DUNGOWAN DAM AND PIPELINE PROJECT

Environmental Impact Statement

October 2022

NSW GOVERNMENT

EMM creating opportunities

Acknowledgement of Country

The Department of Planning and Environment acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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Dungowan Dam and pipeline project

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More information

Visit https://water.dpie.nsw.gov.au/water-infrastructure-nsw/dam-projects/dungowan-dam for more information

Acknowledgements

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Glossary and abbreviations

Term	Description
ACHA	Aboriginal Cultural Heritage Assessment
ACHMP	Aboriginal Cultural Heritage Management Plan
ACM	Asbestos Containing Material
AHD	Australian Height Datum
AHIP	Aboriginal Heritage Impact Permit
AIP	*NSW Aquifer Interference Policy*
Amendment	A change in what the proponent is seeking approval for during the assessment. It requires changes to the project description in the EIS or modification report and amendments to the associated infrastructure application or modification request. Applications can only be amended with the agreement of the Planning Secretary.
Amendment report	A report prepared by the proponent to support amendments to an infrastructure application or modification request (see the *State Significant Infrastructure Guidelines – Preparing an Amendment Report*).
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG DV	Australian and New Zealand *Guidelines for Fresh and Marine Water Quality Default Guideline Values*
Approval authority	The approval authority for a CSSI application or CSSI modification request. This will be the Minister for Planning and Homes.
APZ	Asset Protection Zone
AQGHGA	Air Quality and Greenhouse Gas Assessment
AQMP	Air Quality Management Plan
ARMCANZ	Australian and New Zealand *Guidelines for Fresh and Marine Water Quality 2000*
AS	Australian Standard
ASC	Australian Soil Classification
ASS	Acid Sulphate Soils
AST	Above Ground Storage Tank
BAM	Biodiversity Assessment Method
BAU	Business As Usual
BC Act	NSW *Biodiversity Conservation Act 2016*
BCF	Biodiversity Conservation Fund
BDAR	Biodiversity Development Assessment Report

Term	Description
BFMP	Bushfire Management Plan
BoM	Bureau of Meteorology
BOS	Biodiversity Offsets Scheme
CBP	Concrete Batching Plant
CCAP	Climate Change Adaptation Plan
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CEWH	Commonwealth Environmental Water Holder
CFMP	Cultural Flow Management Plan
CLMP	Contaminated Land Management Plan
CoPC	Contaminants of Potential Concern
Critical State Significant Infrastructure (CSSI)	Infrastructure that is declared to be Critical State Significant Infrastructure under Section 5.13 of the EP&A Act.
CSSI	Critical State Significant Infrastructure
Cumulative impacts	The combined impacts of the project on a matter with other relevant future projects (see the Department's *Cumulative Impact Assessment Guidelines for State Significant Projects*).
CWP	Cold Water Pollution
DCA	Dungowan Creek Alluvium
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DDB	Dungowan Dam (possible) Burial
DDBAS	Dungowan Dam Low Density Background Artefact Scatter
DDCS	Dungowan Dam Cultural Site
DDFA	Dungowan Dam Past Foci and Activity
DDGG	Dungowan Dam Grinding Groove
DDIF	Dungowan Dam Isolated Find
DDOS	Dungowan Dam Artefact Scatter
DDPC	Dungowan Dam Post-Contact Activities
DDSA	Dungowan Dam Stone Arrangement
DDST	Dungowan Dam Culturally Modified Trees
DE	Dermosols
DE/RU	Dermosols/Rudosols
Department	Department of Planning, Industry and Environment
Determination	A decision by an approval authority for a CSSI application to either approve the application subject to modifications or conditions or refuse the application.
DPE	NSW Department of Planning and Environment
DSEP	Dam Safety Emergency Plan

Term	Description
ECA	Environmental Contingency Allowance
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EMM	EMM Consulting Pty Limited
ENM	Excavated Natural Material
Environmental assessment reports	Reports required to be submitted to the Department by a proponent seeking approval for a CSSI application or modification request. These reports include scoping reports, EISs, submissions reports, amendment reports, preferred infrastructure reports and modification reports.
Environmental impact statement (EIS)	An environmental impact statement prepared by the proponent to support a CSSI application.
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2021*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPD	Environmental Production Declaration
EPI	Environmental Planning Instrument (including a SEPP or Local Environmental Plan) made under part 3 of the EP&A Act.
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
EWA	Environmental Water Allowance
EWR	Environmental Watering Requirements
FFMP	Flora and Fauna Management Plan
FM Act	*Fisheries Management Act 1994*
FSL	Full Supply Level
GDE	Groundwater Dependent Ecosystem
GHG	Greenhouse Gas
GIA	Groundwater Impact Assessment
GL	Gigalitres
GLVIA	*Guidelines for Landscape and Visual Impact Assessment* (3rd edition)
GWMP	Groundwater Management Plan
ha	Hectare
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HHMP	Historic Heritage Management Plan
HIA	Health Impact Assessment
HV	Heavy Vehicle
IBRA	Biogeographic Regionalisation of Australia

Term	Description
ICNG	*Interim Construction Noise Guideline*
IPART	Independent Pricing and Regulatory Tribunal
IPCC	Intergovernmental Panel on Climate Change
IS	Infrastructure Sustainability
LCU	Landscape Character Units
LEA	Local Effects Analysis
LGA	Local Government Area
LMP	Land Use Management Plan
LOS	Level Of Service
LSC	Land and Soil Capability
LSEA	Land Soil Erosion Assessment
LTAAEL	Long Term Average Annual Extraction Limit
LTWP	Long Term Water Plan
m	Metres
Matter	An element of the environment that may be affected by a CSSI project (e.g. air, amenity, biodiversity, economic, social).
MCA	Multi-Criteria Analysis
MDBA	Murray Darling Basin Authority
Minister	The NSW Minister for Planning and Homes
Mitigation	Actions or measures to reduce the impacts of the project.
ML/d	Megalitre Per Day
MLO	Multiple Level Offtake
MNES	Matters of National Environmental Significance
Modification	Changing the scope or terms of a CSSI approval, including revoking or varying a condition of approval. A modification requires approval under the EP&A Act.
Modification report	A report prepared by the proponent to support a modification request (see the *State Significant Infrastructure Guidelines – Preparing a Modification Report*).
Modification request	A request seeking to modify a CSSI approval under section 5.25 of the EP&A Act.
MOL	Minimum Operating Level
NCAs	Noise Catchment Areas
NMLs	Noise Management Levels
NOA	Naturally Occurring Asbestos
NPfI	*Noise Policy For Industry*
NSW	New South Wales
NVIA	Noise and Vibration Impact Assessment
NVMP	Noise and Vibration Management Plan

Term	Description
PAF	Potential Acid Forming
PAR	Population At Risk
PASS	Potential Acid Sulphate Soils
PCT	Plant Community Types
PESCPs	Progressive Erosion and Sediment Control Plans
PFAS	Polyfluoroalkyl Substances
PFR	Peel Fractured Rock
Planning Secretary	The Secretary of the Department.
Planning Systems SEPP	*State Environmental Planning Policy (planning Systems) 2021*
PLL	Potential Loss of Life
PM_{10}	Particulate Matter less than 10 Microns
$PM_{2.5}$	Particulate Matter less than 2.5 Microns
PMF	Probable Maximum Flood
POEO Act	*Protection of the Environment Operations 1997*
POEO Regulation	*Protection of the Environment Operations (Waste) Regulation* 2014
PRA	Peel River Alluvium
Preferred infrastructure report	A report prepared by a CSSI proponent at the request of the Planning Secretary that outlines any proposed changes to the SSI to minimise its environmental impact or to deal with any other issue raised during the assessment of the application concerned (see the *State Significant Infrastructure Guidelines – Preparing a Preferred Infrastructure Report*).
Project	Dungowan Dam and pipeline project
Proponent	The proponent seeking approval for a CSSI application or modification request.
Proposal	A proposed project that is not yet the subject of a lodged CSSI application.
PSI	Preliminary Site Investigation
RAP	Registered Aboriginal Party
RCP	Representative Concentration Pathways
Refinement	A change that fits within the limits set by the project description and does not change what the proponent is seeking approval for or require an amendment to the infrastructure application for the project.
Registered environmental assessment practitioner (REAP)	A person who is registered or certified under a professional scheme that is specified as a registered environmental assessment practitioner scheme in the Accredited Registered Environmental Assessment Practitioner (REAP) Schemes published on the NSW Planning Portal.
REZ	Renewable Energy Zone
RFS	NSW Rural Fire Service
RNP	*Road Noise Policy*
RSA	Road Safety Audit

Term	Description
RTA	NSW Roads and Traffic Authority (former)
RWS	Regional Water Strategy
SAII	Serious and Irreversible Impacts
Scoping	The process of identifying the matters that require further assessment in an EIS.
Scoping report	A report prepared by the proponent to inform the setting of SEARs for a CSSI project (see the *State Significant Infrastructure Guidelines – Preparing a Scoping Report*).
SEARs	Secretary's Environmental Assessment Requirements
SEPP	*State Environmental Planning Policy*
SES	NSW State Emergency Service
SIA	Social Impact Assessment
SMUs	Soil Mapping Units
SOHI	Statement Of Heritage Impact
SSI	State Significant Infrastructure
SSMP	Soil Stripping Management Plan
Submission	A written response from an individual or organisation, which is submitted to the Department during the public exhibition of an EIS, amendment report, preferred infrastructure report or modification report for CSSI.
Submissions report	A report prepared by the proponent to respond to the issues raised in submissions (*see the State Significant Infrastructure Guidelines – Preparing a Submissions Report*).
SWA	Surface Water Assessment
SWMP	Soil and Water Management Plan
Tamworth Regional LEP	*Tamworth Regional Local Environmental Plan 2010*
TBDC	Threatened Biodiversity Data Collection
TEC	Threatened Ecological Community
TfNSW	Transport For NSW
TIA	Traffic Impact Assessment
TMP	Traffic Management Plan
TSP	Total Suspended Particulate Matter
TUFLOW 2D	Dam Breach Hydraulic Model
TWS	Town Water Supply
VENM	Virgin Excavated Natural Material
VIA	Visual Impact Assessment
WAL	Water Access Licence
WM Act	NSW *Water Management Act 2000*
WMP	Waste Management Plan
WSP	Water Sharing Plans
WTP	Water Treatment Plant

Declaration

Project details	
Project name	Dungowan Dam and pipeline project
Application number	SSI-10046
Address of the land on which the infrastructure is to be carried out	Land within the Tamworth Local Government Area described within the Environmental Impact Statement
Proponent details	
Proponent name	Water Infrastructure NSW
Proponent address	Level 30, 4 Parramatta Square, Parramatta, 2020, NSW, Australia
Proponent ABN	20 770 707 468
Details of the person by whom this EIS was prepared	
Name	Christopher Holloway
Address	EMM Consulting, 20 Chandos Street, St Leonards, NSW, 2065
Professional qualifications	Bachelor of Science, University of Technology Sydney, 2002 Post Graduate Certificate in Water Resource Management, Charles Sturt University, 2013 Certified Environmental Practitioner No. 1258

Project details	
Declaration	The undersigned declares that this EIS: • has been prepared in accordance with the *Environmental Planning and Assessment Regulation 2021;* • contains all available information relevant to the environmental assessment of the development, activity or infrastructure to which the EIS relates; • does not contain information that is false or misleading; • addresses the Planning Secretary's environmental assessment requirements (SEARs) for the project; • identifies and addresses the relevant statutory requirements for the project, including any relevant matters for consideration in environmental planning instruments; • has been prepared having regard to the Department's *State Significant infrastructure Guidelines - Preparing an Environmental Impact Statement*; • contains a simple and easy to understand summary of the project as a whole, having regard to the economic, environmental and social impacts of the project and the principles of ecologically sustainable development; • contains a consolidated description of the project in a single chapter of the EIS; • contains an accurate summary of the findings of any community engagement; and • contains an accurate summary of the detailed technical assessment of the impacts of the project as a whole.
Signature	
Date	20 October 2022

CHAPTER 1

Introduction

1 Introduction

The Dungowan Dam and pipeline project (the project) is critical to improving long-term water security for the region. The project will provide improved drought resilience and water security for Tamworth, while maintaining average annual general security allocations for irrigation as the city grows.

The Peel River, part of the Namoi River catchment, provides water for irrigation as well as being the primary water supply for the city of Tamworth. Prompted by the millennium drought, investigations into the future water supply and demand for bulk water were undertaken for the regional city of Tamworth and the Peel Valley water users. The project has been identified as the preferred development option to provide additional storage to improve water security and resilience to climate change for the Tamworth region.

Image credit: Andrew Pearson Photography

Photograph 1-1 Peel valley, Tamworth region

The project includes a new dam at Dungowan (new Dungowan Dam) approximately 3.5 km downstream of the existing Dungowan Dam and a new section of pipeline about 32 km long between the new dam outlet and the tie in point to an existing pipeline from Dungowan Showground to the Calala Water Treatment Plant (WTP). The project would replace the existing Dungowan Dam and delivery pipeline currently owned and operated by Tamworth Regional Council.

The new Dungowan pipeline provides a network connection with the Chaffey Dam pipeline, which would operate during future drought conditions (subject to a separate approval). It would resolve existing serviceability and future capacity issues with the current Dungowan pipeline.

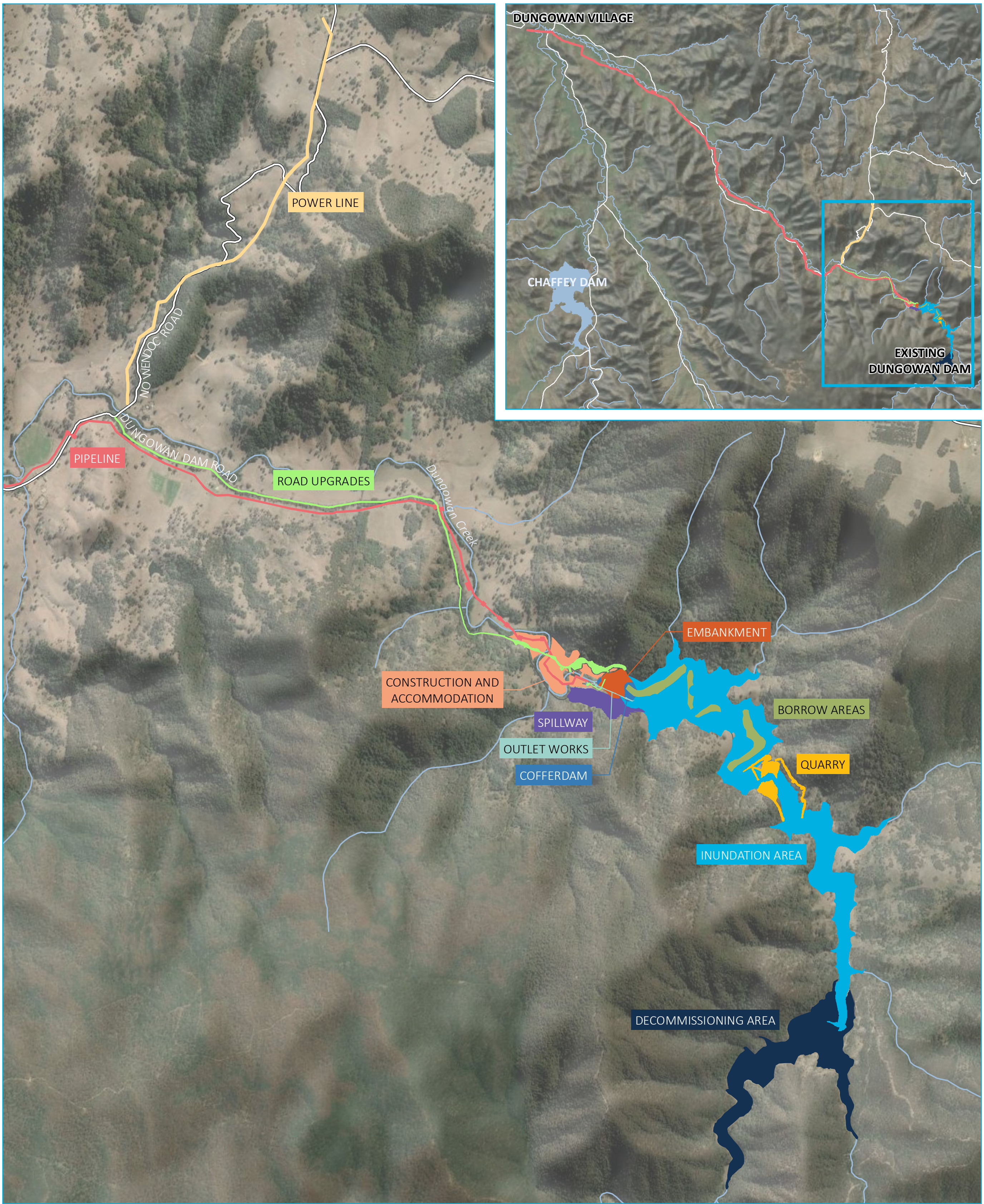
1.1 New Dungowan Dam and pipeline

An overview of the project is shown in Figure 1-1. The key elements of the project design include:

- A new dam about 3.5 km downstream of the existing Dungowan Dam, with an expected capacity of 22.5 gigalitres (GL). The new Dungowan Dam infrastructure would include an earth and rockfill embankment, spillway, outlet works as well as coffer dams and diversions.
- A new buried 32 km, 71 megalitre per day (ML/d) delivery (gravity) pipeline delivering water from the new Dungowan Dam to the connection point with the Chaffey Dam pipeline near Dungowan Showground. This would replace a 33 km section of the existing 22 ML/d delivery pipeline.
- Ancillary infrastructure involving temporary works to facilitate construction (such as construction and accommodation areas, quarry) as well as permanent works and services (such as powerlines) to facilitate operation of the new Dungowan Dam.
- Decommissioning of the existing ~6.3 GL Dungowan Dam.

The catchment area for the new dam is about 33% larger than that of the existing dam, and while the project does not increase the overall availability of water, it would affect the way in which water is stored, distributed and shared, subsequently increasing the security of supply to Tamworth and maintaining water reliability for users in the Peel Valley.

A description of the project is included in Chapter 4 of this EIS and a detailed project description is included as Appendix B1, with detailed maps and plans provided in Appendix B2.



Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

0 0.5 1 km
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KEY

- Inundation area
- Borrow areas
- Construction and accommodation camp
- Outlet works
- Cofferdams
- Embankment
- Quarries
- Spillway
- Road upgrade
- Decommissioning area
- Power line footprint
- Pipeline construction footprint

Existing environment

- Major road
- Minor road
- Named watercourse
- Named waterbody

Project overview

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 1.1

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1.2 Background

In response to one of the worst recorded droughts that occurred between 2017 and 2020, the New South Wales (NSW) Government's response was to fast track a portfolio of drought relief and water security projects. On 13 October 2019, the then Prime Minister and NSW Premier announced a jointly funded infrastructure package for rural and regional communities in NSW for the planning and delivery of three new or augmented dams in NSW. Included in this package was the Dungowan Dam and pipeline project.

The new Dungowan Dam was explored in the WaterNSW 20-year Infrastructure Options Study completed in 2018, with WaterNSW initially leading the project and progressing design development.

The new Dungowan Dam is also identified in the Namoi Regional Water Strategy (RWS) as a key opportunity to improve town water security, maintain suitable water quality and support growth and jobs in the region.

1.2.1 Project development

While a Dungowan Dam option was initially identified in 2015 and further explored in 2018 during an options study, a concept design was not progressed until 2020. During this period, several option and feasibility investigations were completed as well as definition of the project through the business case process (concluding in 2022) (see Chapter 2 for further detail on options considered and confirmation of the project).

The consideration of options and development of the project was informed by iterative environmental constraint assessment comprising both desktop and field survey, with the aim to reasonably avoid and minimise significant impacts to the environment and the local community. This resulted in changes to the pipeline and powerline alignments, as well as the location of ancillary facilities, and informed the sizing and operating rules of the new Dungowan Dam.

The detailed design for the project is currently underway and a contractor would be appointed by Water Infrastructure NSW for construction of the project. Once construction and commissioning has been completed, the ownership and operation of the new pipeline and new Dungowan Dam would be transferred to other entities. The current proposed ownership model is that Tamworth Regional Council would be responsible for the management, operation and general maintenance of the pipeline and WaterNSW would own and operate the new Dungowan Dam.

1.2.2 Approval process

In September 2022, the Minister for Planning and Homes (Minister) declared the project to be Critical State Significant Infrastructure (CSSI) as it is a development that is essential for the State for economic and social reasons. This requires Schedule 5 of the *State Environmental Planning Policy (Planning Systems) 2021* to be updated to reflect the CSSI status of the project.

As CSSI, the project is subject to Part 5, Division 5.2 of the EP&A Act, which requires the preparation of an environmental impact statement (EIS) in accordance with Secretary's Environmental Assessment Requirements (SEARs) (Appendix A) and the approval of the Minister. This EIS has been prepared for the planning approval application for the project.

In addition to requiring approval from the Minister, the project has been deemed a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and requires approval from the Commonwealth Minister for the Environment and Water. The Minister for the Environment and Water has accredited the NSW planning process for the assessment of the project. Therefore, a single EIS has been prepared to address the requirements set out by the NSW Department of Planning and Environment (DPE) and the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

The project would also require amendment of the relevant Water Sharing Plans (WSP) to allow the dam to operate, in accordance with the NSW *Water Management Act 2000* (WM Act).

1.3 Operations and infrastructure delivery

WaterNSW is responsible for dam operations and managing water stored in all its 42 water storages. Each valley has different water storage and supply issues. In the coming decades, the most important environmental change with significant implications for water infrastructure is a reduction in water availability. WaterNSW pursued the feasibility and initial design development of the project and it is proposed that WaterNSW will own and operate the new Dungowan Dam.

Tamworth Regional Council sources water from three existing sources: Chaffey Dam, Dungowan Dam and The Paradise Drift Wells (emergency only). Tamworth Regional Council owns and operates the existing Dungowan Dam and pipeline and are proposed to own and operate the new pipeline once replaced.

Water Infrastructure NSW, a division of DPE-Water, was established in November 2020 to provide enhanced strategic oversight and coordination of critical water infrastructure investment across NSW. From late 2020 Water Infrastructure NSW played a key role in the leadership and direction of the project and responsibility for the project formally transferred from WaterNSW to Water Infrastructure NSW on 1 September 2021.

The proponent for the project application is Water Infrastructure NSW.

1.4 Location and setting

1.4.1 Regional setting

1.4.1.1 Social and land use context

Dungowan Dam is in the Namoi River catchment about 50 km south east of Tamworth in NSW. The Namoi catchment covers 4,700 km2, borders the Gwydir and Castlereagh catchments and is bounded by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south, and the Nandewar Ranges and Mount Kaputar to the north.

The existing Dungowan Dam is on Dungowan Creek, a tributary of the Peel River, and has a catchment area of 126 km^2. The Peel River is a major regulated tributary of the Namoi River catchment and services dryland and irrigated agricultural production as well as Tamworth's town water supply. Dungowan Creek is partially regulated by the existing Dungowan Dam, while the Peel River system is partially regulated by Chaffey Dam, which is in the upper catchment near Woolomin, about 43 km from Tamworth.

The project is in the Tamworth Regional Council Local Government Area (LGA) and the New England Tablelands bioregion. The project is in the south of the New England region of NSW, which is west of the Great Dividing Range. The region is home to about 186,900 people and has a total area of around 99,100 km^2.

The New England and North West region is known for diverse landscapes and rich natural resources. Important industries for the regional economy include agriculture, agribusiness, livestock meat production, mineral resource development, renewable energy, health and education sectors. The regional economy has key strengths in primary production, intensive agriculture and food processing sectors that take advantage of the area's rich soils and climate. In 2016–17 the gross value of agricultural production in the region was worth $3.0 billion and represented 21% of the total gross value of agricultural production in NSW. The major agricultural commodities in the region include cattle, cotton and wool. The region also supports nature based and cultural heritage tourism.

Existing land uses reflect the economic drivers for the region. About 80% of the land in the New England and North West region is used for agriculture with the most common land uses being grazing (~32% by area) and cropping (~22% by area) (ABARES 2022). Services and infrastructure in the region are concentrated in the cities and urban centres. Tamworth functions as a major regional hub for the New England North West region.

Tamworth is the nearest (and largest) town to the project and the region is home to around 59,663 residents[1]. Other regional towns near the project footprint include Quirindi (70 km west), Manilla (60 km north-west), Gloucester (90 km south-east), Armidale (100 km north) and Gunnedah (80 km west). The regional setting of the project is shown in Figure 1-2.

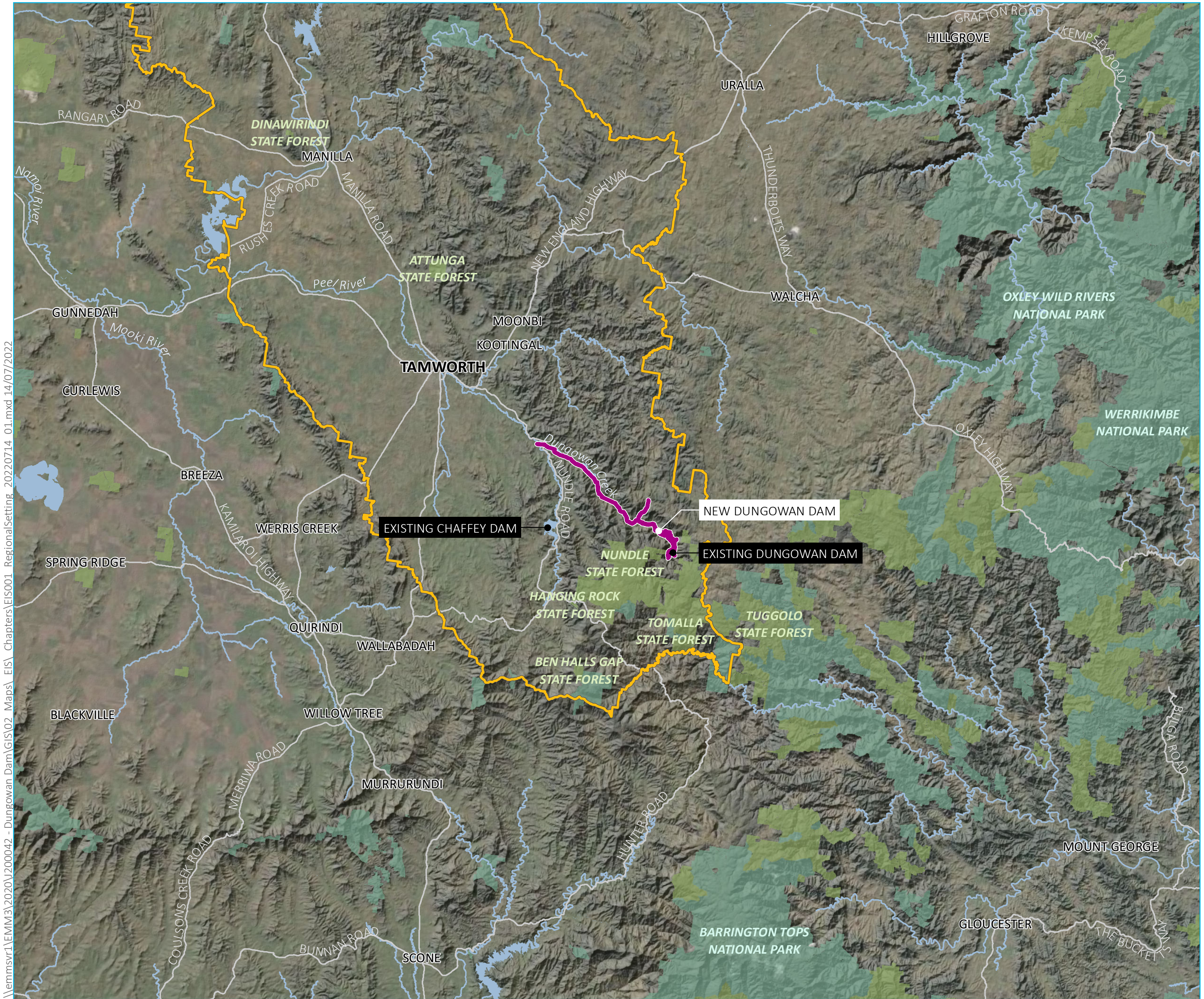
[1] Population of Tamworth Regional LGA (2016 Census of Population and Housing)

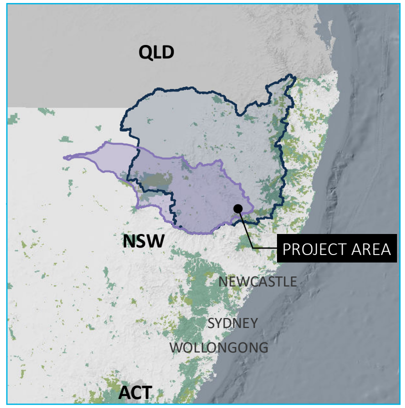
1.4.1.2 Tamworth water supply

The Peel River supplies water for irrigation, stock and domestic uses, and Tamworth's town water supply and industrial water needs. Chaffey Dam, which was completed in 1979 and augmented in 2016, has a total storage capacity of about 100 GL. The Chaffey Dam storage is a shared resource servicing both the water supply needs of Tamworth and agricultural production in the area.

Tamworth water supply is also sourced from the existing Dungowan Dam, which has a nominal maximum capacity of 6.3 GL. Dungowan Dam provides water to Tamworth via an existing pipeline that delivers raw water from Dungowan Dam to the Calala WTP for treatment before delivery to Tamworth via its reticulation network. Recently in 2019-2020, a new pipeline was constructed from the existing Chaffey Dam to a connection point with the existing Dungowan pipeline at Back Woolomin Road near Dungowan Showground (the Chaffey Dam pipeline).

The Chaffey Dam pipeline was constructed in response to the severe 2017‑2020 drought to improve town water security and prolong the water stored in Chaffey Dam by reducing transmission losses through increasing the transfer efficiency between Chaffey Dam and the Calala WTP in Tamworth. The pipeline was commissioned in June 2020 and short-term authorisation to operate the Chaffey Dam pipeline expired in September 2021. WaterNSW is currently seeking approval for the long- term operation of the Chaffey Dam pipeline to allow for future transfer of water during drought conditions when storage within Chaffey Dam falls below 20%





KEY

- Project footprint
- Major road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest
- Tamworth Regional local government area

INSET KEY

- Namoi River catchment
- New England North West region

Source: EMM (2022); WaterNSW (2021); DFSI (2017); GA (2013)

0 25 50 km

GDA 1994 MGA Zone 56

N

Regional setting

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 1.2

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1.4.2 Local setting

The project sits within the Peel Valley, which is a valley surrounded by low peaked hills with a north-westerly alignment, generally undulating to steep terrain, and more elevated towards the east. The local setting of the project is shown in Figure 1-3.

The project is located on Dungowan Creek. Ogunbil village is a small residential settlement of about 150 people and located about 5 km downstream (north west) from the new Dungowan Dam along Ogunbil Road. Land that would be impacted within the project footprint (including the pipeline and powerline routes) is zoned RU1 Primary Production under the *Tamworth Regional Local Environmental Plan 2010* (Tamworth Regional LEP).

The landholdings, including built structures, within the new Dungowan Dam and inundation area footprint are owned by Tamworth Regional Council, as is the existing Dungowan Dam and local access road. The nearest private residences are about 2 km north west of the new Dungowan Dam. The inundation area also contains some existing infrastructure (access road, telecommunications and electricity) that service the existing Dungowan Dam and nearby community.

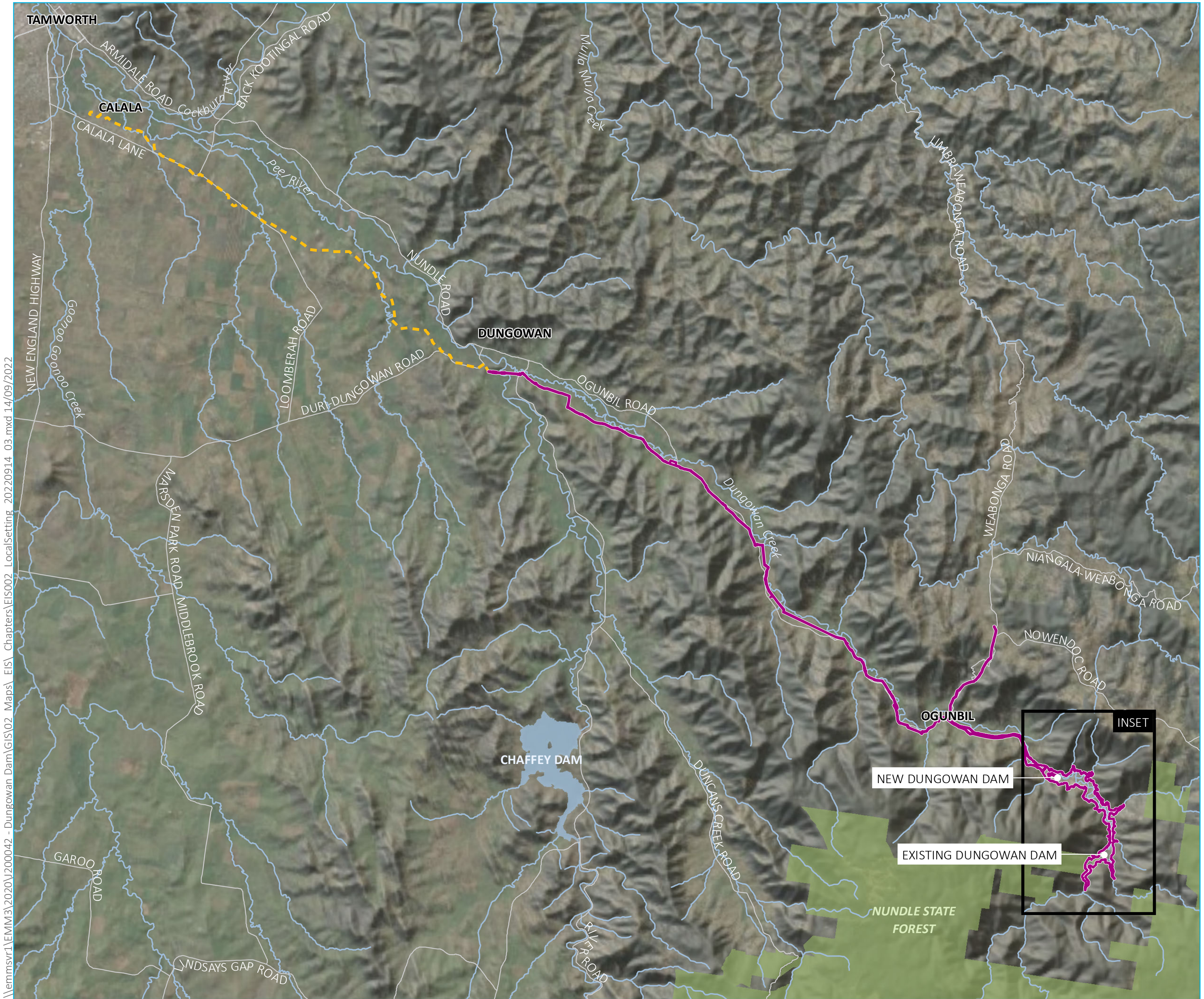
The landscape within the inundation area is defined by Dungowan Creek, which is confined in a narrow V-shaped valley between two prominent ridge lines. The valley floor is partially cleared with a vegetated riparian corridor along the creekline. The cleared areas are primarily associated with past pastoralism and grazing.

The new pipeline route is in the valley floor, primarily containing agricultural land. There are several, small residential areas and sensitive receivers (such as local schools) located along the route, including the villages of Ogunbil and Dungowan. The pipeline crosses Dungowan Creek eight times and the Peel River once.

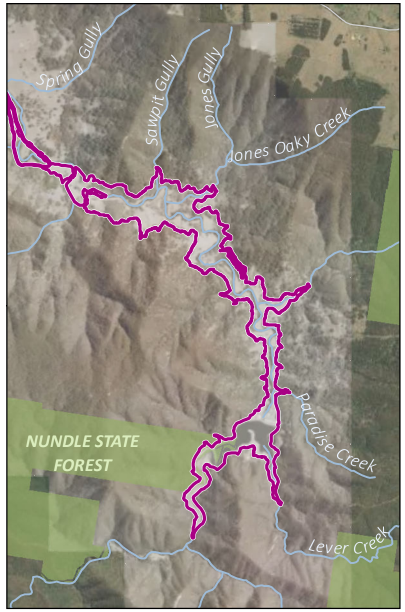
The area surrounding the powerline comprises private landholdings that stretch from the valley floor northwards up steep terrain to the escarpment above. Upon the escarpment is more densely vegetated forest with intermittent clearings associated with agricultural land and an existing transmission line easement.

Existing land uses in and around the project footprint area include:

- Existing Dungowan Dam and associated infrastructure.
- Residential areas of Ogunbil and Dungowan.
- Pastureland currently or previously used for livestock grazing.
- Rural landholdings and structures associated with past agricultural activities.
- Nundle State Forest to the south of the existing Dungowan Dam. Nundle State Forest borders Hanging Rock State Forest to the west and Terrible Billy State Forest to the east.



Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)



KEY

- Project footprint
- Dungowan Village to Calala WTP pipeline
- Major road
- Named watercourse
- Named waterbody
- State forest

Local setting

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 1.3

EMM
creating opportunities

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1.5 Related development

Any other infrastructure or development that is required for the project but subject to a separate approval process is considered related development. This also includes any development that may be needed as a result of the project. Related development to the Dungowan Dam and pipeline project is discussed in this section. Where required, cumulative impacts of the project with related development are addressed in the relevant technical assessments appended to this EIS and Chapter 21 (Cumulative impacts).

1.5.1 Chaffey Dam

Chaffey Dam is situated on the Peel River, 43 kilometres south-east of Tamworth in the New England region of NSW. Chaffey Dam was constructed between 1976 and 1979 and is owned and operated by WaterNSW. Chaffey Dam was recently upgraded to increase its capacity and currently holds approximately 100 GL of water that is used for town water supply to Tamworth and for irrigation purposes. This water is supplied via run of river transfers along the Peel River.

Chaffey Dam is currently the primary water source for Tamworth, however, operates in combination with the smaller existing Dungowan Dam. Once the new Dungowan Dam is completed, it would be prioritised over Chaffey Dam for supplying raw water to Tamworth. The proposed operational arrangements between Chaffey Dam and the project are detailed further in Chapter 4.

1.5.2 Water pipeline infrastructure

There are two existing or approved water supply pipelines relevant to the project that would connect with the new Dungowan pipeline to supply water to Tamworth. The related pipelines are shown on Figure 1-4 and described in the following sections.

1.5.2.1 Chaffey Dam pipeline

The Chaffey Dam pipeline enables water to be delivered from Chaffey Dam to Calala WTP, via a connection to the existing Dungowan pipeline. This pipeline was constructed to mitigate transmission losses along the Peel River associated with run of river transfers from Chaffey Dam to Calala WTP, and was only authorised to operate when Chaffey Dam water levels fall below 20%.

Conditional approval to operate the pipeline was granted under the *Water Supply (Critical Needs) Act 2019* and the pipeline commenced operations on 17 June 2020. The pipeline then ceased operation in July 2020 when Chaffey Dam water levels returned to greater than 20%. The conditional approval expired on 30 September 2021.

A separate planning approval under the EP&A Act is being progressed by WaterNSW for the long term operation of the Chaffey Dam pipeline as a drought asset (SSI-46313959).

1.5.2.2 Replacement pipeline from Dungowan Showground to Calala

The purpose of the replacement pipeline from Dungowan Showground to Calala is to improve the reliability of water supply from both Chaffey Dam and the future Dungowan Dam, reducing losses associated with pipe failure and minimising ongoing maintenance costs.

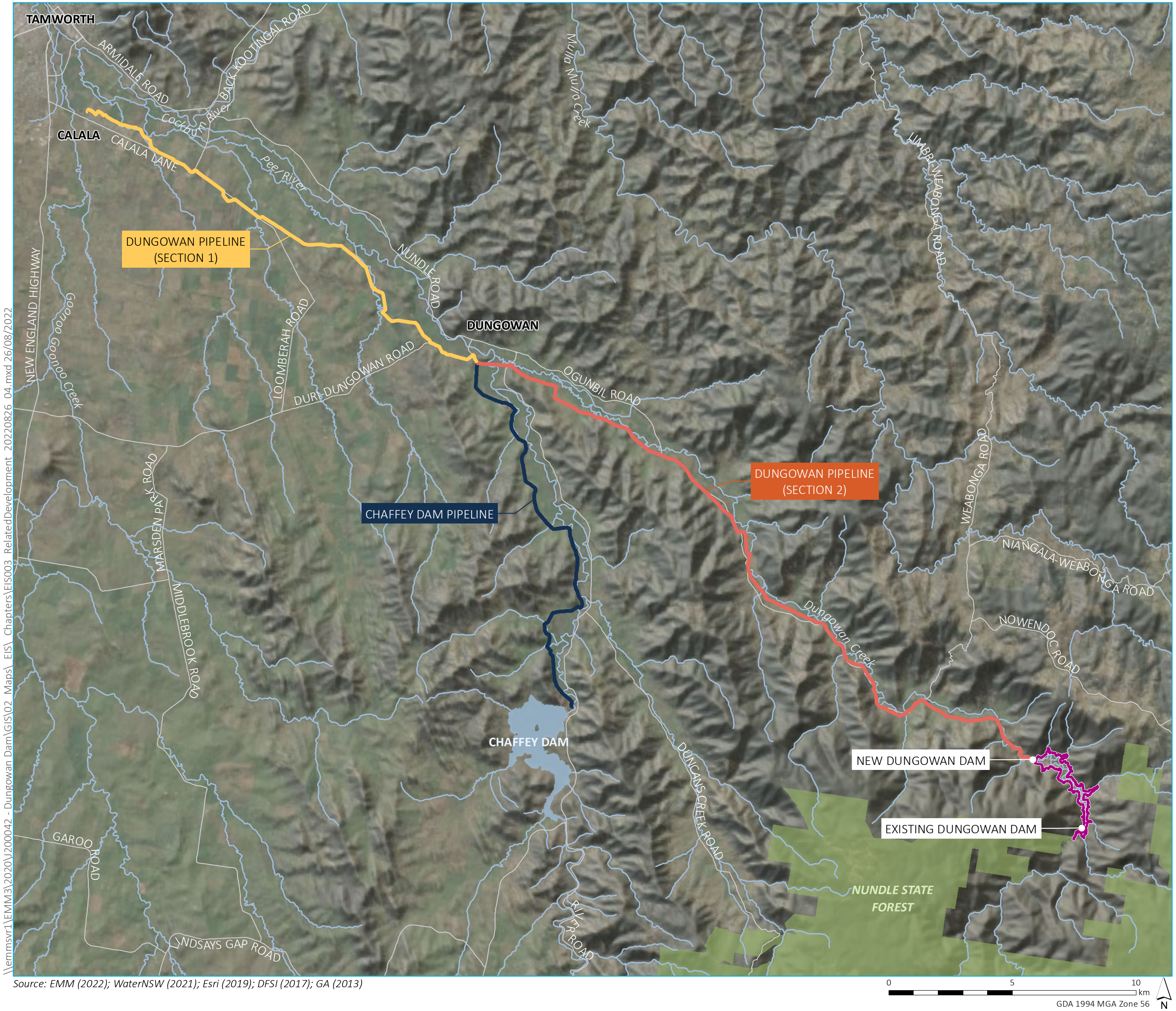
The NSW State Government is supportive of commencing infrastructure projects in rural regions as soon as possible and acknowledges its priority to secure water security for the Peel Valley region. The Dungowan pipeline works are therefore being delivered in two sections:

- Section 1 involves the replacement of the existing Dungowan pipeline from Dungowan Showground to Calala WTP. This pipeline section is about 21 km in length.
- Section 2 involves replacing the remaining 32 km section of the pipeline from near to the intersection of the Chaffey Dam pipeline to the new Dungowan Dam.

Section 1 (the replacement pipeline from Dungowan Showground to Calala) is being delivered separately to the Dungowan Dam and pipeline project and was assessed and determined by Water Infrastructure NSW under Division 5.1 of the EP&A Act. Construction of Section 1 commenced in February 2022 and the Review of Environmental Factors is available at:

https://pp.planningportal.nsw.gov.au/part-5/replacement-pipeline-between-dungowan-village-and-calala

Section 2 of the Dungowan pipeline is a key project element considered in this EIS and will be assessed subject to Division 5.2 of the EP&A Act. It is further described in Chapter 4.



Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

Related pipeline locations

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 1.4

EMM creating opportunities

1.5.3 Other major projects

No other existing or committed major projects are considered related projects/development to the Dungowan Dam and pipeline project.

There are currently investigations into renewable energy projects in the surrounding area but they are in various phases of development. Notably pre-investment studies have commenced into a potential Dungowan Dam Pumped Hydro Energy Storage project. While this project has potential to interact with the Dungowan Dam, it is still in an early phase of investigation and is not yet a committed project. As no details of that project or whether it will proceed are currently available, this EIS does not consider any cumulative impacts associated with a Dungowan Dam Pumped Hydro Energy Storage project. Should a Dungowan Dam Pumped Hydro Energy Storage project proceed, any cumulative impacts with the Dungowan Dam and pipeline project would need to be considered through the planning approval process for that project.

Other known projects in the surrounding area that are in the planning phase include the Middlebrook Solar Farm and the Hills of Gold Wind Farm. These projects are approximately 40 km away and may result in minor cumulative impacts with the Dungowan Dam and pipeline project relating to the availability of local housing for the project workforce. Cumulative impacts are addressed in Chapter 21.

1.6 Purpose of this document

This EIS has been prepared by EMM Consulting Pty Limited (EMM) on behalf of Water Infrastructure NSW to support the CSSI application for approval of the Dungowan Dam and pipeline project under Part 5, Division 5.2 of the EP&A Act. It has been prepared to the form and content requirements set out in clauses Section 190 and 192 of the NSW *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation). It has also been prepared to align with the *State significant infrastructure guidelines - preparing an environmental impact statement* (DPIE 2022a).

This EIS addresses the construction and operation of the project and has been prepared to address the SEARs issued by DPE on 27 July 2020 and later extended on 16 June 2022. The SEARs and where they have been addressed in this EIS are provided in Appendix A. The EIS is supported with input from technical specialists.

1.7 Structure of the EIS

This EIS is structured as follows:

- Chapter 1 – Introduction
- Chapter 2 – Strategic context
- Chapter 3 – Statutory context
- Chapter 4 – Description of the project
- Chapter 5 – Engagement
- Chapter 6 to Chapter 20 – description and assessment of environment, social and economic considerations of the project
- Chapter 21 – Cumulative impacts
- Chapter 22– Project justification
- Appendix A – SEARs compliance table
- Appendix B – Detailed project description (B1) and maps and plans (B2)
- Appendix C – Statutory compliance tables
- Appendix D – Community and stakeholder engagement technical report
- Appendix E – Mitigation measures
- Appendix F to Appendix Y – Technical assessment reports

CHAPTER 2

Strategic context

2 Strategic context

The Dungowan Dam and pipeline project is of critical significance to Tamworth, the Namoi region and NSW, providing vital additional water security for Tamworth. The strategic context of the Dungowan Dam and pipeline project is provided in this chapter, and is supported by the Dungowan Dam Summary Business Case (Summary Business Case) (DPE 2022a) available on the project website[2].

2.1 Project objectives

Tamworth is the largest regional centre in North Western NSW and the second largest regional centre in NSW. It is a critical public and private services hub for local residents, businesses, and surrounding communities in the south of the New England region. The most recent drought experienced in 2017–2020 demonstrated the existing town water supply system for Tamworth does not provide sufficient security for this important regional centre and highlighted the immediate need for alternative water security solutions. After almost two years without rain, Chaffey and Dungowan dams had fallen from full in June 2017 to 13% capacity in January 2020. At this time, Tamworth had just under 18 months of water remaining even with severe water restrictions in place (DPE 2022b).

The project seeks to address this immediate need and has the following objectives:

- **Objective 1:** improve water availability and security for the city of Tamworth and to enable growth, whilst maintaining average annual reliability of allocations for other Peel Valley water users.
- **Objective 2:** provide efficient and affordable bulk water supplies to Tamworth.
- **Objective 3:** promote environmental and social outcomes in Tamworth and the Peel Valley.

2.2 Policy context

The project supports the priorities identified in the NSW Water Strategy (DPIE 2021a) and is identified in the draft Namoi Regional Water Strategy (DPE 2022b) as an existing government commitment to improve water security for Tamworth. The draft Namoi Regional Water Strategy (DPE 2022b) also provides additional non-infrastructure solutions to improve water efficiency and security that will complement the project in the near term and provides additional infrastructure solutions to complement the project to further improve town water security for Tamworth in the medium to long term.

[2] https://water.dpie.nsw.gov.au/__data/assets/pdf_file/0008/523979/dungowan-dam-summary-business-case.pdf

In addition to joint State and Commonwealth Government commitments for the project, the alignment of the project with relevant policies, strategies and plans is outlined in Table 2-1.

Table 2-1 Key Government policies and commitments relating to the project

Policy/Strategy/Plan	Relevance to project
NSW Water Strategy	The project supports the priorities identified in the NSW Water Strategy, specifically: increase resilience to changes in water availability; support resilient, prosperous and liveable cities and towns; and support economic growth within a capped system.
Draft Namoi Regional Water Strategy	The draft Namoi Regional Water Strategy identifies the project as an existing government commitment to improve water security for Tamworth and identifies additional complementary non-infrastructure and infrastructure options to further improve water security for Tamworth and the Namoi region.
NSW State Infrastructure Strategy 2022–2042	The objectives of the project align with the infrastructure requirements for water security across metropolitan and regional NSW. The delivery of the project contributes to securing long-term water supply to Tamworth and is aligned with the State's infrastructure goals.
Namoi Regional Job Precinct	Water security is critical to both on-farm and post-gate agricultural processing, with Tamworth heavily dependent on commercial and industrial processing for local employment.
WaterNSW 20 Year Infrastructure Options Study	The Options Study identifies the New Dungowan Dam and augmented supply pipeline (the project) as a solution to improve water availability in the Peel Valley.
Tamworth Regional Blueprint 100	The new Dungowan Dam is identified as a key project to realising the quality-of-life aspirations of the community and to accelerate the region's aspirations for increased productivity and exports.
Tamworth Tomorrow: Driving the Tamworth Region's Economic Growth	Strengthening the region's long-term water security is one of several pillars to assist the growth of local industry sectors. This strategic pillar is aligned with the key project objectives to improving local water security and reliability.
New England North West Regional Plan 2036 and draft *New England North West Regional Plan 2041*	Water security is identified as a critical input to achieving many of the long-term objectives of the region, including future growth in the cities of Tamworth and Armidale and efficient on-farm agricultural production. Adapting to climate change and increasing climate resilience is a key strategic direction identified in the updated (draft) regional plan.
Namoi Water for the Future Strategy	The Strategy identifies an array of threats to water security, water availability and reliability including climate change, prolonged dry periods and expanding industrial and commercial uses. The project seeks to address many of the identified threats in promoting greater water security to Tamworth.

2.3 Need for the new Dungowan Dam and pipeline

2.3.1 Tamworth is growing

Tamworth is expected to grow significantly in population, housing and employment over the next 20 years. Much of this growth will be stimulated by local, state and national investment in schemes such as the New England Renewable Energy Zone and the Namoi Regional Job Precinct. These programs will drive business and population growth across the north-east of NSW (Tamworth Regional Council 2020). While population growth projections range from a modest 10% increase to a 50% increase over the next 20 years, the project assumes a growth of approximately 20% over this period (DPIE 2019).

The key challenge for all levels of government is to ensure that growth is sustainable. This includes ensuring access to reliable and secure water supplies, while retaining and enhancing the character of the environment, the city and surrounding regions.

2.3.2 Tamworth's existing water supply infrastructure is ageing

The existing Dungowan Dam is about 60 years old and therefore does not meet current dam safety standards. There have been upgrades completed over its life however the existing infrastructure is considered a sub-optimal arrangement for maintaining public safety and has high ongoing maintenance costs. Similarly, the existing Dungowan pipeline experiences regular serviceability issues. Tamworth Regional Council is subject to ongoing management, operation, maintenance costs and safety risks associated with the continued use of the existing Dungowan Dam and pipeline. An improved infrastructure arrangement would help alleviate these risks.

2.3.3 Importance of a reliable water supply to the regional economy

Tamworth is the largest regional centre in north-west NSW, providing an important hub for services and employment for people and businesses across the region. Currently, around 63,000 people – 65% of the Namoi region’s population – live in the Tamworth local government area (DPIE 2021b). The city of Tamworth provides key services in manufacturing, transport, health care, entertainment, retail and education. Tamworth’s gross regional product is currently $4.2 billion per year and is growing at an average of 3.8% each year (DPE 2022b).

In addition to supporting social services for much of the inland north, Tamworth is of state-wide significance to the agricultural and manufacturing industries. The area hosts some of the largest livestock processing facilities in Australia as well as distribution facilities that drive employment and help to link farmers in the region with national and international consumers. As such, Tamworth has:

- The largest number of agricultural employees for a local government area in NSW.
- The highest number of food manufacturing employees outside metropolitan Sydney (DPIE 2021b).

Tamworth is particularly vulnerable to adverse economic impacts from drought conditions given the high demand for potable water from regionally significant businesses including industrial food processors (representing 48% of water demand in 2019–2020, whilst the residential sector accounted for 52% of potable water demand) (DPIE 2021b). The vulnerability of Tamworth's economy to drought highlights the immediate need to improve water reliability and security for existing and future businesses in Tamworth.

2.3.4 Cost of drought and water restrictions to the economy and households

The 2017–2020 drought period resulted in a 2.1% contraction in regional economic output for the Tamworth region. This equates to $70 million less value added to the economy in 2020 compared to 2016. It is estimated that the Tamworth economy will produce $293 million less annually in the next decade compared with what it could have produced had the drought not occurred in 2017–2020 (CSIRO 2020).

Tamworth has implemented water conservation measures since 2002, with high levels of water restrictions required for several extended periods (DPE 2021a). In adapting their behaviours and complying with the water conservation measures and water restrictions, Tamworth residents and businesses have been successful in minimising their per capita average consumption of potable and non-potable water. However, water restrictions have an economic cost to households, communities and the wider economy. Table 2-2 summarises the annual economic cost of restrictions on households, and these values have been adopted in quantifying the economic cost of water restrictions in Tamworth.

Table 2-2 Cost of water restrictions in Tamworth (DPE 2021b)

Annualised cost of restrictions for 'separate houses'	Level 1	Level 2	Level 3	Level 4	Level 5
Estimated costs for Tamworth (2022) per household p.a. (*based on % reduction in water use*)	$4 (*8%*)	$5 (*9%*)	$15 (*13%*)	$112 (*30%*)	$326 (*45%*)

Using these costs, it is estimated that the most recent drought may have had a total direct cost for residents and businesses of Tamworth of approximately $17 million (DPE 2021b). Over the next thirty years, hydrological modelling estimates the average annual cost of water restrictions to Tamworth to be between $0.5 million and $2.5 million per year (2022 dollars) (DPE 2021b).

2.3.5 Tamworth is exposed to an unreliable water supply

Tamworth's high degree of reliance on surface water does not provide adequate water security for extended droughts and for future growth in water demand. Water security is expected to further deteriorate given longer and more frequent droughts due to climate change and the high predicted growth in town water demand. Groundwater is not a viable emergency water source for Tamworth's town water supply given the high degree of connectivity between surface water and groundwater and the over allocation of groundwater in the Peel River (NSW Office of Water 2010).

