-frogs

         c. *Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method* (DPIE 2020) https://www.environment.nsw.gov.au/research-and-publications/publications-search/surveying-threatened-plants-and-their-habitats-survey-guide-for-the-biodiversity-assessment-method

         d. *"Species credit' threatened bats and their habitats* https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/species-credit-threatened-bats-survey-guide-180466.pdf

         e. *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (DEC, 2004), https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/draft-threatened-biodiversity-survey-guide.pdf.

      If a proposed field survey methodology is likely to vary significantly from the methods in the guidelines above, then the proponent should discuss the proposed methodology with the Biodiversity, Conservation and Science Group (BCS) prior to undertaking surveys for the REF, to determine whether BCS considers the proposed methodology appropriate.

      The results of recent (less than five years old) field surveys may be used. However, the results of previous field surveys should not be used if they have:

      - been undertaken in seasons, weather conditions or following extensive disturbance events when the subject species are unlikely to be detected or present, or

- utilised methodologies, survey sampling intensities, timeframes or baits that are not the most appropriate for detecting the target subject species,

unless these differences can be clearly demonstrated to have had an insignificant impact upon the outcomes of the field surveys.

If the results of previous field surveys are used, then field surveys for any additional threatened entities listed under the BC Act since the previous field surveys took place, must be undertaken and documented.

The list of potential threatened species, populations, ecological communities, or their habitats for the site should be determined in accordance with:

- the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (DEC, 2004) https://www.environment.nsw.gov.au/research-and-publications/publications-search/threatened-biodiversity-survey-and-assessment
- the Department's Threatened Species website http://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species
- the *Bionet Atlas of NSW* http://www.environment.nsw.gov.au/wildlifeatlas/about.htm
- the Vegetation Information System (BioNet Vegetation Classification) http://www.environment.nsw.gov.au/research/Visclassification.htm
- other data sources (e.g. SEED, PlantNET, Online Zoological Collections of Australian Museums (http://www.ozcam.org/), previous or nearby surveys etc.) may also be used to compile the list.

II. The following information as a minimum:

a. A description, spatial data files, and geo-referenced mapping of the study area, (overlays on topographic maps, satellite images and /or aerial photos, including details of map datum, projection and zone), showing all field survey locations, vegetation communities classified in accordance with the BioNet Vegetation Classification (http://www.environment.nsw.gov.au/research/Visclassification.htm), key habitat features and reported locations of threatened species and ecological communities present in the subject site and study area.

b. A description of survey methodologies used, including timing, location and weather conditions.

c. Details, including qualifications and experience, of all staff undertaking the surveys, mapping and assessment of impacts as part of the REF.

d. Identification of national and state listed threatened biota known or likely to occur in the study area and their conservation status.

e. A description of the likely impacts of the proposed activity on biodiversity values, including direct and indirect impacts and construction and operation impacts, with impacts quantified, wherever possible, such as the amount of each vegetation community or species habitat to be cleared or impacted, and/or the degree of fragmentation of a habitat connectivity.

f. Identification of the avoidance, mitigation and management measures that will be put in place as part of the proposed activity to avoid or minimise biodiversity impacts, including details about alternative options considered and how long-term management arrangements will be guaranteed.

g. A description of the residual impacts of the proposed activity.

III. The '*test for determining whether proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats'* as outlined in Section 7.3 of the BC Act undertaken in accordance with the gazetted *Threatened Species Test of Significance Guidelines* (OEH 2018) available at: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/threatened-species-test-significance-guidelines-170634.pdf.

2. If the REF determines under 1 above that the proposed activity is likely to significantly affect threatened species, then in accordance with Section 7.8 of the BC Act, an Environmental Impact Statement must be prepared that is accompanied by a Species Impact Statement prepared in accordance with Part 7, Division 5 of the BC Act, or, if the proponent so elects, a Biodiversity Development Assessment Report prepared in accordance with Part 6, Division 3 of the BC Act.

3. If the REF determines under 1 above that the proposed activity is unlikely to significantly affect threatened species, then the proposed activity should:

    a. be designed to avoid and minimise impacts on biodiversity values to the fullest extent possible, and

    b. include a biodiversity offset package to offset remaining direct and indirect impacts on biodiversity values, prepared in accordance with the Department's 13 offsetting principles available at http://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm.

Note:

For the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999,* the REF should identify any relevant Matters of National Environmental Significance and whether the proposal has been referred to the Commonwealth or already determined to be a controlled action.

D. National Parks and Wildlife Service Estate

1. Where appropriate, likely impacts (both direct and indirect) of the proposed development on any adjoining and/or nearby National Parks and Wildlife Service (NPWS) estate reserved under the *National Parks and Wildlife Act 1974 s*hould be considered, with reference to the *Developments adjacent to National Parks and Wildlife Service lands Guidelines for consent and planning authorities* (DPIE, 2020) available at https://www.environment.nsw.gov.au/research-and-publications/publications-search/developments-adjacent-to-national-parks-and-wildlife-service-lands.

2. The NPWS has clear guidelines for assessing the environmental impact of developments and activities proposed within NPWS managed lands. These include guidelines for the preparation of a REF for activities proposed on land reserved under the *National Parks and Wildlife Act 1974,* including national parks and nature reserves. The *Guidelines for preparing a Review of Environmental Factors* provides information on how to determine whether certain activities are permissible, as well as specific information on matters for consideration during the preparation of an REF. The guidelines can be found at http://www.environment.nsw.gov.au/research-and-publications/publications-search/guidelines-for-preparing-a-review-of-environmental-factors.

3. For those proposals within NPWS managed areas that seek a lease or licence under Section 151 of the *National Parks and Wildlife Act 1974*, in addition to an REF, applications must also be accompanied by a sustainability assessment. The assessment must address the criteria adopted by the Chief Executive of the former Office of Environment and

Heritage. Templates for completing a Sustainability Assessment can be found at http://www.environment.nsw.gov.au/protectedareas/sustainabilityassessments.htm.

Note: Proposals which may impact marine protected areas should be referred to the Department of Primary Industries to determine the assessment and approval requirements.

F. Flooding, Coastal Process and Associated Hazards

1. The REF should include an assessment of the following referring to the relevant guidelines in Attachment 2:
    a. The potential effect of coastal processes and coastal hazards including potential impacts of sea level rise:
        i. on the proposed activity; and
        ii. arising from the proposed activity.
    b. Whether the proposed activity is consistent with any coastal zone management plans.
    c. Whether the proposed activity is consistent with any floodplain risk management plans.
    d. Whether the proposed activity is compatible with the flood hazard of the land.
    e. Whether the proposed activity will significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other proposals or properties.
    f. Whether the proposed activity will significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.
    g. Whether the proposed activity incorporates appropriate measures to manage risk to life from flood.
    h. Whether the proposed activity is likely to result in unsustainable social and economic costs to the community as a consequence of flooding.
2. The implications of flooding over the full range of potential flooding, including the probable maximum flood, should be considered as set out in the NSW Government Floodplain Development Manual and should include:
    a. Full details of the flood assessment and modelling undertaken in determining any design flood levels (if applicable), including the 1 in 100 year flood levels.
    b. A sensitivity assessment of the potential impacts of an increase in rainfall intensity and runoff (10%, 20% and 30%) and sea level rise on the flood behaviour for the 1 in 100 year design flood if applicable.
3. All site drainage, stormwater quality devices and erosion / sedimentation control measures should be identified and the onsite treatment of stormwater and effluent runoff and predicted stormwater discharge quality from the proposed activity should be detailed.