The risk of greater climate variability and a drier climate fundamentally changes the outlook for the residents of Tamworth and the agricultural businesses in the region.

2.3.6 Current climate

Across the Namoi region droughts are becoming shorter and more severe than those before the 1950s. In the Peel Valley, the three driest three-year periods since 1890 (when records commence) all occurred between 1965 and 2020 and the recent drought in the region was one of the worst on record. In response, a range of emergency drought relief projects have been delivered to extend water supplies for critical human needs in Tamworth and its surrounds including the Chaffey Dam pipeline. These projects partially protect Tamworth running out of water in an extreme drought, however, they do not in isolation fully reduce the risk to an acceptable level and they do not address the significant periods of water restrictions that Tamworth currently experiences.

Further details of the historical and current climate are detailed in the Surface Water Assessment (Appendix F). Photograph 2-1 and Photograph 2-2 were taken during site investigations for the project and show the variability in climate for Dungowan Creek during 2020 (drought) and 2021 (high flow).

Photograph 2-1 A section of Dungowan Creek downstream of the dam during the drought (January 2020)

Photograph 2-2 Photograph: Dungowan Creek during a high flow event (November 2021)

2.3.7 Future climate

New climate datasets developed by Adelaide University (refer Surface Water Assessment, Appendix F) and improved hydrological modelling capability has recently allowed the NSW Government to obtain an in-depth understanding of the natural variability of the region beyond the 130 years of observed historical weather records. This investment in new climate data and modelling improves the understanding of past climate conditions and plausible climate futures, and provides a more accurate picture of the frequency, duration and magnitude of extreme climate events, such as extended droughts.

Key observations from hydrological modelling completed for the project and draft Namoi Regional Water Strategy (DPE 2022b), and refined as part of this EIS (refer to Surface Water Assessment (Appendix F)) include:

- The likelihood of a supply shortfall is 1 in every 1,400 years at current levels of demand.
- The likelihood of a supply shortfall is expected to increase to 1 in 520 years when Tamworth's water demand increases by 20% due to population growth.
- In a worst case dry climate scenario, the likelihood of a supply shortfall could increase further to 1 in 20 years.
- This supply shortfall could place critical human needs and businesses at risk.
- The likelihood of moderate to severe water restrictions will increase with population growth as demand for water increases. A 20% increase in water demand in a dry climate scenario could result in Tamworth being under moderate to severe water restrictions 69% of the time.
- The project will reduce both the time spent in water restrictions and the severity of water restrictions across a range of future climate scenarios.

These observations highlight the urgent need to address the lack of Tamworth's town water security, with any additional delay further exposing local residents and businesses to significant economic and social pressures.

2.4 Alternatives and options considered

2.4.1 Do-nothing alternative

The do-nothing alternative is continuing to operate the existing dam and pipeline. Additional upgrades would be required to prolong use of this ageing infrastructure and Tamworth Regional Council and the community would accept the associated dam safety risk and risk of water shortage during future drought.

Tamworth has an inadequate level of water security for town water needs. With current water demands, Tamworth spends on average 18% of the time with water restrictions. Exacerbated by a changing climate and increased demand, the frequency and duration of restrictions is expected to increase to 22% of the time with future demands (i.e. +20%), with more common and more severe restrictions as the climate changes. These restriction impact on the existing Tamworth Regional Council town water supply customers and other users and stifles economic growth in the region, inhibiting the liveability and economic growth of Tamworth and the wider region.

As such, the do-nothing alternative is not considered feasible.

2.4.2 Tamworth town water security alternatives

The identification and assessment of alternatives and options for the project is explained in detail in the Summary Business Case. The options identification and development pathway commenced in 2015 and has involved several stages including engagement with and participation by key stakeholders, including WaterNSW and Tamworth Regional Council. A long list of options was assessed, and a short list was selected which included the project, one infrastructure alternative and one non-infrastructure alternative for further consideration. The short list was:

- New Dungowan Dam and Pipeline (the project).
- A pipeline from Keepit Dam to Tamworth (infrastructure alternative).
- Increased Urban Reserve (non-infrastructure alternative).

The business case (DPE 2022a) assessment of the short listed options included:

- Hydrological modelling to assess performance of project and alternate options in meeting the project objectives.
- Economic assessment to determine capital and operational costs, as well as economic benefits for the project and alternate options.
- Strategic merit assessment, considering the performance of the project and alternate options against a range of criteria including performance, investment decision readiness, implementation risks and complexity, alignment with government policy and stakeholder acceptance.

The process by which alternatives/options were identified and assessed throughout the project development lifecycle is summarised in Figure 2-1 below and is outlined in more detail in the Summary Business Case.

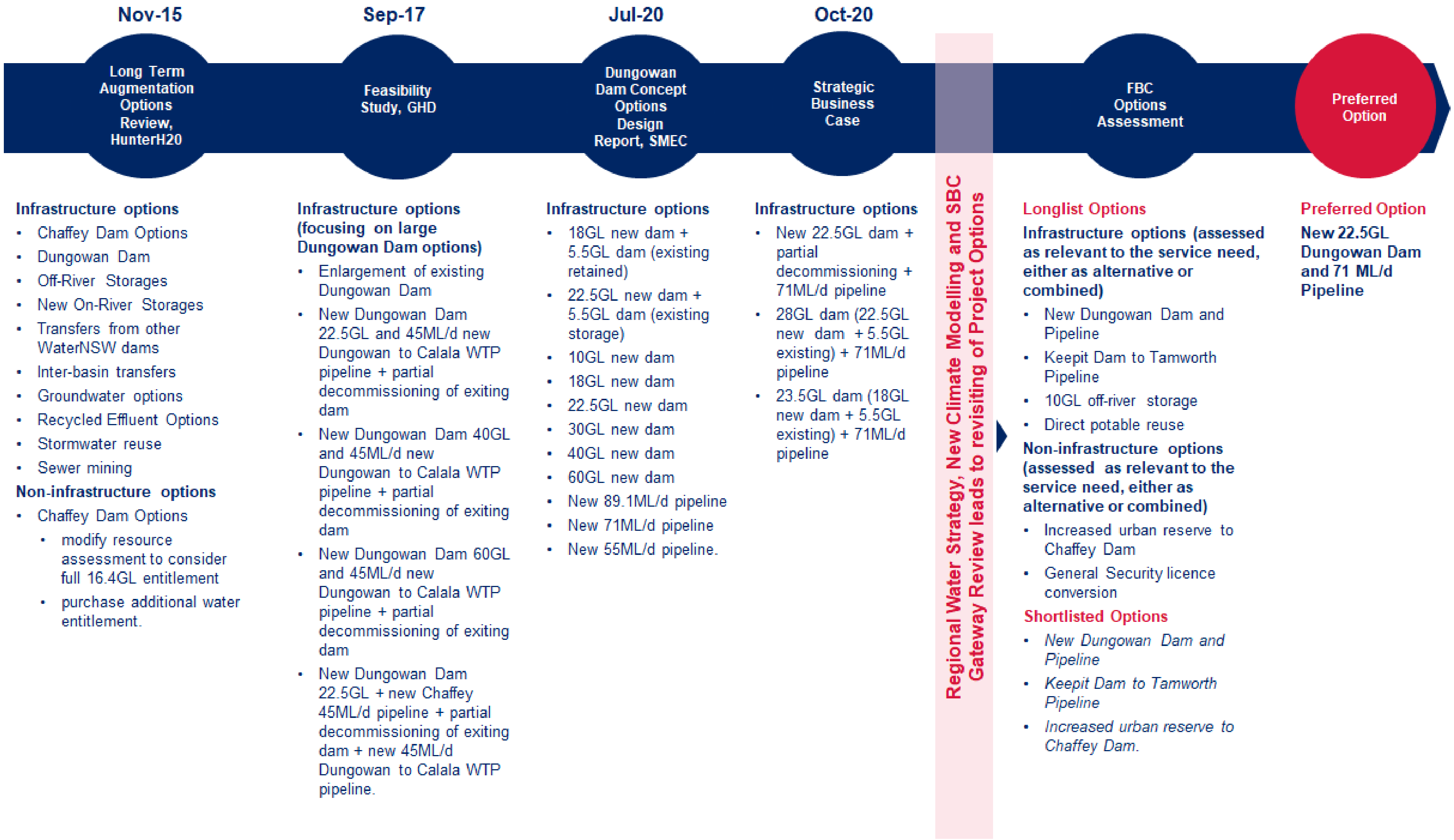


Figure 2-1 Snapshot of the options development pathway

Source: Water Infrastructure NSW Summary Business Case

2.4.3 Options considered

Prompted by the millennium drought, investigations into the future water supply and demand for bulk water were undertaken for the regional city of Tamworth and the Peel Valley water users.

The consideration of options and development of the project was informed by iterative environmental constraint assessment comprising both desktop and field survey, with the aim to reasonably avoid and minimise significant impacts to the environment and the local community. This resulted in changes to the pipeline and powerline alignments as well as the location of ancillary facilities, and informed the sizing and operating rules of the new Dungowan Dam. Table 2-3 below provides a summary of the key project design options considered as part of the concept design.

Table 2-3 Options assessment approach

Key design elements	Options considered	Preferred option	Reasons
Existing Dungowan Dam	Construction of the new Dungowan Dam and upgrade of the existing Dungowan Dam Construction of the new Dungowan Dam and partial or full decommissioning of the existing Dungowan Dam.	Construction of the new Dungowan Dam and full decommissioning of the existing Dungowan Dam.	Decommissioning of the existing Dungowan Dam was found to be the less expensive option and would also reduce dam safety risks and lower the construction costs associated with developing the new Dungowan Dam.
Dam type	Earth and rockfill embankment Roller compacted concrete gravity dam.	Earth and rockfill embankment.	An earth and rockfill embankment was adopted due to risks associated with foundation conditions at site.
Storage capacity	Various sizes from 10 GL to 60 GL.	22.5 GL	As part of the concept design the project costs (including total construction costs and costs to own and operate the new dam) were assessed for the various storage capacities and associated yields with 22.5 GL selected as the preferred option.
Location of key project components	Alignment of pipeline Alignment of powerline Location of ancillary facilities.	As detailed in Chapter 4 and Appendix B.	Improvement to construction outcomes, whilst avoiding and minimising significant impacts to the environment and the local community.

2.4.4 Preferred option

As further detailed in the Summary Business Case, the results of the strategic merit assessment identified the new Dungowan Dam and pipeline project as the preferred option. It is the only option that:

- Develops new storage capacity to improve water security and climate change resilience.
- Is focussed on developing new capacity and therefore doesn't shift the burden between stakeholders within the Peel Valley or the Namoi Region.
- Is advanced in its development, reducing uncertainty in responding to the immediate need for improved water security outcomes.

The preferred option (new Dungowan Dam and pipeline project) also aligns with a number of Government's key policies and strategies:

- The NSW Water Strategy, draft Namoi Regional Water Strategy and the relevant Water Sharing Plan.
- The NSW State Infrastructure Strategy, the NSW Government Action Plan, New England North West Regional Plan, Namoi Regional Job Precinct Plan, as well as various Government announcements and commitments to regional water infrastructure and water security such as the National Water Grid Fund.
- The National Water Grid Investment Framework supporting nationally important regional water infrastructure that benefits the agriculture and primary industry sectors and supports regional economic development.

As such, the new Dungowan Dam and pipeline project has been progressed as the preferred option. A detailed description of the project is provided in Chapter 4 and Appendix B.

2.4.5 Future options for Tamworth's town water security

As Tamworth continues to grow into the future, so too will its water demand. Even with the new Dungowan Dam and pipeline being constructed, at a point in the future this growth in demand will result in the risk of town water failure and time in restrictions exceeding acceptable criteria. Additional measures would need to be provided at this time to ensure that Tamworth continues to have a secure and reliable town water supply.

Based upon hydrological modelling, the risk of town water failure and time in restrictions will exceed acceptable criteria when the Tamworth town water demand from the Chaffey Dam and Dungowan Dam system reaches an annual maximum mean of 11 GL/year. As future options would result in fundamental changes to impacts and operations, the environmental assessment for the Dungowan Dam and pipeline project has been based on a mean maximum town water demand on the Chaffey Dam and Dungowan Dam system of 11 GL/year.

It is important to note that while the new Dungowan Dam and pipeline project is the preferred option and is necessary now, additional infrastructure and non-infrastructure measures will need to be taken in the future to ensure Tamworth remains resilient to climate and population changes. These additional measures are being investigated through the draft Namoi Regional Water Strategy to form part of a longer investment pathway for water security and efficiency in the Peel and Namoi Valleys.

2.5 Benefits of the Dungowan Dam and pipeline

The Dungowan Dam and pipeline project is critical to improving long-term water security for the region. The project will provide improved drought resilience and water security for Tamworth, while maintaining average annual general security allocations for irrigation as the city grows.

The frequency and severity of water restrictions in Tamworth would decrease following construction of the new Dungowan Dam, while average annual general security allocations would remain unchanged. With current demands, the frequency of water restrictions would decrease from 18% of the time to around 7% of the time. With future demands (i.e. +20%), the frequency of water restrictions would decrease from 22% of the time to around 10% of the time, i.e. restrictions would occur half as often (Figure 2-2).

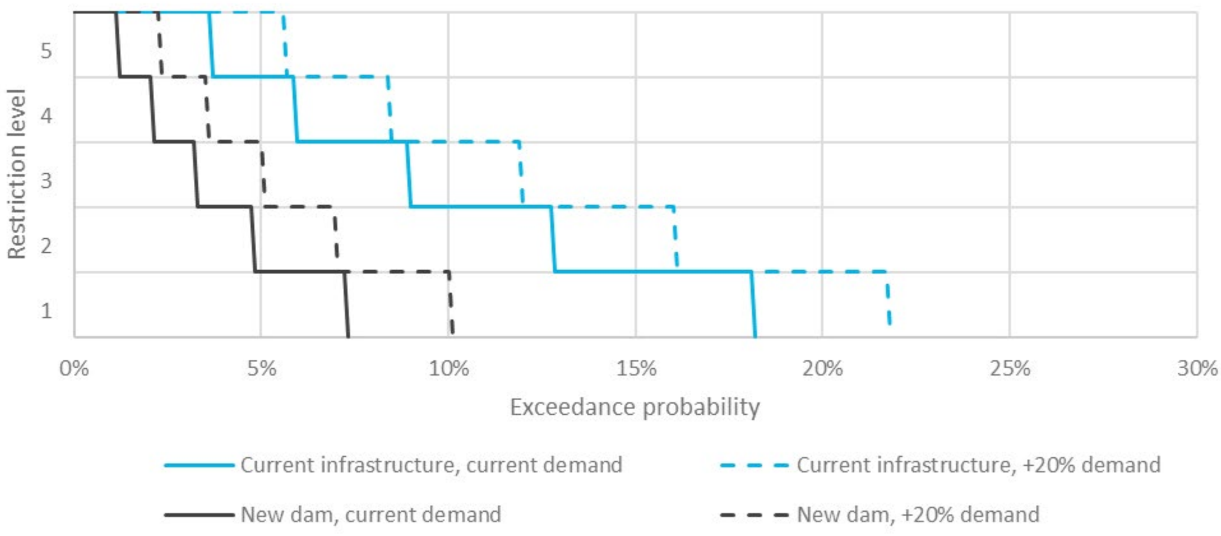


Figure 2-2 Modelled probability of water restrictions in Tamworth

The key benefits of the project are:

- Improving town water security for Tamworth's town water supply as Tamworth's water demand grows, whilst maintaining average annual reliability of allocations for general security licence holders.
- Addressing climate change and providing a resilient solution for improved water security to the region.
- Replacing aging dam and pipeline infrastructure to address serviceability and dam safety risks. Dam safety and maintenance risks associated with the existing Dungowan Dam would be removed. A new dam built to current design standards would have improved safety and maintenance outcomes.
- Maximising local opportunities during construction of the project including opportunities for Aboriginal participation in construction. Local economic impacts during construction would be substantial and provide over 900 direct and indirect local jobs over the six year construction period and $263 million in annual direct and indirect regional output or business turnover.
- Supporting the objectives of the NSW Water Strategy, draft Namoi Regional Water Strategy and the Tamworth Regional Council's Blueprint 100 community strategic plan.

CHAPTER 3

Statutory context

3 Statutory context

This chapter addresses the statutory requirements of the project, including those identified in the SEARs, in a format consistent with the *State significant infrastructure guidelines – preparing an environmental impact statement* (DPE 2022a, 'Guidelines'). Consistent with the DPE 2022 Guidelines, this chapter provides details on:

- The approval pathway and permissibility for the project under the EP&A Act.
- The approvals required before the project may be carried out, including under the Commonwealth EPBC Act.
- Any relevant and mandatory statutory matters for consideration by the approval authority before the application can be determined.

A detailed consideration on the statutory requirements for the project is provided in Appendix C. In addition, relevant policies, plans and guidance are identified and considered throughout the EIS as relevant to the discussion and assessment of specific issues.

3.1 Approval pathway

An application to declare the project as Critical State Significant Infrastructure (CSSI) under Section 5.13 of the EP&A Act was provided to the Minister for Planning and Homes (Minster) in August 2022. The basis of the application was that:

- A safe and secure water supply is essential for supporting Tamworth's:
  - Existing industry and services and their future growth.
  - Existing and future population.
- Tamworth is one of NSW's largest regional centres.
- Tamworth contains large food processing, manufacturing, service and construction industries that underpin the development and economy of north west NSW and contributes significantly to the overall NSW economy.

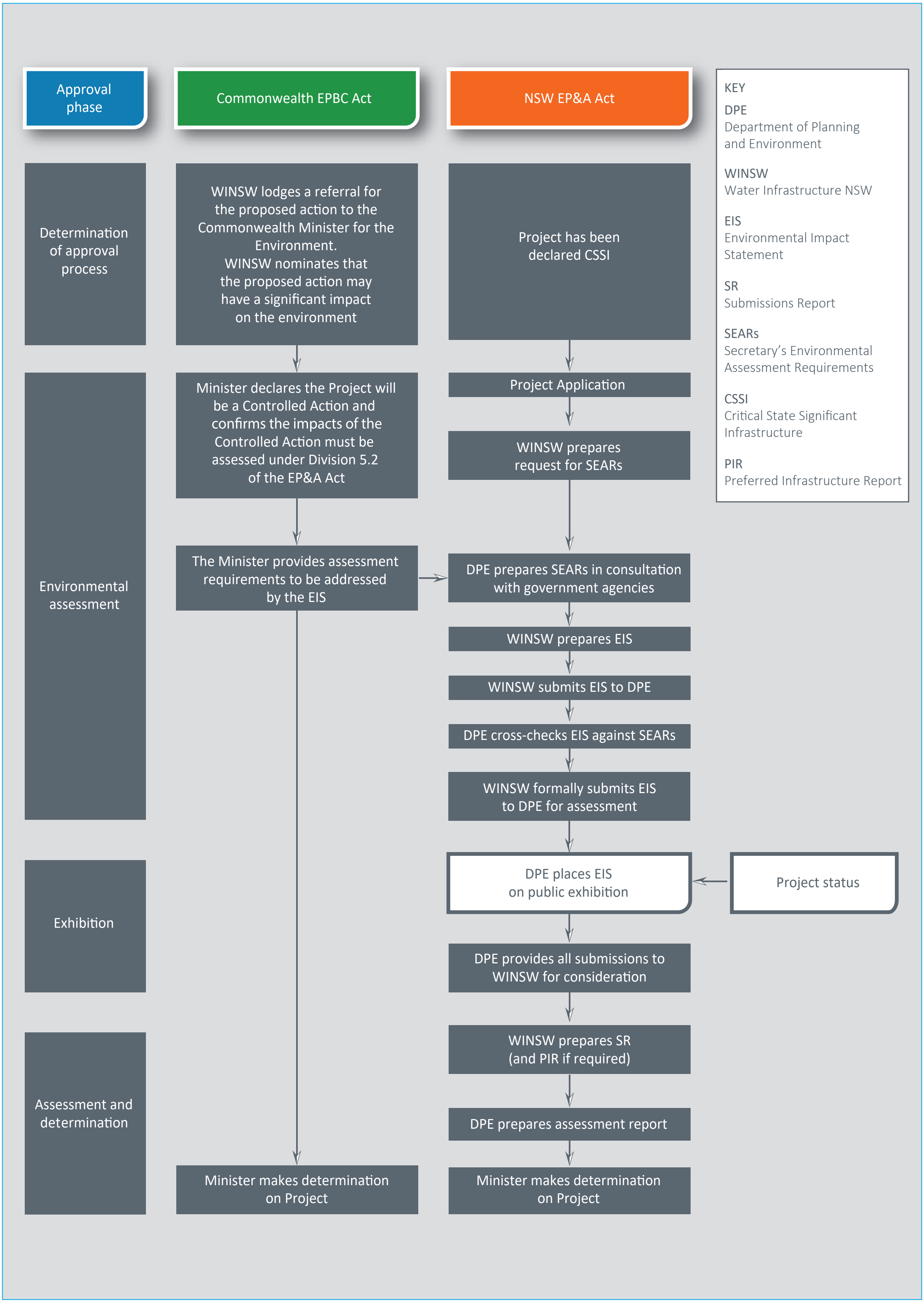
In September 2022, the Minister declared the project to be CSSI as it is a development that is essential for the State for economic and social reasons. This requires Schedule 5 of the *State Environmental Planning Policy* (Planning Systems) 2021 to be updated to reflect the CSSI status of the project.

The assessment and approval process for a CSSI project requires assessment under Part 5, Division 5.2 of the EP&A Act and is permissible only with the NSW Minister for Planning and Homes (Minister) approval under Section 5.19 of the EP&A Act.

To obtain approval, Water Infrastructure NSW has taken the following steps in accordance with Part 5, Division 5.2 of the EP&A Act and relevant sections of the EP&A Regulation:

- An application and Scoping Report to request SEARs was lodged with DPE in March 2020.
- The Planning Secretary issued SEARs on 27 July 2020, and provided an extension of these SEARs on 16 June 2022 (Appendix A).

In addition, a decision was made by the Commonwealth Minister for the Environment (or their delegate) on 16 June 2020 under Section 75 of the EPBC Act, that the project is a "controlled action". The project will be assessed under the assessment bilateral agreement between the NSW and Commonwealth Governments. The approval process for the project is summarised in Figure 3-1. This EIS has been submitted for assessment in accordance with the requirements of the SEARs, Section 5.17 of the EP&A Act and Part 8 of the EP&A Regulation.



Approvals process
Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 3.1

3.2 Changes to water sharing plans

Water Sharing Plans (WSPs) are made under the *Water Management Act 2000* (NSW). WSPs (amongst other things) set out the water management objectives for the relevant plan, establish environmental water, identify the requirements for water, and establish access licence dealing rules (trade rules).

There are four relevant water sources in the Peel Valley for the purposes of the project:

- The Peel Regulated River Water Source to which the *Water Sharing Plan for the Peel Regulated River Water Source 2022* applies.
- The Peel Unregulated River Water Sources to which the *Water Sharing Plan for the Namoi and Peel Unregulated Rivers Water Sources 2012* applies.
- The Peel Alluvium Water Source to which the *Water Sharing Plan for the Namoi Alluvial Groundwater Sources 2020*.
- The Peel Fractured Rock Water Source to which the *Water Sharing Plan for the NSW Murray-Darling Basin Fractured Rock Groundwater Sources 2020* applies.

While extraction of groundwater is required during construction, no groundwater take during operation of the project is required. No change to the two groundwater WSPs, noted above, is required.

The management of the Peel River catchment surface water resources (including Dungowan Creek) is provided for in the *Water Sharing Plan for the Namoi and Peel Unregulated Rivers Water Sources 2012* and *Water Sharing Plan for the Peel Regulated River Water Source 2022.*

Despite the existing Dungowan Dam being located on Dungowan Creek, the creek is currently classed as 'unregulated' and the *Water Sharing Plan for the Namoi and Peel Unregulated Rivers Water Sources 2012* applies to it. It is proposed that Dungowan Creek would remain 'unregulated' and this plan would continue to apply without any amendment required.

The extraction of water from Dungowan Dam and Chaffey Dam for Tamworth's water supply is provided for in the *Water Sharing Plan for the Peel Regulated River Water Source 2022*. This plan requires amendments to:

- Change Clause 52 of the WSP to reflect the proposed increase in Tamworth's town water reserve at Chaffey Dam from 14 GL to 30 GL.
- Establish the proposed 200 ML/year Dungowan Dam Environmental Water Allowance.
- Include a clause that triggers a review of the WSP and water sharing arrangement in the Peel River which also considers the environmental impacts of any changes. This review would be triggered when Tamworth's mean maximum town water demand from the Chaffey and Dungowan system reaches 11 GL/year.
- Refer to any transitional arrangements which may be required between the time of the water sharing plan update and the completion of dam commissioning works. At this stage no transitional arrangements have been identified.

The only other potential change to the WSP and/or potentially Water Access Licence (WAL) is the proposed increase in translucency volumes from the new Dungowan Dam, which would increase from up to 10 ML/day to up to 13 ML/day. The translucency requirement is a condition of the WALs held by Tamworth Regional Council and this is appropriate while Tamworth Regional Council owns and manages the existing Dungowan Dam. However, as the new Dungowan Dam is proposed to be owned and managed by WaterNSW, an alternative approach to specifying translucency requirements may be required. Further consultation with DPE Water, WaterNSW and other relevant approval agencies would be undertaken to determine the most appropriate approach to codifying translucency requirements.

3.3 Other approvals and relevant legislation

Other approvals and relevant legislation to the project are described in Table 3-1.

Table 3-1 Other approvals relevant to the project

Approval category	Requirements
Approvals that should be substantially consistent with approved CSSI	The following approvals are necessary to carry out the project. Therefore, if the project is approved by the Minister, in accordance with Section 5.24 of the EP&A Act the following approvals cannot be refused and are to be substantially consistent with the planning approval: • An environment protection licence (EPL) under Chapter 3 of the *Protection of the Environment Operations Act 1997* (NSW) (POEO Act): − For construction, an EPL to authorise the carrying out of ancillary activities that are scheduled activities, being chemical storage, concrete works, and crushing, grinding or separating. − For operation, an EPL in accordance with Section 120 of the POEO Act regarding the prohibition of pollution of waters. The project has potential for cold water pollution impacts during operations, which would require regulation under an EPL. However, WaterNSW may be exempt from an EPL pursuant to an approval under the *Water Management Act 2000*[3]. This is discussed further in the Surface Water Assessment provided at Appendix F of this EIS. • A consent under Section 138 of the *Roads Act 1993* (NSW): The project involves works within public road reserves (upgrade of Dungowan Dam Road), therefore prior to those works being carried out, consent will be obtained from Tamworth Regional Council as the appropriate Roads authority. The other kinds of approvals listed under Section 5.24 of the EP&A Act are not required for the project.

[3] Clause 56A of the POEO Act

Approval category	Requirements
Approvals that are not required for approved CSSI	The following approvals, in accordance with Section 5.23 of the EP&A Act, are not required to be obtained if the project is approved by the Minister: • A permit under Section 201, 205 or 219 of the *Fisheries Management Act 1994* (NSW). • An approval under Part 4 or an excavation permit under Section 139 of the *Heritage Act 1977* (NSW). • An Aboriginal heritage impact permit under Section 90 of the *National Parks and Wildlife Act 1974* (NSW). • A bushfire safety authority under Section 100B of the *Rural Fires Act 1997* (NSW). • A water use approval under Section 89, a water management work approval under Section 90 or an activity approval (other than a groundwater interference approval) under Section 91 of the *Water Management Act 2000* (NSW).
EPBC Act approval	A referral decision for the project was made on 16 June 2020 (EPBC 2020/8655), that the project is a controlled action under the EPBC Act. The project therefore requires approval from the Commonwealth Minister for the Environment and Water. The relevant controlling provisions under the EPBC Act relate to listed threatened species and communities (Sections 18 and 18A). The project will be assessed under the assessment bilateral agreement between the NSW and Commonwealth Governments. The use of an accredited assessment process does not alleviate the approval requirements of the Commonwealth Minister for the Environment and Water under the EPBC Act. After the assessment process has been completed, the assessment information will be provided to the Commonwealth Minister for the Environment and Water for a decision as to whether or not to approve the controlled action under the EPBC Act.
Other approvals not expressly integrated into the CSSI assessment	Approvals that are required for the project but are not expressly integrated into the CSSI assessment are as follows: – *Water NSW Act 2014* (NSW): As WaterNSW is the proposed future owner of the new Dungowan Dam infrastructure, the new Dungowan Dam will need to be included in the WaterNSW operating licence granted under Section 11 of the *Water NSW Act 2014*. This is likely to be a relatively simple change in updating the area of operations and including the new Dungowan Dam in the figure of Appendix B of the operating licence. – *Water Management Act 2000* (NSW): The following water licences are required: – During construction: WAL for taking of water from the existing Dungowan Dam for use in construction of the new Dungowan Dam and to account for groundwater take during excavation of the dam and spillway. Generally, this would be via obtaining a zero allocation WAL and purchasing water from other

Approval category	Requirements
	water users. Based on the results of a steady state analytical model, the maximum volume required for licensing of groundwater during construction is: – 24.9 ML/yr from the Dungowan Creek Management Zone within the Peel Alluvium Water Source. – 3.9 ML/yr from the Peel Fractured Rock Water Source. – The licencing pathway for groundwater entitlement during construction is via the water market. Further detail is provided in the Groundwater Impact Assessment (Appendix G of the EIS). – During operation: WaterNSW will manage the new Dungowan Dam and delivery of water to Tamworth when required. The supply of water will continue to operate under the existing Upper Peel River Tributaries town water supply WAL held by Tamworth Regional Council. Changes to the WSP are required for changes to the surface water regime as discussed in Section 3.3. – No groundwater take is expected during operation of the project and hence no licensing is required. – For CSSI projects, a water supply works and use approval is not required if the water supply works are included and assessed as part of the EIS. The project approval would effectively be the water supply works approval.
	• *Crown Land Management Act 2016* (NSW): A lease, licence or easement will be needed for use of Crown Land during construction and operation of the pipeline and upgrade of Dungowan Dam Road. A licence or easement in favour of Water Infrastructure NSW can be granted by the Minister for Lands and Water, for infrastructure that is in the public interest. • *Work Health and Safety Act 2011* (NSW): Licences under the *Work Health and Safety Act 2011* (NSW) will be required to transport dangerous goods such as petrol, diesel, explosives. • *Heavy Vehicle (Adoption of National Law) Act 2013* (NSW): Oversize Overmass permit will be required under the Heavy Vehicle National Law should overmass vehicles be required. • *Local Government Act 1993* (NSW): An approval under Section 68 of the *Local Government Act 1993* would be required to connect the existing Council pipeline with the new pipeline. • Further detail on legislation relevant to the project is provided at Appendix C.

3.4 Considerations for the approval authority

The matters that the Minister must consider when deciding whether to approve the carrying out of the project are stated at Section 5.19(2) of the EP&A Act, as follows:

- The Planning Secretary's report on the infrastructure and the reports, advice and recommendations contained in the report.
- Any advice provided by the Minister having portfolio responsibility for the proponent. The Minister with portfolio responsibility for the proponent is the Minister for Lands and Water.
- Any findings or recommendations of the Independent Planning Commission following a review in respect of the State significant infrastructure.

Relevant and mandatory matters for consideration by the Minister addressed in this EIS are identified in Table 3-2.

Table 3-2 Relevant and mandatory matters for consideration

Matters for consideration	Requirement	Where addressed in the EIS
Pre-conditions to the Minister exercising the power to grant approval to the project	The pre-conditions to the Minister exercising the power to grant approval to the project are: • An application for the approval of the Minister under Part 5, Division 5.2 of the EP&A Act to carry out CSSI must be made (s5.19(1)(a) of the EP&A Act). • An EIS with respect to the infrastructure is made publicly available (s5.26(2) of the EP&A Act). • The Planning Secretary must give his or her report on the CSSI project to the Minister (s5.19(1)(b) of the EP&A Act).	• An application for the project was lodged in the required form in October 2022. • This EIS for the project will be publicly exhibited as per the minimum exhibition timeframe of 28 days. • The Planning Secretary is responsible for providing the report to the Minster. Section 5.18 of the EP&A Act specifies what must be included in the Planning Secretary's report.
EP&A Act and consideration of biodiversity values	The EP&A Act has effect subject to the provisions of Part 7 of the Biodiversity Conservation Act 2016 (NSW) (BC Act) (s1.7 of the EP&A Act). Section 7.14 of the BC Act requires that the Minister, when determining an application for SSI that is required to be accompanied by a Biodiversity Development Assessment Report (BDAR) (which is the case for this project), must consider the likely impact of the project on biodiversity values as assessed in the BDAR. The Minister may (but is not required to) further consider under the EP&A Act, the likely impact of the project on biodiversity values.	A BDAR for the project has been completed and is attached at Appendix H.
Objects of the EP&A Act and ecologically sustainable development	When determining the project, the Minister must have regard to the objects of the EP&A Act, which includes the principles of ecologically sustainable development as specified at s193 of the EP&A Regulation: (a) The precautionary principle. (b) Inter-generational equity. (c) Conservation of biological diversity and ecological integrity. (d) Improved valuation, pricing and incentive mechanisms.	This EIS has considered and addressed the principles of ecologically sustainable development (ESD) in the assessment of significance of biodiversity impacts (Appendix H), and ESD Pathway report (Appendix Y) and Chapter 22 (Justification).

3.4.1 Environmental planning instruments

Section 5.22 of the EP&A Act confirms that:

- Part 4 and Division 5.1 of the EP&A Act do not apply to or in respect of State significant infrastructure, except as expressly provided by Division 5.2.
- Part 3 of the EP&A Act and environmental planning instruments do not apply to or in respect of State significant infrastructure except that they apply to the declaration of infrastructure as State significant infrastructure or as CSSI, and to enabling infrastructure to be carried out in accordance with an approval granted under Part 5, Division 5.2 of the EP&A Act.

Nevertheless, SEPPs have been considered as part of this EIS in Appendix C and include:

- *State Environmental Planning Policy (Transport and Infrastructure) 2021.*
- *State Environmental Planning Policy (Biodiversity and Conservation) 2021.*
- *State Environmental Planning Policy (Planning Systems) 2021.*
- *State Environmental Planning Policy (Resilience and Hazards) 2021.*
- *State Environmental Planning Policy (Resources and Energy) 2021.*
- *Tamworth Regional Local Environmental Plan 2010*.

CHAPTER 4

Project description

4 Description of the project

Water Infrastructure NSW proposes to build a new dam at Dungowan (new Dungowan Dam) about 3.5 km downstream of the existing Dungowan Dam and an enlarged delivery pipeline from the new Dungowan Dam outlet to the tie in point to the existing pipeline from Dungowan Showground to the Calala WTP. The existing pipeline from Dungowan Showground to the Calala WTP is not part of the Dungowan Dam and pipeline project.

The description of the project is based on the concept design prepared by SMEC with the detailed design process currently underway. This chapter describes the key components of the design required to build and operate the new Dungowan Dam and pipeline.

A more detailed project description is included in Appendix B1 and detailed plans and design information are included in Appendix B2.

4.1 Project summary

The key elements of the project design are shown in Figure 4-1. They include:

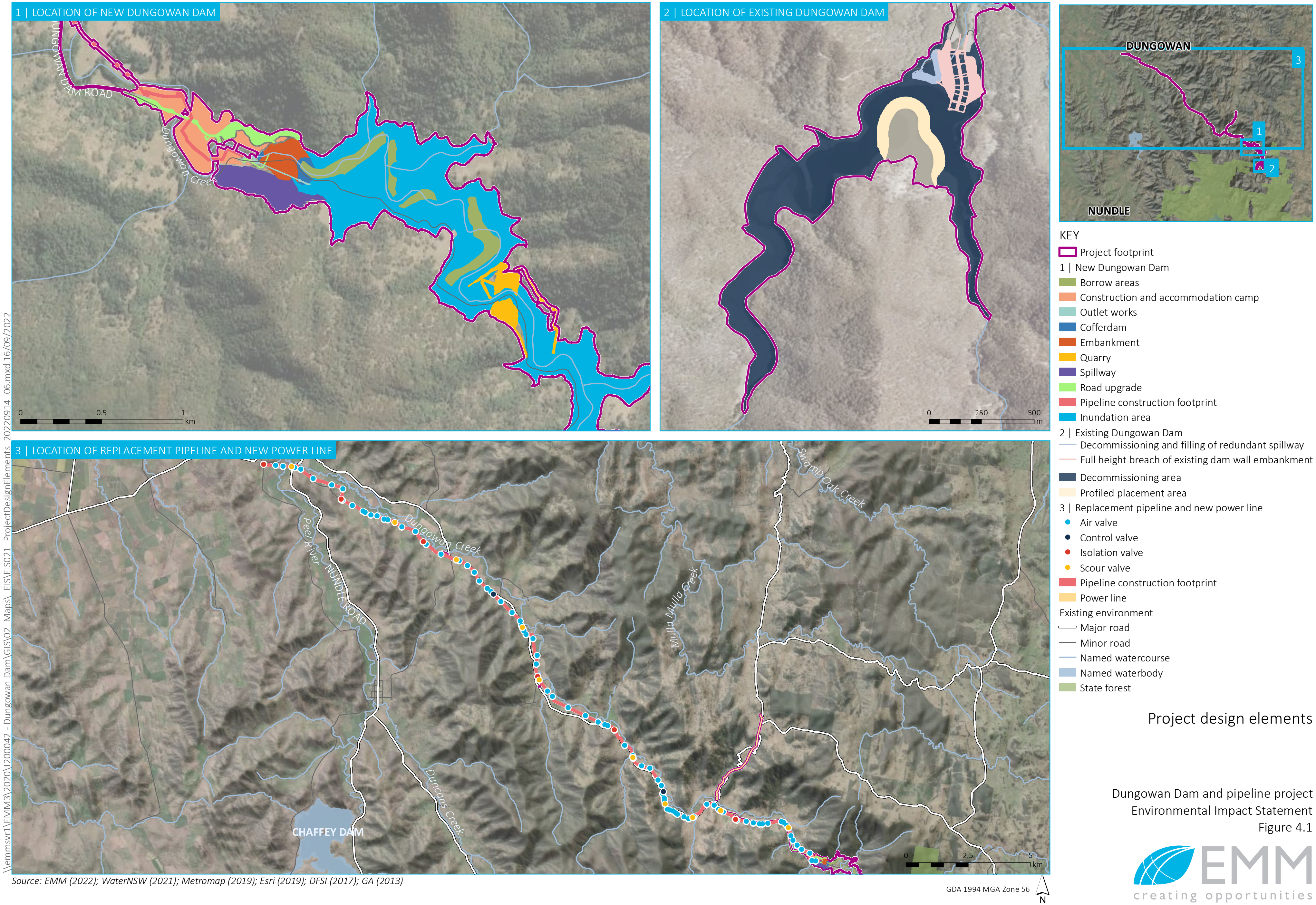
- Dam infrastructure involving an embankment, spillway, and outlet works. Coffer dams and diversions are also part of the design for the dam infrastructure.
- Pipeline infrastructure involving a replacement pipeline and associated valves, both below and at the surface.
- Ancillary infrastructure involving temporary works to facilitate construction (such as compound areas, quarries) as well as permanent works and services (such as powerlines) to facilitate operation of the dam.
- Decommissioning of the existing Dungowan Dam.

A summary of the project is provided below in Table 4-1. Once operational, the new Dungowan Dam would provide improved water security for the Tamworth region, especially in times of drought. A conceptualisation of the new Dungowan Dam is shown in Figure 4-2.

Table 4-1 Overview of the project

Project element	Summary of the project
New Dungowan Dam infrastructure	Earth and rockfill embankment dam with height of ~58 m and a dam crest length of ~270 m.
	Storage capacity of 22.5 GL at full supply level (FSL) of RL 660.2 m AHD.
	The new Dungowan Dam on Dungowan Creek has a catchment size of 175 km^2 and is part of the Peel Valley and Namoi River catchment.
	Inundation extent (to FSL) of 130 ha (1.3 km^2).
	Spillway to the south of the dam wall including an approach channel, uncontrolled concrete ogee crest, chute and stilling basin. Free standing multiple-level intake tower connected with a bridge to the embankment, diversion tunnel with outlet conduit, valve house and associated pipework and valves.
	A permanent access road over the Dam crest to the valve house for operation and maintenance.
	Water diversion works including a diversion tunnel and temporary pipeline and upstream and downstream cofferdams to facilitate construction of the dam wall embankment.
Pipeline infrastructure	31.6 km of buried high density polyethylene (HDPE) pipe between 710 mm to 900 mm nominal diameter.
	Maximum 71 ML/day from the proposed dam to the junction with the pipeline from Chaffey Dam to the Calala Water Treatment Plant, to replace the existing 22 ML/day pipeline. The pipeline would connect to the valve house on the left abutment of the embankment. Valve infrastructure would include control valves installed in two above ground buildings along the pipeline.
	10 m wide easement for the 31.6 km length of the pipeline. The replacement pipeline extends from the new Dungowan Dam to a connection point with the existing pipeline between Dungowan Showground and Calala WTP.
Ancillary infrastructure and works	Road works to improve existing roads to provide construction access, temporary establishment and use of a construction compound, an accommodation camp, two upstream quarries and four borrow areas within the inundation area.
	A new 4.2 km long 11 kV overhead powerline (including a new easement and access track) connecting to an existing overhead line approximately 6 km north west of the dam. The existing overhead line that extends approximately 13.2 km to the Niangala area would also require minor upgrades, including re-stringing of new overhead wiring and replacement of some poles.
Decommissioning of existing Dungowan Dam	Dewatering of existing dam, removal of existing Dungowan Dam infrastructure and full height breach of the existing Dungowan Dam wall. Rehabilitation of inundation area of the existing Dungowan Dam.

Project element	Summary of the project
Disturbance	Areas of disturbance have been identified based on the direct impacts of the project. There is some overlap in the areas disturbed during construction and operation, with a resulting total disturbance area proposed for the project of 315 ha (project footprint). Disturbance would occur in a staged manner, with construction requiring disturbance of approximately 315 ha (construction footprint). Following construction and once rehabilitation is completed, there would be a permanent disturbance of approximately 158 ha comprising the inundation area and permanent infrastructure (operational footprint).
Construction	Construction duration of approximately 6 years.
	Construction workforce of approximately 125 workers at construction peak.
Operation	It is proposed that WaterNSW will be responsible for management, operation and general maintenance of the new dam. It is proposed Tamworth Regional Council will be responsible for the management, operation and general maintenance of the pipeline. Public use and access to the dam would not be permitted and there would be no public facilities available during operation.
	One to two new full time workers plus part time work for existing WaterNSW operations team. Due to the new Dungowan Dam being prioritised over Chaffey Dam for Tamworth's future water supply, the water reserved for town water in Chaffey Dam would increase from 14.3 GL to 30 GL to ensure that water is set aside to meet Tamworth's town water supply water demand in years when rainfall is low.
Design life	100 years for zoned earthen embankment, structural concrete elements of the dam and the pipeline. 15 to 50 years for other non-structural project elements and pavements.
Assessment period (operational)	The assessment end point is when the water system performance reaches a level when an additional water supply option or change to the Water Sharing Plan is required. This has been estimated to be when the mean average water demand from Tamworth increases to 11 GL/year.



Source: EMM (2022); WaterNSW (2021); Metromap (2019); Esri (2019); DFSI (2017); GA (2013)

Project design elements

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 4.1

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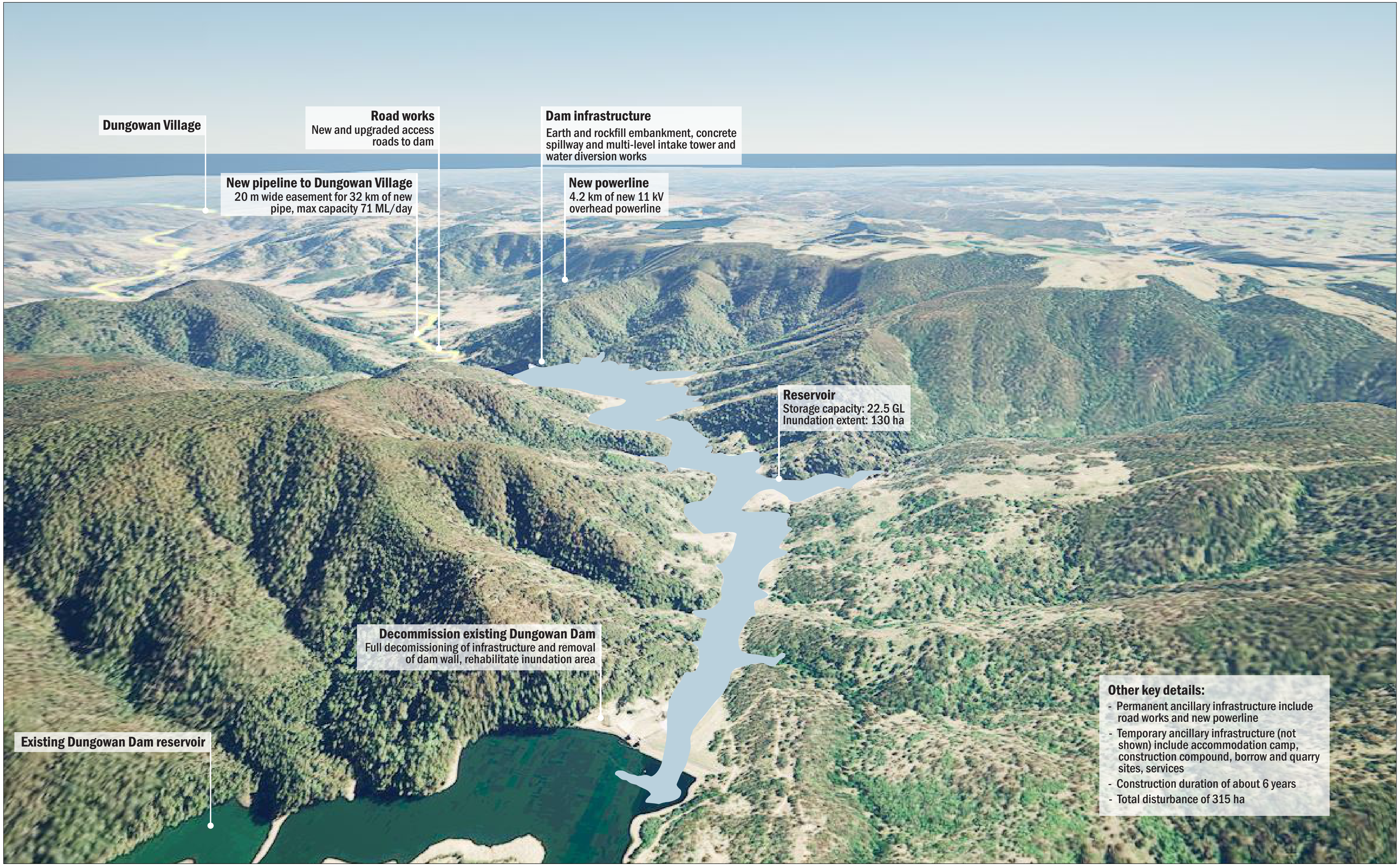

Figure 4.2 Overview of Dungowan Dam and pipeline project

EMM
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4.2 Project areas

A project footprint has been defined to facilitate the assessment of direct impacts from the project:

- Project footprint: all areas where direct impacts may be experienced during construction and/or operation.

The project footprint has an area of 315 ha and is comprised of the construction and operational footprints, of which there is some overlap:

- Construction footprint: areas where vegetation clearing and/or ground disturbance is required for construction of the dam, pipeline, powerline and ancillary facilities, including the area needed to decommission and rehabilitate the existing dam.
- Operational footprint: areas where there would be permanent operational elements or easements, including infrastructure needed to operate the new Dungowan Dam and pipeline. The operational footprint includes the inundation area, being the area defined by the proposed full supply level (FSL) for the project.

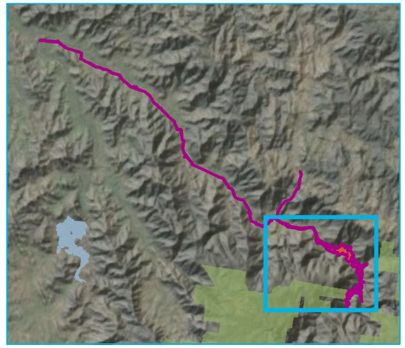
The project construction footprint is shown in Figure 4-3 and the operation footprint in Figure 4-4.

Additional areas outside the project footprint have also been considered where relevant to the assessment of project impacts and include:

- Upstream flood extent: an area above the FSL to the level of a probable maximum flood (PMF) event that would be inundated for relatively short periods during operation associated with extreme rainfall events.
- Project area: a 10 km buffer around the project footprint defined to allow for assessment of potential indirect impacts.
- Downstream impact area: the area where hydrological changes may occur due to the project. This area is discussed in detail in the Surface Water Assessment appended to the EIS, as well as other technical reports subject to changed flow regimes as a result of the new Dungowan Dam operation. The downstream impact area includes Dungowan Creek and also the Peel River downstream of Chaffey Dam.

In addition to the project areas, terminology commonly used in the EIS include ‘upstream’ and ‘downstream’ with reference to the dam wall. Reference to left and right abutments is defined as the sides of the valley when looking in the downstream direction. ‘Embankment’ or ‘dam wall’ means the infrastructure that impounds the water, while the ‘reservoir’ or ‘storage’ is the waterbody impounded by the dam wall. The extent of the reservoir or storage is referred to as the ‘inundation area’.

Technical assessments prepared to support the EIS may also refer to a ‘study area’. These study areas are explained in the relevant assessments and sections of the EIS.



KEY

- Project footprint
- Construction footprint
- Major road
- Minor road
- Named watercourse
- State forest

Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

GDA 1994 MGA Zone 56

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Construction footprint

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 4.3a

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KEY

- Project footprint
- Construction footprint
- Major road
- Minor road
- Named watercourse

Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

0 1 2 km

GDA 1994 MGA Zone 56

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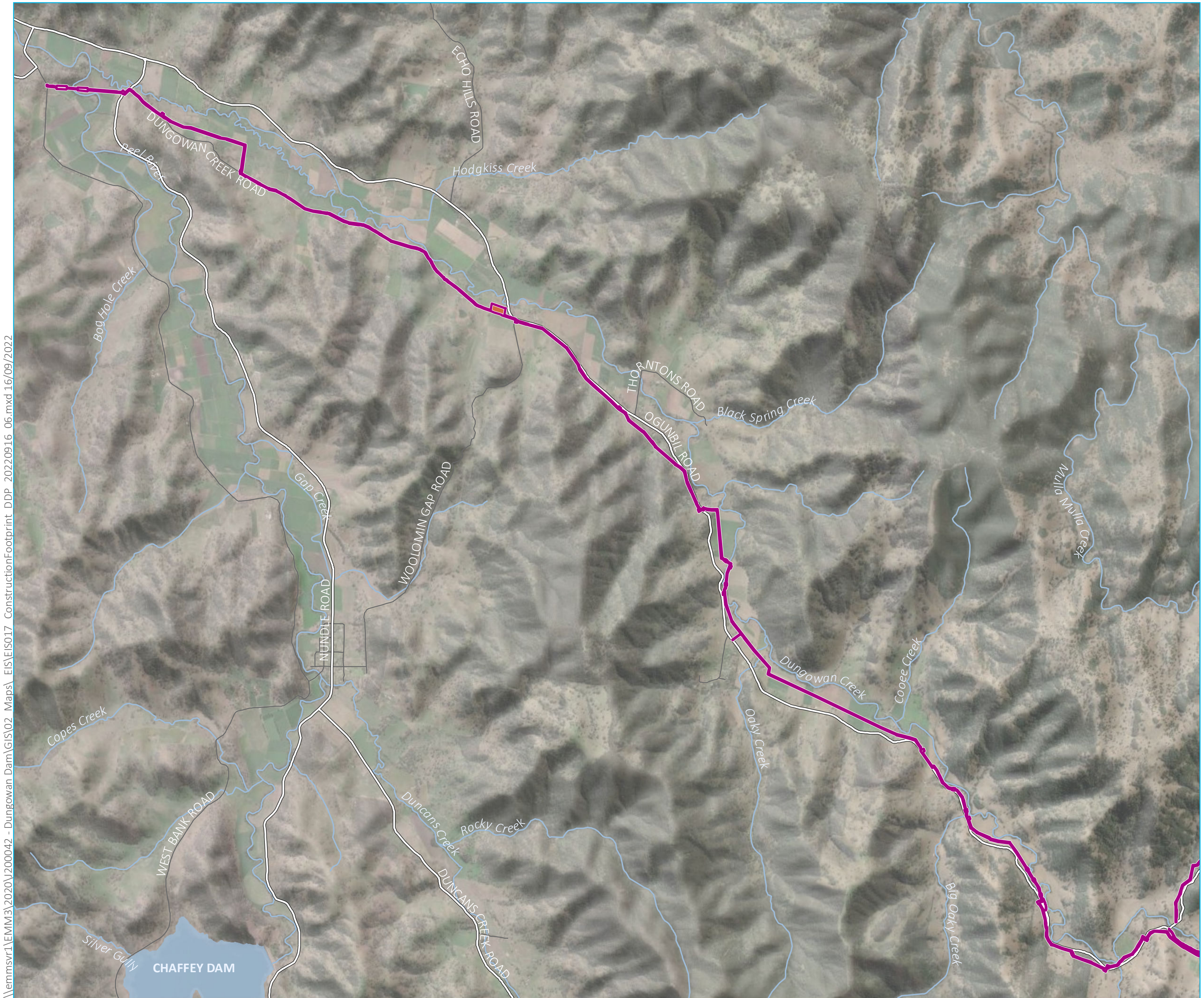
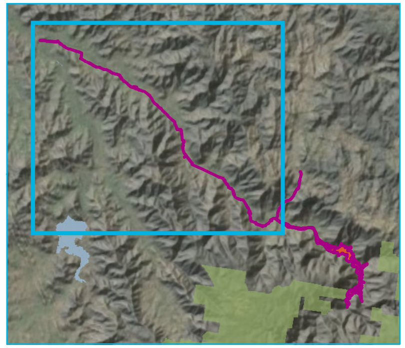
Construction footprint

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 4.3b

creating opportunities





KEY

- Project footprint
- Construction footprint
- Major road
- Minor road
- Named watercourse
- Named waterbody

Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

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Construction footprint

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 4.3c

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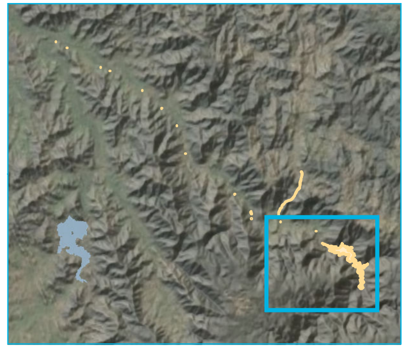

KEY
- Operational footprint
- Major road
- Minor road
- Named watercourse
- Named waterbody
- State forest

Source: EMM (2022); WaterNSW (2021); Metromap (2019); Esri (2019); DFSI (2017); GA (2013)

0 1 2 km
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Operational footprint

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 4.4a

EMM
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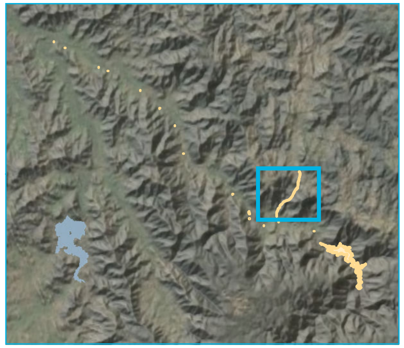

KEY
- Operational footprint
- Major road
- Minor road
- Named watercourse
- Named waterbody

Source: EMM (2022); WaterNSW (2021); Metromap (2019); Esri (2019); DFSI (2017); GA (2013)

Operational footprint

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 4.4b

EMM
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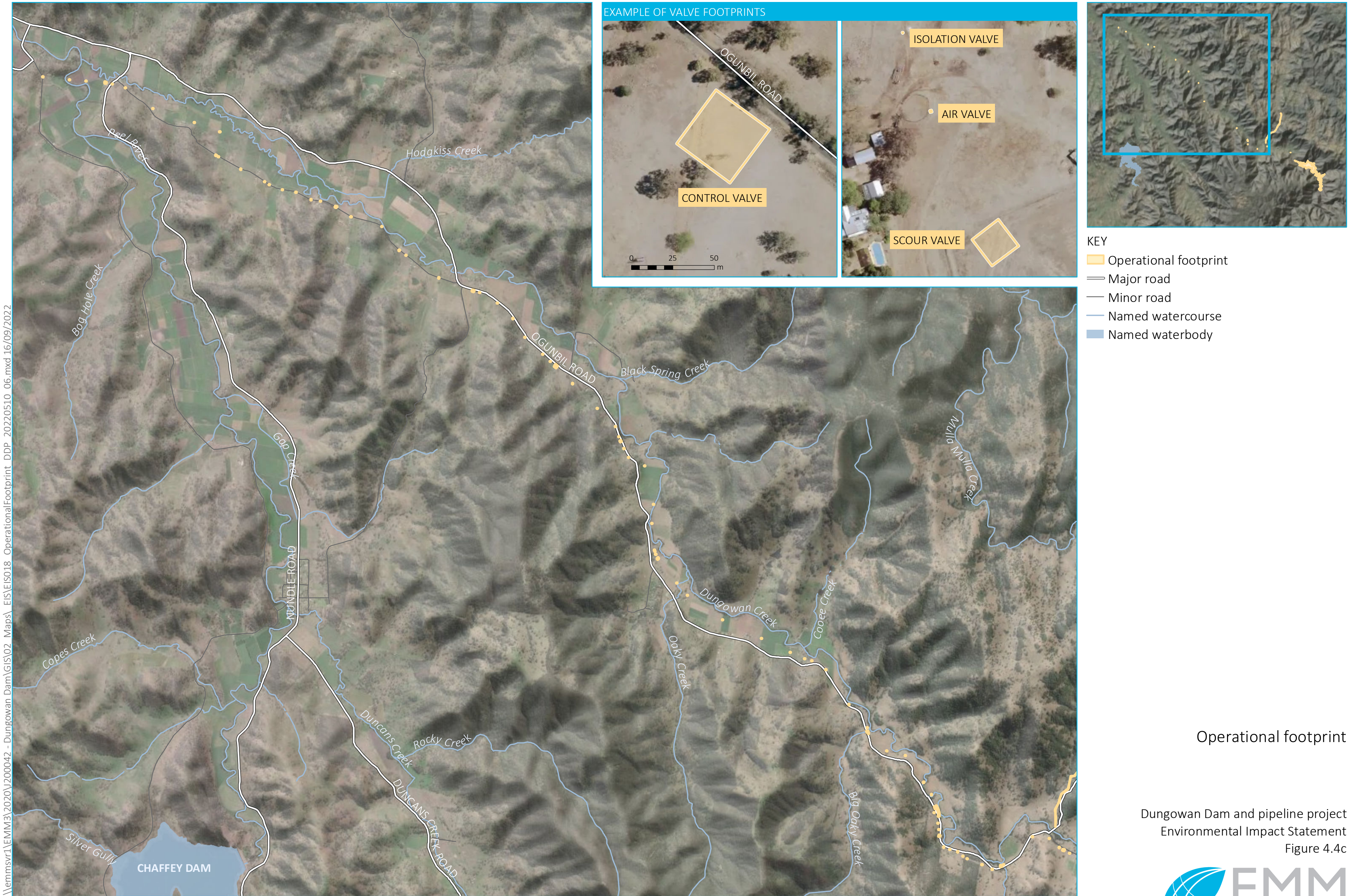

KEY
- Operational footprint
- Major road
- Minor road
- Named watercourse
- Named waterbody

Source: EMM (2022); WaterNSW (2021); Metromap (2019); Esri (2019); DFSI (2017); GA (2013)

0 1 2 km
GDA 1994 MGA Zone 56
N

\\emmsvr1\EMM3\2020\J200042 - Dungowan Dam\GIS\02_Maps_EIS\EIS018_OperationalFootprint_DDP_20220510_06.mxd 16/09/2022

Operational footprint

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 4.4c

EMM
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4.3 Project design

4.3.1 Dam infrastructure

The new Dungowan Dam would be an embankment dam that would impound nominally 22.5 GL of water within the reservoir at FSL and would comprise:

- Zoned earth embankment across Dungowan Creek.
- Concrete lined spillway chute excavated within the left abutment.
- Outlet works located within the left abutment of the dam including a multiple level intake tower, diversion tunnel with outlet conduit and valve house.