G. Cumulative Impacts

1. The cumulative impacts, including both construction and operational impacts, from all clearing activities and operations, associated edge effects and other indirect impacts on cultural heritage, biodiversity and NPWS Estate in accordance with the *Environmental Planning and Assessment Act 1979*.

2. The cumulative impacts, including both construction and operational impacts, of the proponent's existing proposals and other proposals and associated infrastructure (such as access tracks etc.), as well as the cumulative impact of the proposed activity in the context of other proposals located in the vicinity.

Attachment 2 – REF Guidance material

Title	Web address
Relevant Legislation	
Biodiversity Conservation *Act 2016*	https://www.legislation.nsw.gov.au/#/view/act/2016/63/full
Coastal Management Act 2016	https://www.legislation.nsw.gov.au/#/view/act/2016/20/full
Commonwealth Environment Protection and Biodiversity Conservation Act 1999	http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/
Environmental Planning and Assessment Act 1979	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N
Fisheries Management Act 1994	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+38+1994+cd+0+N
Marine Parks Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+64+1997+cd+0+N
National Parks and Wildlife Act 1974	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+80+1974+cd+0+N
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Water Management Act 2000	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+92+2000+cd+0+N
Wilderness Act 1987	http://www.legislation.nsw.gov.au/viewtop/inforce/act+196+1987+FIRST+0+N
Biodiversity	
Biodiversity Assessment Method (DPIE, 2020)	https://www.environment.nsw.gov.au/research-and-publications/publications-search/biodiversity-assessment-method-2020
Biodiversity Development Assessment Report	https://www.legislation.nsw.gov.au/#/view/act/2016/63/part6/div3/sec6.12
Guidance and Criteria to assist a decision maker to determine a serious and irreversible impact (OEH, 2017)	http://www.environment.nsw.gov.au/resources/bcact/guidance-decision-makers-determine-serious-irreversible-impact-170204.pdf

Title	Web address
Accreditation Scheme for Application of the Biodiversity Assessment Method Order 2017	https://www.legislation.nsw.gov.au/regulations/2017-471.pdf
Biodiversity conservation actions	www.environment.nsw.gov.au/resources/bcact/ancillary-rules-biodiversity-actions-170496.pdf
Reasonable steps to seek like-for-like biodiversity credits for the purpose of applying the variation rules	www.environment.nsw.gov.au/resources/bcact/ancillary-rules-reasonable-steps-170498.pdf
Threatened Species Website	www.environment.nsw.gov.au/threatenedspecies/
NSW BioNet (Atlas of NSW Wildlife)	www.bionet.nsw.gov.au/
Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method (DPIE 2020)	https://www.environment.nsw.gov.au/research-and-publications/publications-search/surveying-threatened-plants-and-their-habitats-survey-guide-for-the-biodiversity-assessment-method
Threatened biodiversity survey and assessment - Guidelines for developments and activities (2004 working draft)	https://www.environment.nsw.gov.au/research-and-publications/publications-search/threatened-biodiversity-survey-and-assessment
Field survey methods for environmental consultants and surveyors when assessing proposed developments or other activities on sites containing threatened species (OEH undated)	https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/field-survey-method-guidelines.pdf
NSW Survey Guide for Threatened Frogs (DPIE 2020)	https://www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-survey-guide-for-threatened-frogs
Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide (DPE 2022)	https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/koala-phascolarctos-cinereus-biodiversity-assessment-method-survey-guide-220249.pdf
'Species credit' threatened bats and their habitats (OEH 2018)	https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/species-credit-threatened-bats-survey-guide-180466.pdf

Title	Web address
BioNet Vegetation Classification - NSW Plant Community Type (PCT) database	www.environment.nsw.gov.au/research/Vegetationinformationsystem.htm
SEED Data Portal (access to online spatial data)	http://data.environment.nsw.gov.au/
Threatened Reptiles Biodiversity Assessment Method survey guide (DPE 2022)	https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/threatened-reptiles-biodiversity-assessment-method-survey-guide-20220563.pdf
Department of Primary Industry Policy and guidelines for fish habitat conservation and management (2013)	https://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/fish-habitat-conservation
NPWS Estate	
List of national parks	http://www.environment.nsw.gov.au/NationalParks/parksearchatoz.aspx
Revocation, recategorisation and road adjustment policy (OEH, 2012)	http://www.environment.nsw.gov.au/policies/RevocationOfLandPolicy.htm
Developments adjacent to NPWS lands Guidelines for consent and planning authorities (DPIE 2020)	https://www.environment.nsw.gov.au/research-and-publications/publications-search/developments-adjacent-to-national-parks-and-wildlife-service-lands
Acid Sulfate Soils	
Acid Sulfate Soils Planning Maps	http://data.nsw.gov.au/data/
Acid Sulfate Soils Manual (Stone et al. 1998)	http://www.environment.nsw.gov.au/resources/epa/Acid-Sulfate-Manual-1998.pdf
National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, Canberra, ACT. (Sullivan, L, Ward, N, Toppler, N and Lancaster, G. 2018a)	https://www.waterquality.gov.au/sites/default/files/documents/dewatering-acid-sulfate-soils.pdf

Title	Web address
National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual, Department of Agriculture and Water Resources, Canberra ACT.(Sullivan, L, Ward, N, Toppler, N and Lancaster, G. 2018b)	https://www.waterquality.gov.au/issues/acid-sulfate-soils/sampling-and-identification-methods-manual.pdf
National Acid Sulfate soils Guidance: Overview and management of monosulfidic black ooze (MBO) accumulations in waterways and wetlands, Department of Agriculture and Water Resources, Canberra ACT. (Sullivan, LA, Ward, NJ, Bush, RT, Toppler, NR, Choppala, G. 2018c)	https://www.waterquality.gov.au/issues/acid-sulfate-soils/monosulfidic-black-ooze-accumulation.pdf
National Acid sulfate soils guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management, Department of Agriculture and Water Resources, Canberra, ACT (Simpson, SL, Mosley, L, Batley, GE and Shand P. 2018)	https://www.waterquality.gov.au/sites/default/files/documents/dredging-sediments-spoil.pdf
National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments, Department of Agriculture and Water Resources, Canberra, ACT. (Shand, P, Appleyard, S, Simpson, SL, Degens, B, Mosley, LM 2018)	https://www.waterquality.gov.au/issues/acid-sulfate-soils/dewatering-groundwater-environments.pdf
Flooding, Coastal Processes and Associated Hazards	
Reforms to coastal erosion management	http://www.environment.nsw.gov.au/coasts/coastalerosionmgmt.htm
Floodplain development manual	https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Floodplains/flood-risk-management-manual-2023-230220.pdf
Guidelines for Preparing Coastal Zone Management Plans	http://www.environment.nsw.gov.au/resources/coasts/130224CZMPGuide.pdf

Title	Web address
NSW Climate Impact Profile	http://climatechange.environment.nsw.gov.au/
Climate Change Impacts and Risk Management	Climate Change Impacts and Risk Management: A Guide for Business and Government, AGIC Guidelines for Climate Change Adaptation

Appendix L

Communications and Stakeholder Engagement Plan



Communication and Stakeholder Engagement Plan

Pindari Cold Water Pollution Mitigation

November 2024

File name	Pindari Cold Water Pollution Mitigation CESP
Document owner	Joanna Linehan
Document status	Draft
Version #	V 1.0

Monitoring, evaluation and review, revision history

Approvals required	Status
Nathan Velautham	Approved 14/10/24
Daniel Kemp	Approved 16/10/24
Carl Butcher	Approved 25/10/25
Matt Gordos – DPIRD Fisheries	Approved 10/11/25

Table of contents

1. Introduction 6
1.1 Purpose of document 6
1.2 Project background and overview 6
1.3 Project objectives 6
1.4 Project location 7
1.5 Project scope 8
1.6 Timing 8
1.7 Project risk 9
1.8 Constraints 11
2. Stakeholder analysis 12
2.1 Stakeholder mapping 12
2.2 Stakeholder Engagement 15
2.3 Communication Schedule 19
Timing 20
Action/activity 20
Target audience 20
Channel 20
Notes 20
Measure of success 20
End of Oct 20
CESP draft and approval 20
Internal WaterNSW + partners 20
CESP 20
Approval 20
End of Nov 20
Drafting of comms collateral including: 20
All 20
TBC 20
Media announcement 20

All **20**
TBC **20**
Awaiting funding **20**
December **20**
Establish site signage **20**
All **20**
- Education and information about the project **20**
One month prior to construction **20**
Stakeholder briefing **20**
Council **20**
Virtual/F2F **20**
Tier 1 + 2 Stakeholders **20**
Attendance **20**
Two weeks prior to start of construction **21**
Notification of commencement of works **21**
All Stakeholders **21**
Email **21**
All **21**
Site mobilisation **21**
Induct all work crews, sub-contractors and project team members into the community relations aspect of the project **21**
Onsite **21**
Commencement **21**
Start of work media release **21**
LALC **21**
Onsite **21**
Ongoing **21**
Work ongoing- project updates, community news stories, video **21**
Website **21**
Ongoing **21**
School tours to provide education outcomes **21**
Local schools **21**
Onsite **21**

Increase in hits on newspaper sites and on WaterNSW social platforms 21
Completion 21
Commissioning ceremony 21
All 21
Onsite 21
Completion 21
Community and school tours to showcase benefits and outcomes of the project/trial 21
All interested community/stakeholders etc 21
Onsite 21
2.4 First Nations 22
3. Communication and engagement activity 23
3.1 Communication objectives 23
3.2 Communication approach 24
3.3 Communication tools 25
3.4 Key messages 27
3.5 Policies and Protocols 31

1. Introduction

1.1 Purpose of document

Project delivery will require effective communication within, amongst, and from multiple Government agencies and WaterNSW to ensure successful project delivery. However, project delivery will be made easier if key delivery partners have a shared understanding of key messages that must be communicated to decision-makers, key stakeholders, and to the wider local community. The goal of this plan is to provide proactive communication and engagement activities that empower stakeholders through clear and consistent, values-based communications that will be key to building social capital with the target audience.

1.2 Project background and overview

Cold water pollution (CWP) is what happens when the bottom cold layer of water from large, stratified dams is released downstream resulting in an artificial drop in river temperatures during the warmer summer months. CWP discharges from eight (8) NSW priority dams and negatively impacts more than 2,000 km of mainstem waterways in the Murray Darling Basin (Lugg 1999) where it causes pervasive ecological, social, cultural, and economic impacts that are well documented and acknowledged by state and federal governments and the scientific community (refer to reviews by Chaaya and Miller 2022a and NSW DPI Fisheries 2023).

Implementation of the Pindari Dam CWP Mitigation Project is expected to deliver broad environmental benefits both within Pindari Dam and its downstream river ecosystems, including:

- increased water temperatures (expected 10°C improvement below the dam)
- improved water quality that reduces cyanobacterial bloom risk, and
- healthier more resilient fish populations within the Border Rivers catchment.

These environmental benefits are expected to flow onto social, recreational, cultural, and financial benefits. Importantly, CWP mitigation represents a tangible and enduring commitment by both the Commonwealth and NSW Governments towards the recovery of riverine ecosystems while addressing widely held environmental and social concerns by the community at large.

1.3 Project objectives

The primary objective of this project is to mitigate the harmful impacts of CWP downstream of Pindari Dam along 200 km of the Severn and Macintyre rivers via established bubble plume technology. The successful demonstration of bubble plume technology in the Murray-Darling Basin to mitigate CWP will strengthen the case to deploy the technology as an effective mitigation option at the remaining high priority dams Basin-wide. A secondary objective of this project is to

employ a green energy solution to offset the high energy demand of the bubble plume system to ensure that ongoing operations are both cost and carbon neutral

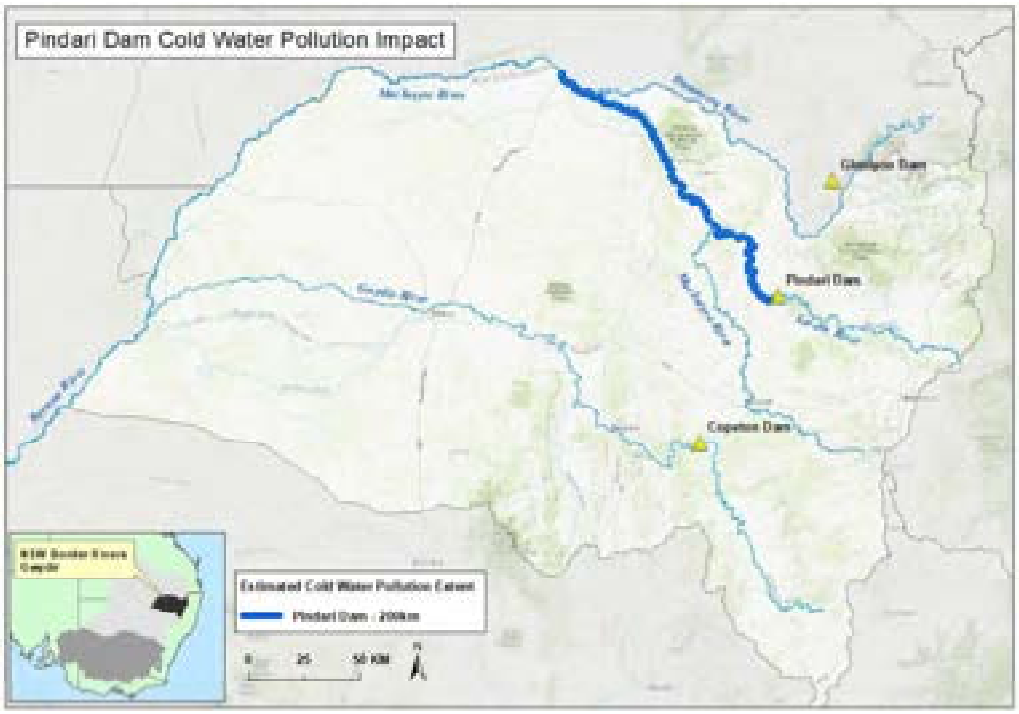


FIGURE 1: Remediation of CWP at Pindari Dam will improve water quality and habitat condition for up to 200 km of the Severn and MacIntyre Rivers

1.4 Project location

The project is located at the Pindari Dam site. All works will be undertaken on WaterNSW operational land. Pindari is located approx. 1 hr north of Inverell and 25 min East of Ashford.