The infrastructure is shown conceptually in Figure 4-5 and detailed plans provided in Appendix B2.

The embankment dam would be a maximum height of 58 m (from downstream embankment toe), 270 m long and with a crest width of 10 m. The crest elevation is 672.3 m Australian Height Datum (AHD). The embankment includes an earthfill core and rockfill shoulder. The materials needed to build the embankment (about 1.94 M m^3 in total) would be sourced from the spillway excavation or from within the inundation area, meaning minimal material would need to be imported to or exported from site.

The concrete lined spillway is 60 m in width and designed for a peak headwater level (probable maximum flood level) at 671.74 m AHD. During operation, it would be able to convey water at peak outflow of 5,244 m^3/s.

The multiple level intake tower would be a maximum height of 50 m and allow for eight intake ports within the range of the dam's minimum operating level (MOL) and FSL. The purpose of these multiple intakes is to provide the ability to selectively draw from different depths of the reservoir and to manage cold water pollution effects. An outlet conduit would release water downstream of the dam to Dungowan Creek for environmental flows and operational drawdown and to the replacement pipeline for water supply needs. This outlet conduit is a pipe beneath the embankment about 1.2 m in diameter. The release of water is regulated by the valve house pipework, valves and control system.

The dam infrastructure would enable the storage of 22.5 GL of water within the reservoir when at FSL, which would have an extent of about 130 ha. While FSL would be at RL 660.2 m AHD, a further 2 m above FSL has been considered in the design for wave action and erosion.

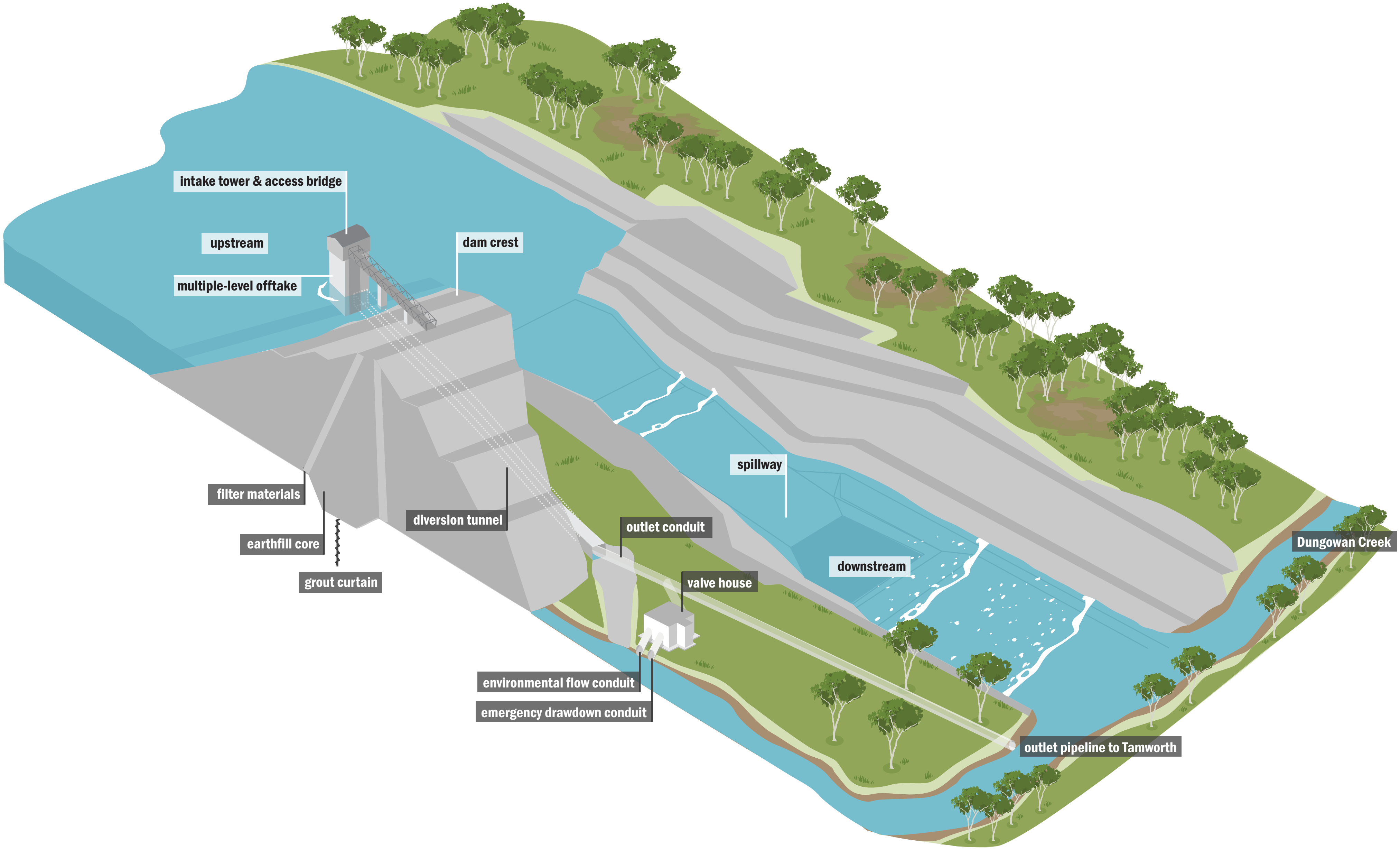

Figure 4.5 Concept view of Dungowan Dam infrastructure

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4.3.1.1 Dam construction

Dam construction would generally occur as follows:

- Diversion of Dungowan Creek through the establishment of a diversion tunnel and temporary pipework and cutover works and initial outlet works construction. This is discussed in detail in the next section.
- Intake tower works, including excavation of intake tower footing and intake tower access bridge footings, construction of reinforced concrete tower base and shaft and approach channel walls. Remaining intake tower works would be completed concurrently with dam wall and spillway construction.
- Construction of coffer dams involving vegetation removal, the stripping and stockpiling of topsoil, overburden and weathered rock, completing coffer dam foundations, and placing of earth fill materials in 150–250 mm layers.
- Excavation and bulk earthworks to establish the dam wall embankment, involving vegetation removal, the stripping and stockpiling of topsoil, overburden and weathered rock. This would involve open cut excavation of the embankment foundation and the placement of dam wall embankment materials by bulldozers, excavators and dump trucks.
- Open cut excavation and benching of the spillway followed by establishment of spillway concrete structures. The spillway excavation would be completed concurrently with the construction of the dam wall embankment and would provide a large volume of the dam wall embankment materials required. Material would generally be excavated from the spillway by mechanical ripping. However, blasting may be required depending on the material encountered.
- Installation of outlet works and completion of intake tower. The outlet works would be undertaken concurrently with the embankment and spillway construction and involve completion of the intake tower and installation of bridge piers, construction of the access bridge to the intake tower (once embankment completed), installation of mechanic equipment within the intake tower, and construction of the downstream valve house and associated pipework and mechanical items.
- Vegetation management and preparation of inundation area prior to filling. Vegetation within and up to 2 m above the FSL level would be cut to stump height prior to filling the reservoir and the vegetation removed to reduce impacts on water quality. Erosion protection materials such as rock armour may also be placed around sections of the inundation area shoreline.

4.3.1.2 Diversion of Dungowan Creek

Diversion of Dungowan Creek during construction of the dam would be required to transfer normal river and flood flows through the construction site and provide a relatively dry working environment. This diversion and dry working environment would be achieved through the construction of cofferdams and a diversion tunnel. Cofferdams would be established at both the upstream and downstream extents of the embankment and the diversion tunnel would be provided within the left abutment. The diversion tunnel would also be used to accommodate a temporary bypass pipeline during the construction works to allow the continued supply of raw water from the existing Dungowan Dam during the project construction. The temporary bypass pipeline would be installed within the diversion tunnel and would be connected to the existing Dungowan Dam pipeline and would continue to operate until the proposed dam is commissioned. The staging of the diversion works is shown in Figure 4-6.

At the completion of construction, the diversion tunnel would remain as a permanent tunnel housing the outlet conduit and providing access for maintenance and operation (the outlet works). This is shown on Figure 4-7.

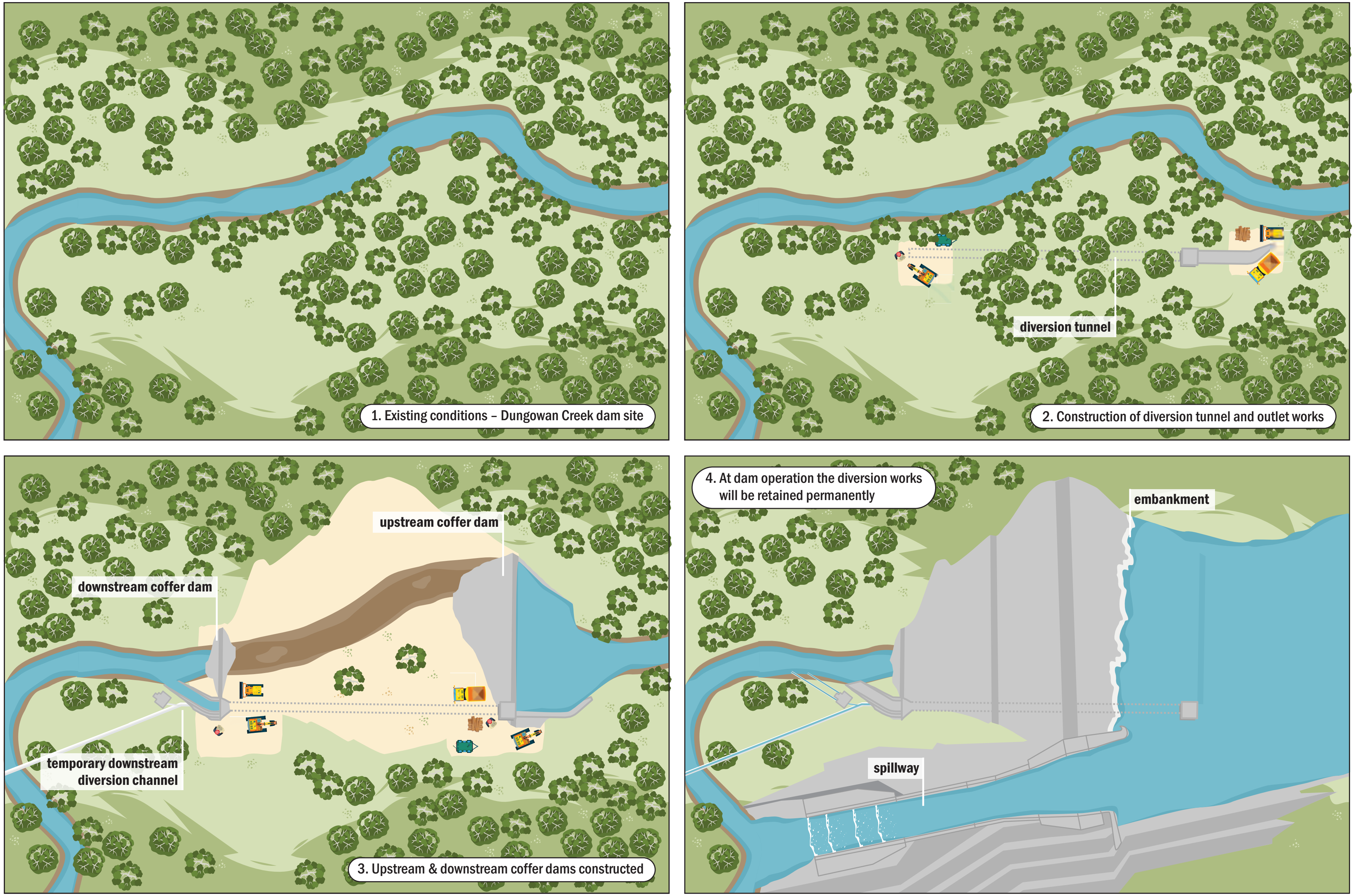
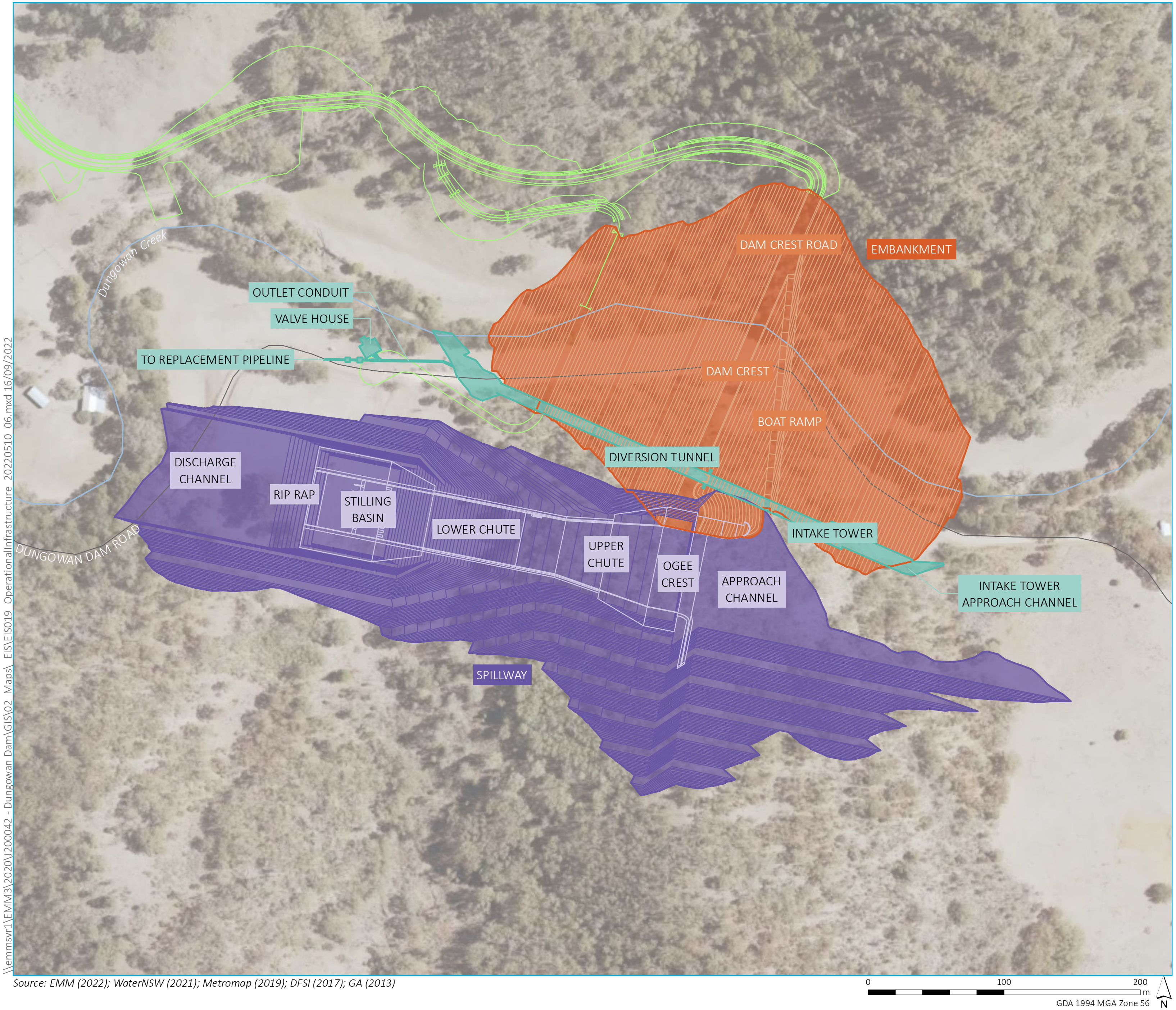


Figure 4.6 Staging of diversion works

EMM creating opportunities



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Source: EMM (2022); WaterNSW (2021); Metromap (2019); DFSI (2017); GA (2013)

Operational infrastructure

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 4.7

EMM creating opportunities

4.3.2 Pipeline infrastructure

The existing Dungowan pipeline (between Dungowan Dam and Dungowan village) would be replaced by a new pipeline installed to deliver water from the new Dungowan Dam to the Calala WTP. A new section of pipeline about 32 km long, would be constructed between the new Dungowan Dam outlet and the tie in point to the existing pipeline from Dungowan Showground to the Calala WTP.

Pipeline infrastructure includes 710 mm to 900 mm internal diameter HDPE pipe, buried underground along the alignment shown on Figure 4-8. The pipeline would have a maximum flowrate of 71 ML/day. A series of valves are needed along the alignment to control flows, pressure and facilitate maintenance. These valves are control valves, scour valves, isolation valves and air valves.

Two control valve stations are needed along the pipeline and involve the construction of approximately 8.1 m x 6.4 m x 3.5 m high Colourbond sheds, surrounded by security fencing.

All other valves would be required to be exposed and accessed during operation and therefore would have either an element of above ground or ground level infrastructure, including pits, exposed valve arrangements and safety/protection bollards. Pits associated with these valves would typically be up to approximately 1.5 m^2 in size and would be required to be accessed throughout operation.

During construction, a temporary bypass pipeline would be established to ensure continued supply of water to downstream customers. This bypass pipeline is connected to the diversion tunnel and outlet conduit (at valve house) and conveyed to the existing Dungowan pipeline until it is decommissioned and transferred to the new pipeline.

4.3.2.1 Pipeline construction

The replacement pipeline would be installed within a construction footprint that is a maximum of 20 m wide and this would include a trench and an area to accommodate construction access, set down points, pipeline stringing and storage areas. This may reduce in width at certain points to avoid constraints and to limit biodiversity impacts. Excavators would dig the trench, with topsoil separated and then spoil stockpiled adjacent to the trench for backfilling after the pipeline is installed. Any excess spoil from the trench excavation would be reused within the project footprint or disposed of to a suitably licensed facility. The trench would typically be 1.35 m wide and up to 2.2 m deep. Pipe would be laid progressively within the trench and valve infrastructure would also be installed progressively.

The pipeline would be trenched across Dungowan Creek at eight locations. Construction would be managed through the use of coffer dams and temporary waterway diversions (shown in Figure 4-9).

Crossing of the Peel River for the pipeline would be undertaken using Horizontal Directional Drilling (HDD). The HDD would involve drilling an initial pilot bore approximately 200 mm in diameter with subsequent larger bores drilled until a hole of approximately 1 m diameter is completed, at which point the 800 mm HDPE pipe would be pulled through the entire bore. The location of the HDD under the Peel River is shown in Figure 4-8, Inset 1.

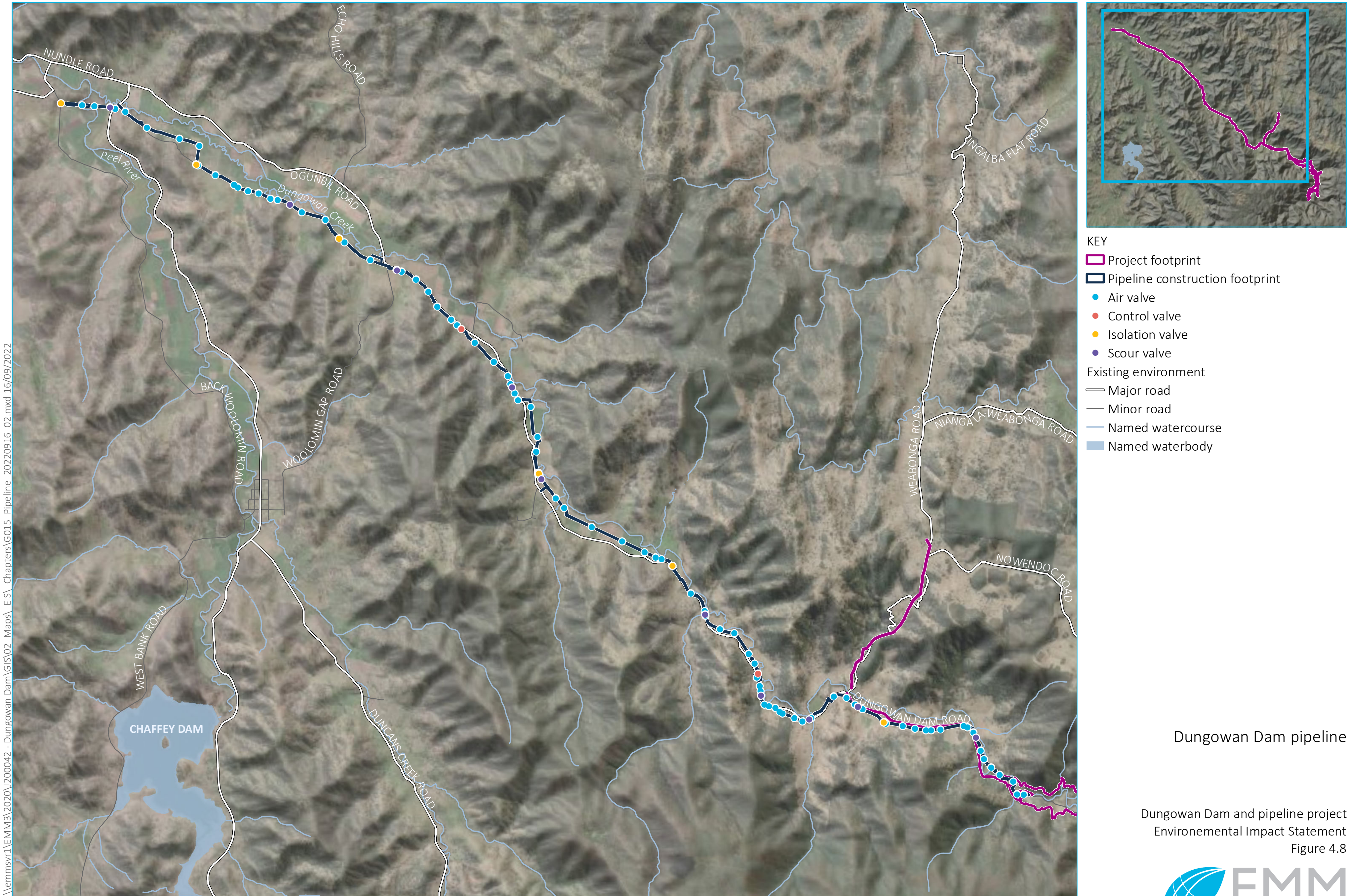
The pipe delivered to site would be up to 20 m in length and would be transported on extendable trailer trucks carrying between 10 and 20 pipe segments per delivery and stored at laydown locations. Pipes would then be transferred onto smaller more agile trucks for delivery along the route as installation proceeds. Pipe laying would be undertaken progressively and may involve multiple work crews at separate locations.

Pipeline construction would proceed in sections generally ranging from 50 m to 200 m per day, with the actual rate of progress determined by ground conditions and the construction methodology adopted by the design and construction contractor.

4.3.2.2 Customer connections

The current raw water pipeline from the existing Dungowan Dam supplies water to around 65 existing customers through a series of connections teeing off the existing raw water pipeline. Customers would continue to be supplied raw water through the replacement pipeline, either through tapping into existing customer connections (i.e. where the replacement raw water pipeline is in close proximity to the existing raw water pipeline) or through the provision of new customer connection points.

All properties on the replacement pipeline alignment would be provided with a connection point as a result of the project, with an additional 52 new customers (totalling 117 new and existing connections) being supplied raw water from the replacement raw water pipeline. Customer connection infrastructure would include a typically 20 mm copper pipe running directly from the replacement raw water pipeline to an above ground meter assembly located on private property.



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Source: EMM (2022); WaterNSW (2021); Metromap (2019); DFSI (2017); GA (2013)

KEY

- Project footprint
- Pipeline construction footprint
- Air valve
- Control valve
- Isolation valve
- Scour valve

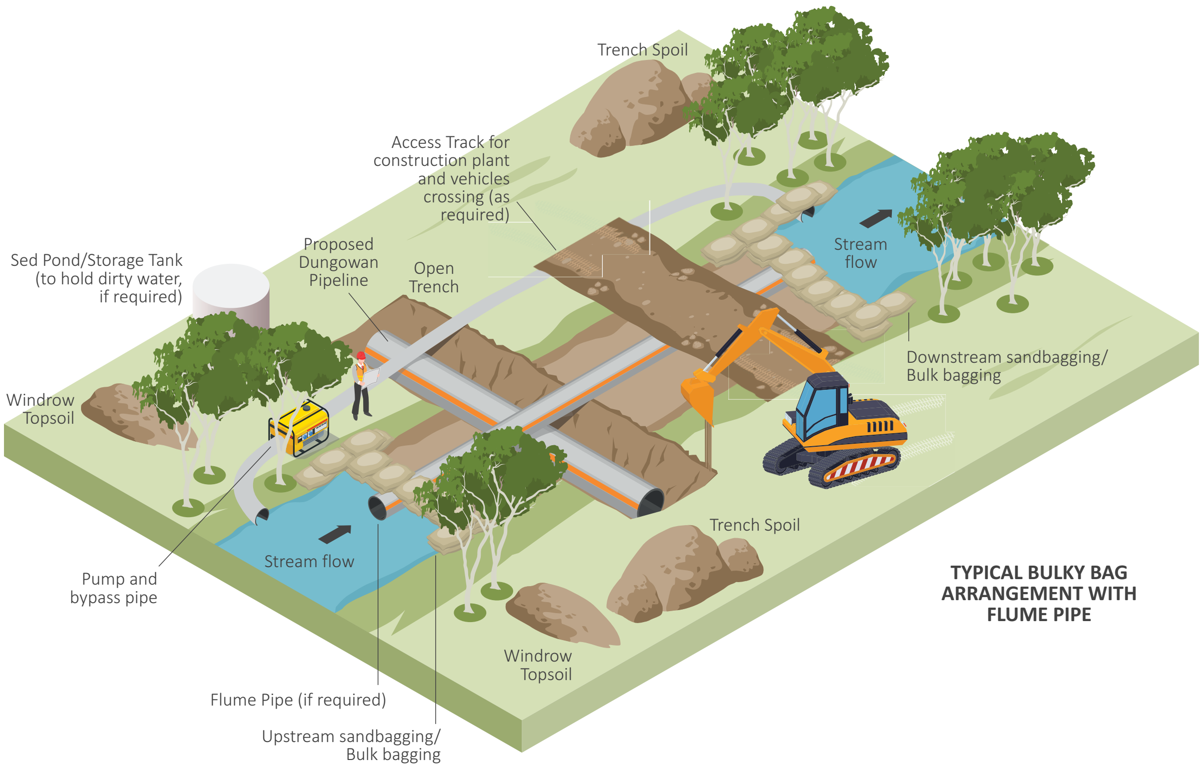
Existing environment

- Major road
- Minor road
- Named watercourse
- Named waterbody

Dungowan Dam pipeline

Dungowan Dam and pipeline project
Environemental Impact Statement
Figure 4.8

creating opportunities



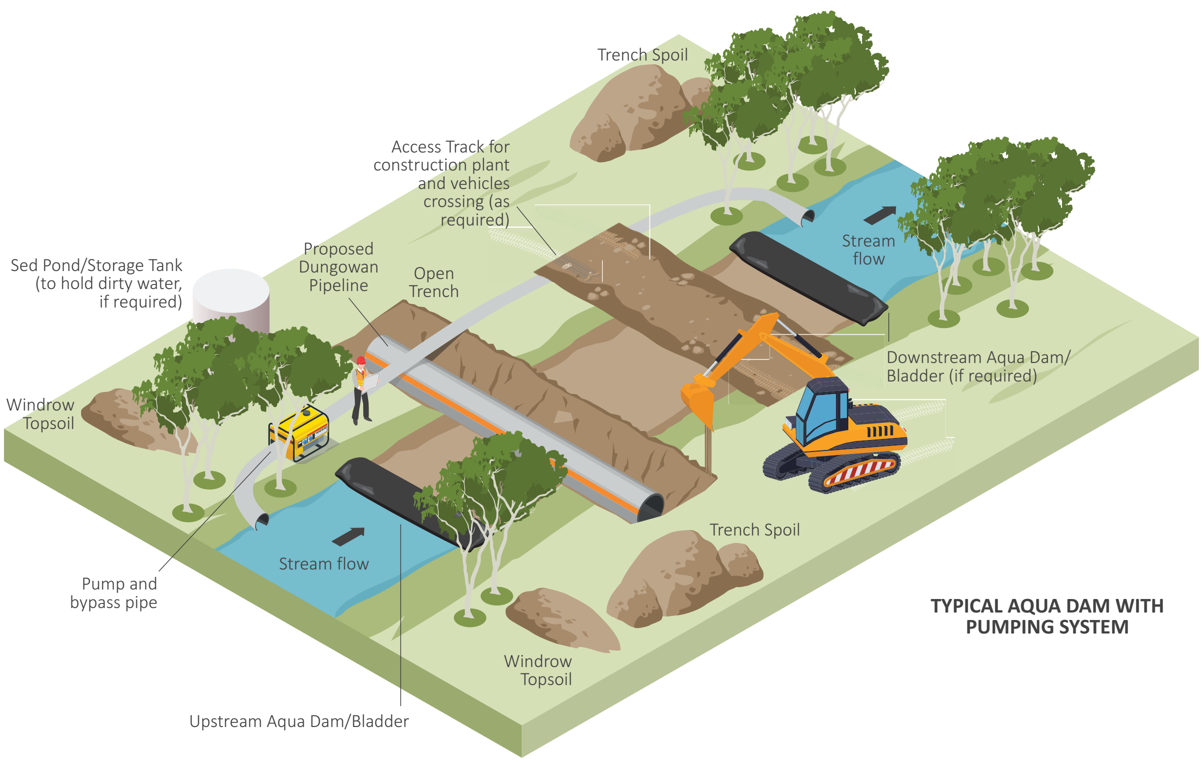


Figure 4.9 Typical cross section arrangements

4.3.3 Ancillary infrastructure

Ancillary infrastructure includes the supporting infrastructure needed to enable and support the main design (being the dam and pipeline). Ancillary infrastructure needed for the project includes temporary infrastructure needed to support construction as well as permanent infrastructure needed to support operation. Temporary infrastructure would be decommissioned and rehabilitated once construction is completed. Temporary construction ancillary infrastructure is described in Table 4-2 and their locations are shown in Figure 4-10.

Table 4-2 Temporary construction ancillary infrastructure

Infrastructure	Purpose	Description
Accommodation camp	To provide overnight accommodation to up to 125 workers during construction.	The accommodation camp would be operational throughout the project construction and would provide facilities for the overnight accommodation of workers including single storey units, central facilities, stormwater detention/quality treatment, maintenance areas, bus and car parking.
Construction compound (dam)	To provide support facilities and laydown to dam wall embankment construction.	The construction compound would provide construction support facilities, such as a concrete batching plant (CBP), laydown yard and site sheds. The CBP would produce up to about 90,000 m^3 of concrete through the construction period.
Construction compound (pipeline)	To provide support facilities and laydown to pipeline construction.	Uses of this compound would include crib sheds, offices, parking, amenities, laydown and storage areas for equipment and fuels/chemicals. In addition, portable ablution facilities or smaller mobile site sheds are likely to be established along the pipeline corridor, within the 20 m construction footprint, to reduce the need for vehicle movements back to the main construction compound. These would be relocated as construction progresses. The 20 m construction footprint could also be utilised for the laydown or storage of any material, equipment or pipe sections.
Quarries and borrow areas	To provide source materials for construction. In total about 1.9 million m^3 of construction materials would be required.	Up to two new quarries would provide a source of rock aggregates for the project construction. The quarries would be located predominantly within the inundation area. Up to four borrow areas would provide low permeability material (silt and clay) for the project construction. The borrow areas have been sited entirely within the inundation area. A majority of construction materials would also be sourced from the excavation of the spillway.

Infrastructure	Purpose	Description
Construction utility supplies	To provide water and power during construction.	It is assumed water would initially be required from the existing Dungowan Dam, but the majority would be from rainfall captured behind the upstream coffer dam once constructed, via a temporary intake pipeline that would be reticulated throughout the construction footprint. Potable water supply during construction would be delivered by truck from a mains water supply in Tamworth. Construction power would be provided by a connection to the existing 11 kV powerline within the footprint of the construction compound. There may also be some minor use of diesel generators.

There may also be some road realignment or upgrade required to Dungowan Dam Road between the proposed dam wall and the existing Dungowan Dam. These upgrades would only be required to provide access during the project construction including access to the quarry and borrow areas and to provide access for vehicles and equipment for operation and maintenance of the existing Dungowan Dam and for its subsequent decommissioning. To minimise the project footprint, any road realignment or widening outside the existing roadway would be entirely within the inundation area for the proposed dam or within areas already disturbed such as the quarry area. The road would no longer be needed following decommissioning of the existing dam and would be inundated during operation.

Permanent ancillary infrastructure is required both during construction and operation and are described in Table 4-3 and shown in Figure 4-10.

Table 4-3 Permanent ancillary infrastructure

Infrastructure	Purpose	
Access roads	New access roads and access road upgrades are required to allow safe construction and operational access to the project.	Two new or upgraded roads would be retained permanently: • Dungowan Dam Road: as main access and haul road to Dungowan Dam, the road would require upgrade (such as re-surfacing) and widening to 8 m where practical along about 3.5 km. • Dam crest access road: a new road to provide private access to the proposed dam crest. It requires a bridge over the creek and a two-way, two lane, sealed road suitable for heavy vehicles.

Infrastructure	Purpose	Description
Relocation of 11 kV powerline	Existing powerlines within the proposed dam inundation area currently supply the town of Niangala and would require decommissioning to enable the construction of the proposed dam.	A section of existing Essential Energy overhead assets would be decommissioned including timber poles, pole top cross arms and accessories, pole mounted substations and bare conductors. A new 11 kV overhead line including a new easement and 4 m wide access track (approximately 4.2 km) and connecting it with the existing overhead line to the Niangala area (approximately 13.2 km). The existing overhead line would potentially require some minor upgrade works including re-stringing of new overhead wiring and replacement of some poles. The new connection would be established before any decommissioning to ensure power supply to the Niangala area is maintained throughout construction and operation of the project.
Services	To provide power and communications for operation of the project.	Power would be supplied to the valve house and to the dam crest from existing 11 kV overhead powerlines on Dungowan Dam Road. Communications between the dam and Calala WTP would be via a fibre optic cable buried within the trench of the replacement pipeline.
Other supporting infrastructure	To support operation and maintenance activities.	Access to the site would be restricted to WaterNSW staff and their contractors by a fence at all access points. Public use or access to the dam would not be permitted. A boat ramp would provide operational and maintenance staff access to Dungowan Dam. The boat ramp would be located on the left abutment adjacent the spillway approach channel. Instrumentation and telemetry would be established to support the project construction and operation. This includes various survey points, piezometers, seepage measuring locations, reservoir level gauges, anemometer and a rainfall gauge.

Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

0 2.5 5 km

GDA 1994 MGA Zone 56

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KEY

- Project footprint
- Existing power line to be decommissioned
- Compound/laydown area
- Borrow area
- Construction and accommodation camp
- Quarries
- Road upgrade
- Power line footprint

Existing environment

- Major road
- Minor road
- Named watercourse
- Named waterbody

Ancillary infrastructure

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Figure 4.10

creating opportunities

4.3.4 Decommissioning of the existing Dungowan Dam

The existing Dungowan Dam would be decommissioned to eliminate dam safety risks and reduce project costs for the new Dungowan Dam. The decommissioning would involve a full height breach through the existing embankment which would effectively restore run of river flows. Decommissioning work would not start until the new Dungowan Dam is substantively complete. The indicative decommissioning works are shown in Figure 4-11.

Decommissioning the existing Dungowan Dam would involve:

- Dewatering of existing dam through outlet works (or augmented with pumping).
- Removal and salvage of existing spillway crest gates.
- Demolition of all concrete works to ensure the concrete structures do not retain water. Concrete will remain in place and be entombed by the excess material.
- Excavate through existing dam embankment to the natural creek bed level, with excess material used to fill in adjacent redundant structures and natural low points with the balance of material placed in upstream area.
- Construct channel at base of existing dam to route flows to Dungowan Creek/new Dungowan Dam.
- Provide appropriate erosion protection (such as rock armour) in the flood zone.
- Shape and profile excavation and embankment surfaces to blend into surrounds and direct stream flows.
- Rehabilitate the catchment within the inundation area of the existing dam below the FSL (682.8 mAHD).

It is expected that an excess volume of spoil material would be created by the embankment breach excavation, exceeding what is required for the downstream levelling and left abutment remediation. The excess material would be used to construct an additional profiled placement area within the existing reservoir. The placement area would be on the peninsula immediately upstream of the embankment, and below the existing full supply level to limit any incremental environmental impact beyond the existing reservoir footprint (Figure 4-11 and Figure 4-12). Concrete rubble from the demolition works would also be disposed of in discrete layers with embankment material and entombed in the final profiled placement area.

Following the de-watering of the existing dam, revegetation works would be completed within the former inundation area. Revegetation works would include topsoiling and seeding of the area between the current FSL of the existing dam. A detailed rehabilitation plan would be prepared for the total area of about 59 ha to be revegetated and rehabilitated.

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Source: EMM (2022); WaterNSW (2021); Metromap (2019); Esri (2019); DFSI (2017); GA (2013)

0 250 500 m
GDA 1994 MGA Zone 56
N

KEY

Project footprint
Decommissioning and filling of redundant spillway
Full height breach of existing dam wall embankment
Profiled placement area
Profiled placement area
Decommissioning area

Existing environment
Minor road
Named watercourse
Named waterbody

Existing dam decommissioning works

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 4.11

creating opportunities

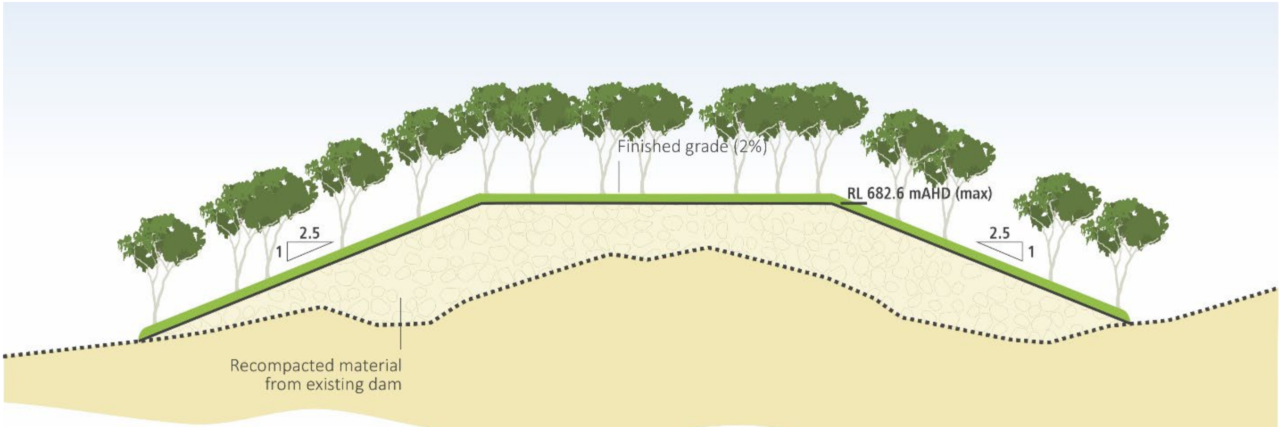


Figure 4-12 Schematic section of profiled placement area

4.4 Construction management

Construction of the project would take about 6 years to complete. The project development would involve different phases and activities with the indicative construction sequencing shown in Figure 4-13.

Figure 4-13 Indicative construction sequencing

4.4.1 Construction hours

Construction works would generally be conducted within the hours outlined in Table 4-4. However, it is likely that activities need to support construction such as spillway concreting (in summer months) would be undertaken 24 hours a day, seven days a week. The project construction environmental management plan (CEMP) would include measures to manage potential impacts of construction activities during non-standard work hours.

Table 4-4 Standard work hours

Work type	Recommended standard hours of work
Normal construction	Monday to Saturday 7.00 am to 6.00 pm.
	Sundays or public holidays – low noise and low traffic generating work may be carried out 9.00 am to 5.00 pm.
Blasting	Monday to Saturday 9.00 am to 5.00 pm.
	No work on Sundays or public holidays.

4.4.2 Workforce

The project would require up to about 125 persons at peak construction. The indicative distribution of the workforce over the construction program is shown in Figure 4-14. It is expected that the contractor would preference recruitment of the workforce locally where suitable skills and capacity are available. The workforce would be housed in the accommodation camp described in Section 4.3.3, or in existing accommodation in Tamworth in some circumstances. Buses are likely to be provided for workers to be transported to site each day.

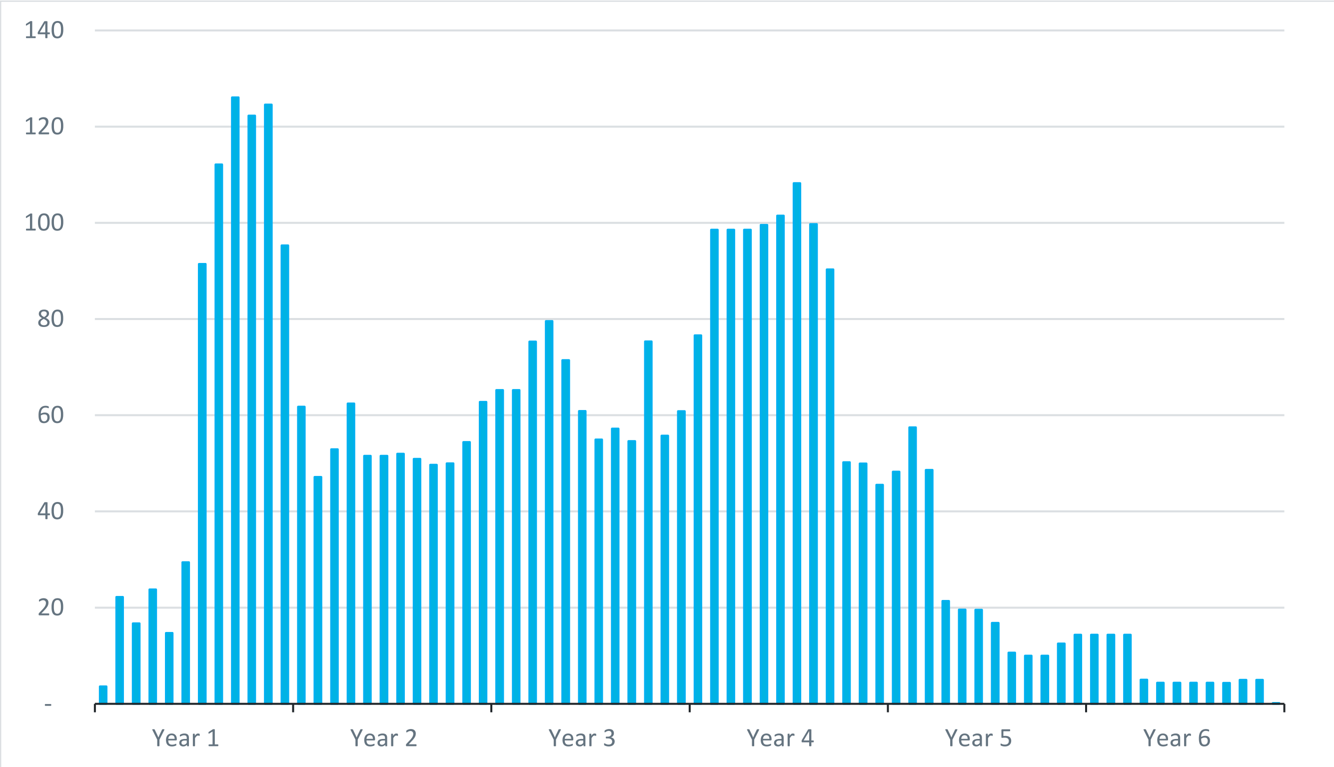


Figure 4-14 **Indicative workforce histogram**

4.4.3 Construction traffic and transport

The primary transport route follows the New England Highway to Nemingha (about 7 km south-east of Tamworth) and turns onto Nundle Road to Dungowan. Vehicles would then turn off Nundle Road at Dungowan onto Ogunbil Road followed by Dungowan Dam Road. The following road sections would not be used by the project construction traffic:

- Duri Dungowan Road west of Back Woolomin Road (which connects from Nundle Road to the New England Highway south of Tamworth).
- Nundle Road south of Dungowan Creek Road (to and from the Nundle direction).
- Any access to and from the East from the Niangala/Nowendoc Road direction.

Traffic would be generated during the project construction due to the transport of construction materials, equipment, personnel and waste on the main transport route. The project construction traffic is expected to consist predominantly of Heavy Vehicle (HV) movements. An estimate of the average daily HV movements during the project construction is provided in Figure 4-15.

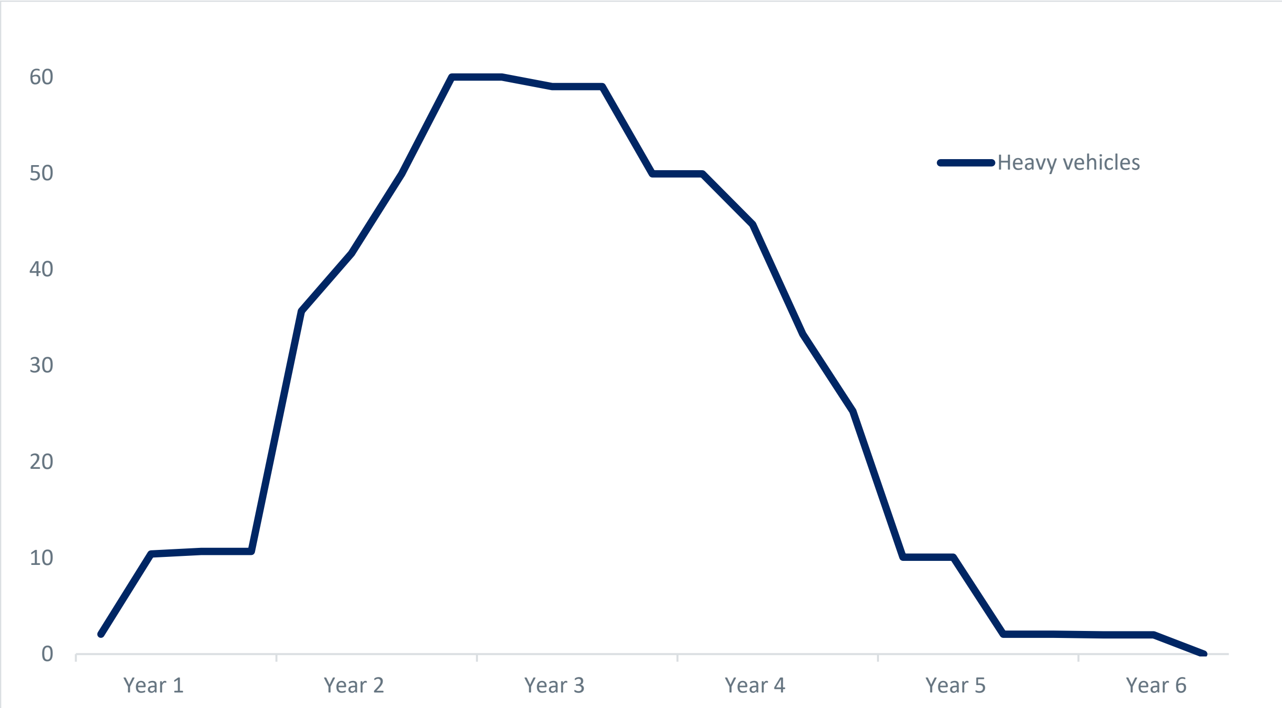


Figure 4-15 Average daily heavy vehicle traffic volumes (total trips per day)

4.5 Operation

4.5.1 Ownership

An Asset Ownership Working Group was established in 2022 to progress discussion on the potential ownership and operation of the various aspects of the project. The working group consisted of Tamworth Regional Council, NSW Treasury, WaterNSW and Water Infrastructure NSW as the representative of the NSW Government. The NSW Government (likely through the Water Administration Ministerial Corporation) would be the initial owner of the infrastructure during the construction. Once construction and commissioning has been completed, the ownership and operation of the new pipeline and new Dungowan Dam would be transferred to other entities. The current proposed ownership model is that Tamworth Regional Council would own and operate the new pipeline and associated customer connections and WaterNSW would own and operate the new Dungowan Dam.

This EIS has been prepared based on this proposed ownership model. Ongoing discussions and negotiation with all parties regarding operations and ownership of the pipeline and dam would continue throughout the further development, construction and commissioning phases of the project.

4.5.2 Commissioning

The new Dungowan Dam would become operational when the diversion tunnel is permanently closed and all discharge pipelines and valves are commissioned and closed. Commissioning the new Dungowan Dam would involve filling the dam to above the minimum operating level (MOL). This would be achieved through a combination of rainfall events and emptying the existing Dungowan Dam.

Pipeline commissioning would involve flushing of the pipeline with raw water, testing and commissioning of valves and other pipeline control elements and undertaking leak tests. A plan to manage and dispose of any water used in pipeline commissioning would be developed to manage environmental impacts.

4.5.3 Operating principles

4.5.3.1 Operations

It is proposed the new Dungowan Dam and replacement pipeline would be operated by WaterNSW and Tamworth Regional Council in accordance with final conditions of consent and as specified within the relevant Water Sharing Plan. The management and operation of the new Dungowan Dam and associated infrastructure would be consistent with the management and operation of other water storage facilities across NSW. This includes all necessary activities such as monitoring, surveillance and maintenance.

The new Dungowan Dam’s primary function is the supply of raw water to Calala WTP via the replacement pipeline. The project would also:

- Supply raw water to customers that have connections to the existing pipeline and to additional new customers along the route of the replacement pipeline.
- Provide water via run of the river discharges to any Stock and Domestic water licence holders along Dungowan Creek.
- Provide environmental flows through translucency releases and a new Environmental Contingency Allowance (ECA).

The new Dungowan Dam and pipeline would operate in parallel with the existing Chaffey Dam to supply raw water to the Calala WTP. The only change in the operations at Chaffey Dam would be that the water reserved for town water would increase from 14.3 GL to 30 GL. It is likely that this would be implemented through a change to the Water Sharing Plan. This change in town water reserve ensures that water is set aside to meet Tamworth’s water demand in years when rainfall is low.

One or two staff would be required for the day-to-day management of the dam and pipeline.

4.5.3.2 Maximum town water demand

Once the new Dungowan Dam is operational and the proposed changes to the town water reserve at Chaffey Dam are made, the system would be able to meet increased water demand at higher levels of security. However at some point in the future, the water demand from Tamworth would increase such that the risk of failure of the water system due a prolonged drought and/or time in water restrictions would increase to an unacceptable level.