1.5 Project scope

The Pindari Dam bubble plume system includes several on-land and under-water components. See figure below for the overall layout of the proposed aeration system. On land, two large air compressors operated together in parallel will generate compressed air that will be delivered via an air supply pipeline to a diffuser located near the bottom of the dam. The diffuser pipe is 500m long and has 110 No. 5mm diameter ports that will release air into the water column. The rising bubble plume mixes the water, providing consistent warmer temperatures throughout the dam that mitigates cold water pollution discharges.

Bubble plume instrumentation is located at the base of the dam and consists of two compressors, a Low Voltage electrical kiosk, and above ground stainless steel pipework. New concrete foundations and awning structures are to be constructed for the compressor and electrical switchboards. A pad mounted 1MVA transformer will be located adjacent to the compressor slab to provide grid energy connection.



1.6 Timing

The key activities and timeline to meet the project scope are summarised in the table below.

Activity	Target by when
Project initiation (Inception meeting and detailed delivery program)	September 23
Contract Award to EDP - Design Services	September 23
50% Detailed Design	March 24
Final Detailed Design	December 24
Environmental Approval (REF)	December 24
Procurement of long lead items (Compressors)	October 24 - September 25
Tendering for Construction	December 24
Contract Award	March 25
Site Mobilisation	April 25
Construction	April 25 - December 25
Commissioning	December 25
Practical Completion	December 25
Bubble Plume System Trial	December 25 - March 26
'Before' Monitoring	February 23 - March 25
'After' Monitoring	December 25 - March 26

1.7 Project risk

Risks will be evaluated and addressed on a case-by-case basis. Where appropriate, matters will be escalated to the Project Control Group (PCG) if they cannot be addressed at the officer level. If necessary, the Director of Freshwater Environment will have opportunities to raise matters with Ministers through regular ministerial updates.

Description of risk	Risk rating	Mitigation strategies
Stakeholders do not understand the Project or how it will achieve positive outcomes for NSW	Moderate	• Stakeholder profiling informs key targeted messages • Communicate links to Project Information and associated website • Provide a feedback loop for stakeholders to ask questions and identify concerns (Contact Us email) • Develop a Project FAQ and provide answers and incorporate into the Project website.
Stakeholder criticism of the Project is used to undermine implementation	Moderate	• Identify negative influencers and engage with key groups to understand and, where possible, address concerns.

		• Leverage known supporters particularly within the Border Rivers community to advocate on behalf of the project to build trust. • Stakeholder profiling informs key messages for stakeholder group, e.g. 'what's in it for them?' • Clearly communicate the quadruple bottom line and positive flow on effects to regional communities • Champion WaterNSW's leadership role • Develop an inclusive 'We are all in this together' approach to communication and engagement material.
Expectations could be raised for priority dam sites that are not yet funded	Very high	• Ensure communication assist with managing funding expectations, while identifying outputs that might support future funding bids at other dam sites. • Clarity about the role of the CWP Strategy to address priority dams with a clear message on funding dependency
Project partners not engaged / collaborating and do not deliver on project requirements	Low	• Service Agreements with project partners clearly outline expectations, outputs, and outcomes to be delivered. • Maintain and build upon existing strong working relationships. • Provide partners with information on how their objectives fit with overall project delivery. • Staff to support partners in delivering their project components. • Provide partners with regular updates on overall project achievements (e.g. add to stakeholder database to receive newsletters and announcements) • Assist in communicating the achievements of partners to stakeholders and the general community
Stakeholder and partner fatigue as a result of too much engagement/ communications on Natural Resource Management projects.	Moderate	• Strategic review of all engagement/communications to optimise engagement opportunities • Refresh key messages and streamline to make consistent across communication channels
Mass fish kills have taken place in NSW in other sections of the Basin, e.g. on the Lower Darling-Baaka at Menindee in 2018/19 and in March 2023. In circumstances like these, local community's trust in the Government's management of native fish populations dwindles.	Moderate	• Acknowledgement that mass fish kills can be extremely concerning, stressful and traumatic to local communities. • In the event of a future mass fish kill event, DPIRD Fisheries staff will contact community members to answer any questions raised – in particular First Nations communities.

1.8 Constraints

- During construction, a temporary exclusion zone will be implemented whereby no recreational activities will be permitted west of the buoy line (RED) and fixed wing firefighting aircraft may be restricted.
- After construction, a new exclusion zone (PURPLE) will be established, with recreational activities allowed to areas outside of the exclusion zone



2. Stakeholder analysis

2.1 Stakeholder mapping

STAKEHOLDER	PROJECT INTEREST
TIER 1: Key Project Implementation Partners:	
DCCEEW: Commonwealth Government	Project sponsor. Interested in program deliverables being on time and within budget. Overall success of the program being the destratification of Pindari Dam and improvements in the temperature and quality of water released to downstream receiving waterways.
DPIRD Fisheries: State Government	Project manager. Delivering project on time and within budget while achieving expected benefits.
WaterNSW: State Government Corporation	Project delivery manager. Asset owner & operator – Pindari Dam Implications for ongoing Operations and Maintenance (O&M) requirements and expenditure for installed infrastructure Implications for water quality management
Research Institutions: WRL University of Technology Sydney Griffith University	Participation in before-after assessment of Pindari Dam bubble plume system effectiveness in mitigating CWP and improving water quality.
RecFishing NSW and the NSW Recreational Trust	RecFishing NSW and the NSW Recreational Trust provided initial funding to develop cold water pollution mitigation options with the aim to secure funding to demonstrate viability. Acknowledgement of seed funding is required in the initial media release/website etc . . Ongoing briefings of the recreational fishing community is recommended during project implementation to maintain and grow their support.
TIER 2: Key Project Delivery Stakeholders	
State & Federal Ministers	Project endorsement and promotion. Delivering project on time and within budget while achieving expected benefits. Address stakeholder considerations and concerns as they arise.