When this occurs either an additional water supply option would need to be provided or non-infrastructure option such as a change in the Water Sharing Plan or ongoing complimentary water efficiency measures and water reuse solutions to moderate water demand growth would need to be implemented. Additional measures are being investigated through the Namoi Regional Water Strategy to form part of a longer investment pathway for water security and efficiency in the Peel and Namoi Valleys.

These measures may either lock-in the worst-case impacts from the project or would result in a change in the impacts of the dams, which at this stage cannot be predicted. Consequently, when the water system performance reaches a level when an additional water supply option or non-infrastructure options are required, this would be the maximum town water demand from the system and no further changes in hydrology would occur due to the project. Based on a number of factors, this has been determined to be when the mean water demand from Tamworth increases to 11 GL/year. This is further discussed in the Surface Water Assessment, appended to the EIS (Appendix F).

4.5.3.3 Flood operations

The new Dungowan Dam has no dedicated flood storage capacity and has an uncontrolled spillway which does not allow the management of flood waters. When the reservoir water level is below the FSL, the new Dungowan Dam would have a greater capacity to capture flood waters than the existing dam, however, the magnitude of flood mitigation is dependent upon the size of the flood event and the reservoir water level when the flood event begins.

In the rare situation when the dam is at FSL when a major inflow event occurs, there would be a minor increase in flooding downstream of the dam as the dam would not have capacity to capture flood waters, and the new dam has a larger catchment area and spillway than the existing dam. Flooding impacts are further described in the Surface Water Assessment, appended to the EIS (Appendix F).

During high rainfall events, inflows into the dam may exceed the capacity of the spillway and water levels in the dam may exceed the FSL for short periods of time and areas of land above the FSL would experience temporary inundation. There is no infrastructure in this area or privately owned land.

4.5.3.4 Environmental flows

Environmental flows would be provided by a dedicated offtake from the outlet conduit and would be discharged into Dungowan Creek near the valve house. Two types of environmental flows would be provided:

- Translucent flows up to a maximum of 13 ML/day. This is an increase from the current 10 ML/day and is based on the larger catchment of the dam.
- An environmental contingency allowance (ECA) of a maximum of 200 ML/year. The ECA would be based on the General Security licence allocations for the Peel River each year.

The increased translucent flows and new ECA for the new Dungowan Dam have been provided to mitigate some of the impacts of the new dam, particularly in Dungowan Creek. The volume of Held Environmental Water owned by the Commonwealth Environmental Water Office would remain the same and would not be impacted by the project.

4.5.4 Water supply

The existing raw water pipeline from the existing Dungowan Dam supplies water to around 65 customers through a series of connections teeing off the main raw water pipeline.

Existing customers would continue to be supplied raw water through the replacement pipeline, either through tapping into existing customer connections (i.e. where the replacement raw water pipeline is in close proximity to the existing raw water pipeline) or through the provision of new customer connection points. The existing raw water pipeline would remain in situ but would not be utilised to supply raw water once the replacement pipeline is commissioned.

There would be negligible disruption to the supply of raw water to existing customers during the pipeline construction and commissioning. Around three planned interruption periods are proposed that are expected to be between 24–48 hours in duration, with advanced notice provided to customers.

Approximately 52 new customers would also be supplied raw water from the replacement pipeline.

4.5.5 Maintenance and monitoring

Water quality monitoring in the reservoir would be consistent with WaterNSW’s water quality monitoring program. Monitoring equipment would be located in the outlet tower and would be able to be remotely accessed for analysis and setting of gate positions for draw off. No water treatment would be undertaken at the dam site. Raw water from the dam would be transferred via the replacement pipeline to the Calala WTP for supply to Tamworth and surrounds.

Instrumentation and telemetry would be established within the construction footprint to support the project construction and operation. A description of indicative instrumentation and telemetry required for the project is provided in Appendix B1.

Regular and emergency maintenance of the pipeline and associated infrastructure would be required. In some cases sections of the pipeline would need to be isolated and drained via scour valves. Water from scour valves would drain to waterways and appropriate erosion protection would be provided downstream of scour valves. As the pipeline is carrying raw water (i.e. it is not chlorinated or treated), the quality of the water would be similar to that in the downstream waterways and no water quality impacts would be expected.

The operation and maintenance of the new section of 11 kV overhead powerline would be the responsibility of Essential Energy. This would include ongoing management of vegetation to reduce the risk of power outages and potential bushfires as well as the maintenance of access tracks required to perform maintenance operations. All operational activities would be undertaken in accordance with Essential Energy operational procedures.

4.5.6 Cold water pollution

As the environmental flows are drawn from the water supply pipe, the water would be the same quality as drawn for town water supply. The selected level of draw off from the reservoir would be managed to reduce the potential for cold water pollution (CWP) downstream. To prevent stratification of the reservoir and algae blooms leading to poor water quality, a destratification system would be employed if necessary. Detailed design would investigate the need and, if necessary, the sizing of the two commonly accepted methods for mitigating stratification:

- The direct injection of air, or bubble plumes, through a network of pipes laid on the bottom of the reservoir.
- The installation of floating or fixed large impellers.

4.5.7 Interaction with other water supply sources

It is proposed the new Dungowan Dam and pipeline would be operated by WaterNSW and Tamworth Regional Council in accordance with final conditions of consent and as specified within the relevant Water Sharing Plan. It would also operate in parallel with the existing Chaffey Dam to supply raw water to Tamworth. The sequence for supplying water from the two dams to Tamworth would be:

1. When the new Dungowan Dam holds between 3 GL and 22.5 GL of water, water would be sourced from the Dungowan Dam. When the water level in Dungowan falls below 3 GL, supply would switch to Chaffey Dam.
2. Chaffey Dam would supply water to Calala WTP when the water level in Dungowan Dam is 3 GL or less.
3. If Chaffey Dam is supplying water to Tamworth and inflows to Dungowan Dam increase its level to above 3 GL, both dams would supply water to Tamworth on a proportional basis until the water level in Dungowan Dam reaches 4GL, at which point Dungowan Dam would supply 100 percent of Tamworth’s daily demand. Optimisation of this transition criteria will be undertaken during operation, but any minor changes would not change the outcomes of the environmental assessment in the EIS.

4. Once the water supply in Chaffey Dam falls below 5 percent, water would be sourced from the remaining water in Dungowan Dam (i.e. the 3GL or less depending on evaporation and inflows).

The sequence of water supply may change occasionally due to water quality, maintenance, incidents or other operational reasons.

4.6 Future design refinements

The works as described form the basis of the environmental impact assessment for the project and are based on the concept design for the new Dungowan Dam and pipeline.

Design refinements may be needed as a result of ongoing and future consultation. This includes with Essential Energy for specifications and upgrade requirements of the existing powerline requiring re-stringing. Minor changes to pipeline design may also occur until landowner negotiations are finalised. Optimisation of the dam operating principles may also occur following further modelling and consultation, such as optimisation of town water reserves in Chaffey Dam and environmental release arrangements.

The detailed design process would be completed prior to commencement of construction and during this process infrastructure may potentially vary from the concept design assessed within the EIS. However, the nature of such variations would generally be consistent with the concept design and its environmental outcomes. Should deviations to the design potentially be inconsistent with the concept design and its environmental outcomes, further environmental assessment and approval would be sought.

CHAPTER 5

Engagement

5 Engagement

Community and stakeholder engagement for the project commenced in January 2020, shortly after its formal announcement. Since that time, the project team have been engaging with community and stakeholders to provide information and to seek feedback and input to the development of the project.

A range of engagement mechanisms have been used to consult with local landholders, neighbouring property owners, Tamworth Regional Council, community groups, local service providers, State and Commonwealth Government departments and other stakeholders. Engagement was undertaken by WaterNSW until 1 September 2021, when responsibility for the delivery of the project, including engagement activities, transferred to Water Infrastructure NSW.

This chapter provides an overview of the communication and engagement activities carried out before and during the preparation of this EIS, identifies stakeholder and community views, and proposes future engagement activities. In doing so, this chapter demonstrates compliance with requirements set out in the *Undertaking Engagement Guidelines for State Significant Projects* (SSP Engagement Guidelines 2021) (DPIE 2021c).

A detailed Communications and Stakeholder Engagement Technical Report was prepared by Water Infrastructure NSW for the project and is provided in Appendix D. The relevant SEARs and where they have been addressed are summarised in Appendix A.

Consultation has also been undertaken specifically to inform the Social Impact Assessment (SIA) (Appendix L) in accordance with the *Social Impact Assessment Guideline for State Significant Projects* (SIA Guideline 2021) (DPIE 2021d).

5.1 Engagement undertaken

5.1.1 Engagement strategy and objectives

Stakeholder engagement has been undertaken in accordance with the requirements of the SSP Engagement Guidelines 2021 and the project SEARs. The Dungowan Dam and pipeline project: Engagement Strategy and Management Plan: Pre-construction Phase (Annexure A of Appendix D) has guided and supported the delivery of consultation on the project. This engagement strategy was designed to assist in the identification and support of effective engagement with communities and stakeholders of the project and has been regularly updated during development of the EIS.

When developing the engagement strategy in line with its guiding principles, the project first undertook a research-based analysis to understand community sentiment and provide a strong evidence base for the engagement strategy and associated objectives. Best practice research processes were adopted to understand 'what matters most' to the communities impacted by the project. Through focus groups, stakeholder conversations, surveys and research, the following six engagement objectives were identified:

- Demonstrate fairness and equity in everything we do.
- Demonstrate a commitment to providing accurate and unbiased information about the project.
- Establish and maintain a strong on-the-ground and trusted presence in the community.
- Demonstrate how the project supports a vision for regional economic growth and prosperity.
- Involve the community in the project in a meaningful way.
- Commit to providing people with balanced and meaningful information about the project.

The EIS phase project engagement activities included three further objectives:

- Develop a clear understanding of the EIS process and its purpose.
- Develop a clear understanding of how feedback has or has not influenced the EIS and why.
- Meet the engagement and consultation requirements under the SEARs.

5.1.2 Stakeholder identification

The engagement strategy extensively mapped stakeholders and identified appropriate methods of engagement and engagement levels for various stakeholders, justified by their interests in the project and project objectives. A detailed overview of key stakeholders, including their responsibilities and/or interest and issues associated with the project is provided in the Communications and Stakeholder Engagement Technical Report (Appendix D). A summary of key project stakeholders is provided in Table 5-1.

Table 5-1 Summary of project stakeholders

Group	Stakeholders
Commonwealth Government	• Department of Climate Change, Energy, the Environment and Water (DCCEEW) • Murray Darling Basin Authority (MDBA) • Commonwealth Environmental Water Holder • National Water Grid Authority • Regional Development Australia Northern Inland NSW

Group	Stakeholders
NSW Government	• WaterNSW • Department of Planning and Environment – Planning and Assessment • Department of Planning and Environment – Water group • Department of Planning and Environment – Environment and Heritage group • Department of Planning and Environment – Resources and Geoscience group • Department of Planning and Environment – Natural Resources Access Regulator • Department of Primary Industries – Fisheries • Department of Premier Cabinet • NSW Treasury • Independent Pricing and Regulatory Tribunal (IPART) • Infrastructure NSW • Department of Regional NSW • Aboriginal Affairs NSW • Dams Safety NSW • NSW Environment Protection Authority • Transport for NSW • NSW Crown Lands • Essential Energy • NSW Rural Fire Service
Local Government	• Tamworth Regional Council
Political	• NSW Government (Premier of NSW – Dominic Perrottet; Minister for Water, Property and Housing and NSW Member for Tamworth – Kevin Anderson MP; Deputy Premier, Treasurer of NSW and Minister for Energy – Matt Kean MP • Federal Government (Federal Member for New England – Barnaby Joyce MP)
Community	• Tamworth Regional Local Government Area community • Impacted landowners – pipeline alignment
Community groups	• State Emergency Service – Tamworth Unit • Tamworth regional residents and Ratepayers Association • Inland Rivers Network • Tamworth Water Security Alliance
Business	• Dungowan Dam and pipeline project related business portal registered businesses • Project contractors and suppliers • Tamworth Business Chamber
Water customers and other users	• Peel Valley Water Users Association • Dungowan Creek and Valley Water Users Association • Other water users who are not members of the above associations

5.1.3 Engagement activities

A variety of methods have been used to facilitate equal access to information and ensure engagement opportunities have been provided for the community and stakeholders to engage in a way that best suited them and their needs. The engagement program included a range of activities such as:

- In-person community information sessions.
- Online webinars during COVID-19 lockdowns and as requested by the community.
- Stakeholder meetings.
- Community pop-ups.
- Letter box drops.
- Fact sheets and feedback surveys on the draft EIS technical report findings.

5.1.3.1 Community engagement

The project began engagement with community members, community groups, landowners and businesses from 2020. Between June 2020 and June 2021, the engagement focussed on informing the community of what the EIS is and what it meant in their context, why the EIS was undertaken, why their engagement was important, and how they can engage in the process and at what points. From June 2021, engagement on specific technical areas began incrementally as each draft technical specialist report became available.

The project team has held 55 community events[4] with close to 1,200 attendees, including meetings with community groups and local organisations interested in keeping their membership informed about the project as it progresses.

Engagement with landowners also began in 2020 with landowners whose properties would be impacted by the project. The project team has had close to 390 landowner meetings[5]. In addition, landowners have been targeted and captured through the community engagement outlined above and an information session specifically for landowners has been held.

Local businesses have also been targeted and captured through community engagement and also with business specific engagement sessions. From 2020 local businesses were invited to register their interest in the project via a Local Business Register. Those who signed up were invited to attend business information sessions where the content, including EIS content was directed at their interests.

An example community dashboard is provided in Figure 5-1, highlighting the number of interactions via each of the key community engagement pathways. A timeline of the key community engagement activities completed to July 2022 is detailed in Figure 5-2.

Other industry stakeholder consultation was also carried out including engagement with the Tamworth Business Chamber, Peel Valley Water Users Association and Dungowan Valley Water User Association. Ten briefings have been held with these stakeholders.

[4] As at 1 July 2022

[5] As at 1 July 2022

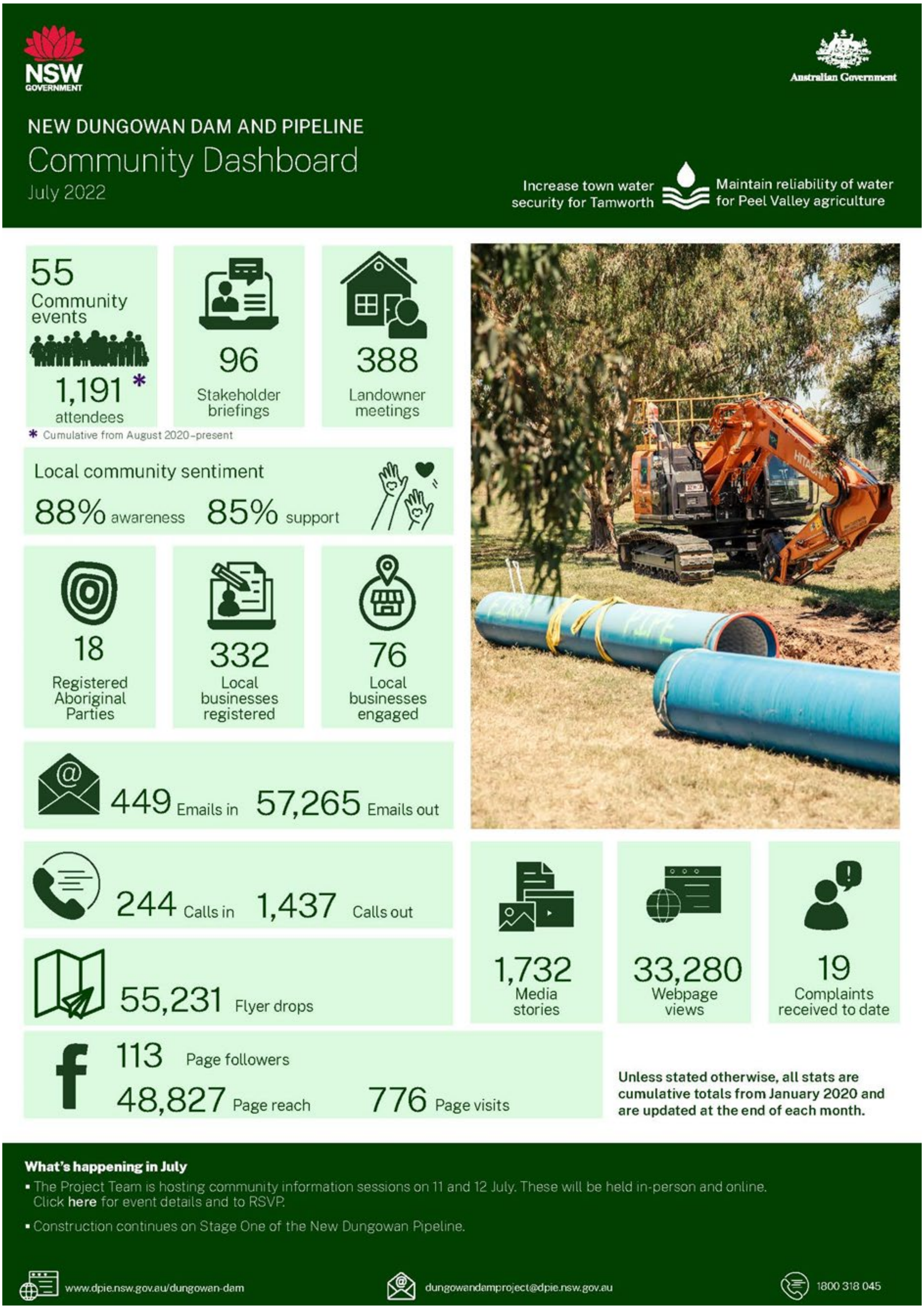


Figure 5-1 Project engagement dashboard July 2022

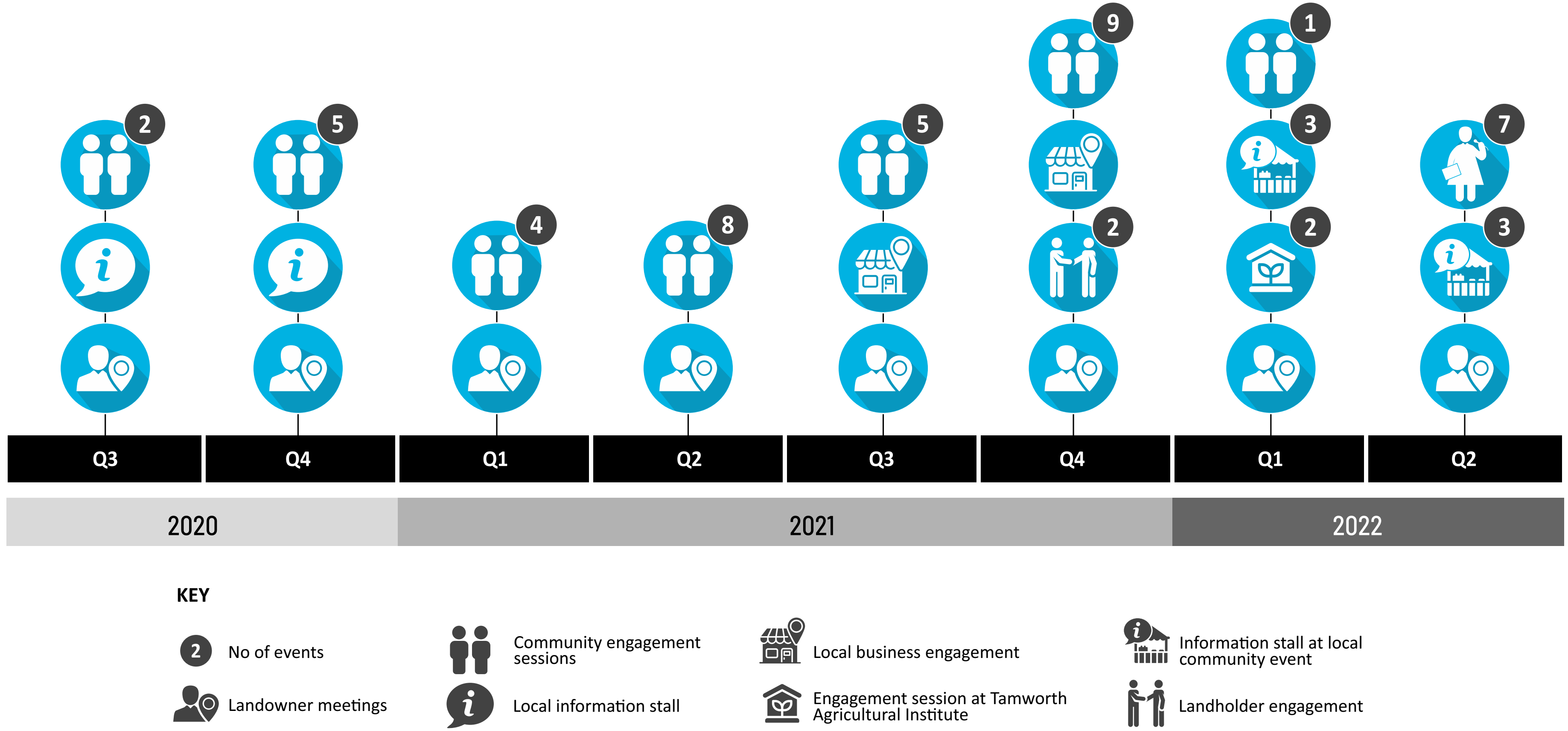


Figure 5.2 Community engagement activities timeline

5.1.3.2 Aboriginal cultural heritage consultation

Aboriginal consultation for the project has been undertaken in accordance with the processes and methods outlined in the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW, 2010a), as well as more extensive activities stemming from a project specific Aboriginal Community Engagement Strategy (EMM, 2021). Overall, the project has been liaising with between 10 and 18 registered Aboriginal party (RAP) organisations and/or individuals since April 2020. These include those identified as part of the consultation strategy, and through formal notification as part of the Heritage NSW consultation requirements. Details of the Aboriginal consultation for the project are provided in the Aboriginal Cultural Heritage Assessment (Appendix J).

5.1.3.3 Local Government and political consultation

Regular meetings have been held with Tamworth Regional Council, including the General Manager, Mayor and executive staff in addition to briefings and updates at Council/Councillor ordinary meetings. Workshops/roundtables have also been regularly held to maintain project visibility and identify partnership opportunities, given that Tamworth Regional Council is the owner of the existing Dungowan Dam and pipeline (to be decommissioned) and is proposed to be responsible for the management, operation and general maintenance of the pipeline infrastructure of the project. Regular meetings have also been held with State and Federal local members, with 96 stakeholder briefings[6] occurring with local and political government stakeholders such as New England MP Barnaby Joyce's office, Tamworth MP Kevin Anderson's office and the Mayor, Councillors and executive of Tamworth Regional Council.

5.1.3.4 Government agencies

Consultation with Commonwealth and State Government agencies for the project has been extensive during the development of the EIS. This has included numerous general and issue specific workshops, meetings, emails, discussions and interactions with Commonwealth and State Government agencies. Meetings and workshops for these issues are summarised in Figure 5-3. This consultation also includes the following working and advisory groups and meetings specifically for the project since the project's inception:

- Water Resources Management Group: Water Infrastructure NSW, DPI Fisheries, DPE Planning & Assessment, DPE Water, DCCEEW, MDBA.
- Environment and Heritage Working Group: Water Infrastructure NSW, DPE Environment and Heritage, DPI Fisheries, DPE Planning & Assessment, DPE Water, DCCEEW, MBDA, Treasury, Regional NSW, Crown Lands.

The Working Groups met monthly in 2020 and 2021. They were discontinued in 2022 and replaced by more targeted consultation with individual and select groups of regulatory agencies.

[6] As at 1 July 2022

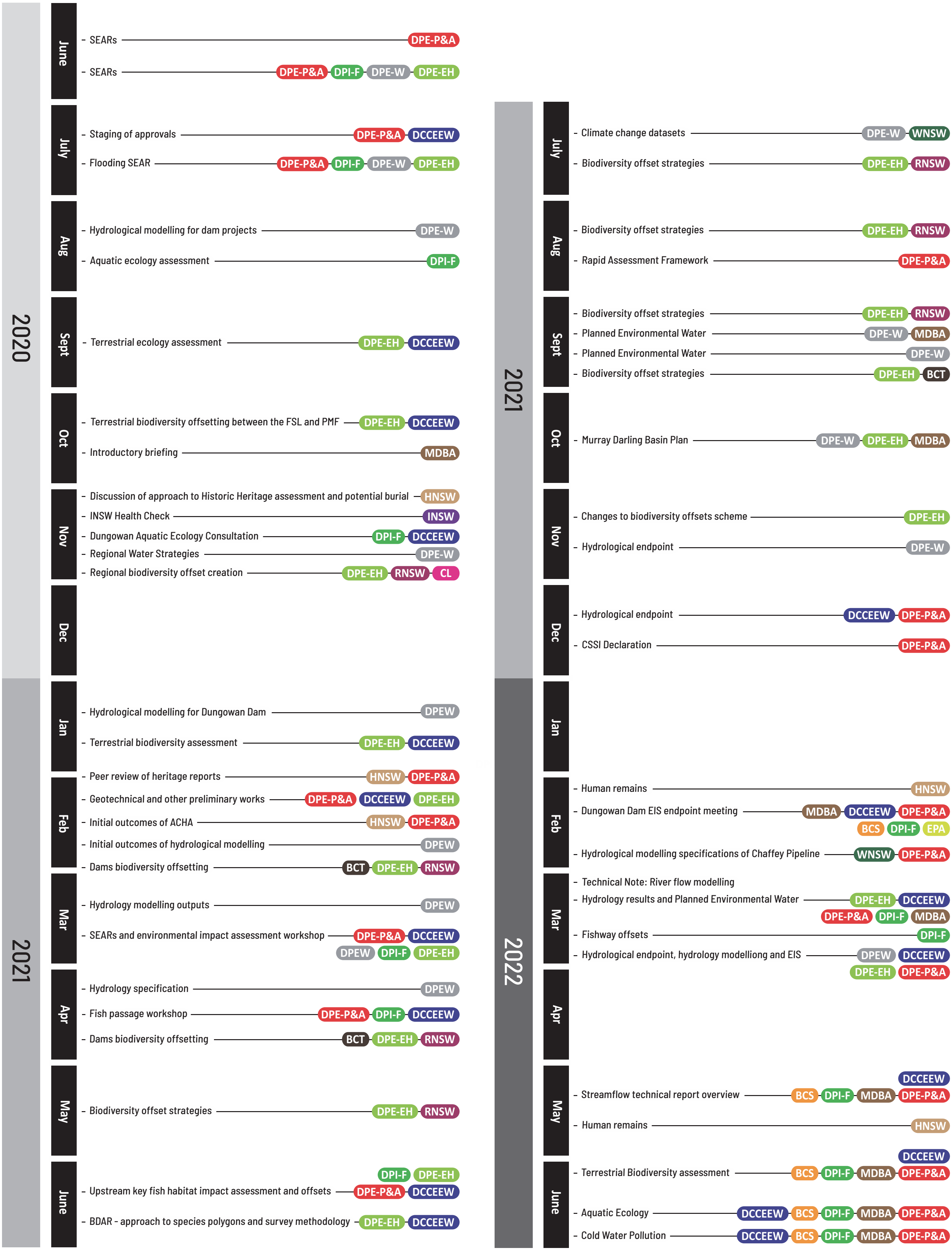


Figure 5.3 Stakeholder engagement activities timeline

5.2 Stakeholder and community views

Throughout the consultation period, the project recorded and considered feedback from all stakeholders. Where it has not been possible or applicable for this feedback to influence the project, this feedback has been addressed with the relevant stakeholder directly.

5.2.1 Commonwealth and State Government stakeholder views

A summary of the key issues raised through Commonwealth and State Government stakeholder engagement are outline in Table 5-2.

Table 5-2 Summary of government agency matters raised

Agency	Issue summary	How the project addressed this issue	Relevant EIS references
DPE Water	• Impact on other water users. • Hydrological modelling. • Consistency with the Regional Water Strategy for the Namoi.	The primary purpose of the project is to increase town water supply security for Tamworth. A secondary objective of the project is to maintain the reliability of water for agriculture across the Peel Valley as Tamworth grows. WaterNSW (the proposed owner and operator for the future new Dungowan Dam) would continue to meet water delivery obligations. Overall, the volume of storage in the Peel Valley would increase, leading to greater security of supply. All modelling for the project has been undertaken by Hunter H2O on behalf of DPE Water, utilising DPE Water models. The hydrological modelling, data, calibration and climate change assessment have been developed in close consultation with DPE Water. Modelling and other aspects of the project have been developed in close consultation with the Regional Strategy team.	Surface Water Assessment (Appendix F)

Agency	Issue summary	How the project addressed this issue	Relevant EIS references
DPI Fisheries	• Aquatic impact assessment methodology. • Hydrological assessment and data. • Impacts and mapping of fish key habitat. • Cold water pollution. • Fish passage.	The project team has consulted with DPI Fisheries throughout the preparation of the aquatic impact assessment to agree on assessment methodologies, data requirements and interpretation of impacts. This has also included consultation throughout the development and post-processing of hydrological modelling data to identify data requirements to inform the aquatic ecology impact assessment. Key fish habitat data has been obtained from DPI Fisheries and supplemented by data collected from the project team. Consultation with DPI fisheries has been undertaken on potential impacts upstream and downstream of the new Dungowan Dam. Impact assessment and mitigation information for cold water pollution downstream of the new Dungowan Dam has been presented to DPI Fisheries and comments from been incorporated into the final impact assessment, including consideration of additional 'worst-case' scenarios. Four offset locations for fishways have been agreed with DPI Fisheries and a Draft Plan of Management for each location has been included in the EIS as an annexure to the Aquatic Ecology Assessment.	Aquatic Ecology Assessment (Appendix I) Surface Water Assessment (Appendix F)

Agency	Issue summary	How the project addressed this issue	Relevant EIS references
Environment and Heritage	• Terrestrial biodiversity impact assessment. • Prescribed impact assessment for changes in hydrology. • Biodiversity offsetting. • Hydrological assessment and data. • Analysis of Environmental Water Resources (EWRs). • Hydrological endpoint.	The project team has consulted Environment and Heritage throughout the preparation of the terrestrial biodiversity assessment on fieldwork requirements, individual species impact assessment and other matters relating to the Biodiversity Assessment Methodology. Specific consultation was undertaken to refine the methodology for assessing prescribed impacts due to changes in hydrology, with feedback incorporated into the assessment presented in the Biodiversity Development Assessment Report. Potential options for biodiversity offsetting both direct and prescribed impacts from the project have been discussed, including prescribed impacts and impacts between the FSL and the PMF level. The project team has consulted Environment and Heritage throughout the modelling and post-processing of hydrological data to identify data requirements for the assessment of flow dependant impacts. Workshops and correspondence with Environment and Heritage have been undertaken to agree on the correct assessment and interpretation of EWRs from the Long Term Water Plan. Workshops and correspondence on the hydrological endpoint were discussed with regulators, including rational for this method and implications.	Biodiversity Development Assessment Report (Appendix H) Surface Water Assessment (Appendix F)
DCCEEW (formerly DAWE)	• Impacts on EPBC listed threatened aquatic and terrestrial species. • Impacts on migratory birds. • Facilitated impacts. • Same issues raised by DPI Fisheries and Environment and Heritage.	As the project would be assessed under the assessment bilateral agreement between the NSW and Commonwealth Governments, consultation with DCCEEW has been integrated with that undertaken with DPE Water, DPI Fisheries and Environment and Heritage. The majority of the consultation outlined able for these groups has also been undertaken with DCCEEW. Specific consultation was undertaken with DCCEEW in relation to fieldwork and assessment requirements for EPBC listed threatened aquatic and terrestrial species.	Biodiversity Development Assessment Report (Appendix H) Aquatic Ecology Assessment (Appendix I) Surface Water Assessment (Appendix F)

Agency	Issue summary	How the project addressed this issue	Relevant EIS references
MDBA	• Compliance with Sustainable Diversion Limit. • Hydrological assessment and data. • Planned Environmental Water.	As with DCCEEW, consultation with the MDBA has been integrated with that undertaken with DPE Water, DPI Fisheries and Environment and Heritage. Specific consultation meetings, and follow up correspondence, were held to discuss the assessment approach in relation to the Sustainable Diversion Limit and Planned Environmental Water.	Surface Water Assessment (Appendix F)
NSW Rural Fire Service (RFS)	The RFS identified key issues for the project management of bushfire risk including potential impacts on access to existing fire trails.	Initial consultation was undertaken with RFS during the development of the Bushfire Hazard Assessment. Follow up consultation has also been undertaken, and is ongoing, in relation to access to fire trails.	Bushfire Hazard Assessment (Appendix O)

5.2.2 Community views

A summary of the key issues raised through community engagement and how they have been considered through the development of the project are outline in Table 5-3.

Table 5-3 Summary of matters raised by the community

Theme	Key issue summary	How the project addressed this issue	Relevant EIS references
Strategic context	**Asset ownership** • Concerns about the eventual ownership of the new Dungowan Dam and pipeline.	A special task force was set up with members from Water Infrastructure NSW, Tamworth Regional Council, NSW Treasury and WaterNSW to determine the optimal owner and operator of the new assets. WaterNSW is proposed to be the owner and operator of the new Dungowan Dam and Tamworth Regional Council is proposed to be the owner and operator of the pipeline.	Chapter 2
	Change in government • Tamworth and Dungowan Communities raised concerns that a change in Federal or State Government would impact the project.	The Federal Labour Government was elected to replace the sitting Liberal National Government in May 2022, partway through the consultation process for the project. Water Infrastructure NSW cannot comment on what the stance of new government is on the project, however they would have the opportunity to read the Final Business Case, which presents the case for the project.	Chapter 2
	Project objectives • Concerns that the extra water from the project would not be available to irrigators.	The primary purpose of the project is to increase town water supply security for Tamworth. However, the project would maintain average annual water allocations for General Security licence holders in the Peel.	Chapter 2

Theme	Key issue summary	How the project addressed this issue	Relevant EIS references
Project design	• Impacted landowners raised concerns that that pipeline alignment doesn't consider existing agricultural infrastructure. • Impacted landowners raised concerns that the pipeline depth is not optimal.	The route alignment and configuration for the pipeline used a multi-criteria analysis (MCA) approach that considered engineering, economic, environmental and social constraints and opportunities. Consultation was undertaken with Tamworth Regional Council and landowners through the design process. In consultation with landholders, changes were also made to pipeline design in certain areas where pipeline depth would affect land productivity.	Chapter 11 Chapter 13 Social Impact Assessment (Appendix L) Land Use Assessment (Appendix P)
Community engagement	**Aboriginal cultural heritage** • Dungowan and Tamworth community members suggested further opportunities be explored which share any findings and educate communities of any outcomes from the Aboriginal Cultural Heritage surveys.	The Aboriginal Cultural Heritage Assessment has recommended the preparation of an Aboriginal Cultural Heritage Management Plan (ACHMP). The ACHMP would include procedures for the curation and long-term management of recovered cultural materials. Aboriginal stakeholders involved in the development of the ACHA have indicate that any curation should remain on Country and remain accessible to the local Aboriginal community into the future. The ACHMP would also be supported by a heritage-interpretation strategy that would identify the interpretive values of the project footprint, and specifically Aboriginal heritage values across the project footprint, and provide direction for potential interpretive installations and devices.	Chapter 9 Aboriginal Cultural Heritage Assessment (Appendix J)

Theme	Key issue summary	How the project addressed this issue	Relevant EIS references
Economic, social and environmental impacts	**Traffic and transport** Road condition • Quality of the roads that would be used for the construction route and the impact that construction related traffic and heavy vehicles would have on the roads. Congestion and road safety • Potential for construction traffic, especially large vehicles, to cause significant congestion and safety issues. • Construction crew needing to travel to and from site would increase safety concerns and traffic volumes. • Movement of animals across the road to different paddocks due to the number of trucks passing through each day along the construction traffic routes. Maintenance and management • Vegetation maintenance along the construction traffic route and pipeline route is important to safety for residents when entering and exiting driveways and at intersections/corners. Public transport • Impact on school bus routes.	The quality of the existing road network and the ability to accommodate construction traffic associated with the project has been considered as part of the Traffic Impact Assessment (TIA). The TIA also included a safety inspection of the existing transport facilities and a road safety audit. Recommendations from these investigations have been incorporated into the project design (e.g. proposed upgrades to Dungowan Dam Road) or would be incorporated into a Traffic Management Plan (TMP). The TMP would also specify measures to manage and mitigate potential traffic safety conflicts with road users including school buses along the primary transport route. Further measures requiring consultation with school bus operators are included in the Social Impact Assessment (SIA). Out of hours (non-standard work hours) works would be kept to a minimum. When out of hours works are unavoidable, the community would be engaged, informed and all efforts would be made to mitigate any potential impacts. Potential impacts of night works and general road noise have also been considered as part of the Noise and Vibration Impact Assessment (NVIA).	Chapter 11 Chapter 14 Chapter 16 Social Impact Assessment (Appendix L) Traffic Impact Assessment (Appendix S) Noise and Vibration Impact Assessment (Appendix U)

Theme	Key issue summary	How the project addressed this issue	Relevant EIS references
	<u>Night works</u> • Night works at the dam site requiring trucks to make deliveries during the night posing a safety risk and potential noise impacts. **Noise and vibration** • Concern that any increase in traffic noise would be more noticeable in the rural area surrounding the construction traffic route and the dam site and that this may not have been considered in the noise and vibration technical EIS report. • Importance of considering noise for residents when selecting construction equipment and machinery.	A detailed NVIA has been completed for the project which made conservative assumptions in relation to existing background noise levels. The NVIA has also made conservative assumptions in relation to the selection and operation of construction equipment and would be further considered throughout the development of the Construction Environmental Management Plans. This extends beyond deciding what machinery to use and includes when to use machinery and planning what machines should and shouldn't operate at the same time.	Chapter 16 Noise and Vibration Impact Assessment (Appendix U)
	Greenhouse Gas • Concern that greenhouse emissions caused by the operation of the new dam were not considered in the EIS – i.e. only emissions during construction are considered.	A detailed Air Quality and Greenhouse Gas Assessment has been completed for the project and includes consideration of Scope 1, Scope 2 and Scope 3 greenhouse gas emissions during the operational phase of the project.	Chapter 17 Air Quality and Greenhouse Gas Assessment (Appendix V)
	Visual impacts • Request that a 360-degree study of the dam would be considered for the EIS.	The Visual Impact Assessment (VIA) considers the area of theoretical visibility – i.e. the area within which the majority of potential views of the project components or elements may be located. Each project component was assigned its own area of theoretical visibility. These areas were based on different distance settings, which reflect the likely range at which each component can be distinguished and identified as a discrete landscape feature.	Chapter 18 Visual Impact Assessment (Appendix W)

Theme	Key issue summary	How the project addressed this issue	Relevant EIS references
	Contamination • Mitigating contaminated sediments in the dam given the mining history should be considered. • Removing silt from the old dam should be considered.	Numerous historical mining exploration titles cover the project footprint. The presence of contaminants of potential concern (CoPC) associate with these, and other, historical land uses was considered as part of the Contamination Preliminary Site Investigation (PSI). Consideration of silt within the existing Dungowan Dam was undertaken as part of the decommissioning design optimisation and included sampling to target any sediments potentially deposited in the inundated valley floor as a result of the typical process of sediment erosion, transport and accumulation since the existing Dungowan Dam was constructed. The results of these investigations were considered in the Contamination PSI.	Chapter 13 Contamination Preliminary Site Investigation (Appendix R)
	Waste • Tamworth and Dungowan community members requested that the project consider further measures to reduce and reuse waste, particularly vegetation.	The primary aim of waste management for the project is to prevent and avoid waste followed by the reuse and recycling of materials. Waste avoidance and management strategies are outlined in the Waste Management Assessment and would be further documented in the Construction Waste Management Plan.	Chapter 15 Waste Management Assessment (Appendix T)
	Biosecurity • Landowners identified biosecurity issues as a potential impact of the project.	The risk of diseases or pests being introduced or spread during the construction phase of the project has the potential to increase costs and decrease income of agricultural properties in the vicinity of the project. Impact to biodiversity may also occur through the introduction and/or spread of weeds, or plant pathogens. These potential impacts have been considered in the Land Use Assessment and Biodiversity Development Assessment Report.	Chapter 7 Chapter 13 Biodiversity Development Assessment Report (Appendix H) Land Use Assessment (Appendix P)

Theme	Key issue summary	How the project addressed this issue	Relevant EIS references
	Water <u>Water access/licenses</u> • Dungowan and Peel Valley Water users have concerns that the project would impact general security license for irrigators. <u>Assessment approach</u> • Tamworth community member raised concerns that the Peel River hydrology modelling is separate to the Namoi hydrology modelling. • Tamworth community member raised concerns that the project isn't considering the Murray Darling Basin Plan and Sustainable Diversion Limits. <u>Impact on Dungowan Creek</u> • Concerns that even though the project was found to have negligible impacts overall on base flow in the Peel and Namoi that these impacts would still be visible to those who live on Dungowan Creek.	A secondary objective of the project is to maintain the reliability of water for agriculture across the Peel Valley as Tamworth grows. WaterNSW would continue to meet water delivery obligations. Overall, the volume of storage in the Peel Valley would increase, leading to greater security of supply. All modelling for the project has been undertaken by Hunter H2O on behalf of the NSW Department of Planning and Environment – Water, including specific modelling considering the Murray Darling Basin Cap/Sustainable Diversion Limit. Hunter H2O have utilised DPE Water models. The Surface Water Assessment has considered impacts on the Peel River and broader Namoi Valley, however has also assessed potential local impacts to Dungowan Creek. This has included, but is not limited to, consideration of changes to flow, depth, water quality and geomorphology within Dungowan Creek.	Chapter 6 Surface Water Assessment (Appendix F)
	Biodiversity • Questions about the area required to be cleared for the project.	The project footprint has an area of 315 hectares (ha). The impacts of clearing on biodiversity values is considered in the Biodiversity Development Assessment Report (BDAR). The BDAR has been prepared in accordance with the Biodiversity Assessment Method (DPIE 2020a).	Chapter 7 Biodiversity Development Assessment Report (Appendix H)

Theme	Key issue summary	How the project addressed this issue	Relevant EIS references
	Socio-economic Price of water • Dungowan community members and landowners raised concerns about the impact of the project on the bulk water costs. • Tamworth rate payers and residents raised concerns that the project would significantly raise town water costs. Pipeline water access • Landowners with access to existing Dungowan pipeline were concerned that they would not get access to new pipeline. • Landowners receiving the new Dungowan pipeline were concerned that it was inequitable for them to not receive a customer connection to the new pipeline. • Landowners concerned that a new customer connection may not provide access to water.	The impact of the project on typical customer bills was assessed by Water Infrastructure NSW as part of the Final Business Case developed for the project in 2021 and is presented as part of the socio-economic assessment for the project. Initial project communication indicated that everyone with access to the existing Dungowan pipeline would continue to have a connection on the pipeline. In March 2022 it was also announced that that all properties receiving the new Dungowan pipeline would also receive a customer connection. Landowners would need to enter into an agreement with Tamworth regional Council and negotiate access to the water.	Chapter 11 Social Impact Assessment (Appendix L) Dungowan Dam and pipeline project – Customer Bill Impacts (Appendix M)

Theme	Key issue summary	How the project addressed this issue	Relevant EIS references
	Public safety • Concern that the lack of mobile reception would create safety risks during construction. • Concern that downstream communities may not be aware of when the dam would release water.	Telecommunications is a significant consideration for the efficient and safe delivery of the project, with options to address safety concerns continuing to be investigated and would be considered as part of construction planning. The project design has ensured that the new Dungowan Dam would have real time data available to inform all water users and interested parties. The warning system, roles and responsibilities in an emergency, and triggers for enacting emergency procedures would be described in a Dam Safety Emergency Plan (DSEP), which would be developed prior to commissioning of the new dam.	Chapter 12

Theme	Key issue summary	How the project addressed this issue	Relevant EIS references
Project justification and evaluation	**Project evaluation** Project effectiveness • Concerns that the new size of the dam is too small and should increase beyond the planned 33% increase in catchment area. • Concerns that a new Dungowan Dam won't be sufficient in helping in times of drought without rain. Consideration of alternative • Question whether artesian water was considered as an alternative or additional option for the project. • Concerns that alternate options were not properly considered before the Dam was chosen as the preference and that other options may be more cost effective. • Concerns that further water security options need to be explored.	Based on the outcomes of the initial feasibility study for the project, the proposed location of the new Dungowan Dam and the 22.5 GL size was selected as the preferred project. Alternative options were also considered as part of the Final Business Case. A summary Final Business Case has been released by the NSW Government and published on the project website, which details the options considered and the options assessment process used.	Chapter 2
	Project justification • Tamworth community members raised concerns that an accommodation camp would be inefficient and cost too much. • Tamworth and Dungowan community concerns that the cost of the project outweighs the benefits.	Costs and benefits were considered as part of the Final Business Case informing the progression of the project. A summary Final Business Case has been made publicly available on the project website.	Chapter 2

5.3 Future engagement

Stakeholder engagement would continue following the EIS exhibition period and during assessment of the project. Community 'roadshows' would be scheduled during the EIS exhibition period, allowing the community multiple opportunities to view summary presentations from the project team on the EIS and to ask any additional questions they may have to inform any formal submission during the exhibition period.

In addition to the EIS being available on the DPE planning portal, a digital EIS summary has been provided on the project webpage to provide interactive project information to support stakeholders in understanding the EIS.

Hard copies of the EIS have also been made available for viewing at local locations, as specified on the project website.

Once exhibition of the EIS is concluded, feedback received would be reviewed and considered by Water Infrastructure NSW and a submissions report would be prepared that analyses the issues raised and describes the actions that have been taken to address those issues and/or cross-referenced to the EIS to ensure all concerns have been addressed. Submissions would also be considered by DPE to inform the determination of the project. All submissions received would be published on the major project website.

Throughout the assessment process ongoing community and stakeholder engagement would continue to occur and include updates on the planned construction activities and program and responding to enquiries and concerns in a timely manner.

Prior to construction commencing, an engagement strategy would be developed as part of the CEMP for the project, detailing the processes that would continue to facilitate successful engagement using the methods and channels applied to date.

CHAPTER 6

Water

6 Water

This chapter presents a detailed summary of the project's impacts upon water. Detailed technical reports for the Surface Water Assessment (SWA) and Groundwater Impact Assessment (GIA) are provided in Appendix F and Appendix G respectively. The relevant SEARs for water and where they are addressed by the SWA and GIA are summarised in Appendix A.

6.1 Existing environment

6.1.1 Climate

The east coast of Australia has experienced long term climate cycles due to effects such as the El Niño/La Niña Southern Oscillation and Southern Annular Mode climatic processes, resulting in both wet periods and droughts. As illustrated in Figure 6-1, long term rainfall trends for the project area show that prior to 1950 there was a trend of increasing rainfall, while since 1950 there has been a trend of decreasing rainfall. Regional droughts have occurred with regularity, with approximately one drought each decade through recorded history (ABS, 1988). Floods have also occurred with regularity through the period of stream flow records (post-1950) (BoM, 2020), with the last notable flood within the Namoi River occurring in 2016 (BoM, 2017).

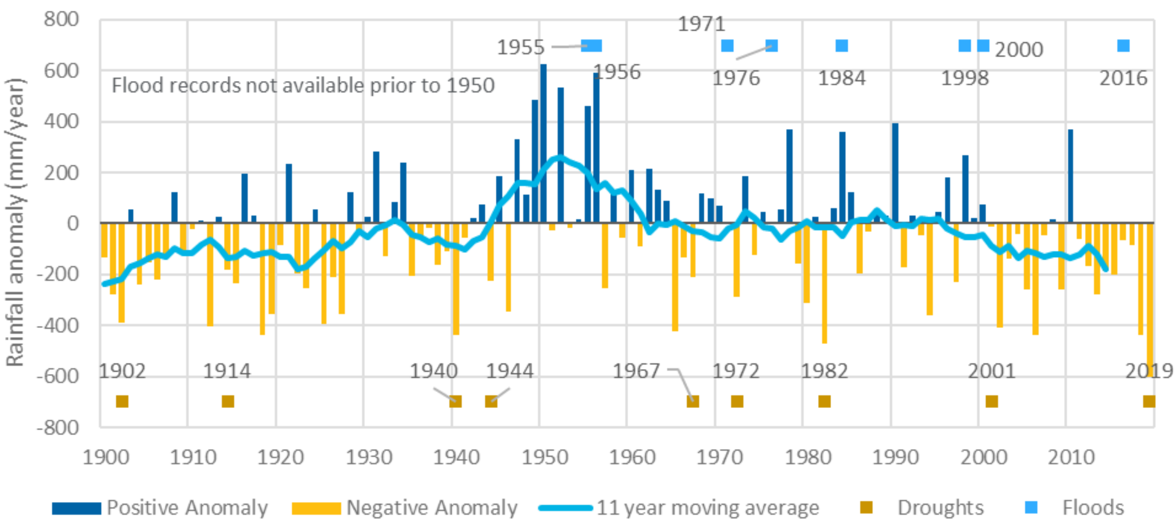


Figure 6-1 Historical rainfall trend at Dungowan Dam, and regional flood and drought markers

6.1.2 Surface water connectivity and catchments

The existing Dungowan Dam was constructed between 1952 and 1956 within the upper reaches of Dungowan Creek to provide water supply for Tamworth and has a 132 km^2 catchment. The current capacity of the storage is estimated to be around 6.3 GL. This capacity is relatively small for the catchment size and use regime, leading to regular filling and partial emptying of the storage, with the average storage volume over the period 1995–2020 around 4.6 GL.

The new Dungowan Dam would capture runoff from the existing dam catchment, plus an additional 43 km^2, for a total catchment area of 175 km^2 and an increase of 33%. The creeks forming the additional catchment originate from forested hills and gullies, other than Terrible Billy Creek and Swamp Gully, which originate from a farmed plateau which forms the eastern watershed divide.

Dungowan Creek meets the Peel River approximately 30 km downstream of the new Dungowan Dam, with Goonoo Goonoo Creek and Cockburn River meeting the Peel River immediately upstream of Tamworth. The new Dungowan Dam catchment represents less than 6% of the combined catchment area at this confluence. The Peel River flows into the Namoi River approximately 60 km downstream from Tamworth.

An overview of the Peel Valley catchment is shown in Figure 6-2.

Figure 6-2 Peel Valley catchment overview

6.1.3 Groundwater systems

The project area contains two distinct groundwater systems, characterised as having very different hydrogeological properties bound by their depositional environment, and include:

- A localised highly permeable shallow groundwater system associated with the Quaternary-aged alluvium, divided into the:
  - Peel River Alluvium located downstream of Chaffey Dam, and comprised of coarse gravel sediments in relatively thick deposits of up to 30 m.
  - Dungowan Creek Alluvium located within the Dungowan Creek floodplain, comprising unconsolidated, sporadic pockets of alluvium of varying thickness.
- A low permeability regional fractured rock groundwater system associated with the metasedimentary rock which occupies the uplifted, mountainous portion of the project area. This unit is formally termed the Peel Fractured Rock (PFR) (NOW 2010).

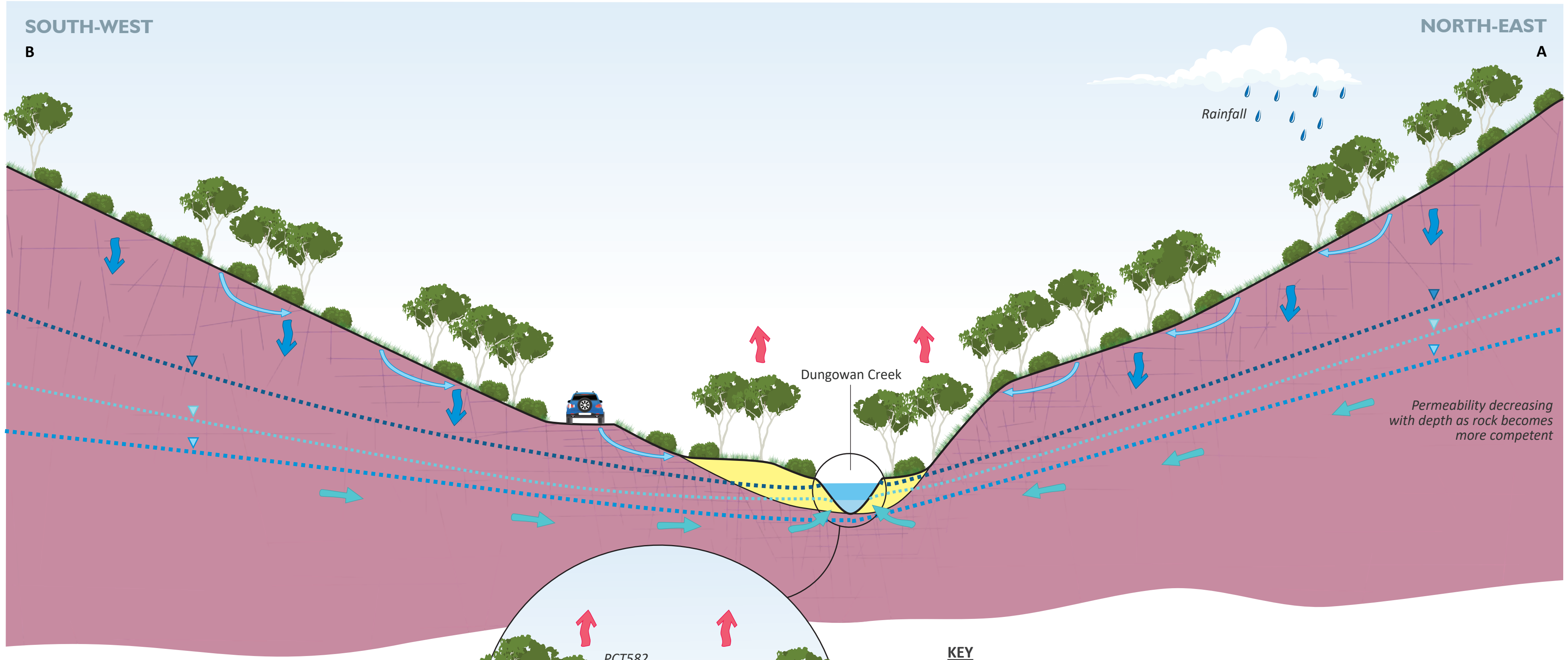
Direct rainfall infiltration is the primary recharge mechanism across the project area, while groundwater discharge occurs via baseflow, seepage/springs, leakage to underlying groundwater systems and evapotranspiration. Groundwater flow in the alluvium is down gradient, while regional groundwater flow in the fractured rock displays a muted reflection of topography, flowing from catchment highs to valley floors, or southeast to northwest, toward Tamworth.

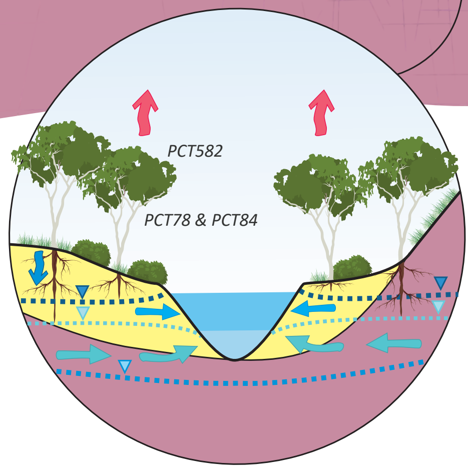
6.1.4 Surface water and groundwater interaction

On a regional scale, the Peel River and Dungowan Creek both lose water to the groundwater system along most of their length (NOW, 2010). The Peel River Alluvium and Dungowan Creek Alluvium are highly connected to surface water features, with more than 70% of the groundwater extracted drawn ultimately from the river (CSIRO, 2007) (NOW, 2010). Estimates of groundwater recharge due to infiltration from the Peel River between Chaffey Dam and Calala WTP are estimated to be between 13–17 GL/year for periods with consistent flow in the Peel River.

On a local scale, Dungowan Creek in its upper reaches (from the new to the existing Dungowan Dam) is conceptually a gaining system receiving groundwater discharge as baseflow along its length, controlled by the steep hydraulic gradient created by local topography. As the valley widens downgradient of the new Dungowan Dam (lower reaches), Dungowan Creek transitions to a mostly losing stream.

Figure 6-3 conceptualises the hydrogeology of Dungowan Creek in the vicinity for the new Dungowan Dam.





See Figure 6.2 regarding watercourse interaction with groundwater

This diagram is a conceptual representation only

KEY

- Quaternary Alluvium
- Sandon Association
- Wet season SWL at shallow depth
- Dry season SWL
- Normal season SWL
- Groundwater recharge
- Evapotranspiration
- Groundwater flow
- Discharge to Dungowan Creek
- Throughflow

PCT78 – River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and rigalow Belt South Bioregion

PCT84 – River Oak- Rough-barked Apple- red gum- box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion

PCT582 – Sedgeland fens wetland of impeded drainage of the Nandewar Bioregion and New England Tableland Bioregion

Figure 6.3 Conceptual hydrogeological model

6.1.5 Existing operations

The existing Dungowan Dam and Chaffey Dam provide most of Tamworth's water supply. Under typical operating conditions, water supply is extracted from Dungowan Dam when the dam is above 50% capacity, and from Chaffey Dam when Dungowan Dam is below 50% capacity. Either dam may be used to augment the supply of the other during periods of high demand, or to manage dam water quality. Chaffey Dam is also used to supply water to Peel Valley irrigators and high security and stock and domestic licence holders.

The existing Dungowan Dam is operated with translucency flows of up to 10 ML/day, meaning that when inflows are less than 10 ML/day, the inflow volume is released to the creek. When inflows are greater than 10 ML/day, 10 ML/day is released and the excess is stored (unless the dam is at capacity, in which case the excess would pass over the spillway). Chaffey Dam does not have a translucency arrangement, but instead releases a minimum of 3 ML/day (other than during critical drought conditions) and stores up to 6.2 GL/year of water for planned environmental releases.

6.1.6 Water users

Tamworth Regional Council has Water Access Licenses (WAL), issued under the *Water Management Act 2000*, to extract water from the existing Dungowan Dam and from Chaffey Dam for the purpose of town water supply. Water is transferred directly from the existing Dungowan Dam to the Calala WTP via the existing Dungowan pipeline. Water released from Chaffey Dam is transferred to Calala WTP via run-of-river transfers along the Peel River.

Woolomin, Dungowan and Ogunbil obtain water supply from a combination of bore water, rainwater, and in some cases water from the Peel River or Dungowan Creek. Several properties along the Peel River and Dungowan Creek are licensed to extract untreated water from the Peel River and Dungowan Creek for domestic and stock purposes, and Tamworth Regional Council supplies untreated water for domestic and stock use to about 100 properties via the existing Dungowan pipeline.

Current agricultural production within the Peel River Valley includes irrigated lucerne, hay, dairy, and irrigated fodder for livestock with irrigated pasture comprising approximately 80% of irrigated land use (NOW, 2010). Properties with access to the Peel River downstream of Chaffey Dam typically access irrigation water via release from Chaffey Dam and transmission along the Peel River. Within Dungowan Creek, properties with access to irrigation water may extract water from the creek using pumps in accordance with their WAL when there is visible flow at Thorntons bridge (NOW, 2010).

Private landowner bores near the project generally target the alluvial groundwater system. Private groundwater use is mostly licenced for water supply, irrigation, stock and domestic purposes. Within a 1 km radius of the pipeline infrastructure and the Peel River downstream of Chaffey Dam to the Calala WTP and within 10 km of the new Dungowan Dam, there are nine registered groundwater bores used for domestic water supply, 236 domestic water supply bores, 119 irrigation supply bores and 22 stock and domestic supply bores.

Water is also required within the Peel River and Namoi River catchment for ecological outcomes such as native fish migration, spawning and recruitment, and vegetation maintenance. The Commonwealth Environmental Water Holder currently holds 1.2 GL of entitlement for release to support environmental outcomes within the Peel River. In addition, the WSP specifies a 5.0 GL allowance within Chaffey Dam based on General Security licence allocations for release to support environmental outcomes within the Peel River and specifies a 3 ML/day minimum release.

Terrestrial and aquatic ecosystems associated with creeks, rivers and riparian habitats receive groundwater baseflow contributions from both the alluvial and fractured rock aquifers. A review of the Bureau of Meteorology (BoM) GDE Atlas identified three plant community types (PCTs) that may have groundwater dependence. Ecosystem dependence associated with these PCTs are characterised as having a facultative-opportunistic reliance on groundwater, accessing temporary groundwater within the shallow alluvial sediments of the Dungowan Creek Alluvium following flooding events or extended wetting periods.

One high priority groundwater dependent ecosystem (GDE) is identified within the WSP at Black Spring. Black Spring is located on Black Spring Creek, a tributary to Dungowan Creek located downstream of the new Dungowan Dam location, approximately 9 km north from Ogunbil, or halfway between the new Dungowan Dam location and the Peel River. This location would not be affected by the project. Further discussion of GDE's is presented in the Biodiversity Development Assessment Report (Appendix H) and the Aquatic Ecology Assessment (Appendix I).

6.2 Assessment overview

Development of the project was informed by iterative environmental constraint assessment comprising both desktop assessment and hydrological modelling, with the aim to reasonably avoid and minimise significant impacts to the environment.

The new Dungowan Dam would be constructed downstream of the existing dam and would have a 33% larger catchment. To maintain Dungowan Creek flows according to a similar flow regime to the current flow regime, the translucency threshold would be increased from the existing 10 ML/day to 13 ML/day. It is also proposed that a new EWA account of up to 200 ML/year would be created for the new Dungowan Dam and operated similarly to the existing Chaffey Dam EWA.

Potential impacts to surface water as a result of the project were assessed for construction and operation activities and included consideration of potential impacts to surface water quality, streamflow regime, geomorphic effects and flooding. Impacts have been identified and described using a risk framework.

The assessment of project-related impacts to groundwater resources and sensitive receivers considers the requirements of the *Water Management Act 2000*, WSPs and the NSW *Aquifer Interference Policy* (AIP).

A number of potential impact pathways on water are related to changes in hydrology within Dungowan Creek and the Peel River due to construction and operation of the new Dungowan Dam and pipeline. The assessment of potential impacts on Dungowan Creek and Peel River hydrology was informed by the DPE Water Peel Valley Source Model. Modelling utilised a stochastically generated 9,800 year climate dataset developed by Adelaide University for DPE Water, so that the potential durations and magnitudes of wet and dry cycles used in the assessment would not be limited to the relatively short historical period.

Consultation has occurred with all relevant State and Commonwealth agencies throughout the preparation of the SWA and GIA on the following:

- Hydrological modelling approach, analysis and data interpretation.
- Methodology for assessing impacts due to changes in hydrology.
- Assessment of cold water pollution (CWP).
- Assessment of planned environmental water.
- Correct interpretation of environmental watering requirements (EWRs) from the Namoi LTWP.

Further details of consultation are detailed in Chapter 5 and Appendix D of the EIS.

6.3 Predicted impacts

6.3.1 Hydrology

Operation of the new Dungowan Dam, and the influence of the project on the operation of Chaffey Dam, would result in changes to flow regimes both in Dungowan Creek, downstream of the new Dungowan Dam, and in the Peel River, downstream of the existing Chaffey Dam. No changes to the flow regime are predicted downstream of Tamworth.

Flow threshold terms are used throughout the water assessment and are illustrated in Figure 6-4.

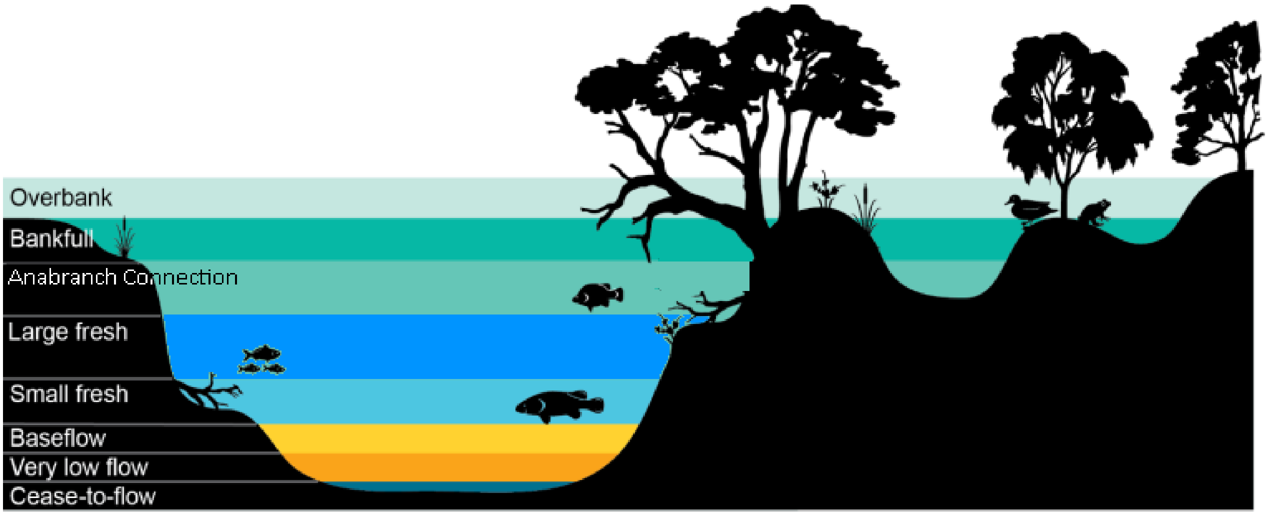


Figure 6-4 Flow thresholds diagram

The operation of the project would reduce the frequency of baseflow events in the Peel River between Chaffey Dam and Calala WTP due to reduction in run-of-river water transfers.

The new Dungowan Dam has the potential to capture fresh events that would have flowed to Dungowan Creek, while the reduced use of Chaffey Dam may result in higher frequency of spills (as the water level in the dam would be higher due to the reduced use of water from the dam and increased town water reserve), leading to a change in the frequency of larger flow events.

In Dungowan Creek (Figure 6-5), flows would not change for approximately 90% of days, as inflows up to 13 ML/day are released from the dam immediately. For approximately 10% of days, flow past the new Dungowan Dam wall may decrease, influenced by dam filling and the capture of water. These reductions in flow would occur during higher flow days.

In the Peel River (Figure 6-6) flow released from Chaffey Dam would remain unchanged on 65% of days and would decrease 30% of days as a result of the new Dungowan Dam operations reducing the need for run-of-river transfers of water from Chaffey Dam to Calala WTP.

The changes in releases from Chaffey Dam and Dungowan Dam would affect flows at Piallamore, located downstream of the confluence of the Peel River and Dungowan Creek (refer Figure 6-2), with reductions in flow on 40% of days. The magnitude of reductions ranges from 0–40 ML/day for the majority of days, which is moderately significant given the median flow of around 60 ML/day. Reductions in run-of-river flow in the Peel River caused by the new Dungowan Dam operation would have a magnitude similar to Tamworth's water demand and could occur at any time of year including moderate to low flow conditions.

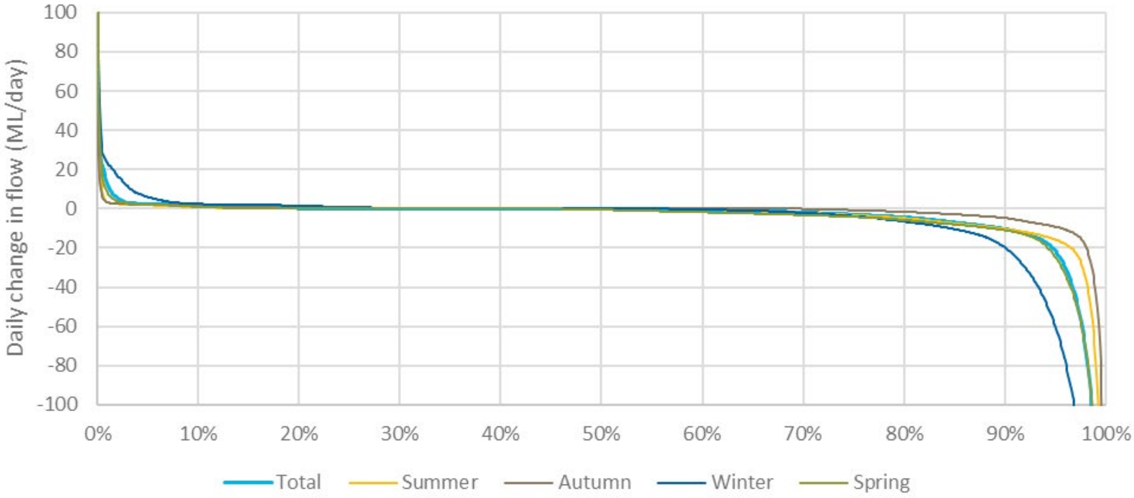


Figure 6-5 **Change in daily flow at Dungowan (419103), current climate, current demand**

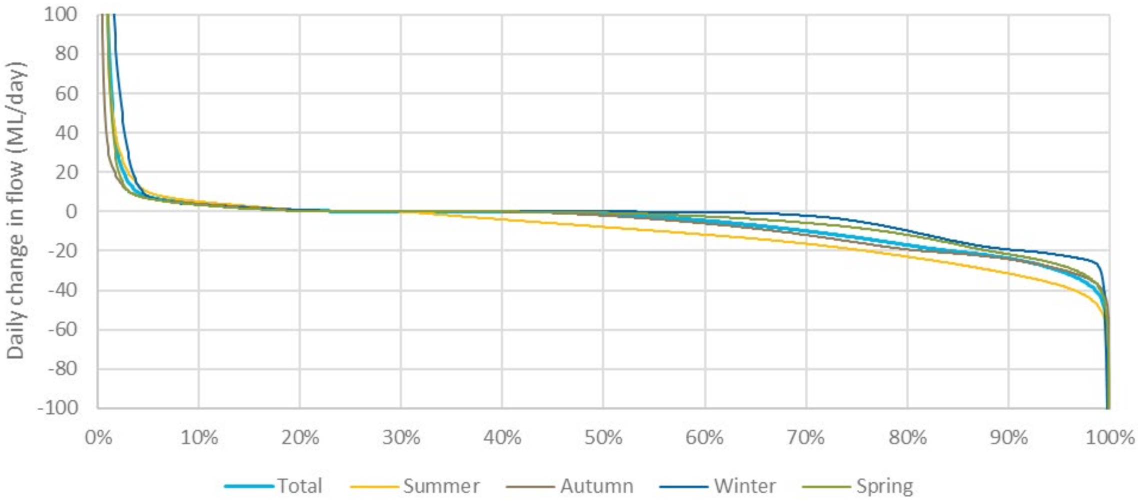


Figure 6-6 **Change in daily flow downstream from Chaffey Dam (419045), current climate, current demand**

Flow reductions caused by the new Dungowan Dam filling could have a larger magnitude, but would tend to occur on higher flow days in response to rain, and so would have smaller relative effect. For example, a flow reduction from 200 ML/d to 150 ML/day could occur by this mechanism, with the effect occurring for the duration of the rain induced flow event.

Downstream from Tamworth, changes to flow due to the new Dungowan Dam operation have no effect, and flow effects are due to the new Dungowan Dam filling only. Modelled flow reductions would typically have no meaningful effect at these locations due to the higher flows generated by the upstream catchments.

Changes to the flow regime as a result of reduced run-of-river releases from Chaffey Dam would be more noticeable in summer, when run-of-river releases would have made a larger proportion of the Peel River flow. Flow changes as a result of the new Dungowan Dam filling are more noticeable in winter, as filling events are more likely with heavy winter rain events.

Despite these reduction in surface water flows, there would be a negligible impact on the Peel River Alluvium's groundwater regime and subsequently negligible impact for GDEs and groundwater users to access groundwater in the Peel River. Analysis of the overall depth regime changes due to the operation of the project indicates that the minor changes to stream flow would result in negligible changes to stream depth in Dungowan Creek and the Peel River. By inference, the project is not expected to affect recharge rates to the Dungowan Creek Alluvium (below the new Dungowan Dam) and Peel River Alluvium (below Chaffey Dam), or effect groundwater access to GDEs or other users.

6.3.2 Geomorphology

Over time, erosion and deposition processes in creeks and rivers can shift banks, create bends and oxbow wetlands, create braids and flood runners. In most rivers, bed material mobilisation would be an expected process associated with the bankfull flow or perhaps with large fresh flows, when the bed shear exceeds the threshold level needed to mobilise bed materials. Changes to the frequency of higher flow events could result in changes to creek and river evolution over the long term.

Within the Peel River, there may be a 13% increase in the frequency of high flow events. This means that changes that might have occurred over the next 50 years may now occur over 40–45 years. Within this timeframe, it is expected that climate change may reduce the frequency of higher flow events, and so increases in flow frequency caused by the project would assist in counteracting climate change effects. Within Dungowan Creek, there may be a 3% reduction in the frequency of higher flow events, which is unlikely to have meaningful geomorphological effects.

6.3.3 Groundwater interception

Groundwater is likely to be intercepted during construction of the new Dungowan Dam, including in the lower levels of Dungowan Creek when excavating the dam foundation, when excavating the spillway chute and stilling basin foundation and when quarrying for construction materials. During pipeline trenching works, groundwater would be intercepted when trenching through Dungowan Creek and could be intercepted when trenching through shallow alluvial sediments.

Drawdown near the excavations is expected to be localised and temporary due to the sequential nature of the works, which would reduce the need for ongoing dewatering during construction. There are no groundwater users within the vicinity of the new Dungowan Dam and spillway excavation areas, and the terrestrial and aquatic ecosystems present do not have a dependent relationship with groundwater. The potential impact to GDEs and groundwater users due to these construction works is negligible to low.

During the construction of the pipeline, groundwater seepage to trenched excavation works is not expected to intercept groundwater. If groundwater is intercepted during trenching the implementation of management and engineering measures would minimise the need to dewater, reducing the likelihood of impact to GDEs and other groundwater users. Trenches would be left open for the minimal amount of time possible limiting dewatering if groundwater is intercepted.

6.3.4 Water quality

Impacts to water quality during construction are not considered a significant risk to surface water and groundwater quality and would be managed through the implementation of a Soil and Water Management Plan (SWMP) and progressive Erosion and Sediment Control Plans.

Water quality during operation could be affected by high nutrient concentrations, which can lead to algal growth and cold water releases, which can cause cold shock to downstream biota. Algal growth and cold water release risk are both increased by thermal stratification.

The new Dungowan Dam would have dimensions smaller than Chaffey Dam and so would experience weaker stratification effects and would release smaller volumes of water downstream. Utilisation of the proposed multilevel offtake is expected to result in a CWP effect that is either negligible or very minor and limited to a short distance downstream of the new Dungowan Dam embankment.

Following filling of the new reservoir the remaining vegetation, which has become inundated, would die and begin to decompose releasing nutrients to the waterbody. High nutrient levels in reservoirs can lead to eutrophication and algal blooms, which have the potential for deoxygenation and the introduction of toxins produced by algae. These effects may be detrimental to fish species in the reservoir and downstream, affect water taste, and increase the cost of treatment for potable water supply.

The nutrient load contained within submerged vegetation would be minimised by clearing the inundation area prior to filling the reservoir. Clearing would remove many tonnes of woody mass and the nutrients contained within, but a substantial nutrient load may remain in leaf litter, topsoil, stumps and roots. It is expected that this matter would cause higher nutrient levels in the reservoir in the first few years of reservoir operation than would occur in later years.

With regard to the AIPs' groundwater quality requirements, the project is not anticipated to result in a lowering of the beneficial use (i.e. environmental value) category of the local groundwater sources.

6.3.5 Water availability

Changes to the flow regime would not affect access to water for stock and domestic purposes. While run-of-river transfers between Chaffey Dam and Calala WTP may decrease in frequency, daily releases of water (minimum 3 ML/day specified in the WSP) from Chaffey Dam would continue. WaterNSW would continue to meet water delivery obligations. Overall, the volume of storage in the Peel Valley would increase, leading to greater security of supply.

The frequency and severity of water restrictions in Tamworth would decrease following construction of the new Dungowan Dam, while average annual general security allocations would remain unchanged. With current demands, the frequency of water restrictions would decrease from 18% of the time to around 7% of the time. With future demands (i.e. +20% population growth), the frequency of water restrictions would decrease from 22% of the time to around 10% of the time, i.e. restrictions would occur half as often (Figure 6-7).

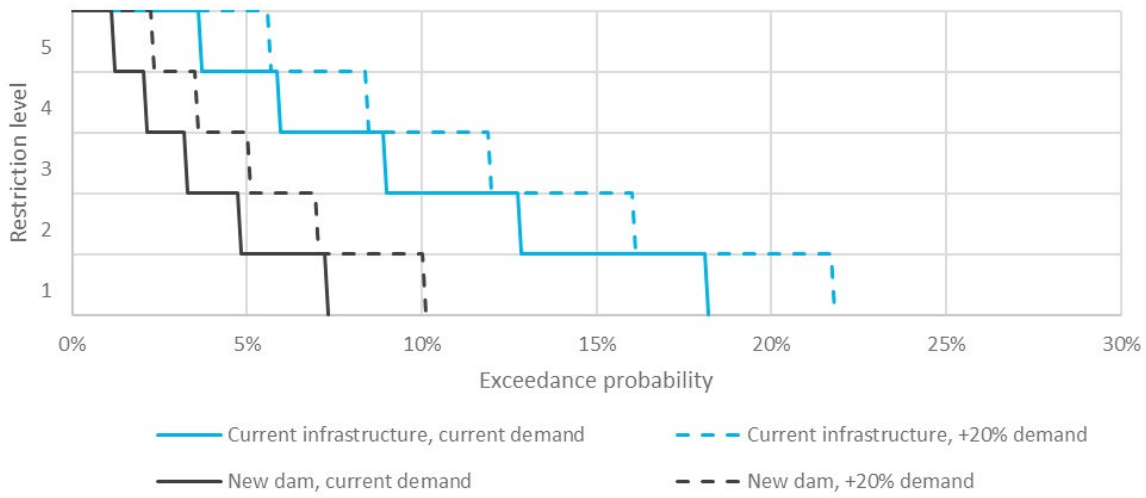


Figure 6-7 Modelled probability of water restrictions in Tamworth

6.3.6 Flooding

The new Dungowan Dam would have a larger spillway than the existing Dungowan Dam and may release marginally more water during flood events. Flood modelling has indicated that this would not have any meaningful effect on flood water levels and would not affect bridge access. Due to its larger volume, the new Dungowan Dam would have the capacity to capture smaller flood events, and so reduce flooding downstream. Flood frequency within Dungowan Valley is expected to reduce marginally.

Depending on how the volumes of water in Chaffey Dam and the new Dungowan Dam are managed, there is the potential that Chaffey Dam may on average have higher storage volumes due to increased use of the new Dungowan Dam. If reservoirs are managed such that average Chaffey Dam volumes are held higher, then the frequency of flooding in Woolomin, located downstream of Chaffey Dam (refer Figure 6-2), could increase marginally.

Existing flood studies have assumed that dams are full at the commencement of flooding. If this is assumed to be the case due to antecedent rain conditions, then the project would have no effect on flooding within the Peel River.

6.3.7 Sustainable diversion limit

The WSP for the *Peel Regulated River Water Source 2022* describes the Long Term Average Annual Extraction Limit (LTAAEL) for the Peel Regulated River water source as 15.1 GL/year. Where the assessment of compliance with the LTAAEL indicates that the extraction of water would exceed the LTAAEL over the long-term, the WSPs prescribes management actions that must be taken to reduce water availability until extraction can be expected to return to within the LTAAEL.

For the Peel Valley Regulated River Water Source, the current WSP requires that 95% of growth in extraction by Tamworth Regional Council is accounted as a growth in water use in the Lower Namoi Regulated River Water Source. This provision recognises that Tamworth Regional Council is the largest single water user in the Peel Valley, and relatively small increases in water use could result in management actions that have a significant impact on other licensed water users. Conversely, there is significantly higher levels of water entitlements and use in the Lower Namoi Valley, and any changes to water access that might arise from growth in water use by Tamworth Regional Council would be distributed across this larger group of water licences and would not result in significant impacts.

The DPE Peel Valley Source model results show that with the existing infrastructure, 253 ML/year of Town Water Supply usage may be attributable to the Lower Namoi Regulated River Water Source, and that this volume could grow to 427 ML/year following construction of the new Dungowan Dam. The increase following construction of the project is due to a reduction in the frequency and severity of water restrictions and corresponding increase in water used.

As a result of increasing extractions attributable to the Lower Namoi Regulated River Water Source, allocations within that water source would be reduced by around 200 ML to remain within Water Sharing Plan diversion limits, resulting in reductions to Namoi General Security allocations of around 0.2%. As such, there would be no meaningful impact to water resources in the Upper and Lower Namoi and total diversions would be managed to remain within the LTAAEL as required by the WSP.

6.3.8 Cumulative impacts

The existing Chaffey Dam pipeline, which was constructed for temporary drought relief, is currently seeking approval for long term operation. The trigger for operation of the Chaffey Dam pipeline would be when Chaffey Dam water levels fall below 20%, which is also the trigger for level 5 water restrictions in Tamworth. The time in level 5 water restrictions would reduce as a result of the operation of the new Dungowan Dam. The construction of the new Dungowan Dam would therefore reduce the frequency and period of time that Chaffey Dam pipeline would be operational. This means that whatever effects to surface water and groundwater that may be attributed to Chaffey Dam pipeline operation would reduce in frequency when the Dungowan Dam and pipeline project is operational. Cumulative impacts on water are discussed further in Chapter 21 and Appendix F.

6.4 Management and mitigation

6.4.1 Mitigation measures

Potential impacts to surface water quality during construction as a result of erosion and sedimentation would be managed through the development of a construction Soil and Water Management Plan (SWMP). The SWMP would be developed for the project prior to the commencement of construction. As part of the SWMP, progressive Erosion and Sediment Control Plans would be developed for all disturbed areas. The design of treatment measures would take into account local design rainfall rates, and local soil erosion hazard. Sediment management infrastructure would be designed in accordance with *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and *Volume 2A Installation of services* (Landcom, 2008). Further detail on erosion and sedimentation management measures are included in the Land, Soils and Erosion Assessment (Appendix Q).

Whilst utilisation of the proposed multilevel offtake is expected to result in a CWP effect that is either negligible or very minor and limited to a short distance downstream of the dam embankment, the detailed design would investigate the need and, if deemed necessary, the sizing of the two commonly accepted methods for mitigating stratification. This would include direct injection of air or bubble plumes and mechanical mixing using fixed or floating impellors.

Impacts to surface water would also be managed through development of a surface water monitoring program that will be implemented over the duration of construction and carried forward for longer term monitoring through the operational phase of the project. The primary objectives of the surface water monitoring program are to:

- Provide additional monitoring of baseline conditions.
- Enable the effectiveness of water quality controls to be assessed.
- Identify and quantify any water quality impacts.
- Identify and quantify any potential impacts on stream flows.
- Enable compliance with relevant consent and licence conditions to be assessed.

A Groundwater Management Plan (GWMP) would be developed for the project to support construction activities, and would include the groundwater monitoring program, reporting requirements, spill management and response, water quality trigger levels, corrective actions, contingencies, and responsibilities for all management measures. The GWMP would include details of the groundwater monitoring program, which would incorporate and update the existing monitoring network (if required), monitoring frequencies and water quality constituents, and physical water take and usage. Reporting frameworks for the above would be prepared in accordance with licensing and agency requirements. Trigger levels for water quality parameters would be developed as part of the GWMP to assist in early identification of water quality trends.

6.4.2 Optimised environmental releases

The new Dungowan Dam would have greater capacity than the existing Dungowan Dam, and would capture larger flow events. The proposed 13 ML/day translucency flow is expected to ameliorate day-to-day effects on downstream ecological communities, but the reduction in higher flows may mean that species which rely on floodplain or flood runner inundation to complete lifecycle processes may be negatively affected. The reduction in frequency of flows over 100 ML/day could be mitigated through strategic use of the proposed 200 ML EWA account. The dam outlet infrastructure would be able to pass 300 ML/day, and so could release infrequent 100 ML/day or 200 ML/day pulses.

An example stream flow regime mitigation method was also investigated in which the translucency threshold is maintained at 10 ML/day; and inflows between 10 ML/day to 13 ML/day are credited to an environmental water account for periodic release. This mitigation method would increase the number of small fresh pulses in Dungowan Creek, potentially mitigating the effect of a greater proportion of flood flows being retained in the new Dungowan Dam.

Ongoing investigation of operating principles would seek to further minimise downstream impacts, in consultation with relevant State and Commonwealth agencies.

6.5 Summary and conclusion

Impacts to water have been considered and minimised through the project design and would be a key consideration throughout project construction and operational management. Potential impacts to water as a result of the project construction and operation activities were assessed and included consideration of potential impacts to hydrology, geomorphology, groundwater resources and receivers, water quality, water users and flooding.

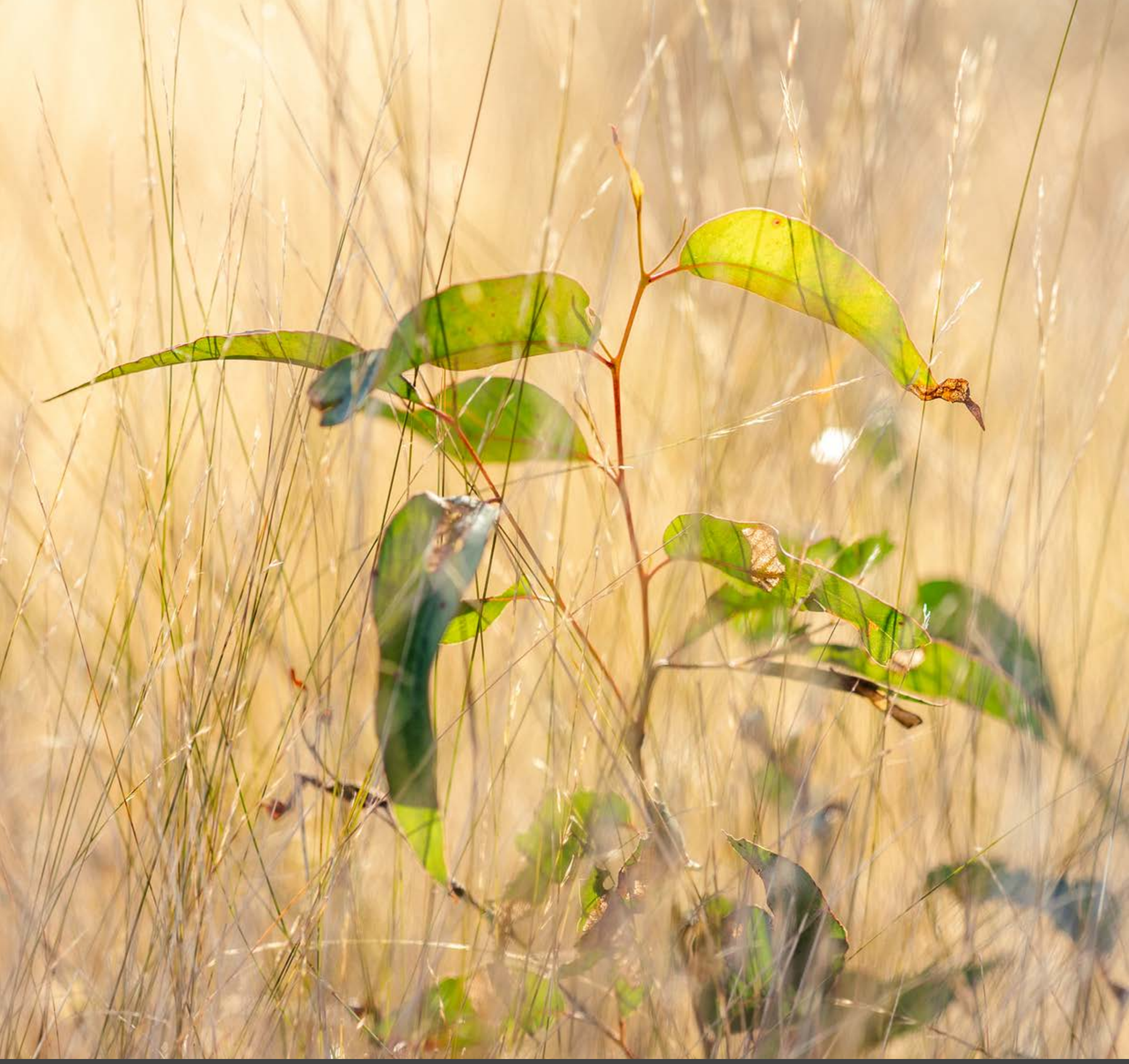
Construction impacts to water quality would be managed by implementing a SWMP and are not considered a significant risk to surface water and groundwater quality. Impacts associated with drawdown near the new Dungowan Dam excavations is expected to be localised and temporary due to the sequential nature of the works. Potential risk of impacts to GDEs and water users due to construction works is negligible to low.

The management of dams and extractions for water supplies unavoidably alters the flow of water within natural rivers and creeks. Dungowan Creek would see a reduction in flow past the new Dungowan Dam wall for approximately 10% of days, influenced by dam filling and capture of water during higher flow days. Flow released from Chaffey Dam would decrease 30% of days as a result of the new Dungowan Dam operations. The magnitude of reductions is moderately significant given the median flow and could occur at any time of year including moderate to low flow conditions.

Analysis of the overall depth regime changes due to the operation of the project indicates that the minor changes to stream flow would result in negligible changes to stream depth in Dungowan Creek and the Peel River. By inference, the project is not expected to affect recharge rates to the Dungowan Creek Alluvium (below the new Dungowan Dam) and Peel River Alluvium (below Chaffey Dam), or effect groundwater access to GDEs or other users.

Changes to the flow regime would not affect access to water for stock and domestic purposes, however would decrease the frequency and severity of water restrictions (occurring half as often) in Tamworth under both current and future demands (i.e. +20% population growth).

Consultation with relevant State and Commonwealth agencies would continue through the optimisation of mitigation and management measures during construction and operation of the project.



CHAPTER 7

Terrestrial ecology

7 Terrestrial ecology

This chapter provides a detailed summary of the assessment of potential impacts to terrestrial ecology arising from the construction and operation of the project and identifies appropriate mitigation and management measures, including offset requirements, proposed to address any unavoidable residual impacts.

A detailed Biodiversity Development Assessment Report (BDAR) addressing terrestrial ecology has been prepared in accordance with the Biodiversity Assessment Method (BAM, DPE 2020a) and is provided in Appendix H. The relevant SEARs for terrestrial ecology and where they are addressed are summarised in Appendix A.

7.1 Existing environment

7.1.1 Landscape features

7.1.1.1 General landscape features

Dungowan Creek is a frequently flowing waterway with distinct banks, narrow floodplains and distinct riparian vegetation communities, which provides habitat for certain semi-aquatic reptiles, mammals and frogs. Within the project footprint, the tributaries of Dungowan Creek are ephemeral or infrequently flowing waterways that are generally unlikely to be consistently occupied by semi aquatic reptiles and mammals.

A relatively narrow floodplain surrounds Dungowan Creek, ranging from less than 100 m wide in parts of the new Dungowan Dam construction and inundation area to over 1 km wide further downstream, closer to the confluence with the Peel River. Except for a narrow band of riparian forest, the floodplain area is largely cleared of native vegetation and much of it has been converted to exotic pasture or cropland.

The low rolling hills surrounding the floodplain have been cleared of much of their original grassy woodland vegetation for livestock grazing. The surrounding steeper areas contain shrubby woodland and forest that has not been as extensively cleared for agriculture, but is still affected, to varying degrees, by a history of timber harvesting, which has reduced the abundance of large mature trees.

There are no nationally or internationally important wetlands near the project footprint or in downstream areas likely to be influenced by the project. The only wetlands identified in DPE wetland mapping in the locality are artificial impoundments (including the existing Dungowan Dam inundation area) and large farm dams.

The new Dungowan Dam construction and inundation area is entirely surrounded by extensive areas of native forest; where the upslope habitat connectivity is considered high. As vegetation is largely cleared from the low undulating hills and flats of the valley floor, main habitat connectivity within the project area is largely limited to the riparian vegetation along and surrounding Dungowan Creek. An example of the landscape within the new inundation area is shown in Photograph 7-1.

Image credit: Andrew Pearson Photography

Photograph 7-1 Landscape setting of the new Dungowan Dam inundation area

7.1.1.2 Bioregions and landscapes

The new Dungowan Dam construction and inundation area, the pipeline route, road upgrade areas and all areas of potential downstream impact are located within the Peel subregion of the Nandewar Interim Biogeographic Regionalisation of Australia (IBRA) region. Part of the powerline footprint is within the adjacent Walcha Plateau subregion of the New England Tablelands bioregion.

The project footprint is located within three BioNet NSW Landscapes. Most of the new Dungowan Dam construction area, the reservoir and the powerline are located in the Niangala Plateau Slopes landscape and most of the pipeline route, road upgrade area and downstream creek areas subject to flow regime changes are in the Peel Channels and Floodplain. Approximately 450 m of the pipeline route at its north-western end is in the Tamworth-Keepit Slopes and Plains landscape.

7.1.2 Ecological context

7.1.2.1 Native vegetation and threatened ecological communities

There are six native plant community types (PCTs), totalling around 185 ha within the project footprint (Table 7-1).

Only one threatened ecological community (TEC) listed under the BC Act and/or EPBC Act is associated with the recorded PCTs. The associated TEC is referred to as 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 (Box-Gum Woodland), under the BC Act and is listed as a critically endangered ecological community (CEEC). This community is also listed as a CEEC under the EPBC Act as White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Within the project footprint, an area of approximately 57 ha was determined to be consistent with the CEEC listing under the BC Act, of which 42 ha is consistent with the EPBC Act listing.

The PCTs and their association with any TECs listed under either the BC Act or EPBC Act are detailed in Table 7-1. All native PCTs recorded varied from higher condition patches to poor condition patches and as such, only certain vegetation zones within each PCT are consistent with an associated TEC listing under the BC Act or EPBC Act. This is noted in Table 7-1 and detailed further in the BDAR (Appendix H).

Table 7-1 Native plant community types in the project footprint

PCT ID	Common name	Total (Ha)	Association with listed TECs
84	River Oak – Rough-barked Apple – red gum – box riparian tall woodland (wetland) of the Brigalow Belt South and Nandewar Bioregions	67.34	Not listed and no association with listed TECs under the BC Act or EPBC Act.
381	Rough-barked Apple – Yellow Box grass/shrub footslope open forest, Brigalow Belt South Bioregion	57.20	PCT 381 is classified as 'partially subset' of the TEC, White Box Yellow Box Blakely's Red Gum Woodland. Some PCT 381 vegetation zones within the project footprint are consistent with the TEC listings under the BC Act and EPBC Act.
541	Silvertop Stringybark – Rough-barked Apple grassy open forest of southern Nandewar Bioregion, southern New England Tableland Bioregion and NSW North Coast Bioregion	24.84	Not listed and no association with listed TECs under the BC or EPBC Acts.

PCT ID	Common name	Total (Ha)	Association with listed TECs
563	White Box – Silvertop Stringybark +/- White Cypress Pine grass shrub open forest of the southern Nandewar Bioregion and New England Tablelands Bioregion	1.15	PCT 563 is classified as 'partially subset' of the TEC, White Box Yellow Box Blakely's Red Gum Woodland, however no areas of PCT 563 in the project footprint are representative of the TEC listings under either the BC Act or EPBC Act.
567	Broad-leaved Stringybark – Yellow Box shrub/grass open forest of the New England Tableland Bioregion	5.85	PCT 567 is classified as 'partially subset' of the TEC, White Box Yellow Box Blakely's Red Gum Woodland, however no areas of PCT 567 in the project footprint are representative of the TEC listings under either the BC Act or EPBC Act.
599	Blakely's Red Gum – Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion	28.50	PCT 599 is classified as 'wholly subset' of the TEC, White Box Yellow Box Blakely's Red Gum Woodland. All PCT 599 vegetation zones within the project footprint are consistent with the TEC listing under the BC Act. Some PCT 599 vegetation zones within the project footprint are consistent with the TEC listing under the EPBC Act.
	Total	**184.88**	

7.1.2.2 Threatened species

A variety of threatened species were either recorded during field surveys or their presence was assumed based on the application of methodology set out in the BAM. These are listed in Table 7-2, along with the conservation status under both the BC Act and EPBC Act.

Table 7-2 Threatened species recorded or assumed to be present on site

Name	Type	Recorded or assumed		EPBC Act Status
Koala (Phascolarctos cinereus)	Mammal	Recorded	E	E
Spotted-tailed Quoll (Dasyurus maculatus)	Mammal	Recorded	V	E
Squirrel Glider (Petaurus norfolcensis)	Mammal	Recorded	V	-
Corben's Long-eared Bat (Nyctophilus corbeni)	Bat	Assumed	V	V
Eastern Coastal Free-tailed Bat (Micronomus norfolkensis)	Bat	Recorded	V	-
Eastern False Pipistrelle (Falsistrellus tasmaniensis)	Bat	Recorded	V	-
Grey-headed flying-fox (*Pteropus poliocephalus*)	Bat	Assumed	V	V

Name	Type	Recorded or assumed	BC Act Status	EPBC Act Status
Large Bent-winged Bat (Miniopterus orianae oceanensis)	Bat	Recorded	V	-
Large-eared Pied Bat (Chalinolobus dwyeri)	Bat	Recorded	V	V
Border Thick-tailed Gecko (Uvidicolus sphyrurus)	Reptile	Recorded	V	V
Black-faced Monarch (*Monarcha melanopsis*)	Bird	Assumed	-	M
Diamond Firetail (Stagonopleura guttata)	Bird	Recorded	V	-
Dusky Woodswallow (Artamus cyanopterus)	Bird	Recorded	V	-
Fork-tailed Swift (Apus pacificus)	Bird	Assumed	-	M
Glossy Ibis (Plegadis falcinellus)	Bird	Assumed	-	M
Latham's Snipe (Gallinago hardwickii)	Bird	Assumed	-	M
Little Eagle (Hieraaetus morphnoides)	Bird	Recorded	V	-
Little Lorikeet (Glossopsitta pusilla)	Bird	Recorded	V	-
Osprey (Pandion haliaetus)	Bird	Assumed	-	M
Painted Honeyeater (*Grantiella picta*)	Bird	Assumed	V	V
Regent Honeyeater (*Anthochaera phrygia*)	Bird	Assumed	CE	CE
Rufous Fantail (Rhipidura rufifrons)	Bird	Assumed	-	M
Scarlet Robin (Petroica boodang)	Bird	Recorded	V	-
Speckled Warbler (Pyrrholaemus sagittatus)	Bird	Recorded	V	-
Swift Parrot (Lathamus discolor)	Bird	Assumed	E	CE
Varied Sittella (Daphoenositta chrysoptera)	Bird	Recorded	V	-
White-bellied Sea-eagle (Haliaeetus leucogaster)	Bird	Recorded	V	-
White-throated Needletail (*Hirundapus caudacutus*)	Bird	Assumed	-	V, M
Austral Toadflax (Thesium australe)	Plant	Recorded	V	V
Tall Velvet Sea-berry (Haloragis exalata subsp. Velutina)	Plant	Recorded	V	V

CE = Critically endangered, E = Endangered, V = Vulnerable, M = Migratory

Photographs of a number of the threatened species visually identified during field surveys are provided in Photograph 7-2 to Photograph 7-5.

Photograph 7-2 Border Thick-tailed Gecko

Photograph 7-3 Squirrel Glider

Photograph 7-4 Tall Velvet Sea-berry

Photograph 7-5 Austral Toadflax

7.1.2.3 Flow-dependent ecosystems

Flow-dependent ecosystems consist of the aquatic ecosystem of Dungowan Creek and the Peel River, riparian forest, and remnant native vegetation on floodplains. PCT 84 was the only terrestrial flow-dependent ecosystem identified in the project footprint.

Outside of the project footprint but within the area subject to potential downstream flow regime changes as a result of the operation of the new Dungowan Dam, an additional terrestrial flow-dependent ecosystems was identified; PCT 78 – River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion.

7.2 Assessment overview

7.2.1 Assessment methods

The BC Act, together with the Biodiversity Conservation Regulation 2017, established the NSW Biodiversity Offsets Scheme (BOS), which includes the Biodiversity Assessment Method (BAM, DPIE 2020a) for use by accredited persons in biodiversity assessment and reports under the scheme. The biodiversity assessment (Appendix H) has been undertaken in accordance with the requirements of the BAM, which provides a framework to assess the impact of actions on threatened species and threatened ecological communities, and their habitats and to determine offset requirements.

In the calculation of offsets under the BAM, there are two broad classes of credits; ecosystem credits and species credits. In some circumstances, a threatened species may require assessment for both ecosystem credits and species credits. This is referred to as a dual credit species.

As the project has been declared a controlled action under the EPBC Act, the terrestrial ecology assessment also addresses the relevant Matters of National Environmental Significance (MNES).

The ecological objectives and targets of the *Namoi Long Term Water Plan* (LTWP) (DPIE 2020b) have also been used as a basis for assessing the potential changes to flow regime caused by the project. The Environmental Water Requirements described in the LTWP apply to the Peel River but not for the Upper Peel River tributaries, including Dungowan Creek.

Biodiversity surveys within the project footprint and adjacent surrounding area were undertaken between 2020 and 2022, including preliminary surveys, numerous targeted flora and fauna campaigns and surveys of areas subject to potential flow regime changes.

7.2.2 Avoidance in design

The consideration of options and development of the project was informed by iterative environmental constraint assessment comprising both desktop and field survey, with the aim to reasonably avoid and minimise significant impacts to the environment, including biodiversity values. This resulted in changes to the pipeline and powerline routes and location of ancillary facilities to minimise impacts to known threatened species, areas of higher quality Box-Gum Woodland, areas with a higher density of mature and hollow-bearing trees, and relatively undisturbed areas of riparian vegetation.

7.2.3 Agency consultation

Consultation has occurred with all relevant State and Commonwealth agencies throughout the preparation of the terrestrial ecology assessment on the following:

- Fieldwork requirements.
- Individual species impact assessment.
- Methodology for assessing prescribed impacts due to changes in hydrology.
- Biodiversity offsetting for both direct and prescribed impacts, (including prescribed impacts and impacts between the FSL and the PMF level).
- Correct interpretation of environmental watering requirements (EWRs) from the Namoi LTWP.

Further details of consultation are detailed in Chapter 5 and Appendix D of the EIS.

1.1.1 Relationship to aquatic ecology assessment

Impacts on aquatic flow-dependent ecosystems as they relate to BC Act listed biodiversity and EPBC Act listed species other than fish, are addressed in this chapter and the BDAR (Appendix H). Impacts on aquatic flow-dependent ecosystems as they relate to *Fisheries Management Act 1994* (FM Act) listed biodiversity and EPBC Act listed fish, are addressed in Chapter 8 of the EIS and the Aquatic Ecology Assessment (Appendix I).

7.3 Predicted impacts

7.3.1 Direct and indirect impacts

The main direct impacts of the project are associated with the loss of native vegetation resulting from clearing of land for the construction of the project and from the inundation of the reservoir area during operation.

The entire project footprint would be cleared or inundated, therefore a total of approximately 185 ha of native vegetation, of varying condition, would be lost (Table 7-1). These direct impacts include the approximately 57 ha of Box-Gum Woodland that is consistent with the BC Act listing, and 42 ha of Box-Gum Woodland and Derived Native Grassland consistent with the EPBC Act listing.

In addition to the direct impacts, the project also has the potential for indirect impacts. Negative indirect impacts include edge effects (i.e. zones of changed environmental conditions occurring along the edges of habitat fragments), temporary habitat inundation during flooding events up to the PMF, disturbance of animals in adjacent habitat during construction, vehicle strike and further potential scenarios. Indirect impacts have been assessed and are unlikely to significantly impact any threatened species or communities.

7.3.2 Prescribed impacts

Consideration has been given to prescribed impacts on threatened species and communities recorded or assumed to be present on site in accordance with the BAM. The prescribed impacts relevant to the project, and the summary of the consequence of the impact on the threatened species or communities, are detailed in Table 7-3. The primary prescribed impact relates to 'water quality, water bodies and hydrological processes that sustain threatened species' and is presented in Section 7.3.2.1 and detailed further in Appendix H.

Table 7-3 Prescribed impacts and consequence of impact on threatened entities

Prescribed impact	Relevant threatened entity	Consequence of impact on threatened entities
Impact on habitat associated with karst, caves, crevices, cliffs, rocks and other geological features of significance.	• Large-eared Pied Bat • Large Bent-winged Bat	The project's impact on these features is unlikely to substantially affect populations of either species.
	• Spotted-tailed Quoll	There is a negligible risk of mortality of a small number of individuals of the species during construction.
	• Border Thick-tailed Gecko	There is a high risk of mortality of a small proportion of the local population of the species during construction as this species was observed in close proximity to these features and is likely to utilise them for shelter and breeding sites. Mitigation measures have been identified to minimise this risk.
Impact on habitat associated with human made structures.	• Large-eared Pied Bat • Large Bent-winged Bat • Eastern False Pipistrelle • Eastern Coastal Free-tailed Bat	The project's impact on these features is unlikely to substantially affect populations of any of the species.

Prescribed impact	Relevant threatened entity	Consequence of impact on threatened entities
Impacts on areas connecting threatened species habitat such as movement corridors.	• Numerous, including arboreal and semi-arboreal mammals, microbats, raptors, owls, birds and plants	During operation, while some species would no longer be able to easily cross the valley due to the large expanse of open water, the project is unlikely to prevent long-term movement of any threatened species of animals from one side of the new Dungowan Dam inundation area to the other as habitat would remain directly connected via large areas of continuous forest and woodland encircling the new Dungowan Dam.
Impacts on threatened species or fauna that are part of a TEC from vehicle strikes.	• Koala • Spotted-tailed Quoll • Little Eagle • Powerful Owl • Barking Owl • Masked Owl • Diamond Firetail • Little Lorikeet • Swift Parrott • Border thick-tailed Gecko	The overall long-term impact of vehicle strike associated with the project is unlikely to have a significant impact on populations of any of the threatened species or fauna that are part of a threatened ecological community.

7.3.2.1 Impacts to biodiversity values from altered flow regime

Due to the influence of the project on the operation of Chaffey Dam, some changes to flow regimes as discussed in Section 6.3.1.

Two PCTs (PCT 78 and PCT 84) occur in riparian areas of Dungowan Creek and the Peel River upstream of Tamworth that are likely to be reliant on baseflow within the groundwater system to maintain parts of their life-cycle.

An assessment against the ecological objectives and targets described in the LTWP identified that within the Peel River, the changes to the flow regime are likely to result in both positive, neutral and negative impacts on flow events and the reliant ecological objectives. Whilst there is predicted to be a decrease in the frequency of years with events meeting the target flow thresholds for baseflow flow events, there was no meaningful change to mean event volumes or durations. In Dungowan Creek there is predicted to be negligible change in the frequency of baseflow events.

As such, is it likely that the soil moisture levels that these riparian communities are reliant on will be retained to a degree that vegetation health and structure would not be significantly impacted.

An assessment of the likely flow changes resulting from the project and associated habitat requirements and ecology of the species known or likely to occur in the riparian areas of Dungowan Creek and the Peel River upstream of Tamworth identified that the impact on threatened and migratory species would be negligible.

7.3.3 Serious and Irreversible Impacts (SAII)

The BAM requires additional impact assessment for species, populations and ecological communities that are listed in the Threatened Biodiversity Data Collection (TBDC, DPIE 2022b) as likely to be at risk of Serious and Irreversible Impacts (SAII). Four relevant threatened species were identified from the TBDC, being the Regent Honeyeater, Swift Parrot, Large-eared Pied Bat and Large Bent-winged Bat. However, an assessment of the SAII triggers identified none are at risk of a SAII, as important or breeding habitat is unlikely to be affected.

The only relevant TEC listed in the TBDC as likely to be at risk of SAII was the White Box Yellow Box Blakely's Red Gum Woodland. The project would affect around 57 Ha of the BC Act listed TEC. The SAII assessment identified that as the impacts of the project are primarily at the existing edges of patches of the TEC, and much of the affected area is already fragmented, an increased edge length is unlikely to cause substantial degradation of remaining areas.

7.3.4 Significance of impacts to EPBC listed species and communities

The terrestrial ecology assessment has considered the significance of impacts on species and ecological communities listed under the EPBC Act. The project is expected to result in significant impacts on Box Gum Woodland, the Koala, Spotted-tail Quoll, Border Thick-tailed Gecko and Tall Velvet Seaberry.

7.4 Management and mitigation

7.4.1 Management measures

Prior to construction, a Flora and Fauna Management Plan (FFMP) would be prepared as part of the CEMP. Detailed minimisation and mitigation measures provided in Appendix H would be included in the FFMP. The detailed measures centre around the key focus areas of:

- Retention of vegetation and habitat during construction.
- Minimising injury of native animals during clearing and construction.
- Weed and pathogen management.

A key mitigation measure for the project is the proposed rehabilitation and restoration of native vegetation in temporary infrastructure locations and in a substantial (59 ha) area of land comprising the footprint of the existing Dungowan Dam.

In addition, due to the likely flow regime changes caused by the operation of the new Dungowan Dam, flow regime targets, triggers and other operational measures would be developed to support the maintenance of ecological values in Dungowan Creek and the Peel River.

7.4.2 Offsets

Offset credits have been calculated in accordance with the BAM and it has been determined the project requires 4,797 ecosystem credits to compensate for impacts on native PCTs and ecosystem credit species. In addition, the project requires species credits for the Koala (3,902), Squirrel Glider (16), Large-eared Pied Bat (5,082), Border Thick-tailed Gecko (504), Austral Toadflax (25) and Tall Velvet Seaberry (2,294).

A biodiversity offset strategy would be developed to meet the requirements of the NSW Biodiversity Offset Scheme and the EPBC *Environmental Offsets Policy* (DSEWPaC 2012). The priority of actions in meeting direct offset liabilities would be; identifying like-for-like offsets to retire credits; ancillary funding of biodiversity conservation actions; identifying offsets using the variation rules detailed in the NSW Biodiversity Offset Scheme (except for any significant impacts under the EPBC Act) and payment to the Biodiversity Conservation Fund (BCF).

It is likely that a combination of payment into the BCF, purchase of credits from existing offset sites, and creation of new offset (stewardship) sites will be the most efficient way of meeting offset requirements.

Water Infrastructure NSW's preference is to target direct offsets based on the priority of exploring the protection of land owned by Tamworth Regional Council in areas of native vegetation adjacent to the project and then seeking stewardship agreements with private landowners. Staging of offsets is proposed to meet the project's offset liability as shown in Table 7-4.