STAKEHOLDER	PROJECT INTEREST
Essential Energy	Asset owner – power lines / grid Line capacity for power draw and renewable energy input
Infrastructure NSW: State Government	Gateway assurance review for project delivery risk.
NSW DCCEEW: State Government	Oversight of *Water Management Act 2000* and associated Works Approval for Pindari Dam including CWP mitigation. Oversite of *Biodiversity Conservation Act 2016* and *National Parks and Wildlife Act 1974*
Heritage NSW: State Government	Oversite of *Heritage Act 1977*
DPIRD Fisheries: State Government	Environmental approval review (REF) with respect to *Fisheries Management Act 1994* provisions. Animal Care & Ethics Committee (ACEC) approvals for native fish monitoring.
Crown Lands: State Government	Ensure appropriate consultation and necessary approvals are obtained to undertake works on Crown Land where relevant. Oversite of *Crown Lands Management Act 2016*.
Transport for NSW: State Government	Revision required to Maritime exclusion zone at Pindari Dam relative to diffuser location.
Inverell Shire Council: Local Government	Environmental approvals review (REF). Interest in regional tourism at Pindari Dam and downstream river reaches. Water quality implications for town water treatment and supply.
Kamilaroi / Gomeroi • Toomelah Local Aboriginal Land Council	

STAKEHOLDER	PROJECT INTEREST
	Have an interest in the recovery of the MacIntyre River. Opportunities for River Ranger learnings and participation Native Title claim is in development for the Gomeroi Nation that includes Pindari Dam, the Severn and MacIntyre Rivers, and further west.
Ngarabal / Kwiambal • Ngarabal and Kwiambal Aboriginal Corporation. • Glen Innes Local Aboriginal Land Council (potentially out of scope) • Ashford Local Aboriginal Land Council – closest LALC to Pindari	No active Native Title claims. Ngarabal and Kwiambal people's homelands is on the Severn River and its catchment particularly Frasers Creek, Marlow Hill and its surrounding area; Deepwater, Edgerton, Pindaroi, Mole River and Nucoorilma Aboriginal Mission stations; the Beardy Plains and the Border Rivers and catchment areas in New South Wales and Queensland. Have an interest in the recovery of the Severn River. Opportunities for River Ranger learnings and participation
TIER 3: Key Project Consultation Stakeholders	
Recreational Fishers	RecFishing NSW and the NSW Recreational Trust provided initial funding to develop cold water pollution mitigation options with the aim to secure funding to demonstrate viability. Acknowledgement of seed funding is required in the initial media release/website etc . . Ongoing briefings of the recreational fishing community is recommended during project implementation to maintain and grow their support.
NSW Task Force on Fish Passage CWP Interagency Working Group	NSW Ministerial direction to review and update current NSW CWP Strategy and assess new approaches to mitigate CWP given the limited benefits of past infrastructure intervention. Pindari Dam CWP Project represents the first demonstration of bubble plume technology at a large dam in the Murray Darling Basin.
Water Customers / Irrigators / Agricultural Corporations	Interest in bubble plume OPEX as water users are accountable for 100% of charges. Interest in ensuring that access to water entitlements is not constrained, and that delivered water is of suitable quality for desired use.
Riparian Landholders	Interest in the quality of riverine water for which they have stock and domestic access to, as well as for recreational use.
General Public	Interest in activities occurring at Pindari Dam, which is a significant regional asset for boating and recreation. Ensure that existing access and water quality is maintained and improved. Maintain and enhance downstream riverine recreation conditions with respect to swimming, boating, etc.
Recreational Fishing & Boating groups (e.g., Ozfish)	Interest in fish conservation and recovery. Investment into regional tourism economy.

STAKEHOLDER	PROJECT INTEREST
	Access and use of Pindari Dam for boating and fishing during bubble plume operation. Access to Severn and MacIntyre rivers downstream of Pindari Dam for boating, fishing, and recreational use.
NSW Rural Fire Service	Revised area that water bombers can access Pindari Dam to avoid impact on bubble plume diffuser and associated buoys.
CEWO: Commonwealth Government	Environmental flows are released from dams to achieve downstream ecological outcomes; however, these outcomes are inherently compromised if the released water is too cold.
MDBA: Commonwealth Government	Oversite of Murray-Darling Basin Plan and associated targets in Schedule 10 & 11 related to water temperature and CWP mitigation.

2.2 Stakeholder Engagement

Stakeholder	Information Required	Information Provider	Frequency of Communication	Method of Communication	Format	Contact Details
Tier 1: Key Project Implementation Partners						
Commonwealth: DCCEEW	Project progress, risk management, project deliverables	Project Team Project Delivery Team	Monthly	Face to Face, Teams, phone and email	Meeting Progress Reports Final Reports	
WaterNSW	Project management, Project finances, Governance	Project Team	Weekly	Face to Face, Teams, phone and email	Meeting Designs Progress Reports Final Reports	
Research Institutes: • UTS • WRL • Griffith Uni	MER Approvals, MER Schedule MER Deliverables	Project Team	Monthly	Face to Face, Teams, phone and email	Meeting Conferences Workshops Progress Reports Final Reports	
Tier 2: Key Project Delivery Stakeholders						

Stakeholder	Information Required	Information Provider	Frequency of Communication	Method of Communication	Format	Contact Details
NSW Government Agencies • DPIRD Fisheries • DCCEEW • Crown Lands • NRAR • Heritage NSW • Transport for NSW • Infrastructure NSW	Project Approval (REF). Consult on key project milestones	Project Team Project Delivery Team	Quarterly and as needed	Face to Face, Teams, phone and email	Designs REF Meeting Presentation Progress Reports Final Reports	
Local Government • Inverell Shire Council	Engage and inform to raise project awareness and understanding Project Approval (REF)	Project Delivery Team	As needed	Face to Face, Teams, phone and email	Designs REF Meeting Presentation Fact Sheets	
NSW & Commonwealth Ministers	Project approval, Project promotion, Project delivery status & budgets	Project Team	Quarterly and as needed	Ministerial Briefings	Briefings Media Releases	
Essential Energy	Energy usage & production	Project Delivery Team	As needed	Letters, Teams, phone and email	Meeting Designs Assessment Reports	
Traditional Owner Groups, Corporations and Aboriginal community members • Kamilaroi / Gomeroi • Toomelah LALC	Consult in specific design processes and activities REF Assessment	Project Delivery Team	In accordance with statutory requirements and as needed	Face to Face engagement, site visits, letters, phone and email	REF Meeting Briefings Fact Sheets	

Stakeholder	Information Required	Information Provider	Frequency of Communication	Method of Communication	Format	Contact Details
• Ngarabal and Kwiambal Aboriginal Corporation. • Glen Innes Local Aboriginal Land Council (potentially out of scope) • Ashford Local Aboriginal Land Council – closest LALC to Pindari						
Tier 3: Key Project Consultation Stakeholders						
NSW Steering and Advisory Groups • Ministerial Taskforce for Fish Passage • CWP Working Group • Pindari Stimulus Flow Reference Group • WaterNSW Customer Advisory Group – Border Rivers	Engage and inform to raise project awareness and understanding	Project Team Project Delivery Team	Quarterly	Face to Face, Teams, and email	Meeting Presentation Briefings	
Commonwealth Stakeholders: • CEWO • MDBA • MDBA Northern Community Forum	Engage and inform to raise project awareness and understanding	Project Team Project Delivery Team	Quarterly	Face to Face, Teams, phone and email	Meeting Presentation Briefings	

Stakeholder	Information Required	Information Provider	Frequency of Communication	Method of Communication	Format	Contact Details
Water Customers / Irrigators / Agricultural Corporations • Border Rivers Food and Fibre • Pindari Water Users Association • Barwon-Darling Water • Cotton Australia • National Irrigators Council • NSW Irrigators Council • NSW Farmers Federation	Engage and inform to raise project awareness and understanding	Project Team Project Delivery Team	As needed	Face to Face, phone and email	Meeting Presentation Fact Sheets	
Riparian Landholders	Engage and inform to raise project awareness and understanding	Project Team Project Delivery Team	As needed	Face to face engagement	Meeting Fact sheets	
General Public	Engage and inform to raise project awareness and understanding	Project Team Project Delivery Team	As needed	Face to face engagement	Meeting Fact sheets Media Releases	
Recreational Fishing & Boating • RFNSW • OzFish	Engage and inform to raise project awareness and understanding	Project Team Project Delivery Team	As needed	Face to face engagement	Meeting Presentations Fact sheets Media Releases	
Local media	Engage and inform to raise project awareness and understanding	Project Team Project Delivery Team	As needed	Face to Face, phone and email	Media Releases	

2.3 Communication Schedule

Timing	Action/activity	Target audience	Channel	Notes	Measure of success
End of Oct	CESP draft and approval	Internal WaterNSW + partners	CESP		Approval
End of Nov	Drafting of comms collateral including: - Website - Factsheet - FAQ - Media release - Social media - Site signage	All			
TBC	Media announcement	All	TBC	Awaiting funding - Will be coordinated with Fisheries etc	
December	Establish site signage	All		- Education and information about the project.	
One month prior to construction	Stakeholder briefing	Council Govt depts (as per CESP) Fisheries LALC	Virtual/F2F	Tier 1+2 Stakeholders	Attendance

Two weeks prior to start of construction	Notification of commencement of works	All Stakeholders	Email Letter Newspaper Signage	All	
Site mobilisation	Induct all work crews, sub-contractors and project team members into the community relations aspect of the project		Onsite		
Commencement	Start of work media release Smoking ceremony Cultural Heritage induction	LALC Contractors Govt depts Ripian landowners	Onsite		
Ongoing	Work ongoing- project updates, community news stories, video		Website Video Project updates Media etc		
Ongoing	School tours to provide education outcomes	Local schools	Onsite		Increase in hits on newspaper sites and on WaterNSW social platforms
Completion	Commissioning ceremony	All	Onsite		
Completion	Community and school tours to showcase benefits and outcomes of the project/trial	All interested community/stakeholders etc	Onsite		

2.4 First Nations

All First Nations groups have an intimate spiritual and cultural connection to, and custodial duties for, water. Natural patterns of river flow have an important role in generating life-history events on Country (e.g fish spawning, plants flowering) which are critical markers for First Nations calendars. These life history events provoke cultural queues such as social gathering, hunting and fishing, and cultural initiation or education. Changes to river flow and water quality negatively impact First Nations people's capacity to practise culture. When the Country is in decline, the people's cultural and spiritual health and economic wellbeing also decline.

CWP is an example of colonial-settler water management activities that have negative cultural impacts on totemic species including Golden Perch or Murray Cod. The protection and enhancement of water quality through CWP mitigation for colonial-settler water management practises aligns with the cultural values of First Nations groups and can support their ability to uphold their totemic duties.

DPIRD recognises the invaluable wisdom and traditional ecological knowledge possessed by indigenous communities, with indigenous engagement activities representing an integral component of this project's success and sustainability. We are committed to fostering meaningful partnerships and collaboration with the Kamilaroi / Gomeroi and Ngarabal communities whose land will be worked on throughout this program. Through meaningful dialogue and collaboration, the aim is to not only share experiences and insights but also learn from the deep understanding indigenous peoples have of waterways and the animals that inhabit them.

DPIRD are committed to exploring opportunities for on-country meetings and collaboration whenever feasible. By prioritising indigenous engagement, the aim is to build trust, promote cultural sensitivity, and create shared values for all stakeholders involved.

Aboriginal nations and communities in the Border Rivers region include the Kamilaroi/Gomeroi, Kambuwal, Githabul, Bigambul, Kwiambul and Ngarabal groups.

Engagement activities for First Nations communities include, but are not limited to, the following:

- Education Sessions: Presentation of Fish Community Condition Assessments for each nation group including an overview of the impact of CWP and the potential for mitigation and associated responses for water management and water quality.
- MER Program: Consult with First Nations groups to develop criteria to assess health of Totemic Species.
- Program Updates: Information sessions post-CWP implementation to detail changes in water quality and fish communities within respective regions and river reaches.

3. Communication and engagement activity

3.1 Communication objectives

Objectives	Outcomes
Build an understanding of CWP impacts and mitigation approaches across government agencies and the general public.	Target audience better understands how CWP occurs, what its impacts are, how it can be mitigated, and the potential ecological, social, cultural, and economic benefits.
Target audiences understand the projects objectives and are informed about delivery activities in a timely manner.	Build trust and goodwill with target audience who can champion project implementation in the regional community. Agency personnel and executives are effectively engaged to ensure support for CWP mitigation.
Effectively communicate how CWP mitigation will enable social, economic, and environmental benefits within NSW.	Target audiences understand how CWP mitigation benefits their interests and wellbeing, reduces key threats, and achieves a net benefit for regional communities.
Share key achievements and lessons learnt.	The target audience has a clear understanding of the Pindari CWP Mitigation Project and how it will be implemented, and how success at Pindari can assist CWP at remaining high priority dams throughout the Basin. Lessons learned are openly shared and discussed.
Effectively promote CWP research and monitoring results.	Through provision of clear, concise evidence the target audience understands the impact of CWP on native fish and how bubble plume destratification can help to restore regional fish populations while improving water quality and social amenity conditions.
Provide an effective platform for which stakeholder considerations and concerns can be raised and addressed.	Stakeholders are actively consulted, considerations and concerns documented, and follow-up engagement occurs in a timely manner to address issues raised.
Build stakeholder trust in DPIRD Fisheries and WaterNSW to mitigate CWP.	CWP is mitigated at Pindari Dam, with the project delivered on time and within budget.

3.2 Communication approach

The engagement approach will be guided by the principles and objectives outlined above, and developed to support the objectives and deliverables of the project, nurture key relationships, while fostering a reputation of openness, transparency and good environmental stewardship.

IAP2 Framework

Engagement with all stakeholder groups will be guided by the IAP2 framework. The Core Values and Code of Ethics of the International Association for Public Participation (IAP2), shown in Figure 1, informs the engagement approach designed to meet the Project objectives and deliver best practice engagement. The model outlines the goal of public participation for each level of engagement, the promise made to the stakeholders and community, and the various tools and techniques available to implement that level of engagement or participation.