Table 7-4 Proposed offset staging

Component	Impact	Offset timing
Stage 1a – main dam construction	Direct loss of vegetation	Retirement of biodiversity credits prior to construction and/or clearing works commencing on Stage 1a.
Stage 1b – pipeline construction	Direct loss of vegetation	Retirement of biodiversity credits prior to construction and/or clearing works commencing Stage 1b.
Stage 2a – clearing in the inundation area	Direct loss of vegetation	Retirement of biodiversity credits prior to construction and/or clearing works commencing on Stage 2a.

7.5 Summary and conclusion

The BDAR (Appendix H) has been prepared in accordance with the BAM, biodiversity-related SEARs and agency-specific assessment requirements. Biodiversity surveys were undertaken between 2020 and 2022 and have informed the evolution of the new Dungowan Dam, pipeline and ancillary infrastructure design to ensure the avoidance and minimisation of biodiversity impacts as far as practicable.

As the entire project footprint would be cleared or inundated, a total of approximately 185 ha of native vegetation, of varying condition, would be lost, including approximately 57 ha of Box-Gum Woodland that is consistent with the BC Act listing, and 42 ha of Box-Gum Woodland and Derived Native Grassland that is consistent with the EPBC Act listing.

Water Infrastructure NSW will compensate for residual impacts through the implementation of a biodiversity offset strategy.

The BDAR (Appendix H) has also considered impacts on species and ecological communities listed under the EPBC Act. The project is expected to result in significant impacts on Box Gum Woodland, the Koala, Spotted-tail Quoll, Border Thick-tailed Gecko and Tall Velvet Seaberry. As the project is being assessed in accordance with the bilateral agreement made between the NSW and the Commonwealth under Section 45 of the EPBC Act, impacts on this listed ecological community and species will be compensated through the implementation of the biodiversity offset strategy.

CHAPTER 8

Aquatic ecology

8 Aquatic ecology

This chapter provides a detailed summary of the potential impacts to the key aquatic values arising from the construction and operation of the project and identifies appropriate mitigation and management measures, including offset requirements, proposed to address identified impacts. A detailed Aquatic Ecology Assessment was also prepared and is provided in Appendix I. The relevant SEARs for aquatic ecology and where they are addressed are summarised in Appendix A.

8.1 Existing environment

8.1.1 Aquatic habitats and key fish habitat

Dungowan Creek is characterised by a series of pool and riffle habitats within a defined channel with muddy clay to clayey sediment and banks, cobble and gravel beds, and sections of intact riparian vegetation and in-stream snags. Dungowan Creek ranges from less than 5 m wide near the existing Dungowan Dam to over 15 m wide at its confluence with the Peel River. Dungowan Creek near the new Dungowan Dam site is shown in Photograph 8-1.

Photograph 8-1 Dungowan Creek near the new Dungowan Dam

The Peel River from the Chaffey Dam wall to Tamworth is characterised by a series of run and pool sequences over cobble and gravel beds with large woody debris, in-stream aquatic vegetation and riparian vegetation, which provide breeding and refuge habitat. Some locations along the Peel River are void of instream woody debris and support little to no riparian vegetation. The Peel River ranges from around 10 m wide below Chaffey Dam to over 30 m wide towards Tamworth. The Peel River downstream of its confluence with Dungowan Creek is shown in Photograph 8-2.

Photograph 8-2 Peel River downstream of the confluence with Dungowan Creek

The local area surrounding Dungowan Creek and the Peel River is highly fragmented, with native vegetation occurring only in isolated patches and surrounded by urban and agricultural land. Aquatic and riparian habitat is generally of poor condition, with invasive exotic species dominant and habitat modification prevalent (e.g. land clearing, agriculture, river regulation, erosion/sedimentation). A narrow corridor of riparian vegetation immediately adjacent to Dungowan Creek is generally intact; however, this dissipates with distance downstream due to encroaching agricultural use.

Key fish habitat mapping indicates that the majority of waterways within the project footprint and in the areas subject to potential changes to flow regime contain key fish habitat. Field survey observations confirmed and evaluated this through the assessment of habitat sensitivity (waterway type) and functionality as fish passage (waterway class) for all assessed locations.

Both Dungowan Creek and the Peel River are classified as Class 1 major key fish habitat. Dungowan Creek is also classified as Type 1 highly sensitive key fish habitat, while the Peel River ranges from Type 1 highly sensitive key fish habitat to Type 2 moderately sensitive key fish habitat. Other tributaries to Dungowan Creek range from Type 1 to 3 and have waterway classes including Class 1, 3 and 4, detailed further in Appendix I.

8.1.2 Threatened ecological communities

There is one threatened ecological community (TEC) within the project footprint area listed under the FM Act; the Lowland Darling River aquatic ecological community (Lowland Darling River EEC). The listing includes all native fish and aquatic invertebrates within all waterways associated with the Darling River, including the Peel River downstream of Chaffey Dam and part of Dungowan Creek, below 500 m AHD (Figure 8-1).

8.1.3 Aquatic vertebrates

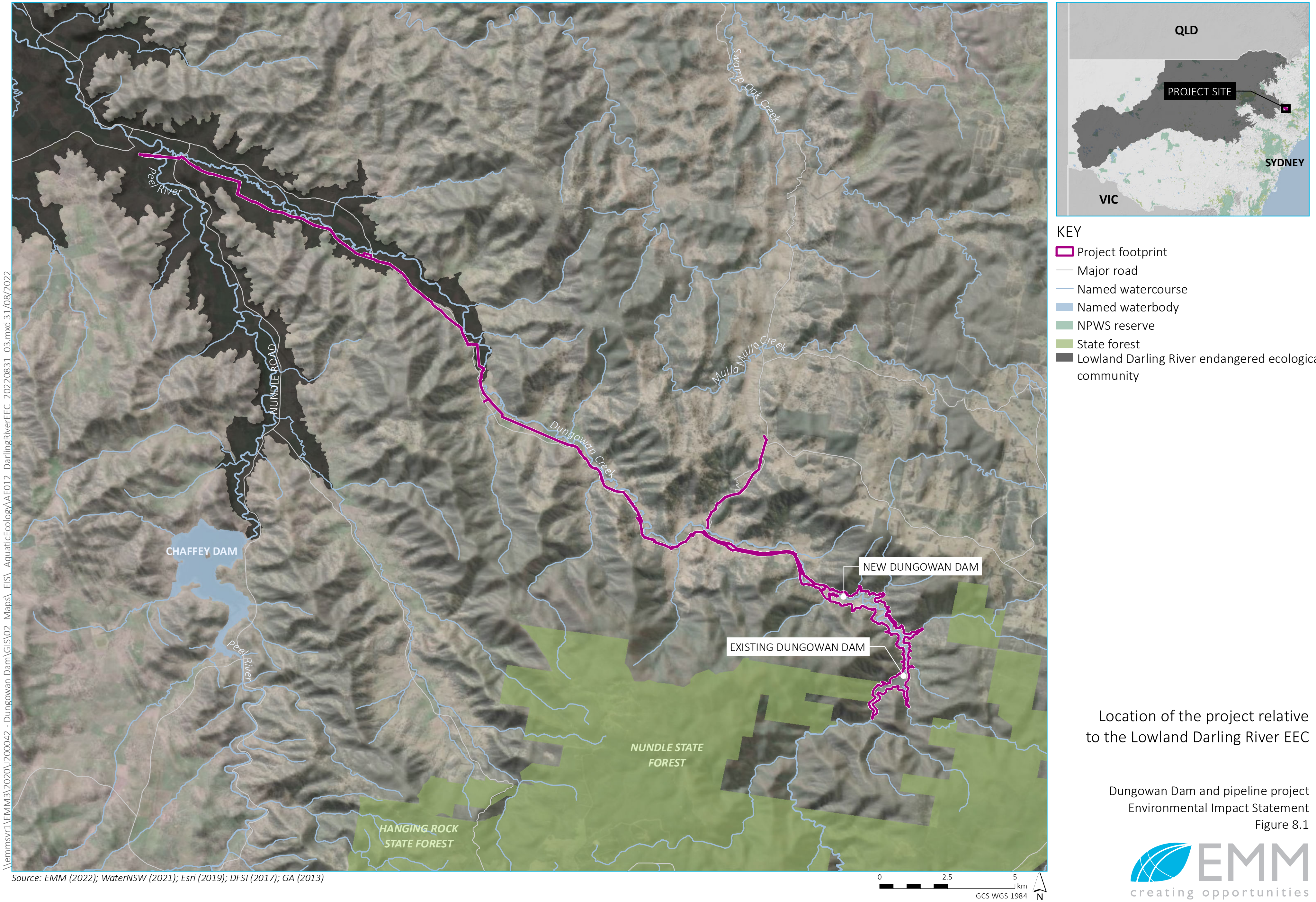
The project area includes a variety of aquatic vertebrate species, including exotic species, native species, threatened species and species associated with the Lowland Darling River EEC.

The Eel-tailed Catfish, Murray Cod and Silver Perch were all observed during surveys. The Murray-Darling Basin population of Eel-Tailed Catfish is listed as an endangered population under the FM Act, the Murray Cod is listed as Vulnerable under the EPBC Act and the Silver Perch is listed as Vulnerable under the FM Act and Critically Endangered under the EPBC Act. Platypus, which is provisionally listed under the EPBC Act whilst more information is gathered, was also recorded in both Dungowan Creek and the Peel River.

While not recorded, the Southern Purple-spotted Gudgeon (listed as Endangered under the FM Act) also has the potential to occur, given the suitable habitat within Dungowan Creek and the Peel River.

A photograph of a juvenile Murray Cod recorded during surveys is shown in Photograph 8-3 and the locations of all threatened species and Platypus recorded during surveys are shown in Figure 8-2.

Photograph 8-3 Juvenile Murray Cod



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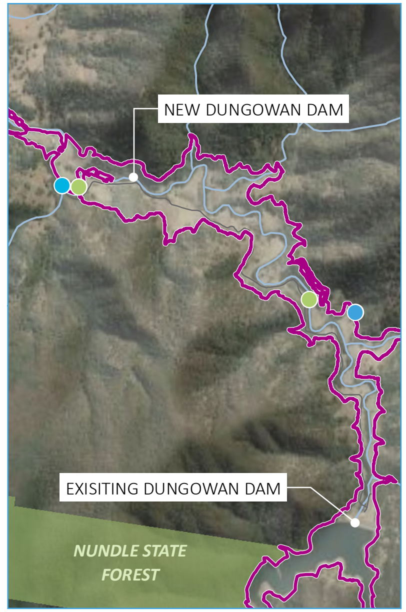
Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

Location of the project relative to the Lowland Darling River EEC

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 8.1

EMM creating opportunities



KEY
- Project footprint
- Eel-tailed Catfish
- Murray Cod
- Platypus
- Silver Perch
- Major road
- Named watercourse
- Named waterbody
- State forest

Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

Location of recorded threatened species, populations and the Platypus

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 8.2

EMM
creating opportunities

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8.1.4 Algae, macros and macroinvertebrates

Dungowan Creek and the Peel River contain a range of phytoplankton and periphyton, however none of the taxa recorded were considered to be threatened or of restricted distribution. Aquatic macrophytes have a limited diversity and distribution in the study area and are not a dominant habitat feature, with none of the taxa recorded considered to be threatened or of restricted distribution. Macroinvertebrate health was observed to be lowest immediately downstream of Chaffey Dam, likely impacted by agricultural pollution or the downstream effect of the dam.

8.1.5 Water and sediment quality

Water quality within Dungowan Creek and the Peel River is variable with pH, suspended solids, turbidity, electrical conductivity and dissolved oxygen outside the ANZECC and ARMCANZ (*Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000*) guideline trigger values at a number of locations, while other parameters were generally within the relevant trigger values.

Sediment analysis indicated that sediment quality is generally within the relevant *Australian and New Zealand guidelines for fresh and marine water quality default guideline values* (ANZG DGV) with the exception of Nickel, which exceeded the ANZG DGVs trigger values at a number of locations.

8.2 Assessment overview

8.2.1 Assessment methodology

Aquatic surveys were undertaken in mid-2020 and early 2022 and included an assessment of key fish habitat, water and sediment quality, aquatic flora, macroinvertebrates and aquatic vertebrates. Survey methods involved direct observation of key fish habitat, laboratory analysis of water, sediments and algae, macroinvertebrate analysis, eDNA analysis, electrofishing and netting.

The Aquatic Ecology Assessment was undertaken in parallel with the Surface Water Assessment (Appendix F). The Surface Water Assessment informed the Aquatic Ecology Assessment, and the development of the Aquatic Ecology Assessment in turn identified additional or alternative presentation of modelling data in the Surface Water Assessment to better inform the assessment of impacts to aquatic ecology values.

A risk assessment approach was utilised to assess the degree of impact a project activity would have on an aquatic species, or species habitat. Both consequence criteria and likelihood descriptors were developed and the risk outcomes ranked as low, medium, high or extreme.

8.2.2 Avoidance in design

As described in Chapter 4, the environmental flows from the operation of the new Dungowan Dam would increase translucent flows in Dungowan Creek from the current 10 ML/day to 13 ML/day, as well as provide a new EWA of up to 200 ML/year. These were built into the design of the project to mitigate some of the flow impacts that have the potential to impact on aquatic ecology values.

The project design has also included a multiple level offtake to allow the most suitable water, based on quality and temperature, to be provided for raw water supply and environmental flows.

8.2.3 Agency consultation

Consultation has occurred with all relevant State and Commonwealth agencies throughout the preparation of the Aquatic Ecology Assessment on the following issues:

- Aquatic impact assessment methodology.
- Hydrological assessment and data.
- Impacts and mapping of fish key habitat.
- Cold water pollution.
- Fish passage.
- Offset locations and timing.

Further details of consultation are detailed in Chapter 5 and Appendix D of the EIS.

8.3 Predicted impacts

The Aquatic Ecology Assessment was undertaken with consideration to the impact pathways as a result of the construction and operation of the new Dungowan Dam, as well as the key aquatic receptors.

The key construction impacts will include a loss of key fish habitat and new barrier to fish movement from the new Dungowan Dam construction, as well as construction risks in the form of habitat removal and construction within waterways and water quality deterioration.

Operational impacts are more complex and are associated with the change in flow regime in both Dungowan Creek and the Peel River, as well as other operational issues including CWP and fish migration over the spillway. As operational impacts differ in Dungowan Creek and the Peel River, the potential impacts have been assessed separately in Sections 8.3.2 and 8.3.3.

8.3.1 Construction impacts

8.3.1.1 Loss of fish passage and key fish habitat

Whilst the existing Dungowan Dam is a barrier to fish movement, no fish passage infrastructure is included in the design of the new Dungowan Dam and, as such, will also pose a barrier to fish passage. In essence, the existing barrier to fish passage on Dungowan Creek will be removed from its current location and established 6.19 km (stream length) downstream.

The construction of the new Dungowan Dam will result in a loss of connectivity to fish habitat via two pathways:

1. The loss of fish passage connectivity to key fish habitat above the new Dungowan Dam. As the new Dungowan Dam would not contain any fishway infrastructure, this would result in a loss of connectivity of 34.2 km of key fish habitat of 3rd order waterway and above, including 26.4 km of type 1 key fish habitat.
2. The direct impact to key fish habitat as a result of the construction works and inundation of the dam up to FSL, which would result in the direct impact to around 210,000 m^2 of key fish habitat, including around 192,000 m^2 of type 1 key fish habitat.

The risk assessment identified that the consequence criteria involved an impact that is long term, extensive and that had an almost certain probability of occurring and therefore the residual risk was considered extreme. Mitigation of this impact is difficult given the project involves the construction of a new dam, therefore an offset approach is proposed both for fish passage and key fish habitat loss (Section 8.4.2).

8.3.1.2 Direct impacts to aquatic receptors

The construction of the new Dungowan Dam and pipeline would require substantial works within Dungowan Creek and some associated tributaries, including the establishment of the embankments of the new Dungowan Dam and coffer dams, trenched construction of the pipeline through Dungowan Creek and tributaries, removal of riparian vegetation and dewatering activities. These would result in potential impacts to aquatic receptors, including:

- Entrapment of fauna (including Platypus) within instream work areas, such as coffer dams and trenches.
- Impact to Platypus burrows.
- Prevention of fish and fauna passage.
- Entrainment of fauna in pumps required for dewatering.

The impacts would be generally manageable with the implementation of construction mitigation measures and therefore the residual risk to aquatic receptors from direct construction activities is considered medium to low.

8.3.1.3 Water quality impacts

Construction in and adjacent to waterways would result in increased risks to aquatic values associated with poor water quality. Risks are primarily associated with sediment laden runoff from cleared areas, construction zones, ancillary areas, stockpiles, dewatering activities and the associated discharge of turbid water or fuels and chemicals to the aquatic environment.

The impacts would be generally manageable with the implementation of construction mitigation measures and therefore the residual risk to aquatic receptors from a reduction in water quality is considered medium to low.

8.3.2 Operational impacts – Dungowan Creek

The operation of the new Dungowan Dam will have a range of potential impacts on the aquatic ecology values within Dungowan Creek, including changes to hydrology (including flow and depth changes), CWP, entrapment of fish in the spillway, as well as continued impacts to fish passage connectivity detailed in Section 8.3.1.1.

8.3.2.1 Hydrology changes

Changes to hydrology is as a key threat for many listed species and changes to flow within Dungowan Creek has the potential to negatively impact aquatic habitats. The key period when flow stability is critical for all species observed during surveys is the spring-summer period. This is the breeding/spawning period for a number of listed species including the Silver Perch, Murray Cod, Southern Purple-spotted Gudgeon, Eel-tailed Catfish and Platypus.

Successful breeding/spawning for these species is reliant on aspects like access to macrophytes prior to and during breeding, inundated solid substrates near complex vegetation, increased water levels or shallow waters, all of which may be impacted by hydrological changes.

Relevant hydrological modelling results and interpretations as they relate to aquatic ecology values in Dungowan Creek are presented in detail in the Aquatic Ecology Assessment (Appendix I). Although detailed modelling has been undertaken, the results show that there will be both increases and decreases to both the daily flows and depths along much of Dungowan Creek but with much of the time showing negligible changes in flows or depth.

With regard to aquatic habitat availability, impacts resulting from hydrology changes are difficult to quantify and as a result, a precautionary approach has been adopted. The risk assessment therefore deemed the residual risk to aquatic habitat availability in Dungowan Creek as high.

Assessment of species specific impacts to key aquatic receptors, including impacts resulting from hydrology changes, are detailed in Section 8.3.4.

8.3.2.2 Cold water pollution

CWP is a risk to the aquatic values in Dungowan Creek during the warmer months, when Dungowan Dam is at higher risk of stratification and when key listed aquatic species are spawning/breeding. The majority of the key listed aquatic species observed in Dungowan Creek follow breeding cues that arise, at least in part, in the form of increasing temperatures during spring. A pulse of cold water may lower ambient temperatures to the point that the breeding cue no longer exists and breeding is aborted or fails to commence.

Temperature modelling for releases from the new Dungowan Dam to Dungowan Creek are presented in the Surface Water Assessment (Appendix F). The modelling shows that if translucency releases were made using cold water (13°C), CWP effects would extend a distance of less than five kilometres downstream before the water warmed to that of Dungowan Creek's ambient temperature.

While 5 km is noted to be a relatively short length for CWP to extend downstream, and noting a multi level offtake would be used to select appropriate temperature water where possible, an algal bloom for example would require the release of deeper, colder water during the spring-summer spawning season. This would result in the potential for spawning to be aborted should breeding cues not occur. The residual risk resulting from potential CWP impacts to Dungowan Creek is therefore considered medium.

8.3.2.3 Downstream migration of fish over the new spillway

Fish passage downstream, over the new Dungowan Dam spillway, is most likely to occur during spill events. The stilling basin is located at the base of the spillway and would be constructed from concrete, 10 m deep and with baffles installed to mitigate the risk of structural damage as a result of the high velocity generated during spilling events. Trauma or death of fish as a result of migration over the spillway is likely.

While fish can survive over spillways, any fish that do survive would possibly be trapped in the stilling basin depending on the flow conditions. Fish passage between the stilling basin and Dungowan Creek would be possible during a spilling event only.

No current design features have been included to allow for dewatering and or fish passage from the stilling basin to Dungowan Creek. The residual risk resulting from trauma of passage over the spillway and any subsequent entrapment in the stilling basin is deemed a medium risk.

8.3.3 Operational impacts – Peel River

The operation of the new Dungowan Dam would result in potential impacts in the Peel River primarily from changes to the hydrology caused by a reduction in run-of-river releases from Chaffey Dam. This has the potential to affect EWRs as set out in the Namoi LTWP. Both hydrology changes and EWR compliance, as they relate to aquatic values in the Peel River, are detailed below.

There are no predicted CWP impacts in the Peel River as a result of the new Dungowan Dam operation. Fewer releases down the Peel River from Chaffey Dam would also decrease the frequency of potential CWP events and as detailed in Section 8.3.2.2, CWP effects would also not extend downstream along Dungowan Creek as far as the Peel River.

8.3.3.1 Hydrology changes

Flow modelling indicates that immediately below Chaffey Dam there would be an increase in the frequency of low flow events, caused by a reduction in the frequency of run-of-river transfers.

This would reduce daily flows and waterway depths in the Peel River up to 65% of the time below Chaffey Dam and up to 25% of the time closer to Tamworth, however it should be noted that other discharges from Chaffey Dam to meet general security, high security and stock and domestic licences would continue.

The reduction to flow volume and depths has the potential to impact on aquatic habitat and fauna passage over natural barriers such as riffles, although the impact is difficult to quantify. Due to the likely occurrence of the impact, the hydrology changes impacting on aquatic habitat and fish passage in the Peel River were determined to have high residual risk.

8.3.3.2 Environmental Water Requirements

Currently the EWRs for the Peel River are not met. The Surface Water Assessment (Appendix F) details the EWRs for the Peel River and shows to what degree water releases currently meet or fail to meet the EWR requirements.

The operation of the project would cause a number of higher flow components that currently don't meet the EWRs to move towards the target ranges and also a number of lower flow components (baseflow) to move away from the target ranges. The risk assessment determined that a reduction in baseflow compliance with the EWRs had a high residual risk due to potential for disruption of a range of species behaviours, including fish passage.

8.3.4 Receptor specific impacts

8.3.4.1 Lowland Darling River EEC

A significant cause of degradation to the Lowland Darling River EEC within the Namoi catchment is the modification of natural flow attributed to river regulation. Other factors contributing to habitat degradation include agricultural practices, removal of in-stream woody debris and cold water release from dams.

The Lowland Darling River EEC occurs within the area of construction impact from trenching of Dungowan Creek and is situated in close proximity to ancillary construction activities that may result in a temporary reduction in water quality. It also has the potential to be impacted by changes to hydrology within Dungowan Creek and the Peel River during operation.

The project would therefore have a direct impact and indirect impact on the Lowland Darling River EEC, however the total area of Lowland Darling River EEC potentially impacted would be less than 1% of its total area and species of the Lowland Darling River EEC present within the area are expected to persist, successfully reproduce and maintain a presence in Dungowan Creek and the Peel River. With the implementation of the fish passage offsets (Section 8.4.2), downstream connectivity for the species forming part of the Lowland Darling River EEC would be improved.

8.3.4.2 Murray Cod

Potential impacts to the Murray Cod from the project include habitat degradation or loss, reduced connectivity to upstream habitat and CWP impacts to spawning within 5 km of the new Dungowan Dam. While these impacts are all likely to have some degree of adverse effects on the species, the impact area is relatively small compared to the overall population of Murray Cod and it is considered unlikely to significantly affect the species.

With the implementation of the fish passage offsets (Section 8.4.2), downstream connectivity for the species would be improved.

8.3.4.3 Silver Perch

Potential impacts to the Silver Perch from the project such as habitat degradation or loss, reduced connectivity to upstream habitat and CWP impact are unlikely to result in a significant impact as it is unlikely that viable, self-sustaining populations of the species occur in the vicinity of the project and are more likely to be limited to occasional stocked individuals. In addition, local conditions are not considered to contain sufficient high quality habitat for the species.

8.3.4.4 Murray Darling Basin population of Eel-tailed Catfish

Potential impacts to the Eel-tailed Catfish from the project include habitat degradation or loss, reduced connectivity to upstream habitat and CWP impact to spawning within 5 km of the new Dungowan Dam. While these impacts are all likely to have some degree of adverse effects on the population, self-sustaining populations are known to occur in both the Peel River and Dungowan Creek and potential habitat availability as a result of the changed flows and depths are not expected to preclude the successful recruitment and persistence of the species. The project is considered unlikely to significantly affect the population of Eel-tailed Catfish.

With the implementation of the fish passage offsets (Section 8.4.2), downstream connectivity for the population would be improved.

8.3.4.5 Southern Purple-spotted Gudgeon

Potential impacts to the Southern Purple-spotted Gudgeon from the project such as habitat degradation or loss, reduced connectivity to upstream habitat and CWP impact are unlikely, as while their presence is not precluded, habitat in Dungowan Creek and the Peel River is generally lacking the habitat complexity preferred by the species. In addition, the species was not recorded and is extremely rare in inland NSW and has only been recorded once since 1983. Exotic fish species are also known to impact Southern Purple-spotted Gudgeon and are already widespread throughout the local catchment.

The project is considered unlikely to significantly affect the Southern Purple-spotted Gudgeon.

8.3.4.6 Platypus

Potential impacts to the Platypus could occur, such as a reduction in feeding habitat or loss of breeding habitat due to lowered water levels, loss of food source (macroinvertebrates) due to temperature change from CWP and various construction impacts including prevention of fauna passage, direct impacts to burrows and entrapment in trenches or infrastructure.

The construction risks are generally considered to be short term and manageable with the implementation of construction mitigation measures. The key operational risk to Platypus is considered to be the reduction in feeding habitat due to lowered water levels, which retains a high residual risk as the area of riffle habitat that is likely to be impacted is not known and therefore a precautionary approach and high residual risk ranking has been adopted.

While Platypus habitat will be impacted as a result of the project, the proportion of the overall population to be impacted is not considered significant and the project is unlikely to result in a significant impact to Platypus.

8.3.5 Cumulative impacts

The cumulative effects of the new Dungowan Dam operation and Chaffey Dam pipeline operation were assessed using regional water modelling. The modelling indicates that as Dungowan Dam would be prioritised to supply water to Tamworth, more water would be retained in Chaffey Dam and the frequency of use of the Chaffey Dam pipeline would be reduced.

This means that any environmental and ecological effects that may be attributed to Chaffey Dam pipeline operation would reduce in frequency when the Dungowan Dam and pipeline project is operational. Cumulative impacts are therefore negligible.

8.4 Management and mitigation

8.4.1 Mitigation

Mitigation measures would be required to manage impacts resulting from the design, construction and operation of the project. The key mitigation measures in the Aquatic Ecology Assessment (Appendix I) would be captured in the development of the FFMP for the project. The key focus of construction mitigation measures is:

- Minimising impacts to water quality, including surveillance monitoring.
- Avoiding in stream works during Platypus nesting periods, where possible.
- Minimising direct impacts to creeks and waterways, including pre works inspections.

Measures are also required to ensure detailed design and operational processes minimise impacts to aquatic values, including:

- Operational processes relating to the use of the multi level offtake to mitigate CWP impacts.
- Consideration of engineering solutions to minimise fish entrapment in the stilling basin.
- Consideration of additional destratification strategies to minimise stratification and prevent algal blooms.

8.4.2 Offsets

Offsets would be required for the impacts to fish passage as a result of the new Dungowan Dam (which does not have any fishway provision) as well as for the direct impacts to key fish habitat as a result of construction impacts and the inundation of the new Dungowan Dam.

Fish passage offsets have been agreed with NSW Department of Primary Industries – Fisheries (DPI Fisheries) and would include the modification to four known fish barriers on the Peel River downstream of the new Dungowan Dam. The barriers and the proposed treatment types, are:

- Calala water gauging station (upgrade).
- Paradise water pipe relocation/upgrade (addition of fishway).
- Jewry Street Causeway remediation/upgrade (addition of fishway).
- Pontibah Causeway remediation/upgrade (box culvert/bridge).

This would facilitate fish passage to an additional 94.7 km of waterway within the Peel River and Dungowan Creek, upstream of the next downstream fish barrier at Gunidgera Weir in Wee Waa. The locations of the fish passage offset locations are provided in Figure 8-3. These fish passage offsets would be completed prior to the operation of the new Dungowan Dam and pipeline project.

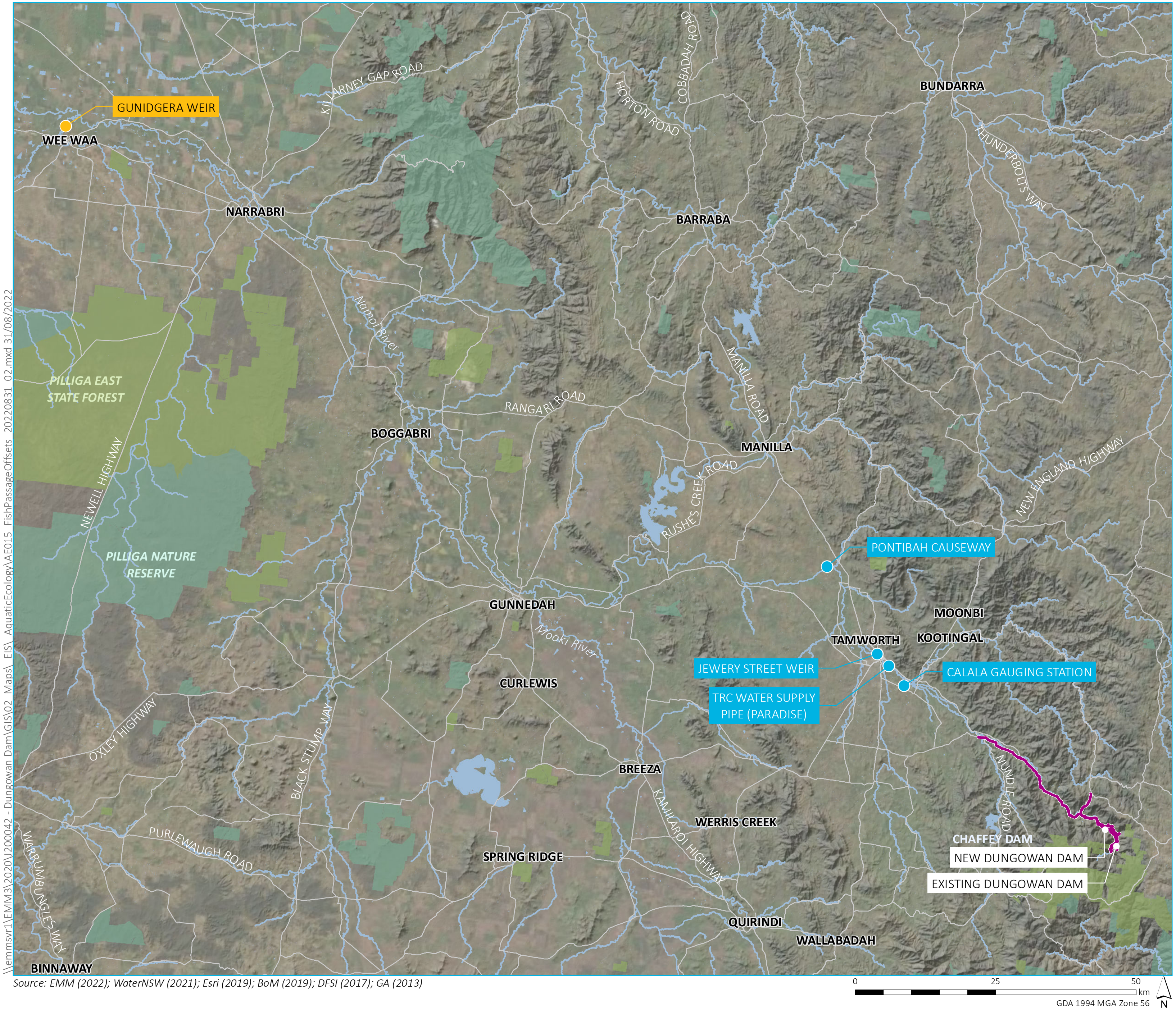
Offsets for the direct impact to key fish habitat have been calculated in accordance with the *NSW Biodiversity Offsets Policy for Major Projects Fact sheet: Aquatic biodiversity* (DPI 2014). The project is estimated to impact 210,563 m^2 of key fish habitat and therefore would be required to either pay a monetary offset amount into the Fish Conservation Trust Fund or agree other supplementary offset approaches with DPI Fisheries. This may include utilising off site offset areas or the rehabilitation of Dungowan Creek upstream of the existing Dungowan Dam, which would be rehabilitated as part of the project.

8.4.3 Optimising translucency releases

The translucent flow for the existing Dungowan Dam is 10 ML/day, which is proposed to be increased to 13 ML/day for the new Dungowan Dam. An option to bank the additional 3 ML/day and deliver the banked amount (up to 100 ML/day) in a pulsed release pattern, between weekly and monthly, was modelled and is presented in the Surface Water Assessment (Appendix F).

The release of larger pulses of water would increase the number of small fresh pulses in Dungowan Creek compared to the currently proposed 13 ML/day translucency release. This would minimise the reduction in flows immediately downstream of the new Dungowan Dam predicted during operation, primarily in the lower flow percentiles.

This would further reduce the assessed impacts to aquatic ecology values in Dungowan Creek and should be considered, and potentially further optimised, during the development of the environmental flow release regime for the new Dungowan Dam. Consideration of potential impacts from CWP while delivering larger flows, particularly spring-summer flow events would also need to carefully consider the species-specific impacts.



Source: EMM (2022); WaterNSW (2021); Esri (2019); BoM (2019); DFSI (2017); GA (2013)

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Fish passage offset locations (and Gunidgera Weir)

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 8.3

EMM creating opportunities

8.5 Summary and conclusion

The Aquatic Ecology Assessment has been undertaken to assess the potential impacts from the construction and operation of the new Dungowan Dam and pipeline on the key aquatic values in Dungowan Creek and the Peel River.

Construction impacts will include a loss of key fish habitat and fish passage connectivity, as the new Dungowan Dam is located downstream of the existing Dungowan Dam, which would be offset. Direct construction impacts to aquatic habitats would result in temporary impacts to aquatic values that would generally be manageable with the implementation of construction mitigation measures.

Operational impacts are more complex and are associated with the change in flow volume and water depth in both Dungowan Creek and the Peel River. The primary operational impacts will be as a result of habitat modification, fish passage and CWP that are generally expected to impact the aquatic values. The extent of impact as a result of modified/or available habitat, primarily riffle habitat, is difficult to quantify based on the available data, however it is expected that impact to fish/fauna passage over natural barriers in the study area would occur more often as a result of the project.

Despite the predicted operational impacts, the project is not expected to preclude the successful recruitment and persistence of any species in Dungowan Creek and the Peel River.

CHAPTER 9

Aboriginal heritage

9 Aboriginal heritage

This chapter provides a detailed summary of the potential impacts to Aboriginal cultural heritage during construction and operation of the project and identifies appropriate mitigation and management measures. A detailed technical Aboriginal Cultural Heritage Assessment (ACHA) is provided in Appendix J. The relevant SEARs and where they have been addressed are summarised in Appendix A.

9.1 Existing environment

The project area falls largely within the traditional country of the Gamilaraay people, who are a large group with prominence in the historical records and literature of Aboriginal Australia (Tindale, 1974). The Gamilaraay name was often written as Gamilaroi, Kamilaroi, Gomeroi and other variations, which are used interchangeably in this chapter and the ACHA based on the source and context.

The project footprint contains a variety of resources that would have been attractive to Aboriginal people in the past, but also would have influenced the potential cultural materials that may have been deposited and survived. Specifically, the alluvial terraces and lower slopes and adjacent waterways would have been conducive to surface and/or shallowly buried stone and shell cultural materials, while more rugged country has some potential for grinding grooves, engravings, rockshelters and associated features.

9.1.1 Landscape overview

The geology of the region includes a range of raw materials, including jasper, chert and serpentine, that were used by Aboriginal people in the past for producing stone artefacts. Sources are also known at nearby Mt Pleasant, Hanging Rock and near to Chaffey Dam.

A detailed field investigation of the soil profiles was undertaken as part of the ACHA, focussing on the new Dungowan Dam and inundation footprint. This investigation found two main soil profiles, both of which exhibit shallow topsoil units, within which cultural material is commonly found and unlikely to extend greater than 80 cm below current ground surface.

The project footprint contains a wide variety of flora and fauna that would have been used by Aboriginal people in the past for food, medicinal, totemic and cultural purposes. The project area has been subject to both natural and anthropogenic disturbance that would affect the survivability of cultural materials if present. These include agricultural, pastoral and vegetation clearance across most of the project footprint that would have resulted in disruption of the upper soil profile and any associated cultural materials. More extensive disturbance includes the establishment of the existing Dungowan Dam in the 1950s at the southern end of the project footprint, which is considered to have resulted in the previous loss of cultural materials in these areas.

9.1.2 Regional context

The project area falls largely within the traditional country of the *Gamilaroi* language group that extends as far west as Lightning Ridge, and with the Tamworth region forming the easternmost border (Tindale 1974). However, the project area is on a border of this boundary and may also have associations with the *Nganyaywana* language group to the north, *Birpai* language to the east and *Geawegal* language to the south. Tindale (1974) estimates that the territory of the *Gamilaroi* extended across an area approximately 75,400 km^2 and represents one of the largest tribes in eastern Australia, surpassed only by the Wiradjuri whose territory lies on their southern border. Within the *Gamilaroi* tribal group, there are two subdivsions; the *Corbon Gamilaroi* (meaning “the people of the greater country of *Gamilaroi*”) whose territory included the Liverpool Plains and beyond, and the *Gammon Gamilaroi* (meaning “the people of the lesser country of the *Gamilaroi*”) whose territory included the more southern area from Murrurundi to a very narrow corridor south into the Hunter Valley (Boileau, 2007; Milliss 1980; Telfer & Milliss 1980). The Aboriginal people living around the Peel River and its tributaries, the area of which comprises the project area, were part of the *Corbon Gamilaroi.* The clans within the *Gamilaroi* language group that lived within the Tamworth area, and by extension at least part of the project area, were reported to have been the *Goonoo Goonoo*, *Gunnedah*, *Manilla* and *Moonbi* peoples (Wilson & McAdam 2000:10).

In 1842, it was estimated by Edward Mayne, the first Commissioner of Crown Lands and ‘Protector’ of Aborigines of Liverpool Plains, that there were 4,000 Aboriginal people living between the Peel, Namoi and Gwydir Rivers (Mayne 1942:169–171). However, this number reflects a population severely impacted by at least two decades of direct European contact, which brought both the loss of resources and the introduction of diseases.

9.1.3 Local beliefs and ceremonial practices

The Northern Tablelands have a high number of ceremonial sites including Bora rings, stone pathways, carved trees and rock art. It is commonly known that the area is spiritually linked to *Baimai* (creator god), *Birrahgnooloo* (his emu-wife) and *Daramulan* (son of *Baimai*) (Flood 2010, p.238). Through oral recounts recorded at the turn of the 21st century, Moore Creek (~15 km north of the project area) was highlighted as an important ceremonial gathering place for the local area (Wilson & McAdam 2000:34–40). It was reported that sites may be located in the Moore Creek area that are related to the use of the area by local clever-men. These sites are likely to be ritual/ceremonial in nature and may include art sites and engraving sites.

9.1.4 Tools, weapons and apparel

Ethnographic accounts of tools in the Northern Tablelands describe wooden spears, clubs, waddies (a type of hunting stick) and boomerangs, as well as axes and stone tools (McBryde 1974, p.13). Many wooden items are unlikely to have survived as artefacts in the archaeological record because they are susceptible to decomposition.

Rugs and cloaks were also noted to made of kangaroo and possum skins with the aid of bone needles and animal sinews for thread. Wood, bark and animal materials were also used to make items like bags, fishing nets and wooden vessels (McBryde 1974, p.13).

9.1.5 Contact and post contact overview

Tensions between Aboriginal people and settlers mounted throughout the early to mid-19th century. During the 1830s, the Northern Tablelands formed one corner of the Government's Mounted Police who were often responsible for the escalation of armed conflict and violence in rural districts. The contact period on pastoral runs in the Northern Tablelands featured many interactions with Aboriginal people. These included massacres that increased through the broader region, with the closest at Waterloo Plains (greater than 45 km north of Tamworth) in 1835 (Ryan et al 2019).

Development of land for grazing by settlers followed, primarily for cattle. Although by the end of the 19th century, this had largely changed to sheep grazing. Aboriginal people often worked as stockmen on the stations. By 1851, the town of Tamworth had a white population of over 250. At around the same time, the number of Aboriginal people in the Northern Tablelands region was estimated by Commissioner George McDonald to be around 600 (McDonald 1845 in Hudson 2006). He also noted the impact of disease and land clearance for sheep grazing (in diminishing macropod numbers) on the Aboriginal population.

By the late 19th century, many of the surviving Aboriginal peoples of the Peel River clans were reported to be living in "a blacks' camp at Calala" (Hobden 1988:7). Ultimately, however, the exact location of this camp, and any notion of its permanency, appears to be unknown (Wilson & McAdam 2000:19).

9.1.6 Archaeological context

A review of Heritage NSW's Aboriginal Heritage Management Information Management System (AHIMS) database identified 151 previously documented sites in the region. These were dominated by sites of varying densities of stone artefacts (67%), but also included rarer site types such as rockshelters, grinding grooves, post-contact habitation sites, ceremonial sites, and culturally modified trees. Prior to fieldwork undertaken for the project, no previously documented sites were identified within the project area, with the nearest being over two kilometres away and the majority further than 10 km. Based on the regional information and characteristics of the project footprint, cultural materials dominated by various stone artefact densities would be expected, especially along Dungowan Creek and lesser tributaries. There is also some potential for a range of other site types, including rockshelters, stone arrangements and culturally modified trees. However, the survivability of such cultural materials will be dependent on past disturbance, which in some areas has likely been considerable.

9.2 Assessment overview

The ACHA undertook cultural mapping, archaeological field survey and test excavations to explore and document the Aboriginal objects, site and places within the project footprint, and to align them within the regional context. The archaeological survey and data collection methods followed Section 2.2 of the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b). The cultural mapping study was carried out to 'map' the tangible and intangible cultural assets of people within the local landscape, led by an experienced anthropologist with key knowledge holders and/or elders.

9.2.1 Aboriginal consultation

The ACHA adopted the processes and methods outlined in the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010a) as well as more extensive activities outlined in a project specific Aboriginal Community Engagement Strategy (EMM 2021) (the strategy).

The strategy was developed with the participating Aboriginal stakeholders and has been subject to continual refinement and improvement over the life of the project. Each of the four iterations of the strategy since April 2020 was provided to the participating Aboriginal stakeholders for review, input and comment before its finalisation and implementation.

Overall, the project has been liaising with between 10 and 18 registered Aboriginal party (RAP) organisations and/or individuals since its inception in April 2020. These include those identified as part of the strategy, and through formal notification as part of the Heritage NSW consultation requirements. The RAPs include a large number of local Aboriginal organisations and/or individuals based in Tamworth and/or immediate surrounds, as well as a smaller proportion that are based in Sydney and Brisbane but have ancestral connections to the region.

Opportunity for Aboriginal involvement in the project was provided throughout the ACHA, including the following key activities:

- Attendance at nine Aboriginal focus group meetings held in Tamworth and/or on-site.
- Participation in a 2 week field survey of the project footprint.
- Participation in a 6 week archaeological test excavation of the project footprint.
- Participation for key knowledge-holders identified by the RAPs to visit the site with a highly experienced anthropologist to discuss cultural values.

Aboriginal consultation for this project included over 450 interactions with the RAPs between April 2020 and June 2022, and over 200 person days of on-site participation.

9.2.2 Agency consultation

As part of the ACHA, various interactions with Heritage NSW have been undertaken, including:

- Notification of the Aboriginal stakeholders involved in the project – 21 April 2020.
- Notification of the initiation of archaeological test excavations for the project – 28 July 2020 and 16 November 2020.
- Informal consultation – various discussions have occurred with Heritage NSW over the life of the ACHA.
- Presentation of the ACHA process, the findings of this report and the proposed recommendations that would be included – 17 February 2021.
- Discussions of the hydrological changes downstream of the project, and the most suitable way for its inclusion in the ACHA and consultation process – 4 May 2022.

9.2.3 Aboriginal stakeholder feedback

The main discussion topics that have been raised during Aboriginal consultation are summarised below:

- Assessment process – understanding how CSSI projects are assessed and how Aboriginal heritage fits into this process.
- Early works activities – investigation, management and discussions about the Stage 1 Dungowan pipeline replacement works, and geotechnical investigations across the project footprint.
- Cultural values mapping – understanding the intangible and spiritual values of the project footprint, sourced from both traditional and contemporary information, and subsequently discussions on the findings of these investigations.
- Chaffey Dam pipeline – discussions around lessons learned from a recently completed nearby project to connect Chaffey Dam to the existing Dungowan Dam pipeline.
- Field survey and excavation findings – the nature of cultural materials found within the project footprint, and how they may be further investigated, managed and/or protected into the future.

- Compilation of data, potential impacts and possible management measures – working out how the numerous cultural sites and values could be combined into a single spatial map for management purposes, discussions on the important aspects of the map produced, and how to manage these values.
- Post-construction interpretation and ongoing access – the need to acknowledge the local Aboriginal community and heritage as part of post-approval activities; and the desire for future access to areas of cultural value around the project area following construction – and specifically the Terrible Billy Creek catchment.

General concerns and issues have been mostly focussed on the level of on-Country participation, especially in relation to RAPs not from the local area; the level of investigation along the proposed pipeline with limited land access; and the suitable conservation and management of important sites. The outcomes of these discussions have been considered in the development and content of the ACHA.

9.2.4 Field investigation

Archaeological field surveys of the project footprint were conducted over nine days during a two week period (30 June 2020 to 14 July 2020). The survey involved pedestrian, linear transects along the project footprint targeting areas where the dam structures, powerline easement and pipeline are proposed. A number of other shorter field surveys and/or site inspections were undertaken of the proposed pipeline alignment throughout the ACHA process between April 2020 and November 2021. The archaeological survey and data collection methods followed Section 2.2 of the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b).

Archaeological test excavations were conducted over a six-week period (14 August 2020 to 11 September 2020). These works were undertaken in accordance with the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b) and consisted of small manually dug test pits in transects across the project area.

Fieldwork for the cultural mapping report was undertaken over four days (12–15 October 2020).

9.3 Predicted impacts

9.3.1 Cultural mapping

The cultural mapping study recorded places that the Aboriginal participants identified as having significance. Through documenting the sites, the study attempted to determine the extent to which the site's importance was based on the experience and knowledge of the Aboriginal participant, and whether this is likely to be a shared opinion. The cultural mapping determined three types of classification for recording purposes:

- Cultural sites that can reasonably be assumed to have been in existence when Europeans first arrived in the region.

- Social history places associated with the contemporary local Aboriginal community.
- Purported cultural sites that have come to attention through senior community members travelling to an area, for which they may have little or no direct life experience, and then interpreting the landscape through a process of seeing what is there (e.g. archaeological material on site, potentially Aboriginal modified trees etc) and gauging their own reaction to the space (i.e. their feelings of a spirit's presence, Ancestor's powers etc).

The key findings of the cultural mapping included:

- Identification of the relevant Aboriginal community for consultation being the Gamilaraay people, and in particular members who live in towns and on properties in the greater Tamworth region.
- Members of the Fermor family, as represented by senior knowledge-holder Donny Fermor, have relevant experiences and knowledge of the Dungowan Creek area that help explain its cultural and historical relationships with the Gamilaraay community.
- Aboriginal people with connections to Dungowan Creek (within the project area) perceive the area, along with the surrounding country, as the product of deeds by the Creation Ancestors, such as the Catfish, and believe that it is within a mountainous region that is still occupied by spirit beings, such as the 'hairy men'.
- The presence of identified cultural sites, which include scarred trees and stone arrangements, as well as gender-specific places. While some identified and purported cultural and historical sites are within the project footprint, the gender-specific place is outside the probable maximum flood (PMF) and would not be impacted by project construction or operation.
- During the mapping project there were no cultural sites identified within the pipeline alignment area nor any discussion of areas in the vicinity of the powerline.

Overall, the report identified 11 sites within the project footprint. Of these, eight could be identified as cultural sites and/or social history places, with three considered as purported cultural sites that lacked robust validation. All sites identified through cultural mapping have been included in the impact assessment presented in Section 9.3.3.

Cultural flows were also discussed through the cultural mapping. Aboriginal people of south-eastern Australia believed that the health of the river system was maintained by the Creation Ancestors, whose actions in shaping the land and making the waters were later celebrated in ceremonial dance, ritual and song (Clarke 2018a, 2018b). It was a belief that after the Creation was over, many of these Ancestors took the form of animals and people. In this way, the physical and cultural dimensions of looking after country were closely intertwined. For contemporary Gamilaraay people, the traditions of the past are still relevant, in spite of the last of the bora ceremonies having occurred back in 1895 at Tallwood (Mathews 1897).

Today, it is common for Aboriginal people in south-eastern Australia to perceive that the wellbeing of their community is dependent upon the 'cultural flows' in the rivers and creeks of their country (Birckhead et al. 2011; Weir 2006). As such, leaving enough water to flow through the water courses serves to maintain or improve the cultural value of the whole river system (Maclean et al 2012). In the Murray-Darling Basin, Aboriginal people assert that the adequate allocations of water for cultural flow supports the continuation of their cultural activities, such as fishing, hunting, artefact-making, ritual and the maintenance of their knowledge on the tracks of the Ancestors (Jackson and Nias 2019; Mooney and Cullen 2019). While no specific focus on cultural flows was vocalised from the cultural mapping study for the project footprint, the identification of a Catfish Creation Ancestor and frequent references to camping and hunting on Dungowan Creek, would indicate similar views are likely for this project.

The potential for the project to result in changes to streamflow has been comprehensively assessed and considered in the Surface Water Assessment (provided in Appendix F of the EIS). The impacts to streamflow within Dungowan Creek and the Peel River are anticipated to be negligible. However, some change to the existing streamflow regime will occur as a result of the project. To ensure potential impacts to Aboriginal sites, objects and/or places are considered in the development of environmental water release plans and other mitigation strategies for the project, a Cultural Flow Management Plan (CFMP) would be developed in consultation with the RAPs to provide the post approval framework for management and monitoring of water regimes in the vicinity of key Aboriginal sites, objects and/or places within the project area.

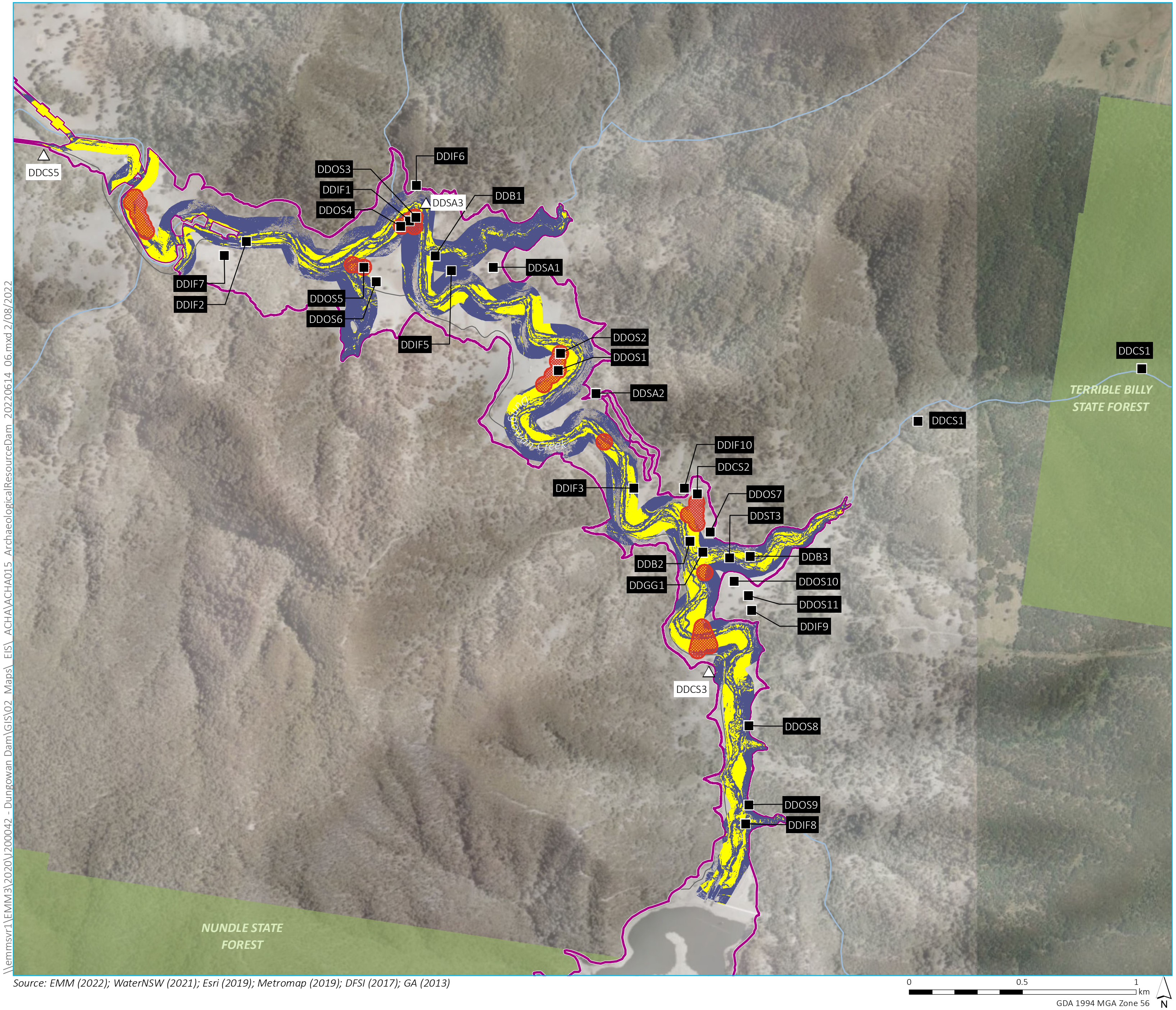
9.3.2 Archaeological resource

Overall, the findings of site investigations largely conform with the regional models, although an increasing focus on intangible and spiritual values was undertaken to supplement the observed archaeological record. When combining and ratifying the findings of these various activities, there are some 17 identified sites and places, along with a continuous and complex distribution of surface and shallowly buried stone artefacts across the project footprint.

These sites are displayed in Figure 9-1a and Figure 9-1b and are described below:

- Six cultural sites, including a gender-specific site (DDCS1) encompassing parts of Terrible Billy Creek, a stone arrangement associated with a Creation Ancestor story (DDSA3), two culturally modified trees (DDST1, DDST2), a grinding groove (DDGG1), and the former Dungowan Station where post-contact activities are believed to have occurred (DDPC1).
- Three social history places, reflecting locales of importance to the specific Aboriginal participants, and including a former residence (DDCS3), an environmental reserve (DDCS4) and a former school site (DDCS5).
- Three purported cultural sites that were identified by RAPs, but which cannot be anthropologically or scientifically validated as part of the ACHA, and including a natural ambush site (DDCS2), and two stone arrangements that were considered to reflect burials (DDB1, DDB3). Recommendations to further explore these are proposed.