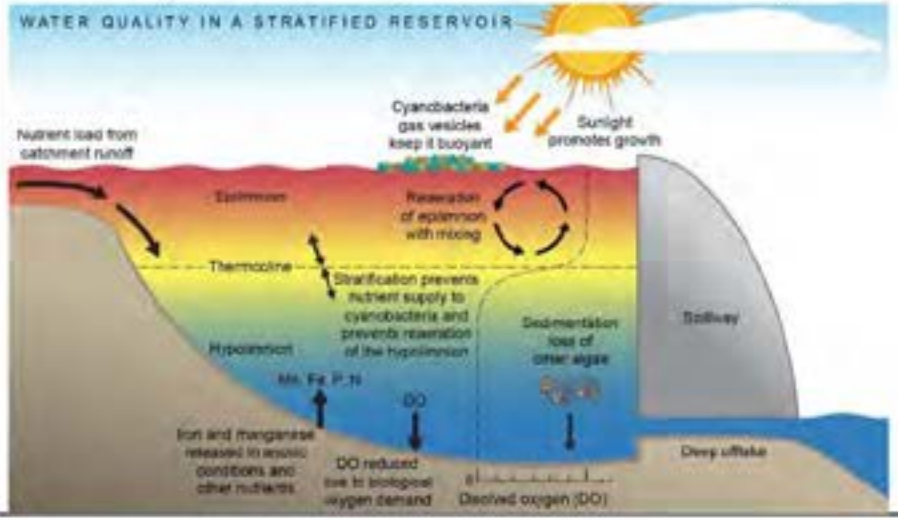
3.3 Communication tools

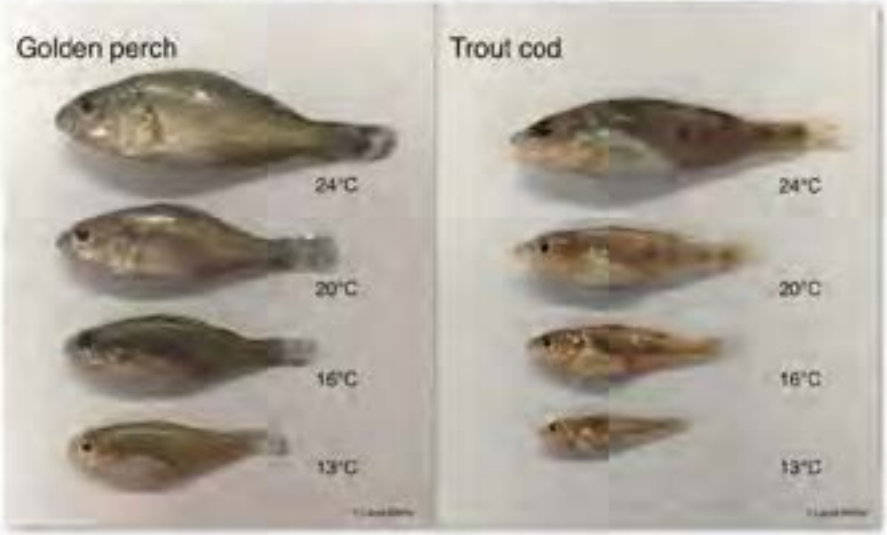
Tool	Purpose
Emails (targeted)	Respond to queries
	Provide project updates
	Invite to targeted meetings / briefings
	Invite feedback
Email (bulk)	Provide project updates
	Invite feedback, contact
Phone call	Respond to queries
	Provide project updates
	Invite to targeted meetings / briefings
Targeted meeting / briefing	Build & nurture relationships
	Address specific stakeholder issues
	Provide project updates
Meeting agenda	Outline objectives of meeting
Meeting minutes	Capture outcomes from meeting
Online or print survey	Gather feedback, concerns, insights and recommendations at relevant stage of project develop
Social pinpoint	
Print and digital ads	

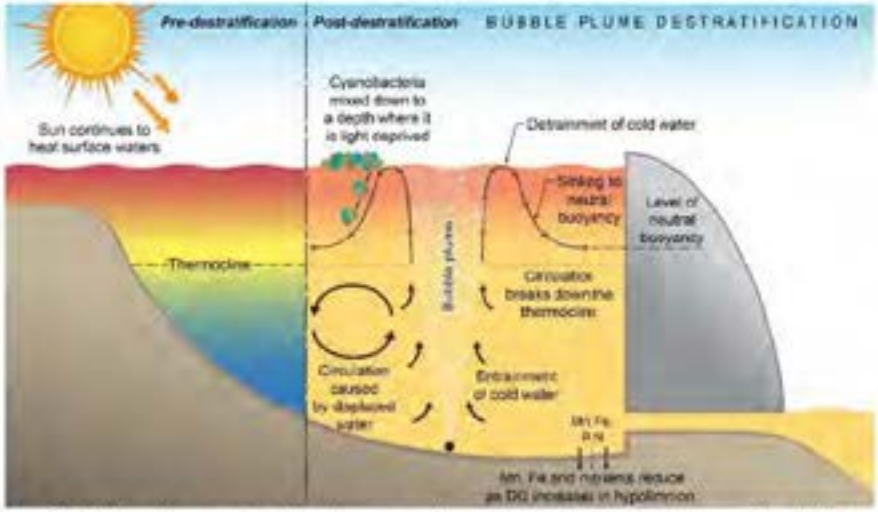
Social media	Provide project updates
	Invite feedback, contact
Media release	Provide project updates
	Invite feedback, contact
	Highlight achievements
Interagency Consultative Committee (Planning phase)	Collectively consult and assess options and refine a preferred risk management solution
FAQ	Address commonly asked questions
Holding statements	Gather approval messaging for contentious or emerging issues
Consultation Manager	Record all stakeholder interactions, identify issues and trends
Video	Highlight project objectives, benefits and milestones in interactive way
Diagram / graphic design	Highlight project objectives, benefits and milestones in interactive way
	Show potential project options; schematic design
In situ signage	
Community updates	
Corporate communication news articles	Provide project updates
	Highlight impacts
	Promote objectives
	Invite feedback, contact
	Provide project updates

	Highlight impacts
	Promote objectives
	Invite feedback, contact
Intranet articles	Highlight project objectives, benefits and milestones

3.4 Key messages

QUESTION	KEY MESSAGES
What is CWP?	• CWP is what happens when the bottom cold layer of water from large, stratified dams is released downstream resulting in an artificial drop in river temperatures during the warmer summer months. 

What are the impacts of CWP?	• CWP largely impacts aquatic animals by increasing mortality, reducing breeding opportunities and suppressing growth. This has long term effects on NSW rivers as it reduces the resilience of freshwater ecosystems. • For native fish, CWP detrimentally impacts all life-cycle stages and is a key contributor to the loss of over half of expected fish species below the major dams in the Murray-Darling Basin. • CWP discharges of **15°C result in 50% mortality of native fish recruits**. This mortality rate increases to near 100% at 13°C. Water temperature at the bottom of large dams remains < 15°C year-round due to reservoir stratification. 
What is the extent of CWP in NSW?	• Eight (8) high priority dams have been identified in NSW that discharge CWP and negatively impact over 2,000 km of mainstem waterways in the Murray Darling Basin. • Pindari is one of the eight high priority CWP dams.
What is the extent of CWP below Pindari Dam?	• CWP impacts can extend as far as 200 km downstream of Pindari Dam to Goondiwindi depending on the season and discharge volume from the dam; however, the main impacts are often observed within the first 70 km of the Severn River below the dam.