- Five archaeological sites, including three stone arrangements (DDB2, DDSA1, DDSA2) and two potentially culturally modified trees (DDST3, DDST4), all of which are assigned a 'tentative' classification with further research recommended.
- A stone artefact background scatter across the entire project footprint and extending beyond its limits within which artefact densities of 10–15/m^2 may be expected, and that includes identified isolated Aboriginal objects (DDIF2-11 inclusive) and low density artefact scatters (DDOS3, 8–14 inclusive). These sites are typically of low significance and reflect the long-term use of the entire landscape by Aboriginal people in the past.
- Eight areas of past foci and activity (DDFA A-H inclusive) within the dam and inundation footprint, characterised by high densities of primarily sub-surface artefacts ranging from 30–>272/m^2, and that reflect long term and/or repeat visitation and occupation by people over at least the last 5,000 years.
- A zone of 69 m either side of major creeks and tributaries (greater than 3rd order) within which higher densities of stone artefacts and/or other areas of past foci may be expected to be present.



KEY

Project footprint

Cultural site

Surveyed Aboriginal site

Key heritage areas

Areas of probable cultural material

More sensitive terrace

Less sensitive lower slopes

Existing environment

Minor road

Named watercourse

State forest

Source: EMM (2022); WaterNSW (2021); Esri (2019); Metromap (2019); DFSI (2017); GA (2013)

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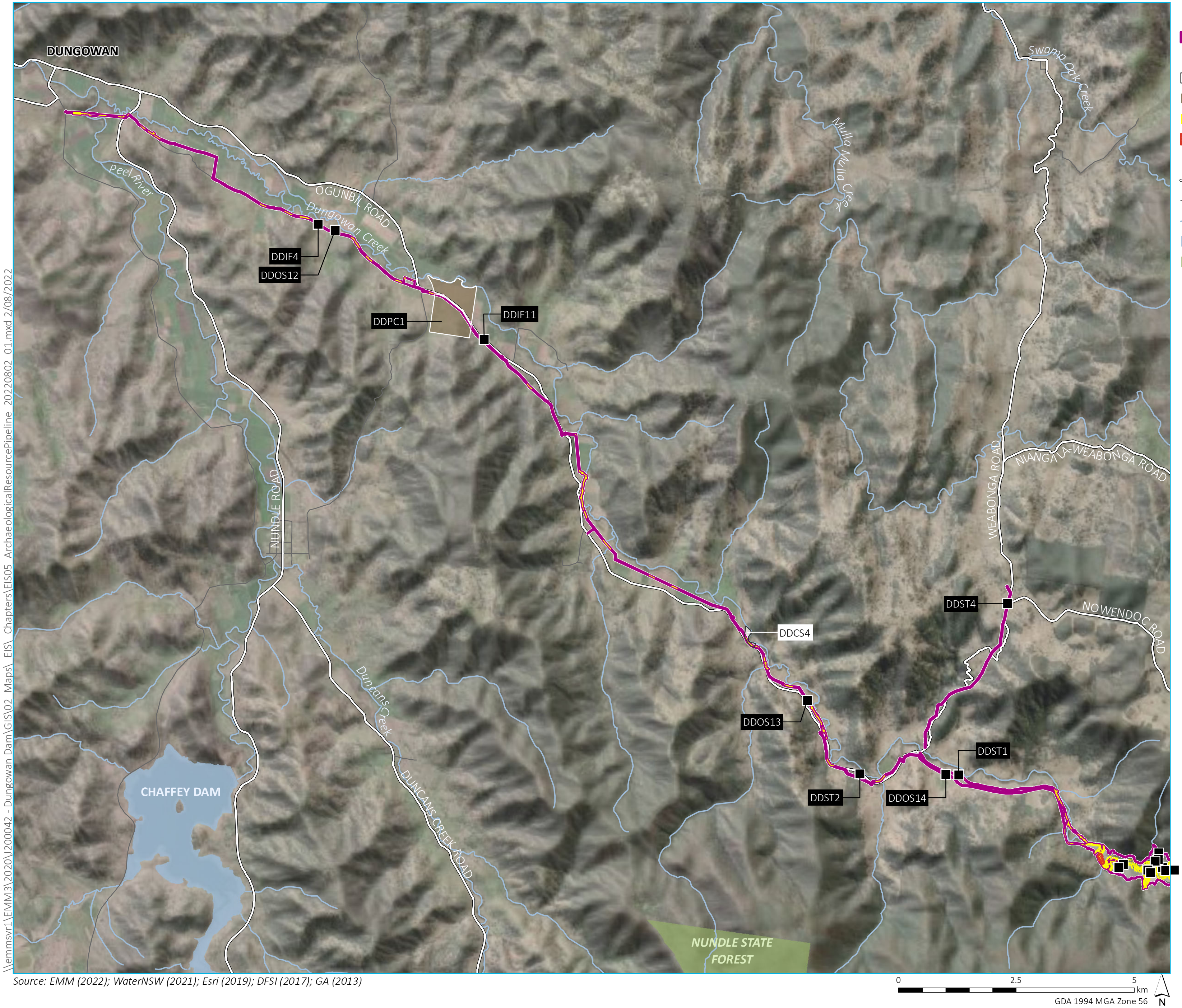
Aboriginal heritage values and archaeological resources - Dam

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 9.1a

creating opportunities



Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

KEY

- Project footprint
- Surveyed Aboriginal site
- Cultural site
- Post contact site
- Areas of probable cultural material
- Key heritage areas

Existing environment

- Major road
- Minor road
- Named watercourse
- Named waterbody
- State forest

Aboriginal heritage values and archaeological resources – Pipeline

Dungowan Dam and pipeline project
Environmntal Impact Statement
Figure 9.1b

EMM
creating opportunities

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9.3.3 Aboriginal heritage impact

A summary of potential impacts to Aboriginal heritage values is provided in Table 9-1. It is anticipated that between four and six out of the 17 discrete Aboriginal sites and places within sites, or near the project footprint would be subject to direct impacts resulting in their complete or partial loss; five would be unaffected, including several of high cultural value; and six would be inundated by the eventual reservoir created.

In addition, the project would:

- Directly impact 2.2 ha of identified areas of high artefact densities.
- Directly impact ~42 ha where such cultural material are more likely to be present based on predictive models.
- Inundate a further ~96 ha of these deposits.

Academic studies demonstrate that submerged soil profiles within dams experience limited modification, and as such the sites and cultural deposits that would be inundated can be considered largely unaffected by the project. A low-density stone artefact background scatter is considered present across the entire project footprint and would also be adversely affected.

In relation to the existing Dungowan Dam, no specific cultural materials have been documented to date. However, it is expected that the current inundation zone would contain comparable cultural materials to those outlined above, especially buried stone artefact densities along the former Dungowan Creek. Within the existing Dungowan Dam, areas where spoil emplacement is proposed may be indirectly affected by the weight of material being situated above them.

The majority of the cultural material documented and/or predicted to be present within the project footprint would only be minimally affected by the project. This includes several of the sites identified as of high cultural value by Aboriginal participants that are entirely outside the project footprint. Many of the sites and deposits would be submerged following the completion of the dam and establishment of the reservoir. Evidence of other dam sites suggests that impact to these sites and deposits would be minimal, and constrained to minor burial by silts and sands, but no other substantial modification to the surface or soil profile would be expected.

Table 9-1 Summary of Aboriginal heritage sites and impacts

Site	AHIMS #	Status	Significance	Type of harm	Location and/or activity causing harm	Degree of harm	Consequence of harm	Notes
DDCS1	25-3-0182	Valid	High	-	-	N/A	N/A	This site is situated in the upper catchment of Terrible Billy Creek, and is situated beyond the proposed inundation extent. Although the exclusion zone around the site as defined by the Aboriginal participants does extend into the project footprint.
DDCS2	29-3-0114	Tentative	Low	Indirect	Within inundation extent	None	No loss of value	
DDCS3	29-3-0113	Valid	Low	-	Within PMF zone	Potentially whole	Potentially complete loss of value	This site is situated on a spur that is situated above the FSL inundation extent, but within the PMF zone. While considered a rare event, if flooding occurred in this zone, fluctuating water levels would potentially result in direct impact and complete loss of this site.
DDCS4	29-3-0112	Valid	Low	-	-	N/A	N/A	This site is situated in close proximity, but outside the current alignment, of the proposed pipeline easement.

Site	AHIMS #	Status	Significance	Type of harm	Location and/or activity causing harm	Degree of harm	Consequence of harm	Notes
DDCS5	29-3-0111	Valid	Low	-	-	N/A	N/A	This site is situated in close proximity, but outside the current alignment, of proposed road upgrades.
DDPC1	29-3-0105	Tentative	Moderate	Direct	Pipeline alignment	Partial	Partial loss of value	This is a poorly defined site and encompasses a significant area. The proposed works are not in the vicinity of the historical homestead, but may affect parts of the station through installation where post-contact activity has occurred.
DDGG1	29-3-0117	Valid	Low	Indirect	Within inundation extent	None	No loss of value	
DDSA3	29-3-0109	Valid	High	Indirect	Within inundation extent	None	No loss of value	
DDST1	29-3-0108	Valid	Low	Direct	Road infrastructure	Whole	Complete loss of value	This site is situated on the edge of an existing road verge. Should the road be expanded, it would require the removal of the tree.
DDST2	29-3-0122	Valid	Low	-	-	N/A	N/A	This site is situated in close proximity, but outside the current alignment, of the proposed pipeline easement.

Site	AHIMS #	Status	Significance	Type of harm	Location and/or activity causing harm	Degree of harm	Consequence of harm	Notes
DDB1	29-3-0115	Tentative	Moderate	Indirect	Within inundation extent	None	No loss of value	A nearby borrow/quarry pit has been redesigned to provide a minimum of 50 m from this site.
DDB2	29-3-0116	Tentative	High	Indirect	Within inundation extent	None	No loss of value	
DDB3	29-3-0118	Tentative	Moderate	Indirect	Within inundation extent	None	No loss of value	
DDSA1	29-3-0104	Tentative	Moderate	Potentially direct	Within inundation zone, within 30 m of the FSL	Potentially whole	Potentially complete loss of value	This site is within the inundation area and would not be subject to direct impacts from flooding. However, the site is close to the FSL and probable fluctuating water levels would potentially result in direct impact and complete loss of this site.
DDSA2	29-3-0120	Tentative	Moderate	Potentially direct	Borrow/quarrying activities	Potentially whole	Potentially complete loss of value	This site is currently outside proposed borrow/quarry pit activities. However, it is within 20 m of some of these activities and may be affected.

Site	AHIMS #	Status	Significance	Type of harm	Location and/or activity causing harm	Degree of harm	Consequence of harm	Notes
DDST3	29-3-0121	Tentative	Moderate	Direct	Within inundation extent	Whole	Complete loss of value	While within the inundation extent, removal of vegetation within this zone, and as such would result in the removal of this site.
DDST4	29-3-0119	Tentative	Moderate	Direct	Within power easement	Whole	Complete loss of value	The site is currently within the power easement and would likely require removal prior to installation.
Low density (background) artefact scatter, including DDIF1-11 and DDOS1-10 and 12-14 (DDBAS1)	29-3-0107	Valid	Low	Direct/ indirect	All activities listed in Section 10.2 of the ACHA	Partial	Partial loss of value	This site is considered to extend across the entire project footprint and extend beyond it. Several discrete observations of this site, including DDOS10, DDIF9, DDOS8, DDOS9, DDIF6, DDIF9, DDIF11 are also outside the proposed activities. Overall, the direct development activities would impact some 190 ha of this site (i.e. the entire project footprint).
DDOS11	29-3-0110	Valid	Moderate	-	-	N/A	N/A	This site is situated on a spur that is situated above the FSL inundation extent, and will be unaffected by the proposed activities.

Site	AHIMS #	Status	Significance	Type of harm	Location and/or activity causing harm	Degree of harm	Consequence of harm	Notes
DDFA A	29-3-0124	Valid	High	Direct	Construction and accommodation activities	Whole	Complete loss of value	This site is entirely within the new Dungowan Dam wall footprint.
DDFA B	29-3-0123	Valid	High	Direct/ indirect	Borrow/quarrying activities; within inundation extent	Partial	Partial loss of value	Some 1,664 m^2 (24%) of the site would be directly impacted by borrow/quarrying activities, with the remaining 5,190 m^2 being subjected to inundation.
DDFA C	29-3-0130	Valid	High	Direct/ indirect	Borrow/quarrying activities; within inundation extent	Partial	Partial loss of value	Some 6,171 m^2 (61%) of the site would be directly impacted by borrow/quarrying activities, with the remaining 4,019 m^2 being subjected to inundation.
DDFA D	29-3-0129	Valid	High	Direct/ indirect	Borrow/quarrying activities; within inundation extent	Partial	Partial loss of value	Some 12,040 m^2 (84%) of the site would be directly impacted by borrow/quarrying activities, with the remaining 2,273 m^2 being subjected to inundation.
DDFA E	29-3-0128	Valid	High	Indirect	Within inundation extent	None	No loss of value	A very small portion (50 $m^{2;}$ 1%) of the site would be directly impacted by borrow/quarrying activities, with the remaining 3,674 m^2 being subjected to inundation.

Site	AHIMS #	Status	Significance	Type of harm	Location and/or activity causing harm	Degree of harm	Consequence of harm	Notes
DDFA F	29-3-0127	Valid	High	Potentially direct/ indirect	Within inundation zone, but in close proximity to the FSL	Potentially partial	Potentially partial loss of value	This site is largely inundated, but 1,165 m^2 (8%) are within 30 m of the FSL and may be subject to impacts from wave action.
DDFA G	29-3-0126	Valid	High	Indirect	Within inundation extent	None	No loss of value	
DDFA H	29-3-0125	Valid	High	Potentially direct/ indirect	Within inundation zone, but in close proximity to the FSL	Potentially partial	Potentially partial loss of value	This site is largely inundated, but 842 m^2 (8%) are within 30 m of the FSL and may be subject to impacts from wave action.
Major tributaries 3^{rd}+ order creek edge's (69m) (DDPAD1)	29-3-0106	Valid	Moderate	Direct/ indirect	All activities listed in Section 10.2 of the ACHA	Partial	Partial loss of value	Some 474,215 m^2 of this zone would be directly impacted by the project activities, with a further 720,141 m^2 being subjected to inundation. Of this, some 261,726 m^2 (21%) of the direct impacts would be to the more sensitive terraces where higher amounts of cultural material may be expected.

Notes: The type, degree and consequence of harm definitions are based on DECCW's Code of Practice for the Archaeological Investigation of Aboriginal objects in NSW.

9.4 Management and mitigation

17 Aboriginal objects and/or sites are within or near the project footprint, along with a complex landscape of buried stone artefactual material. Of the identified sites, up to 12 would be either directly or indirectly affected by the project. Some 4.5 ha of identified areas of high artefact densities and ~47 ha of zones where they may be expected to occur would be directly impacted; and a further ~72 ha would be indirectly impacted.

A series of investigative actions are proposed to validate the identification of several of the sites that cannot be robustly identified as cultural heritage without specialist input and/or further archaeological research. The project design has considered and avoided where feasible Aboriginal cultural heritage objects and values identified through the ACHA process. Further avoidance and minimisation would also be considered through the detailed design process.

Recommendations are proposed for inclusion in the project approval to guide post-approval requirements for Aboriginal heritage. These include the development of an Aboriginal Cultural Heritage Management Plan (ACHMP) to provide a framework for such activities, as well as direction on its content; the development of an Interpretation Strategy and Plan to provide acknowledgement and other visual/educational opportunities for the Aboriginal and broader local community; and the application of a CFMP to further explore and manage hydrological regimes downstream, if affected by the project and its impact on places of cultural value. The following recommendations would be integrated into the management for the project:

- Prior to ground disturbance, an ACHMP would be developed in consultation with the RAPs to provide the post-approval framework for managing Aboriginal heritage within the project area. The ACHMP would include but not be limited to the following:
  - Processes, timing, communication methods and project involvement for maintaining Aboriginal community consultation and participation through the remainder of the project.
  - Detailed descriptions and methods of any additional investigative and/or mitigative archaeological actions that may be required prior to works commencing or during the project. These should include but not be limited to archival recording of all identified Aboriginal objects, sites and places, archaeological excavation of areas of significant buried cultural material and monitoring for any areas identified by the Aboriginal community as having cultural value.
  - Description of actions to minimise impacts to identified Aboriginal objects and/or sites and areas of archaeological sensitivity outside of the construction footprint. This should include, but not be limited to, cultural inductions for all personnel. A suitable regime of monitoring these activities should also be outlined, including locations, methods, personnel and timing.
  - Description and methods of post-excavation analysis and reporting of the archaeological investigations.

- Procedures following current Water Infrastructure NSW guidelines for managing the unexpected discovery of Aboriginal objects, sites and/or human remains during the project.
- Procedures for the curation and long-term management of cultural materials recovered as part of the works. Discussions with RAPs indicate that any curation should remain on Country and remain accessible to the local Aboriginal community into the future.

- A heritage-interpretation strategy would be developed to identify the interpretive Aboriginal heritage values across the project footprint, and to provide direction for potential interpretive installations and devices. Following consultation and feedback on the strategy, a heritage interpretation plan would refine the strategy with content (visual and textual) and design details in order to allow the implementation stage.
- To ensure potential impacts to Aboriginal sites, objects and/or places are considered in the development of environmental water release plans and other mitigation strategies for the project, a cultural flow management plan (CFMP) would be developed to provide the post approval framework for management and monitoring of water regimes in the vicinity of key Aboriginal sites, objects and/or places within the project area. The CFMP would include but not be limited to the following:
  - Clear objectives for the cultural flow in maintaining the significance of the Aboriginal sites, objects, places and values.
  - Description of how water will be managed into the future to maintain necessary water regimes; and any constraints/limitations. This would include information on key personnel to manage and monitor these regimes.
  - A risk assessment, with a description of how they would be minimised, and any management requirements if they eventuate.
  - How the water regime associated with the Aboriginal sites, objects, places and values would be monitored, including methods and timing.
- The CEMP would reinforce how the cultural landscape is considered throughout the project. In discussion with the Aboriginal community, rehabilitation of areas where infrastructure is not remaining after the project should be undertaken to determine suitable ecological communities and other factors in returning the cultural landscape as close to its current state as feasible.

9.5 Summary and conclusion

The ACHA has involved meaningful engagement and comprehensive investigations of Aboriginal heritage values of the project area. While the project would result in some intergenerational/cumulative loss to material culture, there would be opportunity for numerous cultural heritage benefits.

These include the long-term preservation of substantive inundated cultural material that would be inaccessible from future harm, a greater understanding of the past and contemporary values in the region, new ‘created’ Aboriginal spaces and opportunities for heritage interpretation and public outreach.

Impacts to Aboriginal cultural heritage have been considered and minimised through the project design and would be a key consideration throughout the project construction management.

CHAPTER 10

Historic heritage

10 Historic heritage

A detailed summary of the project's impacts to historic heritage is provided in this section. A detailed technical Statement of Heritage Impact (SOHI) is provided in Appendix K. The relevant heritage SEARs and where they are addressed are summarised in Appendix A.

10.1 Existing environment

The landscape of the project area is dominated by alluvial flats within a valley that is generally flat to gently undulating, with the occasional low hilly relief. Prior to European settlement, the vegetation of the subregion was dominated by the woodlands on the lower slopes, box gums on the flats, and river oaks and gums along the major waterways. Much of this vegetation has been cleared on deep fertile soils of the wheat-sheep belt. This is the case along Dungowan Creek where the former residents grew their crops. The landscape retains evidence of the earliest colonial period to the present day.

There are 12 heritage items (Figure 10-1) within approximately 1 km of the project footprint listed on Schedule 5 of the Tamworth Regional LEP and NSW Department of Education s170 register including:

- Ogunbil Brick Shearing Shed and Silo – I283 – Tamworth Regional LEP
- Port Stephens Cutting – I264 – Tamworth Regional LEP
- Dungowan Store and Bakery – I106 – Tamworth Regional LEP
- Former Butchery – I108 – Tamworth Regional LEP
- Former Manwell's Bakery – I109 – Tamworth Regional LEP
- Roman Catholic Church, former Catholic Convent, former Catholic School Site – I110 – Tamworth Regional LEP
- Dungowan Cemetery – I111 – Tamworth Regional LEP
- Dungowan Memorial Hall – I112 – Tamworth Regional LEP
- St Thomas' Anglican Church – I113 – Tamworth Regional LEP
- Dungowan Public School – I114 – Tamworth Regional LEP
- Dungowan Public School – Building B00A – s170 Register (Department of Education)
- Old Piallamore School Building – I285 – Tamworth Regional LEP

10.2 Assessment overview

Research for the SOHI was conducted using various sources including online archives, the State Library of NSW and through stakeholder interviews. Field surveys were conducted between 2020 and 2022 as part of the SOHI to record historical cultural heritage that had the potential to be affected by the project. The surveys were targeted for the most part and guided by features that indicated an earlier structure, or by standing structures.

The SOHI and associated field surveys were undertaken using the principles of *The Australian International Council on Monuments and Sites, Charter for Places of Cultural Significance* (also known as the *Burra Charter,* Australia ICOMOS 2013) and the New South Wales (NSW) *Heritage Manual* (Heritage Office 1996).

The following documents have been used to guide the historical heritage assessment and SOHI:

- *Statements of Heritage Impact Guidelines* (Heritage Office 2006).
- *Investigating Heritage Significance* (Heritage Office 2004).
- *Assessing Heritage Significance* (Heritage Office 2001).
- *Assessing Significance for Historical Archaeological Sites and 'Relics'* (Heritage Branch Department of Planning 2009).

Consultation was undertaken with Heritage NSW in November 2020 to discuss the SOHI assessment approach, with attention paid to the purported burial on the property called *Paradise* and draft management measures. Additional meetings were held with Heritage NSW in February and May 2022 regarding the management of skeletal remains found during the investigation of the purported grave of John Wilson (see Section 10.3 or Appendix K for further detail).

10.3 Predicted impacts

In NSW, historical value is ascribed to buildings, places, archaeological sites and landscapes modified in the Australian historical period for purposes other than traditional Aboriginal use. In addition to listed heritage items (see Section 10.1), research and field survey identified several heritage places or items, described below and shown on Figure 10-1.

Early twentieth century farms in the project footprint have largely been demolished, leaving behind only stockyards, fences and other ephemeral structures. Sites with potential for higher significance are related to Haig's Dungowan Station (1842) for its contribution to the development of the wool industry and its history of squatting and Cadell's Dungowan Station (1867) for its ability to demonstrate the historical development of the area.

The existence of a grave was identified early in the investigation through interviews with a former local resident. It was purported that a man by the name of John Wilson was buried in one of the paddocks in the project footprint. Subsequent investigations confirmed skeletal remains at this location. Investigations are ongoing to confirm ancestry, with further excavation, analysis and laboratory testing potentially required. Should the skeleton be found to be Caucasian, the probability of it being the remains of John Wilson are high. The skeleton is of local significance, with the possibility that scientific analysis may provide answers to historical practices that are of State significance. It is believed he was an itinerant worker or swagman. In addition to possessing significance in its own right, the burial contributes to the cultural landscape of the Dungowan Valley.

Should the skeleton be found to be of Aboriginal ancestry, consultation will be held with the Aboriginal stakeholders, Water Infrastructure NSW, Heritage NSW and NSW Health to agree on a final resting place.

The project is anticipated to have minimal impact on listed heritage items and a greater impact on the cultural landscape values in the construction and operational areas specific to the project. The cultural landscape that would be affected by construction and operational activities of the project is locally significant for its ability to demonstrate changes to the landscape that have resulted from natural forces and human agency, both pre- and post-British settlement. While some physical impacts would occur as a result of the construction of the project, the majority of the impact would be through inundation, which would obscure the landscape rather than destroy it.

The replacement pipeline would be installed through a landscape that was once a part of Dungowan Station, a squatting run that was established in 1847. The original headstation belonging to the run is in proximity to the northern extent of the pipeline but well clear of the project footprint. The survival of any features built or archaeological, of the headstation, is unknown and as the project footprint is outside the property, the project is unlikely to impact upon relics or ruins associated with Haig's Dungowan Station. However, two extant properties being the second Dungowan Station (unlisted) that is operating as a farm, and the 'Ogunbil brick shearing shed and silo' (LEP I283) may be related to the original Dungowan Station headstation and may possess relics that relate to the historical period. Management measures would be implemented to mitigate risks to relics at these items.

The installation of a new overhead powerline would occur in the vicinity and across the locally listed Port Stephens Cutting on Nowendoc Road (LEP I264). However, construction of the powerlines would not have a detrimental impact on the significance of the Port Stephens Cutting and footings and poles could be placed in areas that would not physically impinge on the item even inside the listed curtilage.

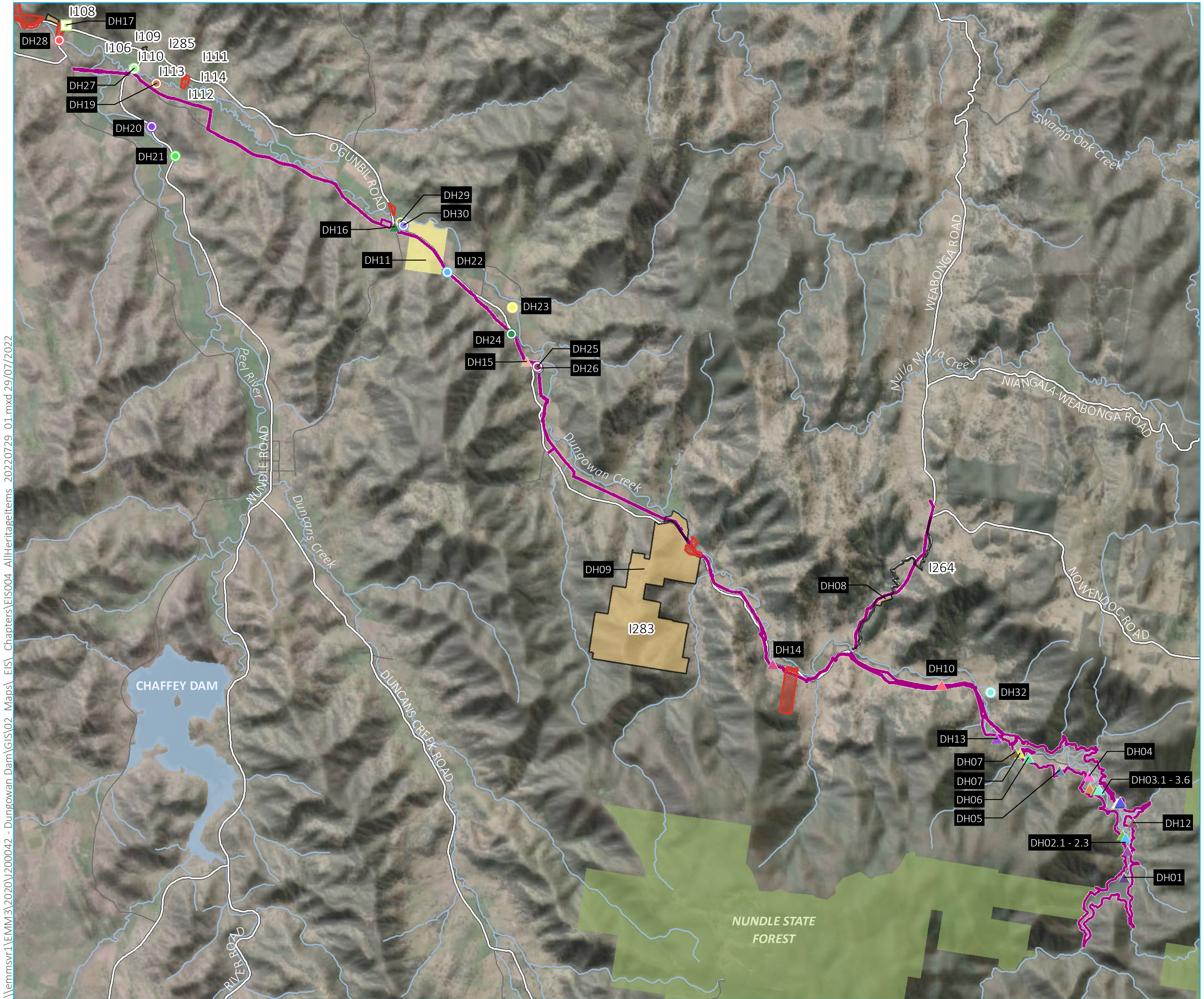
The existing Dungowan Dam is also considered to hold local significance and therefore, its decommissioning should be recorded.

Table 10-1 below provides a summary of the project's impacts to historic heritage values.

Table 10-1 Summary of impacts to historic heritage values

Category	Site/site type	Significance	Predicted impacts
Built heritage	Farm buildings (DH02, DH03, DH04, DH05 and DH06)	Local contributory – not listed	These properties are within the New Dungowan Dam inundation area and would be subject to either inundation or beneath the proposed dam infrastructure. These farms have been assessed to be of contributory significance to the cultural landscape and held little individual significance with respect to archaeological values except for the research potential in the associated drop toilets.
	Existing Dungowan Dam (DH01)	Local – not listed	The project concept design reviewed options to retain the existing Dungowan Dam. The review found that retaining the existing Dungowan Dam would result in unacceptable safety risks of dam failure and high construction costs to upgrade to meet modern dam safety standards. The requirement to decommission the existing Dungowan Dam is thereby considered to be an unavoidable impact of the project.
	Port Stephens Cutting (DH08)	Locally listed item – I264	The installation of power poles in the vicinity and across this item is a vital aspect of the project as the powerline cannot be installed in an alternative location. Care would be taken to avoid impacts to the heritage item by siting power poles and access tracks to avoid the cutting.
	Ogunbil shearing shed and silo (DH09/I283)	Locally listed item I283	The pipeline alignment in this location was sited to maintain a suitable distance from the structures to avoid vibratory or other impacts.
Relics and archaeological resources	Cadell's Dungowan Station and the Ogunbil brick shearing and silo (DH09 and DH11)	Local – contributory	The project will avoid impacts to relics where practical. Relics have not been definitively identified in any location within the project footprint, but the potential for their existence is moderate to high. Avoiding these potential sites is not possible as their locations, if they exist, have not been verified. The key element with potential to encounter elements is the pipeline alignment. During detailed design and construction efforts will be made to minimise and avoid impacts to relics through the development of the pipeline.

Category	Site/site type	Significance	Predicted impacts
Other	John Wilson's grave (DH02.2)	Local	The purported grave of John Wilson is in the inundation area. Further investigations will be carried out in an effort to add evidence to local history of this site. The skeleton and associated artefacts will be excavated and inspected, if possible, in situ to ascertain the ancestry, sex and age of the individual. If in situ identification is not possible, the skeleton will be fully exhumed and analysed in a laboratory. Should the skeleton be found to be Caucasian, the probability of it being the remains of John Wilson are high and consultation with Water Infrastructure NSW, Heritage NSW, NSW Health and other identified stakeholders will be held to decide on the final resting place. Should the skeleton be found to be of Aboriginal ancestry, consultation will be held with the Aboriginal stakeholders, Water Infrastructure NSW, Heritage NSW, NSW Health to agree on a final resting place.
	Places under the existing reservoir	N/A	There is potential for the decommissioning of the existing Dungowan Dam to reveal historic structures associated with inundated properties. There is an opportunity to investigate the historical values of any structures that are revealed.



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Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013); DPIE (2020)

0 2.5 5 km

GDA 1994 MGA Zone 56

N

KEY
- Project footprint
- Major road
- Minor road
- Named watercourse
- Named waterbody
- State forest
- Travelling stock reserve
- Register heritage item

Heritage values in the project area
- DH01 Dungowan Dam
- DH02.1 Location former Paradise residential group
- DH02.2 Possible burial of John Wilson
- DH02.3 Stockyard and ramp
- DH03.1 Waterfall residential and farm group
- DH03.2 Stone-lined road
- DH03.3 Gate posts
- DH03.4 Paddock and trees
- DH03.5 Stockyard and ramp
- DH03.6 Timber beam bridge
- DH04 Eagle Farm residential and farm group
- DH05 Bee boxes
- DH06 Hillcrest residential and farm group
- DH07 Colorbond sheds x 2 large size
- DH07 Carinya
- DH10 Surveyor's tree
- DH12 Brumby holding pen
- DH13 Former Dorset Vale School
- DH14 Wooloban Public School - former
- DH15 Casuarina School 1935-44
- DH16 Dungowan Upper School Union Church 1874-21
- DH11 Cadell's Dungowan Station
- DH19 Hut 1
- DH20 Hut 2
- DH21 Hut 3
- DH22 Hut 4 and yard
- DH23 Hut 5
- DH24 Hut 6
- DH25 Well
- DH26 Hut 7
- DH27 Bridge
- DH28 Dungowan crossing
- DH29 Huts on Cadell's Dungowan Station
- DH30 Woolshed on Cadell's Dungowan Station
- DH32 Old sheep station
- DH17 Original Dungowan Station/Haig's Dungowan Homestead

All historic heritage items

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 10.1

EMM
creating opportunities

10.4 Management and mitigation

Management and mitigation options have been proposed for identified historic heritage sites and include a combination of avoidance, further archaeological test excavation, archival photography, electronic survey, interpretation and adoption of an unexpected finds protocol. Detailed safeguards and mitigation measures are provided in the SOHI (Appendix K) and Appendix E.

A Historic Heritage Management Plan (HHMP) would be prepared to guide construction and operational activities of the project. The primary goal is to avoid impacts, but where that is not possible, the recommendations and management measures in the HHMP would be implemented. The HHMP would detail:

- Historical heritage induction requirements.
- No-go areas.
- Areas where further archaeological excavation is required.
- Archival recording requirements.
- Interpretation and reporting requirements.
- Unexpected finds protocol.

10.5 Summary and conclusion

The project would have minimal impact on listed heritage items but a greater impact on the cultural landscape values in the project footprint. The project has avoided impacts to heritage items through design where practical. Unavoidable impacts would be managed in accordance with the HHMP. Overall, the project's impacts to historic heritage are considered acceptable and would be managed with the implementation of suitable management measures.

CHAPTER 11

Social and economic

11 Social and economic

This chapter provides a detailed summary of the potential social and local economic impacts resulting from the construction and operation of the project. A detailed Social Impact Assessment (SIA) has been prepared in accordance with the *Social Impact Assessment Guideline for State Significant Projects* (SIA Guideline 2021) (DPIE 2021d) and is provided in Appendix L. A Local Effects Analysis (LEA) has also been undertaken to assess the likely economic impacts of the project on the local socio-economic environment and is provided in Appendix M1. The relevant SEARs for social and economic considerations, and where they are addressed, are summarised in Appendix A.

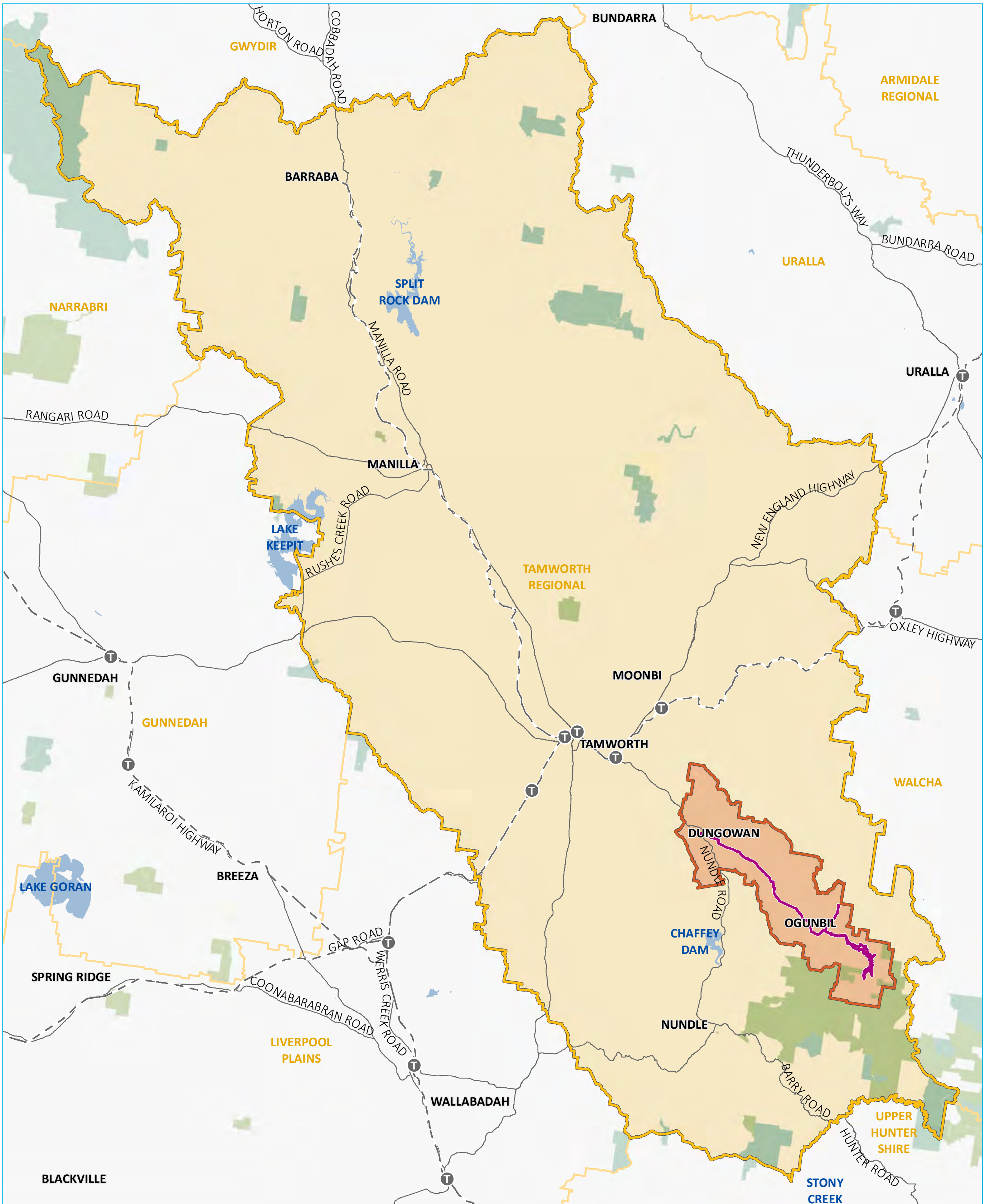
11.1 Existing environment

While the project footprint is localised, direct and indirect impacts may be farther reaching. Thus, impacts of the project are considered within two key areas of potential influence: the local area, including the suburbs of Dungowan and Ogunbil, and the regional area comprised of Tamworth Regional LGA. The SIA study area also includes an area of reference, which includes the New England and North West region. The location of the local and regional areas of influence, and the area of reference is shown in Figure 11-1.

Baseline information used to identify key existing social conditions, including access to housing, social services, health and wellbeing, employment and economic livelihoods, has been obtained for the local, regional and reference areas and presented as the social baseline in Appendix L. The key elements of the social baseline with relevance to the project are summarised below, derived from the 2016 Census of Population and Housing (ABS, 2016) unless stated otherwise.

11.1.1Demographic profile

The local area has a total population of 546 people. Most of these people reside in Dungowan (398) with a smaller portion residing in Ogunbil (148). The population of the local area represents <1% of the regional area population (59,663).



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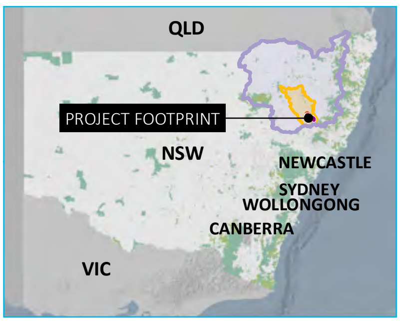
Source: EMM (2022); WaterNSW (2021); DFSI (2017); GA (2013); ABS (2016)

0 10 20 km
GDA 1994 MGA Zone 56
N



KEY

- Project footprint
- Regional area
- Local area
- Local government area
- New England and North West statistical area level 4 (see inset)
- Train station
- Rail line
- Major road
- Named waterbody
- NPWS reserve
- State forest

SIA study area

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 11.1

creating opportunities

11.1.2 Vulnerable minority groups

There are numerous vulnerable groups within the study area community including the elderly and persons with a disability (need for assistance), socio-economically disadvantaged groups, homeless persons, and Aboriginal and/or Torres Strait Islander persons.

In the local area, 1.8% of people have a need for assistance. Rates of homeless are not available for the local area but the regional area and area of reference are lower than NSW rates of homelessness. Approximately 1.8% of the total population within the local area and 10.1% of the regional area population identified as Aboriginal and/or Torres Strait Islander.

11.1.3 Local workforce and skill capacity

The estimated labour force in the local area is 286 people (52% of the local area population) and 27,607 people (46.2%) in the regional area. The unemployment rate in the local area is around 5.2%, which is slightly lower than the regional area (5.8%), area of reference (6.4%) and NSW (6.3%).

Industries of employment that are most relevant to the project are construction and electricity, gas, water and waste services, with construction being a relatively large area of employment in the local area (9.4%). The jobs to resident ratio for Tamworth Regional Council in 2020/21 was 1 resident to 0.96 jobs, meaning that there were less jobs than resident workers. In the regional area, the construction industry has a ratio of 1:0.98, meaning there are slightly fewer jobs than resident workers, suggesting that the regional area has construction employment capacity.

11.1.4 Social infrastructure and services

Access to education, community services, and health services varies across the SIA study area. In the local area (Dungowan and Ogunbil), there is minimal access to services requiring community members to travel to Tamworth to access these services. The local area is particularly lacking in health service provision however Tamworth is well provisioned, with two hospitals and approximately 19 General Practitioner services available in the regional area.

There are two rural fire service brigades in the local area however other emergency services must be sourced from the regional area. Most of the emergency services in the regional area are in Tamworth.

Childcare services and schools are largely centralised in the suburbs around Tamworth. Services include long day care, preschool and outside of school hours care.

Community services cannot be accessed within the local area, however Tamworth is home to several organisations and service providers, which offer a range of services to various groups and include both specific service providers and multi-service providers.

11.1.5Transport

In the local area, the primary means of travel to work is by car, either as the driver or as a passenger (66.1%). Few, if any, people in the local area travel to work using public transport. The relatively large proportion of persons who do not travel to work by car instead work at home – as is largely required of those working in the agriculture industry.

There are school bus routes within the local area and a number of fixed-schedule public bus services that run throughout the regional area.

11.1.6Housing and accommodation

The percentage of homes owned outright in the local area is 33.5% and the proportion of rented homes is 16.5%. In April 2022, there were no properties for sale and no properties for rent in the local area. In selected suburbs in the regional area there were 197 properties for sale and 106 properties for rent, with the vast majority of these available properties were located in Tamworth City.

11.1.7Income and local business

There is variation in the individual and household median weekly incomes across the local area and regional area. Dungowan has a slightly higher individual medium weekly income of $717 compared to Ogunbil ($530), the regional area ($633) and NSW ($664). While Dungowan also had a higher household medium weekly income of $1,286 compared to Ogunbil ($1,125) and the regional area ($1,180), it remains lower than NSW ($1,486).

Of the 5,702 registered businesses in the regional area, 25.8% were in the agriculture, forestry and fishing industry. The industry with the next highest percentage of registered businesses was construction (17.1%) followed by rental, hiring and real estate services (7.9%).

11.1.8Community strengths and vulnerabilities

The generally higher proportion of people in relevant occupations and high proportion of construction businesses is recognised as a strength and opportunity in relation to the project in terms of local procurement. While there is some availability of relevant skilled workers in the local and regional area, a local workforce for highly specialised areas of construction may be difficult to source and will potentially require the utilisation of workers from outside of the regional area.

11.2 Assessment overview

11.2.1SIA methodology

The SIA has been undertaken in accordance with the SIA Guidelines (2021). The key phases of the SIA methodology used for this assessment are presented in Figure 11-2 and a summary of each Phase completed (Phase 1 and 2) is provided below.

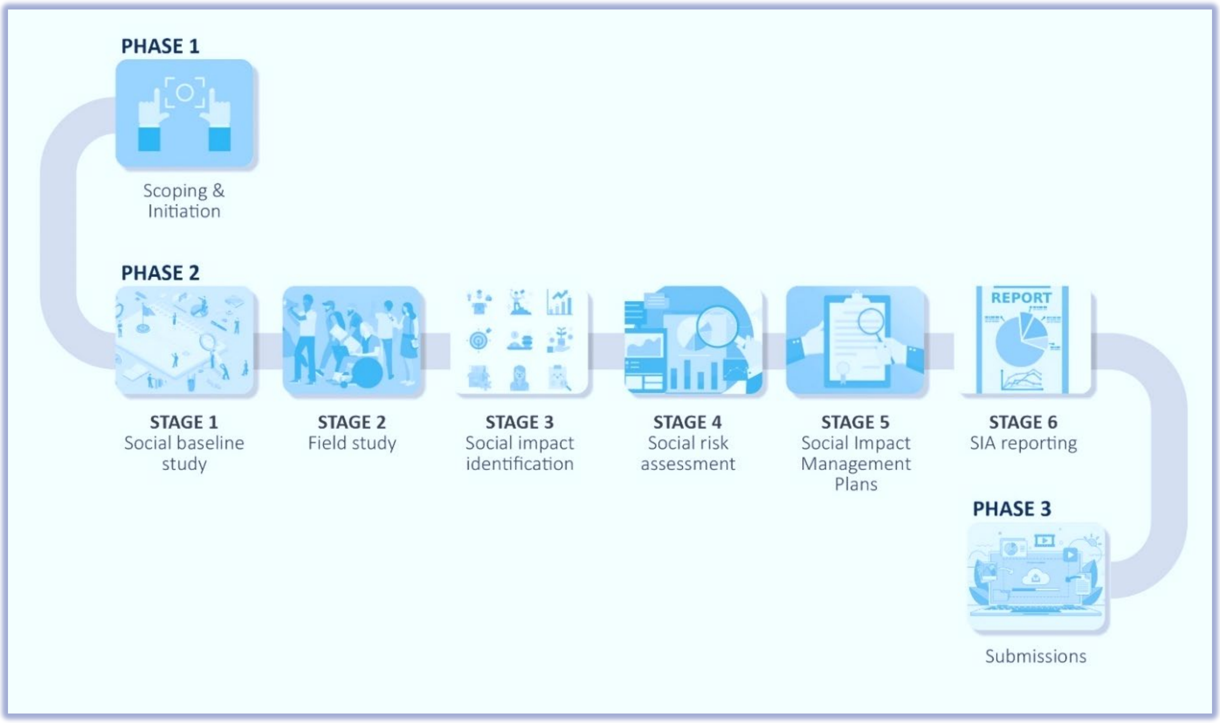


Figure 11-2 Phases of the SIA methodology

Phase 1: A scoping report for the project was prepared in early 2020, which included the development of a demographic profile and identification of the SIA study area.

Phase 2 (Stages 1–6):

1. Social baseline – presented in Section 11.1. Data has been predominantly derived from the 2016 Census of Population and Housing.
2. Field study – included in depth interviews with landowners, service providers and other key stakeholders, as well as two online community surveys in October 2020 and June 2022.
3. Social impact identification – completed with consideration of the existing social environment, field findings, EIS technical reports, local plans and policies and cumulative impacts.

4. Social risk assessment – assessed each of the social impacts and benefits identified to predict the nature and scale of potential social impacts during construction and operation of the project. The risk matrix assigned a risk category of either low, medium, high or very high, and these are presented in Section 11.3 for the identified impacts and benefits.
5. Social impact management plans – a mitigation and management framework was prepared with consideration of all potential social impacts to limit potential impacts and enhance potential benefits. These are detailed in Section 11.4.
6. SIA reporting – Social Impact Assessment (Appendix L).

Phase 3: Submissions phase is the receipt and consideration of feedback on the project following its public exhibition period. This would be addressed in a Submissions Report.

11.2.2 Local effects analysis

A local effects analysis (impact assessment) was undertaken to identify economic impacts on the communities located near the project. Local effects analysis can be seen as an identification and enumeration of local effects with the purpose being to inform communities, identify local impacts and changes, and provide information that will assist in developing mitigation strategies for any adverse impacts. In the absence of guidelines for the application of local effects analysis to water infrastructure projects, the *Guidelines for the economic assessment of mining and coal seam gas proposals* (NSW Government 2015) have been used.

11.2.3 Community engagement and stakeholder feedback

Community and stakeholder engagement for the project commenced in January 2020, shortly after its formal announcement. Since that time, the project team have been engaging with community and stakeholders to provide information and to seek feedback and input to the development of the project. Key engagement activities conducted by Water Infrastructure NSW for the project included community information sessions and events, stakeholder briefings, landowner meetings, and flyer drops. Outcomes of community and stakeholder engagement are detailed in Chapter 5 and Appendix D. Key community values, strengths, vulnerabilities as well as potential social impacts, benefits and opportunities were identified through these engagement forums and the SIA field surveys and are presented in Section 11.3.

11.3 Predicted impacts

A risk-based framework has been adopted for assessment of the potential social impacts and benefits of the project to the community. Social impacts were assessed on a worst-case scenario initially and then the residual effect assessed on the basis that mitigation of negative impacts or enhancement of positive impacts are successfully implemented.

The social impacts and benefits identified and assessed are presented in Sections 11.3.1 to 11.3.8, including the rating of the residual social impact or benefit (provided in brackets), and explanation for key residual impacts or benefits with a medium or higher residual rating.

11.3.1Way of life

The potential way of life impacts and benefits identified included:

- Impacts to the community and built environment caused by noise, vibration and dust during construction and operation (**low negative**).
- Housing demand increase resulting in affordability impacts for the local community (**low negative**).
- Traffic delays and road safety (**medium negative**).
- Water security, quality, price and allocations (**medium negative, very high benefit**).

While there is high social importance placed on traffic and road safety related impacts by the community, with appropriate mitigation measures detailed in the TIA, there is a low risk of traffic delays and a medium risk of road safety issues contributing to way of life impacts. The key potential way of life impacts related to road safety include the potential damage to road infrastructure from construction vehicles and potential impacts to project vehicle interactions with school zones, bus stops, for which measures would be required to minimise potential road safety impacts.

Water security, quality, price and allocations were key issues raised by the community. Many of the matters related to these were considered to be a low risk to way of life impacts, however a number of matters were assessed as having a medium residual impact (change in water price and concern over lack of access to water) and a very high benefit (improved water security).

A Customer Bill Impacts statement (Appendix M.2) was prepared by Water Infrastructure NSW to assess the impact of the project on customer water bills as a result of the project. The statement identifies a minimum bill increase of approximately $50–$53 per annum for residential users. Any increases will not be applied to general security allocations. However, ultimately water prices are set by IPART and subject to a range of factors, and as such the estimated increase is only a preliminary indication. Over the period of a year, $50 is not a significant increase against the estimated annual bill of $1,406 for water and wastewater services, however any increase in water bills may cause additional mental and financial stress for vulnerable members of the community. It is therefore proposed that the future service provider may consider offering a temporary exemption from the water price increase for people who can demonstrate that they are experiencing financial hardship.

The concerns over lack of access to water related to the project are in fact a benefit, as the project would ensure raw water customer connections are maintained, additional raw water customers would be provided with connections along the replacement pipeline route and the project would reduce time in water restrictions for Tamworth and provide overall improvements to water security.

Way of life benefits from improved water security were assessed as very high, with the community identifying that the project is anticipated to have the following economic benefits, due to overall improvements to water security through reduced water restrictions:

- Businesses and service providers including increased income to and investment opportunities for the local and regional community. This may in turn encourage youth retention in the local workforce and agricultural sector.
- The agricultural sector and food production in the local and regional area (e.g. increase in farming income).
- New users enabled with access to raw water infrastructure from the new Dungowan Dam.
- The potential for the regional area to support population growth.

11.3.2 Community

The key impact identified with the potential to impact the community was around community cohesion due to project decision making (**medium negative**), i.e. potential division in those who support or object to the project. How water is managed and allocated remains a source of potential contestation for the local community, with distrust towards current management processes being expressed for the existing Dungowan Dam and pipeline by some SIA survey respondents.

The implementation of measures, including ongoing equitable and consistent community engagement, would help mitigate further risks arising from the inconsistencies demonstrated in the strategic political context surrounding the project.

11.3.3 Accessibility

The potential accessibility impacts and benefits identified included:

- Landowners could experience utility service disruptions, including electricity and water, and construction personnel increases may place strain on local service providers (**low negative**).
- Benefits related to improved access to local services (**high benefit**).

The key accessibility benefit relates to the potential for the establishment of construction telecommunications infrastructure that, if built, could be potentially utilised to service local residents permanently. This matter was identified because there is no internet access in the Dungowan Valley and about a quarter of all residents in the regional area do not have internet access. Therefore, while it does not form part of the current project scope, investigations are ongoing, and if implemented, would provide a high social benefit.

11.3.4 Culture

The potential cultural impacts and benefits identified included:

- Changes to downstream flows affecting ongoing use of the area for cultural and way of life purposes (**low negative**).
- Loss of the ability to gain personal and cultural connection and sustenance (including spiritual) from the land and water (**medium negative**).
- Intergenerational loss of material culture and cumulative loss of material culture (**high negative**).
- Loss of access to land and cultural sites (**high negative**).
- Connections to declining fish populations and impacts on cultural and recreational fishing (**high negative**).
- Information gathering and long term preservation of cultural material (**medium benefit**).

The loss of the ability to gain connection and sustenance, loss of material culture and loss of access to land are impacts that are difficult to mitigate when constructing and operating a dam. The land would be inundated and remain underwater to some extent for perpetuity. The ACHA (Appendix J), details a number of mitigation measures that would be implemented as part of the project to attempt to minimise impacts to cultural heritage in general, noting they would not reduce the losses described.

The impacts on cultural and recreational fishing relate to the establishment of the new Dungowan Dam and the barrier to upstream fish passage it would present as well as direct impacts to areas of key fish habitat caused by inundation. Mitigation for the localised impact is not possible, but as described in the Aquatic Ecology Assessment (Appendix I), fish passage offsets would be implemented downstream of the project to remove or remediate four current fish barriers. It is therefore recommended that additional consultation is undertaken with the local community, and particularly Aboriginal persons, to identify whether the proposed offsets effectively mitigate the cultural impacts of the project, and to understand the cultural impacts and benefits of the proposed aquatic offsets.

While the project would result in some intergenerational/cumulative loss to material culture, it is considered that there would be numerous cultural heritage benefits. These include the long-term preservation of substantive inundated cultural material that would be inaccessible from future harm, a greater understanding of the past and contemporary values in the region, new ‘created’ Aboriginal spaces and opportunities for heritage interpretation and public outreach. These are described in detail in the ACHA (Appendix J) and with their implementation, the information gathering and long term preservation of cultural material is assessed as a medium benefit.

11.3.5 Health and wellbeing

The potential health and wellbeing impacts identified included impacts to the physical health and mental wellbeing of project personnel living and working on site. The potential impacts of dust emissions, noise, isolation and pest infestation were all considered to have a low residual impact and only one matter, bushfire impacts, was assessed as a high negative residual impact. This is due to the location of the project in a relatively remote area that is susceptible to bushfire.

11.3.6 Surroundings

The potential surroundings impacts and benefits identified included:

- Effect of invasive species on ecological communities and farming (**low negative**).
- Environmental, amenity and public health impacts resulting from waste generation and handling (**low negative**).
- Changes to the landscape (**medium** and **high negative**).

Two matters relating to changes to the landscape were identified as having a medium and high residual impact.

Firstly, changes to views and vistas due to the new Dungowan Dam, while not considered as a significant visual impact in the Visual Impact Assessment (Appendix W), were identified as a social impact that had the potential to be mitigated through the provision of recreational opportunities within the new Dungowan Dam catchment. While it is acknowledged that access to the reservoir is unlikely, passive recreational opportunities such as bushwalking within the catchment should be investigated to provide potential social and economic benefits to the region. It is also recommended that onsite amenities provided for construction workers, such as bathrooms and potentially exercise equipment or barbecue areas, be considered as permanent infrastructure to be repurposed for recreational use, should this land use be adopted.