What are the impacts of reservoir stratification?	• Reservoir stratification is the key cause of CWP discharge from large dams. • Reservoir stratification can result in poor water quality within the reservoir and downstream with respect to dissolved oxygen, soluble metals (iron and manganese), nutrients (nitrogen and phosphorus), and cyanobacteria blooms.
How is CWP being mitigated at Pindari Dam?	• WaterNSW will install a bubble plume system at Pindari Dam to destratify the reservoir and mitigate CWP.  • Bubble plume technology employs large compressors to deliver air to diffusers located near the reservoir bottom. The resultant bubble plume creates circulation 'gyres' that destratify the reservoir, resulting in consistent warmer temperatures throughout the water column. • Modelling assessments estimate that the Pindari bubble plume should increase bottom water temperatures in the dam by more than 10°C in summer, thereby mitigating CWP downstream.
How will the bubble plume be powered?	• Bubble plume technology is costly to operate and has high carbon emissions. • A combination of an onsite and offsite solar array will be used to offset bubble plume operating costs and associated carbon emissions.

What are the key objectives of the Pindari Dam CWP Mitigation Project?	• The primary objective of this project is to mitigate the harmful impacts of CWP downstream of Pindari Dam along 200 km of the Severn and MacIntyre Rivers via established bubble plume technology. • A secondary objective of this project is to demonstrate the efficacy of bubble plumes to destratify a large dam (Pindari) and mitigate CWP to strengthen the case to deploy this technology as an effective option at the remaining high priority dams in the Murray-Darling Basin. • A tertiary objective of this project is to employ a green energy solution to offset the high energy demand of the bubble plume system to ensure that ongoing operations are cost and carbon neutral.
What are the key project benefits?	• CWP is mitigated below Pindari Dam. • Improved native fish abundance, diversity, distribution, growth, reproductive health, and recruitment downstream of Pindari Dam including for Golden Perch and Murray Cod. • Improved water quality resulting from reservoir destratification – higher dissolved oxygen, reduced soluble metals, reduced nutrient levels, and reduced cyanobacteria counts. • Reduced risk of cyanobacteria blooms within Pindari reservoir and downstream. • Improved recreational opportunities (swimming, boating, fishing) within and downstream of Pindari Dam. • Enhanced ecological outcomes from the management of dam releases, including environment flows, as required under NSW's water sharing plans and the Murray-Darling Basin Plan. • The project achieves net zero carbon emissions.
What outcomes have been achieved to date?	• Commonwealth funding has been secured to install a bubble plume destratification system and green energy solution at Pindari Dam by December 2026. • Bubble plume designs will be finalised in 2024.
What are the project delivery timeframes?	• The bubble plume system is expected to be operational by spring 2025, while the green energy solution is due for installation the following year.

What monitoring is occurring to quantify project outcomes?	• DPIRD Fisheries and UTS have conducted two years of 'before' monitoring within and downstream of Pindari Dam. A further two years of 'after' monitoring is proposed following bubble plume installation to measure project outcomes.
Additional Key Messages	• Bubble plumes are a proven technology to mitigate CWP at smaller reservoirs (e.g. Tallowa Dam). • The Pindari Dam CWP Project will be good for native fish while having no impact on the delivery of existing water entitlements. • The project will support native fish populations, improve recreational fishing, and help maximise the outcomes of environmental water. • The project is being delivered by DPIRD Fisheries and WaterNSW and is funded by the Australian Government Department of Climate Change, Energy, the Environment, and Water. • For more information: o Email: enagagement@waternsw.com.au

3.5 Policies and Protocols

3.5.1 Approvals

Please note: As per the Services Agreement between NSW Fisheries and WaterNSW, in all circumstances there will be mutual cooperation for communications / media amongst WaterNSW, Fisheries, and the Commonwealth, noting that WNSW is the lead.

Additionally, WaterNSW will also adhere to Clause 21 of the FFA which requires the Commonwealth and NSW to work together for announcements, events and publicity and that the roles of all parties will be acknowledge and recognised appropriately. Appropriate Commonwealth and State and Territory Government representatives will be invited to participate in opening ceremonies, product launches or similar events.

Activity		Responsibility	WaterNSW approver	Notes
Community and Stakeholder Engagement Plan		WaterNSW/Fisheries to develop WaterNSW to update and implement	C&E Manager	DPIRD to approve and support
Ministerial Briefings		WaterNSW government relations team	Manager Government Relations	DPIRD Media Team to be given heads up
Communications collateral		WaterNSW to develop and approve Fisheries FYI	C&E Manager	DPIRD Team to be given heads up
Targeted meetings		WaterNSW to chair	WNSW CSE	DPIRD to be invited
Community and stakeholder enquiries		WaterNSW to draft response, WaterNSW to issue	C&E Manager PM	WaterNSW to respond. Provide monthly update to DPIRD. If required, WaterNSW will contact DPIRD for response.
Stakeholder management platform		WaterNSW to input, report, and maintain stakeholder listing	WNSW CSE PM	
Media Releases and Liaison		WaterNSW media team to draft and approve	WaterNSW	DPIRD to work with WaterNSW Media Team to proactively pitch media stories and respond to any media enquiries.
WaterNSW website and social media content		WaterNSW to draft WaterNSW to notify Fisheries WaterNSW digital team to post	C&E Manager	WaterNSW to draft agreed and approved key messages.

Advertising		WaterNSW to draft and book	C&E Manager	

5.5.2 Media protocols

Social media protocols

WaterNSW is active on three social media platforms (Twitter, Facebook, LinkedIn) and we also post videos on YouTube.

All WaterNSW and project related content needs to be announced via WaterNSW's official website and social media pages. However, we do encourage employees and contractors to share WaterNSW's social media posts.

All social media posts and responses relating to WaterNSW or one of our projects must be reviewed and approved by WaterNSW's Communications and Community Engagement team before publication/sharing.

All social media posts and responses relating to the project or WaterNSW must be in accordance with WaterNSW's Code of Conduct and Social Media Policy.

Media protocols

All media enquiries must be approved by WaterNSW's Manager Media.

- All project media releases must be offered to Minister for Water, Property and Housing for distribution.
- Matters identified as 'Commercial-in-Confidence' will be respected by all parties.
- All Ministers Office correspondence will be through the WaterNSW Government Liaison Adviser with standard approval processes through to the CEO.

5.5.3 Enquiries and complaints management

Feedback, enquiries and complaints can be submitted by:

1. Phone – 1300 662 077
2. Email: engagement@waternsw.com.au
4. Mail – Customer Helpdesk, WaterNSW, PO Box 1081, DUBBO NSW 2830.

- All enquiries and complaints are to be addressed immediately where possible.

- If an enquiry requires further information or a complaint cannot be resolved immediately, an interim response must be provided to the complainant within:
    1. two business days for a verbal interaction
    2. five business days for any correspondence received in writing or email.
- From the initial contact, details of the enquiry and complaint are to be forwarded immediately to WaterNSW Project Manager and Community Engagement Officer.
- Complaints are to be resolved using WaterNSW's existing complaints management policy and procedure which is detailed on WaterNSW's website http://www.waternsw.com.au/customer-service/feedback/feedback-and-complaints-handling-policy
- WaterNSW CSE will manage stakeholder complaints within the specified timeframes outlined above and will be polite and courteous at all times.
- WaterNSW CSE will classify complaints into two main categories: avoidable and unavoidable, however when dealing with the stakeholder both should be treated equally.
- WaterNSW CSE to add relevant complaints, compliments and enquiries to consultation manager within 24 hours of interaction.