Secondly, construction and operation impacting native flora and fauna through inundation or changes to water flows was considered as a high residual impact. Numerous respondents, including residents, farmers and Indigenous participants, expressed concern regarding reductions in river flows and related species loss and displacement. Both terrestrial and aquatic offsets are proposed to mitigate these impacts, however, community consultation is recommended to inform the proposed offset strategies, to understand the social impacts, minimise identified impacts and where possible maximise the social co-benefits.

11.3.7 Livelihood

The potential livelihood impacts and benefits identified included:

- Construction and operation impacts on agricultural activity and productivity (**low** and **medium negative**).
- Growth and economic development (**very high benefit**).
- Increased local employment opportunities (**high benefit**).

Landowners consulted were concerned over potential loss of prime agricultural land and productivity, disturbance of land impacting the integrity of crops and the loss of crops if not given advance warning to re-plant. During the pipeline infrastructure construction, a 20 m wide construction corridor for the pipeline will be temporarily taken out of production, with potential short and long term impacts including reduced soil stability, increased susceptibility to erosion, loss or degradation of topsoil, risk of exposing buried contaminants and introduction of contaminants into soil material. A Land Use Management Plan (LMP) would be developed to support project activities to ensure areas of key concern for farmers are addressed and proactively managed.

The identified benefits relate to economic benefits and increased local employment opportunities. The construction phase of the project will generate demand for a range of goods and services within and outside of the regional area, increasing opportunities for local businesses and therefore have a positive impact on businesses and livelihoods. The Local Effects Analysis (Appendix M.1) found the project is expected to increase employment opportunities in the region and is estimated to make up to the following annual contributions to the regional economy over the approximately six year construction period:

- $263 million in annual direct and indirect regional output or business turnover.
- $94 million in annual direct and indirect regional value-added.
- 922 direct and indirect local jobs.

This is a positive impact, however to enhance livelihood benefits, it is recommended that further business and supplier information sessions are held in the local and regional area and that a Construction Workforce Management Plan is developed that details employment and investment in local and regional job readiness.

11.3.8 Decision-making systems

Decision-making system impacts include the extent to which people can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms (**medium negative**).

While extensive community consultation has been undertaken over an extended period, 44 of the 67 respondents to the 2022 online community survey expressed concern around project transparency, including a distrust and lack of faith in the EIS process due to a perceived lack of communication with, and involvement from, local community and concerns relating to the cost efficiency of the project, who will pay, alternatives and what interests are being prioritised in decision-making processes.

By increasing trust and engagement, through clearer information being distributed to the community regarding issues like options analysis, costs and water allocations, there is potential to reduce the community’s perceived hesitancy towards meaningful engagement.

11.4 Management and mitigation

11.4.1 Monitoring and management framework

It is proposed that a social impact monitoring and management framework be developed to ensure that the identified positive and negative impacts are monitored over time to measure the effectiveness or otherwise of the proposed management measures. The monitoring and management framework would include the following key aspects:

- Ongoing community and stakeholder engagement, including regular project updates and targeted notifications to affected parties.
- Tracking of progress and success of mitigation and management strategies.
- Key performance indicators, targets and outcomes.
- Effective, monitored and reported complaints handling processes.
- Mechanisms for ongoing adaption of management measures when and if required.

11.4.2 Management measures

In addition to the monitoring and management framework, a number of mitigation measures have been identified to minimise social and economic impacts from the project, as well as enhance identified benefits. These measures are in addition to those provided in specific technical reports. Detailed measures are provided in Appendix E and Appendix L, and include the key measures detailed in Table 11-1.

Table 11-1 Key management measures

Aspect	Key management measures
Local benefits	Development of a Construction Workforce Management Plan that commits to best practice in employment and investment in job readiness by Water Infrastructure NSW and its contracting partners, including a strategy for prioritising local and regional workers in the area.
Affected landowners	Development of a Land Use Management Plan to support future project activities, and areas of key concern for farmers addressed by suitable preventative access procedures.
Traffic and transport	The Road Condition Report should include a plan for monitoring and, if damage is attributable to the project, repair of transport routes during and following construction.
	The Traffic Management Plan should include: • Planning project deliveries outside school bus pick up and drop off times. • Monitoring and confirmation of the ongoing safety of each pick up and drop off site along the project route. • Construction in school bus pick up/drop off areas to occur during school holidays.
Health and wellbeing	Regarding bushfire, detailed emergency management planning should be completed prior to construction to ensure the safety of workers.
Housing stress	Establish onsite accommodation and facilities as early as possible to minimise any lag between project commencement and provision of accommodation.
Indigenous community impacts	Implementation of a formal process for monitoring and evaluating social impacts caused by the project to: • Ensure the Indigenous community believe their concerns have been considered and addressed. • Identify whether the proposed terrestrial and aquatic offsets effectively mitigate the cultural impacts of the project.
	Implementation of strategies to support indigenous businesses to take advantage of opportunities relating to future education, tourism and research related to the project.
Recreation	Recreational access to the land around the new Dungowan Dam (e.g. for bushwalking) should be considered.
	On-site amenities provided for construction workers, such as bathrooms and potentially exercise equipment or barbecue areas, should be considered to provide permanent infrastructure if any recreational land use is adopted.

11.5 Summary and conclusion

Both the local and regional area are expected to experience both social impacts and benefits from the new Dungowan Dam and pipeline project.

The key social impacts are primarily associated with the delivery and construction phase of the project, including impacts to road safety, community cohesion, bushfire risk, changes to landscape, agricultural productivity and a community perception of a lack of transparency and open communication.

Some benefits will be realised during construction, including the economic benefits to the local and regional communities and businesses, however most social benefits would be realised once the project is in operation, including additional access to raw water and improved water security.

An adaptive approach is proposed for the project, allowing Water Infrastructure NSW to manage and respond to changing circumstances and new information over time through ongoing monitoring and periodic review of mitigation strategies, allowing for modification if required and appropriate. This adaptive approach will ensure that the management of social impacts identified minimises negative social consequences and maximises social benefits for the community.

CHAPTER 12

Public safety

12 Public safety

This chapter presents a detailed summary of the project’s potential impacts to public safety including aspects relating to dam safety, human health and bushfire risk. Detailed technical reports have been prepared to address key public safety impacts including a Health Impact Assessment (HIA) and Bushfire Risk Assessment, which are provided in Appendix N and Appendix O respectively. A Hydrology and Consequence Assessment was also undertaken as part of the concept design and is attached to Annexure J of the Surface Water Assessment (Surface Water Assessment appended to the EIS as Appendix F). The relevant SEARs and where they are addressed are summarised in Appendix A.

12.1 Existing environment

Stakeholders that may be affected by potential public safety impacts of the project are those in proximity to the project area and downstream of the new Dungowan Dam. These community stakeholders are predominantly within the Tamworth Regional LGA, which is within the Hunter New England Health District area.

The construction works, and infrastructure, are located within the Peel Valley. Downstream of the new Dungowan Dam wall, the land use of the Peel Valley is predominantly agricultural. The nearest residence is over 1.5 km to the northwest of the new Dungowan Dam and 5 km from the existing Dungowan Dam. There are limited residences with 10 km of the new Dungowan Dam, but numerous residences are located in closer proximity to the new pipeline and Dungowan Dam Road upgrade works.

A review of data for the general population health of the Hunter New England Health District suggest some of the population in the areas surrounding the project may be more vulnerable to health-related impacts associated with the project, than the general population of NSW. The underlying reasons for this increased vulnerability are complex, and may include a broad range of lifestyle, behaviour and environmental factors.

12.2 Assessment overview

Key issues relating to public safety have been considered in depth through the design and planning of the project. The considered key issues include:

- Dam safety – management of safety risks related to the construction and operation of the proposed new Dungowan Dam as well as the decommissioning of the existing Dungowan Dam. A hydrology and consequence assessment was carried out for the project (attached to Appendix F). The study involved routing dam break floods for 'sunny-day' failure and flood scenarios to determine the population at risk (PAR), potential loss of life (PLL) and assess the severity of damage and loss. The consequence category was assessed in accordance with *Declared Dams Consequence Category Assessment and Determination Methodology* (Dams Safety NSW, 2019) and *Guidelines on the Consequence Categories of Dams* (ANCOLD, 2012).
- Public health – the potential for the project to result in health impacts to the community surrounding the project. A HIA was completed that assessed the potential health impacts related to potential changes in air quality, noise and vibration, water, contamination, bushfire and traffic from the project. The HIA utilised relevant technical reports' assessments that have been developed for the EIS.
- Bushfire – the management of bushfire risks including the potential for the project assets and personnel to be impacted by bushfire. The strategic actions to reduce the risk of bushfire to assets for the Tamworth Regional LGA is governed by the Tamworth Zone Bushfire Management Committee *Bushfire Risk Management Plan 2011*. A Bushfire Risk Assessment was prepared, which documents the project's bushfire risk in accordance with *Planning for Bushfire Protection 2019* NSW Rural Fire Service (RFS, 2019).

12.3 Predicted impacts

12.3.1Dam Safety

Dam safety has been considered throughout the development of the project design. A dam breach hydraulic model (TUFLOW 2D) was developed to estimate the extent, depth, velocity and other characteristics of the various dam breach floods, which includes both dam failure and no dam failure scenarios. This model was used to quantify the incremental consequences of failure of the new Dungowan Dam.

The model breaches the dam embankment and routes the breach flow and outflow hydrographs to a point just downstream of the Tamworth township, where the incremental flood depths are expected to be negligible. A variety of scenarios were modelled using different assumptions regarding an embankment breach including a Sunny Day scenario and the Probable Maximum Flood (PMF).

The consequences predicted by the dam break modelling are summarised in Table 12-1. Overall, both the Sunny Day and PMF failure scenarios were found to result in a consequence category of 'High A' and major damage severity. The classification of High A arises primarily due to the magnitude and shape of the flood peak. Its rapid rise within a constrained river valley provides little opportunity for attenuation and results in very high estimates for both depth and depth-velocity product. The majority of the PLL are located in the Dungowan Creek floodplain, which is subject to severe, high force flooding characteristics.

Table 12-1 Summary of Estimated Incremental PAR, PLL and Economic Consequences

Consequence	Sunny Day Failure	PMF
Incremental population at risk (PAR)	161	320
Incremental potential loss of life (PLL)	11	42
Incremental damage cost	$375 million	$447 million
Consequence category	High A	High A

The modelled outcomes presented above have applied an upper limit fatality rate assuming 'no warning' could be provided to the community downstream in the event of a dam break. There is potential for the PLL values to be reduce if an effective warning system can be implemented for the downstream community, as is expected to be the case with suitable dam safety monitoring in place. The indicative breach travel time is shown in Figure 12-1.

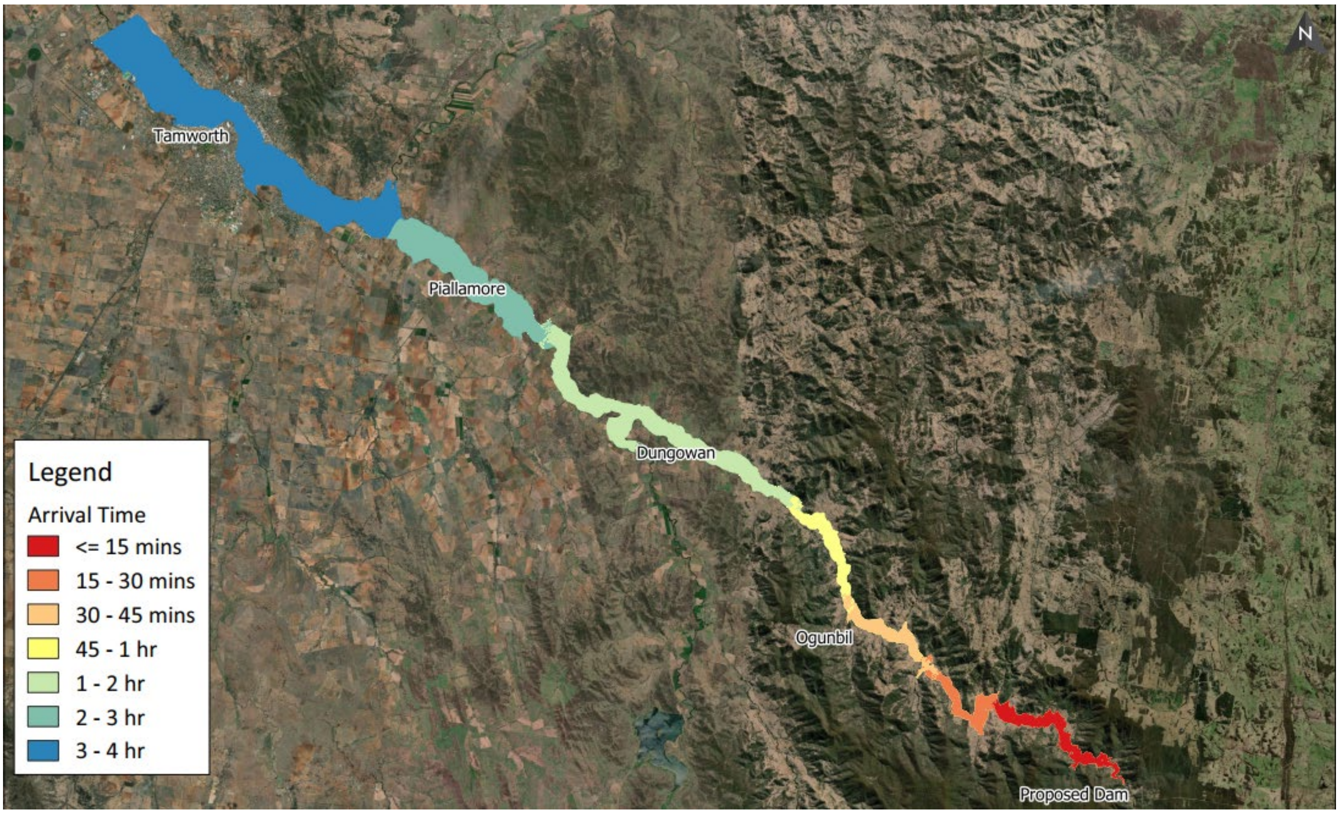


Figure 12-1 PMF breach travel time

Sensitivity analysis found that the travel time for a breach is rapid, providing little opportunity to effectively evacuate the surrounding areas, particularly immediately downstream of the breach. Areas further downstream would have additional time in which warnings could be issued and areas evacuated. Given the high consequences of dam safety risks these aspects have been a key consideration throughout design of the project and will require ongoing monitoring and management.

The risks of dam failure are expected to be suitably managed through the application of suitable safety in design measures and monitoring throughout the project life. Management and mitigation measures that would be implemented to control dam safety risk are discussed further in Section 12.4.1.

12.3.2 Public health

The HIA assesses potential project impacts relevant to public health, identifying that these issues would be suitably managed by the project controls, and that the project would pose no overall health risk issues of concern for the community. Project impacts and the potential for these to result in risks to human health include:

- Air emissions: Where all proposed dust mitigation measures are implemented, there are no health impacts of concern related to community exposure to particulate matter, specifically $PM_{2.5}$, and respirable crystalline silica that may be generated during construction activities. There are no impacts to air quality during project operation.

- Noise and vibration: Based on the predicted noise levels, there are no health impacts of concern for noise generated during construction from static locations or during operations. However, during the construction of the pipeline and Dungowan Dam Road upgrade works, there is the potential for elevated levels of noise that require mitigation to ensure public health is protected. These measures are of most importance during the night-time period should it be required during construction. In relation to road noise impacts, there is the potential for construction traffic to result in impacts to the community located adjacent to some local roads. In particular, minimising the movement of trucks during the night-time period along Nundle Road, Ogunbil Road, Dungowan Dam Road, Dungowan Creek Road and Back Woolomin Road would be of key importance to minimise health impacts, particularly impacts relating to sleep disturbance.
- Water: A range of assessments have been undertaken in relation to changes to surface water and groundwater associated with the project. In relation to aspects that have the potential to impact on community health, the following were identified:
  - The project would not result in substantial changes to flood risks for properties downstream of the project.
  - Water quality (including raw water from the new Dungowan Dam, treated water supplied from the Calala WTP or groundwater sourced from existing bores near the project area) would not be expected to change with the operation of the project.
  - The project would not materially reduce annual average allocations to water users.
- Contamination: There is a limited potential for contamination to be present in the project footprint. Further, where the proposed management measures are implemented, the potential for construction works to disturb and mobilise contamination in the project footprint, such that the offsite community may be exposed to contaminants from these activities, is considered negligible.
- Traffic: Where traffic management measures are implemented, to address safety and access aspects, the potential for changes in traffic to impact on community health is considered to be low.

12.3.3 Bushfire

The project area and surrounds have a history of bushfires. The project is on designated bushfire prone land and the construction phase of the project will require large numbers of workers to be in a relatively remote area that is susceptible to bushfire. Critical infrastructure associated with the new Dungowan Dam would be designed in such a way as to minimise the impact of bushfires and ensure that water infrastructure capabilities are not compromised during bushfire emergencies or after the impact of fires within the dam catchment. The tolerable level of risk would be determined during detailed design and measures put in place reflecting the level of acceptable bushfire attack on key assets.

The new pipeline infrastructure is considered to be a low bushfire risk due to being predominantly underground. Above ground points associated with the pipeline would need to consider vulnerability to radiant heat and consequence of loss or damage to the asset. The control valves will be located in two above ground buildings along the pipeline to reduce pressure. Radiant heat testing of the buildings to reduce radiant heat to tolerable levels will need to be identified and refined during detailed design.

Prior to construction, detailed emergency management planning would be completed to ensure the safety of workers located in relatively remote and bushfire susceptible areas. Emergency plans would be utilised and refined as necessary during the construction period. For temporary construction areas such as compounds, radiant heat testing and sizing of the buildings and compounds to reduce radiant heat to tolerable levels will need to be considered in construction planning.

Where required during construction, the disposal of vegetation by burning would be carefully managed to ensure bushfire safety. All controlled burning of vegetation stockpiles would need to obtain a hazard reduction certificate by the NSW RFS. The vegetation stockpiles would be attended at all times by staff for control purposes and managed in accordance with any specific requirements of the RFS.

The operational phase of the project will require bushfire management measures to be identified within operational environmental management plans to reduce the bushfire attack level on key assets.

12.4 Management and mitigation

Measures that would be taken to mitigate potential risks to public safety predominantly relate to dam safety and bushfire impacts. The project would only have negligible impacts to human health requiring no additional measures beyond those identified within relevant technical studies, as summarised in the consolidated mitigation measures in Appendix E. The following sections describe the key management measures that would be implemented to manage public safety through construction and operation.

12.4.1Dam safety

The new Dungowan Dam will be fitted with instrumentation to ascertain the health and performance of the dam over its full life cycle and will comply with the NSW *Dams Safety Act 2015* and *Dams Safety Regulation 2019* (and future amendments) during the full life cycle.

WaterNSW has a documented dam safety management system in place, which will include a specific Dungowan Dam operation and maintenance plan and Dam Safety Emergency Plan (DSEP). These plans set out the responsibilities of operation and inspections of the dam and associated structures during standard operations and emergency events. Inspections are carried out by qualified personnel and would include routine daily inspections and longer-term comprehensive dam safety inspections and reviews.

The DSEP will include project specific operation and inspection of the new Dungowan Dam and downstream evacuation plans during the different emergency events. Tamworth Regional Council, the State Emergency Service (SES) and other emergency services would be consulted during the preparation of the DSEP.

12.4.2 Bushfire

The project would reduce bushfire risk through several design measures incorporated into the project construction including:

- Establishment of suitable asset protection zones (APZs) providing separation distances from key infrastructure to unmanaged vegetation.
- Design and maintenance of access roads that provide suitable access for emergency vehicles.
- Suitable water supply and water utilities required for firefighting purposes.

The project would also prepare and implement a Bushfire Management Plan (BFMP) prior to construction, in consultation with the RFS.

12.5 Summary and conclusion

Public safety has been considered throughout the design and planning of the project. Detailed consideration has been provided to dam safety, potential impacts to public health and bushfire risk. The HIA has considered potential impacts of the project on community health in relation to air quality, noise and vibration, water, contamination, bushfire risk and traffic.

No health risk issues of concern have been identified for the community. The development and design of the project has carefully considered dam safety and bushfire risk and suitable design measures have been taken to minimise these risks. The project detailed design, construction and operations stages will continue to manage these risks to control and minimise any risks to public safety.

CHAPTER 13

Land

13 Land

This chapter presents a detailed summary of the project's impacts to land including soils and erosion, land use and contamination. Detailed technical reports for the Land Use Assessment; Land, Soils and Erosion Assessment (LSEA); and a Contamination Preliminary Site Investigation (PSI) are provided in Appendix P, Appendix Q and Appendix R respectively. The relevant SEARs for land and where they are addressed are summarised in Appendix A.

13.1 Existing environment

The project footprint is within a landscape of flat to gently sloping terrain, with a surrounding area, which includes some steep to very steep land. The flat terrain is associated with the Dungowan Creek floodplain and valley floor, with the steep slopes generally providing the boundaries of the creek's catchment. The terrain is depicted in Figure 13-1.

The erosion hazard assessment completed as part of the LSEA indicates the project footprint has an erosivity hazard (measured by soil loss classes) ranging from very low to extremely high. The pipeline route is located primarily within low erosion hazard areas (flatter slopes), whereas the powerline is located primarily within high erosion hazard areas (steeper slopes). The inundation area includes areas of both very low and high erosion hazard. While areas of erosion hazard have been identified, no highly erodible or dispersive soils were identified.

Soil types relevant to the project are shown in Figure 13-2 and have been classified using the Australian Soil Classification (ASC). The soils within the operational footprint were sampled, laboratory tested and mapped into soil mapping units (SMUs). Soils are classed as Dermosols (DE) and Dermosols/Rudosols (DE/RU), with little physical difference between the two units. Physically the soils are consistently shallow, particularly on the hillslopes, and coarse fragments are consistent throughout all soil profiles. Chemically the existing soil profile has no salinity or dispersion limitations, and subsequently are expected to pose minimal erosion hazard. The cations within the soil are generally within recommended limits for plant suitability (soils are classed as non-saline).

No acid sulphate soils (ASS) were identified within the project footprint through desktop or limited field investigations. The provisional classification for the site is extremely low to low potential ASS. Notwithstanding, an area of high occurrence is mapped within the existing Dungowan Dam area.

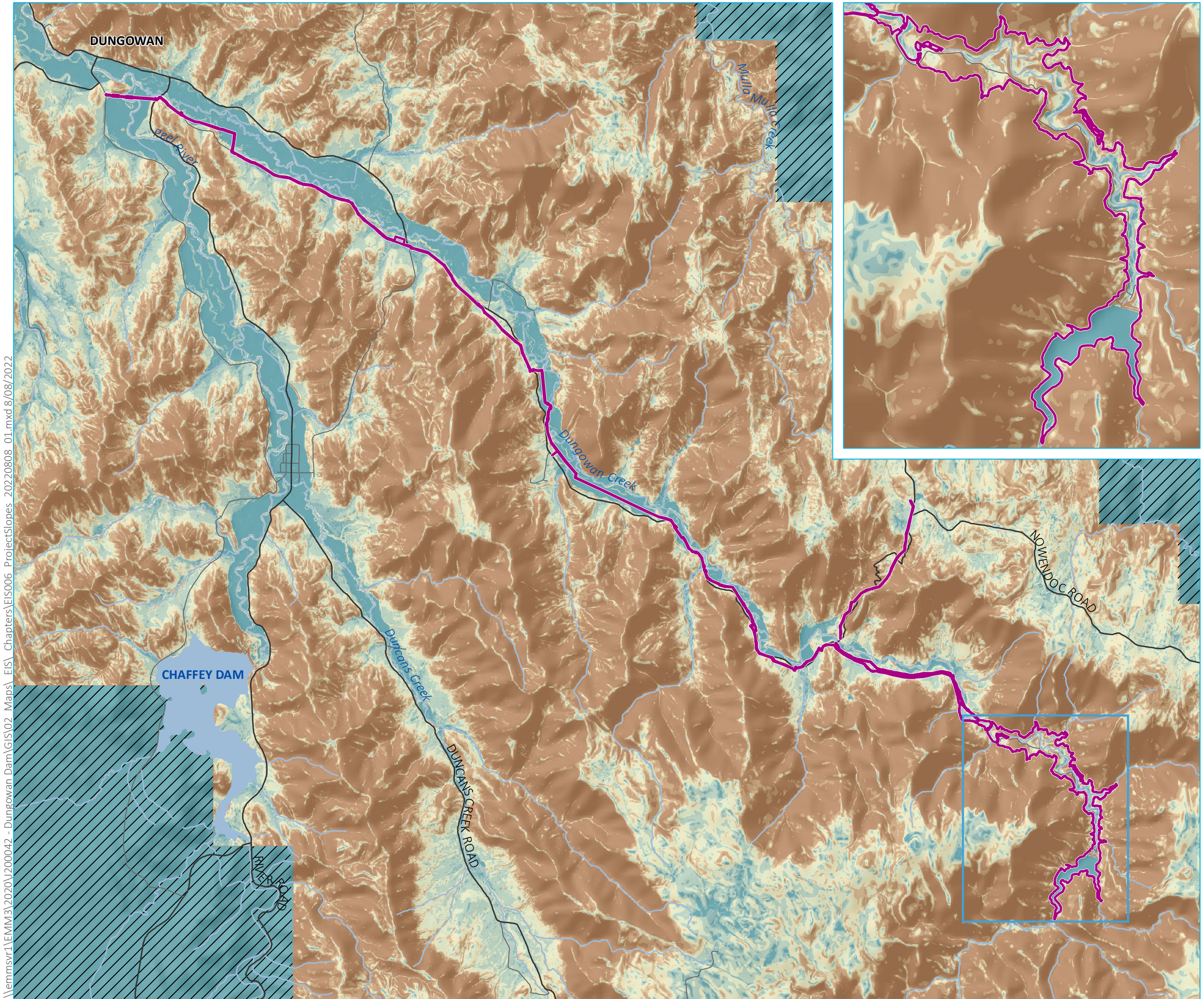
Soil within the project footprint ranges from high to moderately high in inherent soil fertility on the relatively flat area around Dungowan Creek, to low or moderately low fertility on the surrounding slopes. Similarly, Land and Soil Capability (LSC) ranges from class 2 (very high capability land) near Dungowan Creek, to class 7 (very low capability land), which dominates the surrounding steep slopes.

The fertile soils along the flat valley floor provide suitable land for agriculture, and agricultural land uses dominate the project footprint. The majority of agricultural land is currently and has historically been used for grazing livestock and irrigated cropping. The operational footprint of the new Dungowan Dam is not currently used for agriculture or any commercial activities, however has been subject to these activities in the past. There are no active mines within the project footprint and the site is not within a mine subsidence district. There is one current exploration lease (mineral exploration) relevant to the project (EL9003 detailed in Figure 13-3).

Current and past agricultural practices, and rural and infrastructure developments associated with these practices, are the key contributing factor to the presence of contaminants of potential concern (CoPC) across the project footprint. Potential existing sources of contamination identified include:

- Potential uncontrolled landfills/fill material/demolished buildings – across the entire project footprint. Interviews with landowners indicate the potential for localised unregulated waste to be present, however none were visually identified during the site inspections or desktop review.
- Historical application of herbicides and pesticides on agricultural land – all land areas used for agricultural purposes, which comprise most of the project footprint.
- Culverts and pipelines – including potential asbestos – all areas within the project footprint, particularly adjacent to roadways where service conduits exist.
- Historical mining activity/potential acid forming (PAF) rock, acid mine drainage and heavy metals – numerous historical mining exploration titles cover the project footprint and some PAF material was identified during geotechnical investigations.
- Potential/actual acid sulphate soils (ASS) – within the wet/riparian areas of the site including the existing dam area.
- Potential polyfluoroalkyl substances (PFAS) – Ogunbil RFS building on Ogunbil Road adjacent to the project footprint.
- Likely Petroleum hydrocarbons – above ground storage tank (AST) on Dungowan Dam Road with unknown contents.
- Arsenic – former sheep dip – known arsenic contamination at a former dip site located adjacent to the proposed quarry at 801 Dungowan Dam Road, Ogunbil.
- Naturally occurring asbestos (NOA) – two areas near the far western end of the project footprint and another near the central portion of the project footprint have a low probability of NOA.

The locations of potential contamination sources are provided in Figure 13-3.



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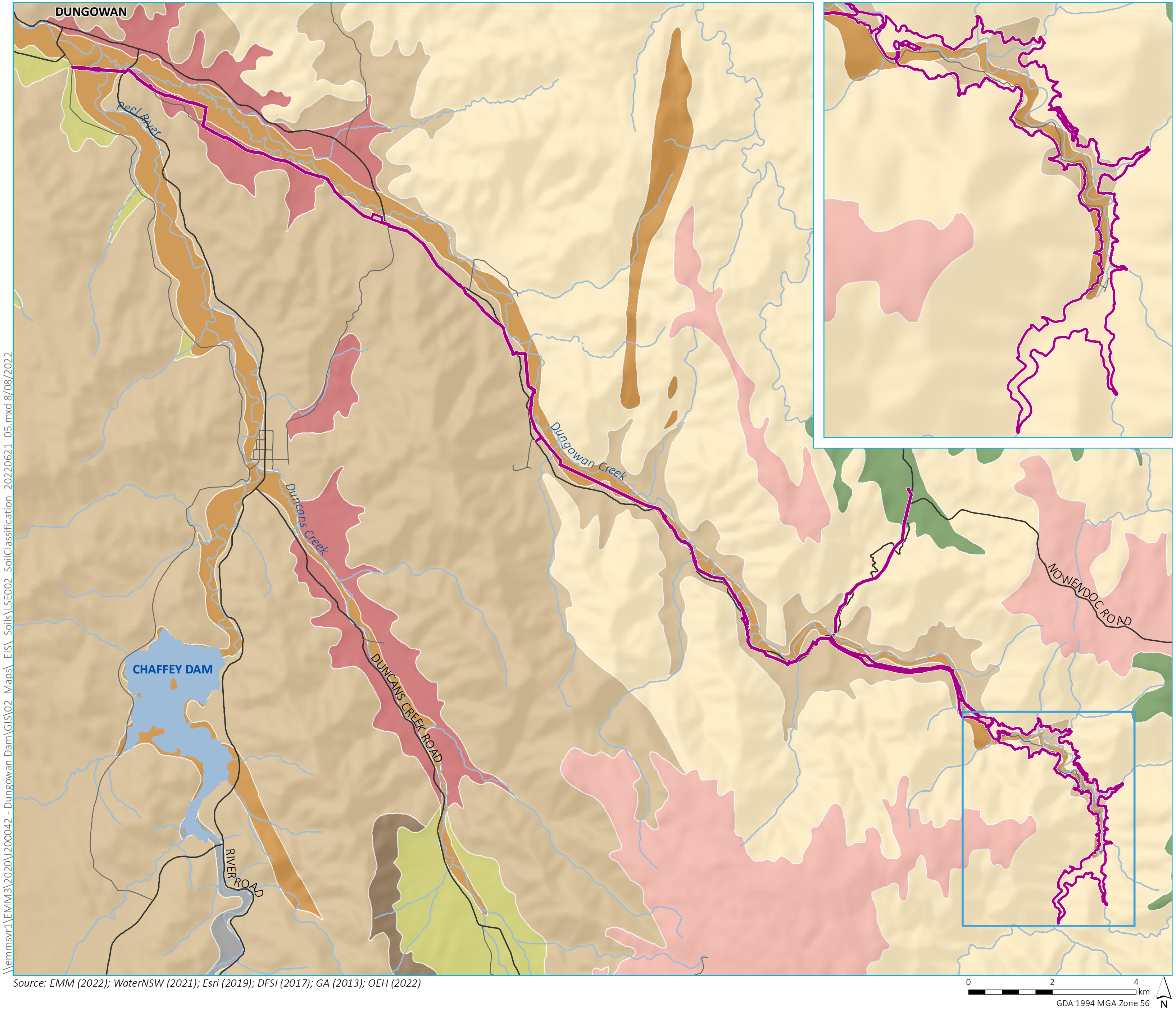
Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013); OEH (2022)

Project slopes

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 13.1

EMM
creating opportunities



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Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013); OEH (2022)

Australian soil classification

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 13.2

EMM
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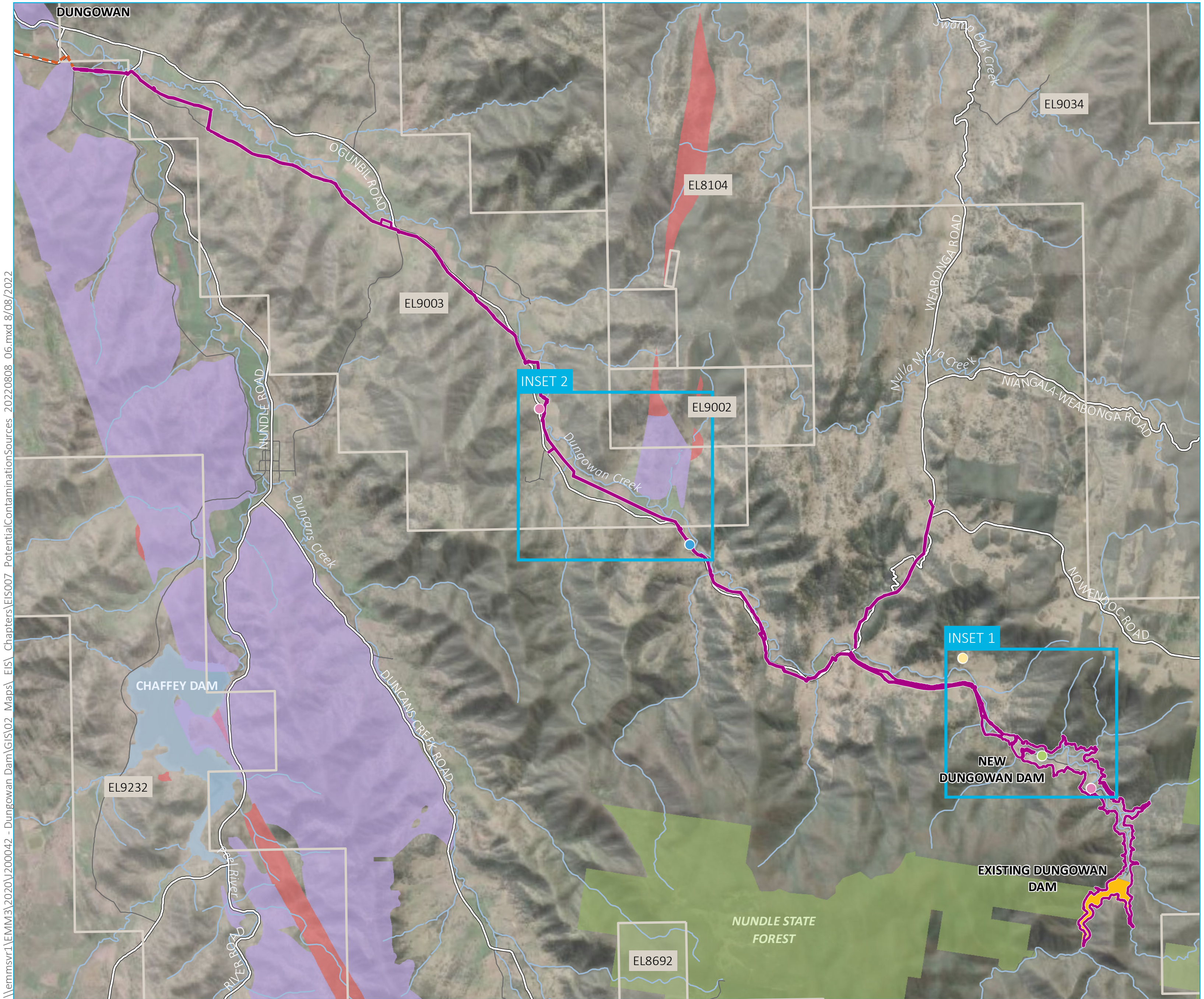

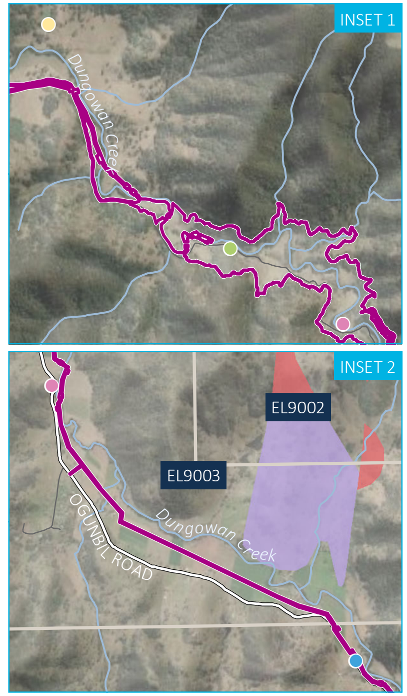

Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013); SEED (2015); CSIRO (2013)

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KEY

- Project footprint
- Confirmed acid sulfate soil
- Confirmed potentially acid forming rock
- Former sheep dip
- Ogunbil RFS
- Existing Dungowan Dam pipeline
- Major road
- Minor road
- Named watercourse
- Named waterbody
- State forest
- Active mining title
- Acid sulfate soil potential (high)

Naturally occuring asbestos potential
- High
- Medium
- Low

Potential contamination sources

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 13.3

creating opportunities

13.2 Assessment overview

The assessment of impacts of the project to land including soils and erosion, land use and contamination has been prepared to address the SEARs. An overview of the contributing technical studies informing the assessment of impacts to land, and how relevant statutory requirements and guidelines have been incorporated, is as follows:

- The Land Use Assessment (Appendix P) involved property inspections and landowner consultation for seven properties, chosen to give a range of geographical locations, project impacts, and types of agricultural enterprises within the project area.
- The LSEA (Appendix Q) considered available mapping and a limited soil sampling program, to characterise the existing soil profile and identify constraints within, and potential impacts arising from the project.
  - Soil profiles were assessed in accordance with the *Australian Soil Survey and Land Survey Field Handbook, 3rd Edition* (NCST 2009) and classified using *The Australian Soil Classification* (Isbell 2016).
  - The biophysical features of the land and soil and the associated hazards and limitations were assessed in accordance with the *Land and Soil Capability Assessment Scheme* (OEH 2012) ('LSC Scheme'). The overall LSC class of the land is based on the most limiting feature/hazard.
  - The erosion hazard assessment was completed per Landcom (2004).
- The Contamination PSI (Appendix R) was based on a combination of desktop review and site inspection and prepared with consideration of the *Contaminated Land Management Act 1997* and relevant EPA Guidelines[7].

Both the Land Use Assessment and Contamination PSI were supplemented by data gathered during interviews conducted for the SIA as well as consultation with North West Local Land Services and Tamworth Regional Council.

[7] EPA Guidelines include Guidelines on the Duty to Report Contamination under the *Contaminated Land Management Act 1997;* Contaminated Land Management Guidelines for the Site Auditor Scheme (3rd Edition); Guidelines for the Consultants Reporting on Contaminated Land; and Guidelines for the Assessment and Management of Groundwater Contamination.

13.3 Predicted impacts

13.3.1Soil erosion and sediment transport

Construction of the project would result in 315 ha of soil disturbance over a period of approximately six years, involving land clearing, grubbing, stripping and construction of infrastructure. The project has a very low to very high erosion hazard and due to the extent of earthworks, roads, infrastructure and the natural surrounding slopes, management and diversion of runoff is important in reducing erosion risks. Potential erosion and sedimentation impacts, if not appropriately managed, include but are not limited to:

- Erosion of constructed landforms such as embankments, roads, tracks, tunnel, spillway, powerline construction pads and stockpiles.
- Erosion of exposed soils from the commissioning of the new Dungowan Dam, including clearing of trees and filling of the dam. However, sediments from these activities would be contained behind the new Dungowan Dam embankment.
- An increase in fine and coarse sediments entering Dungowan Creek, causing changes to the natural bed and flow capacity as well as impacting water quality.

Effective sediment controls that trap sediment and treat turbid runoff are therefore required to protect Dungowan Creek from potential construction related sedimentation impacts of the project. Erosion and sediment control management requirements are stipulated in Landcom (2004) including specific measures where erosion hazard comprises a soil loss capacity (SLC) greater than 4 (Note: the project footprint ranges from SLC 1 to SLC 7). An example of potential erosion hazards requiring prevention and management is shown in Photograph 13-1.

Photograph 13-1 Existing erosion hazard observed in a lateral gully that feeds Dungowan Creek

During operation, potential erosion and sedimentation impacts are limited to:

- Localised soil erosion associated with fluctuating water levels within the reservoir area resulting in overland and concentrated flow over exposed soils.
- Erosion from high velocity flows from discharge of water from the pipeline scour valves during an emergency or routine maintenance activities.
- Localised sedimentation potential from disturbed areas such as unsealed tracks and drainage structures.
- Minimal soil disturbance from maintenance activities such as use of plant and machinery and vehicle traffic.

13.3.2 Soil and landform stability

The project would require large scale earthworks across the project footprint. The following impacts to may affect soil and landform stability:

- Reduced soil stability and increased susceptibility to erosion due to vegetation removal or soil exposure, especially if the subsoil is dispersive.
- Loss or degradation of topsoil material viable for use in rehabilitation, potentially limiting rehabilitation potential.
- Potential subsidence within the pipeline trench from tunnel erosion if compaction and/or soil amelioration is inadequate during the construction phase.

As part of the decommissioning of the existing Dungowan Dam, excess spoil would be emplaced in a profiled placement area on the peninsula immediately upstream of the former embankment. The profiled placement area would be appropriately compacted and feature maximum slope gradients of 2.5H:1V to comply with long term stability requirements. Revegetation of the profiled placement area and contouring into the surrounding natural surface would also be undertaken, minimising erosion potential and contributing to the long term stability of the landform.

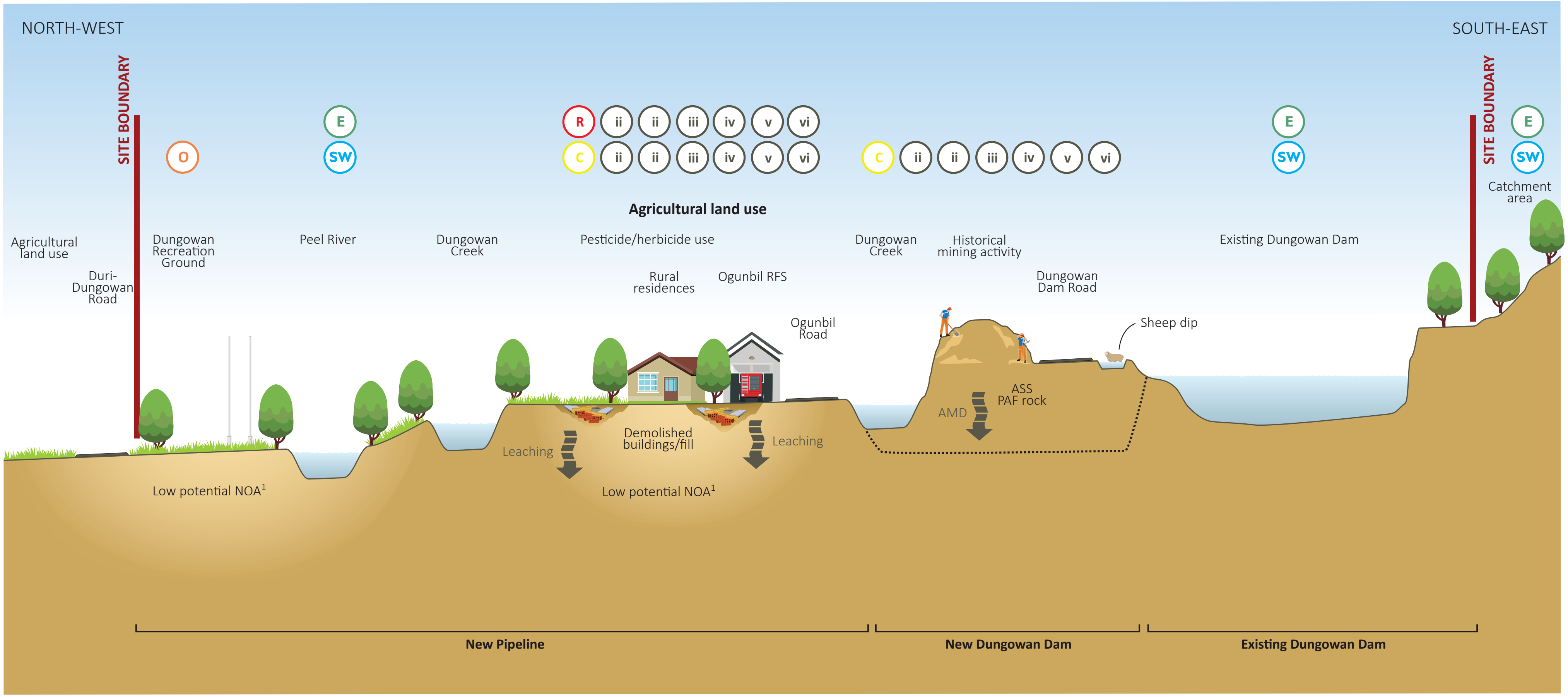
13.3.3 Contamination risks

A conceptual model of the potential contamination pathways for the project are shown in Figure 13-4. The project is only likely to interact with known sources of contamination during the construction phase. A risk assessment was completed for each of the key CoPC (see Appendix R) and rated the overall contamination risk as low for all pathways with a low to medium risk for PAF rock and ASS.

The presence of PAF rock has been identified in one sample (obtained from below the proposed depth of excavation), however all other samples were classified as non-acid forming or uncertain. Acid drainage from excavated areas is considered to be of low to medium risk based on current information noting that further investigation is recommended and a detailed geotechnical investigation is underway that would provide further data on the presence of PAF. Further materials testing would be completed prior to any excavated materials being used in structural areas of the dam. No ASS was identified except for an area of high occurrence within the existing Dungowan Dam area. The decommissioning works would include the management and treatment of any ASS material.

The placement of excess spoil within the placement area would follow a material testing process to ensure that materials are suitable for emplacement (i.e. not contaminated).

The risk of contamination events occurring during operation is considered low.



Key	Receptors	Pathways	
Groundwater level	C Construction workers	ii Dermal contact and incidental ingestion of soil	iv Inhalation of soil/groundwater vapours in outdoor air
Project area	E Terrestrial ecosystem	ii Inhalation of dust from soil/fibres	v Inhalation of soil/groundwater vapours within a trench
[1] NOA – Naturally occurring asbestos	SW Surface water and sediment ecology	iii Dermal contact and incidental ingestion of surface water/groundwater/leachate	vi Plant uptake and/or ingestion by animals
ASS – Acid sulfate soils	O Open space/recreational users		
PAF – Potentially acid forming	R Residential		
AMD – Acid mine drainage			

Figure 13.4 Conceptual site model for contamination pathways

13.3.4 Changes to land capability and use

13.3.4.1 Pipeline easement

Crop and pastureland would be temporarily taken out of production during and after pipeline construction activities. The impacts would be low due to the small areas involved and the relatively short period of time over which production would be lost.

Other potential impacts include crop and pasture damage, temporarily restricted movements, livestock misadventure, disruption to grazing, and fire risks. However, the impacts, if any, are expected to be relatively small and would have minor effect on productivity.

Following construction, suitable rehabilitation would be required to ensure effective replacement of affected pasture and soils to avoid any long term crop and pasture damage.

With appropriate management and mitigation measures, the LSC of agricultural lands along the pipeline easement are unlikely to change from their current LSC and would continue to be available for their current agricultural uses (predominantly grazing).

13.3.4.2 Powerline easement

The majority of the powerline easement is within very low capability land not subject to current agricultural practices. Pastureland at the northern end of the easement would be temporarily impacted by construction of the powerline however once operational, any existing practices would be able to continue provided they do not conflict with electrical infrastructure.

13.3.4.3 New Dungowan Dam

The new Dungowan Dam would result in the permanent loss of land available for use. However, the land, which encompasses the operational footprint of the dam is not currently used for agriculture or any other commercial activity. Therefore, based on the current land use, the impact of the permanent land use loss of the operational footprint of the dam is likely to be negligible.

13.3.4.4 Permanent loss of agricultural production

The total area of the operational footprint is 158 ha, a small fraction of the productive land in the Tamworth Region. The potential permanent loss of value due to the loss of crop and pasture land is estimated at approximately $27,654 per annum. This represents only 0.01% of the gross value of agricultural production for the Tamworth region.

The project is expected to have minimal impact to the availability of water in Dungowan Creek. The replacement of the Dungowan Dam pipeline would be managed to maintain and improve access to water for nearby landholders. Landowners who were connected to the existing pipeline would be connected to the new pipeline. Additional connections would also be provided for landowners not connected to the existing pipeline if the new pipeline traverses their property.

13.4 Management and mitigation

The project land impacts are expected to be suitably managed with the implementation of mitigation measures. Measures that would be implemented during construction would be contained in the following key management plans. In addition to these, relevant measures that address impacts to land during operation would be included within the OEMP for the project.

13.4.1 Soil and water management plan

A Soil and Water Management Plan (SWMP) would be prepared to manage impacts from construction in accordance with the principles and requirements in *Managing Urban Stormwater – Soils and Construction, Volume 1* (Landcom 2004) and other relevant volumes. In addition to the management measures identified to mitigate impacts to water (refer Section 6.4), the SWMP would also include:

- A Soil Stripping and Management Plan (SSMP) to ensure the preservation of soil resources, including quantity and quality.
- The process for rehabilitation of lands once construction is completed.

13.4.2 Contaminated land management plan

A Contaminated Land Management Plan (CLMP) would be prepared and would include, but not be limited to consideration of the following:

- Capture and management of any surface runoff contaminated by exposure to the contaminated land.
- Further investigations required to determine the extent, concentration, and type of contamination, as identified in the site investigations.
- Management of the remediation and subsequent validation of the contaminated land, including any certification required.
- Measures to ensure the safety of site personnel and local communities during construction.
- Complete pre- and post-construction site assessments in areas to be used for project office compounds, depots or laydown areas in accordance with the ASC NEPM.
- Process for tracking excavated material and waste.
- Asbestos handling and management would be undertaken in accordance with an Asbestos Management Plan.

13.4.3 Land use management plan

A Land Use Management Plan (LMP) would be prepared and implemented to minimise and manage disruptions to nearby agricultural activities and businesses. The plan would include but not be limited to:

- Processes for landholder consultation and input to management plan.
- Maximising the use of existing roads, tracks and disturbed areas.
- Avoidance, minimisation and repair of any damage to landholder property caused by construction activities or vehicle access.
- Measures to minimise conflict between livestock and construction activities including the scheduling of noise intensive works and management of vehicle movement around livestock.
- Biosecurity risks would be managed through biosecurity management plans as part of the CEMP.

13.5 Summary and conclusion

The project's potential to impact lands has been considered including soils, contamination and land use aspects. The project impacts are well understood and would primarily occur during the construction phase. Potential impacts during both construction and operation can be mitigated and managed through appropriate engineering design and the development and implementation of relevant management plans.

CHAPTER 14

Traffic

14 Traffic

This chapter provides a detailed summary of the assessment of the potential traffic impacts of the project. A detailed technical Traffic Impact Assessment (TIA) has been prepared by EMM and is provided in Appendix S. The relevant SEARs and where they are addressed is provided in Appendix A.

14.1 Existing environment

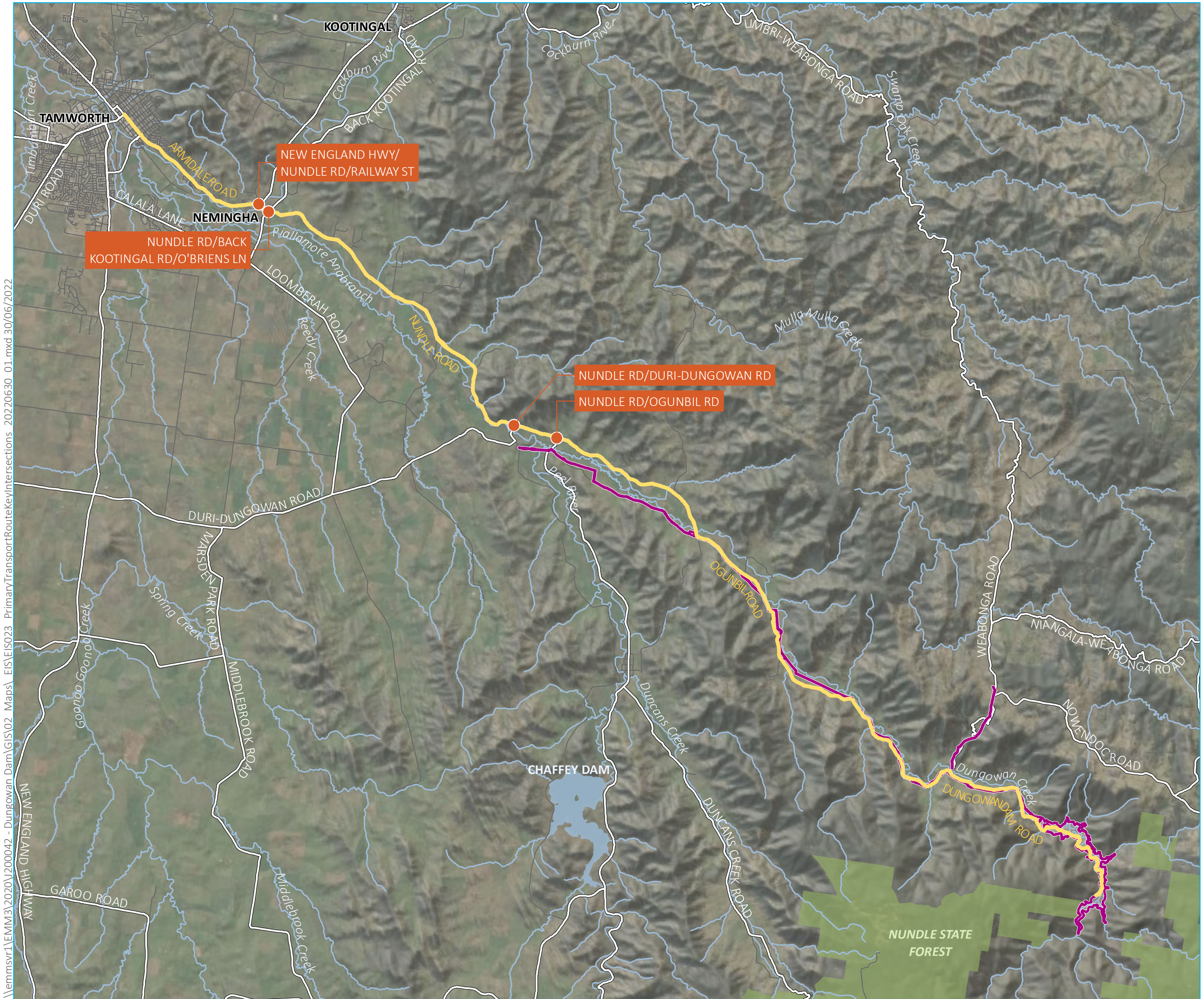
14.1.1 Road network

The primary transport route and road network that would be affected by the project is shown in Figure 14-1. Key roads used by the project would include:

- New England Highway – sealed two-lane National Highway and B-double route that travels northwest/southeast towards Tamworth.
- Nundle Road – sealed two-lane regional road and B-double route intersecting with the New England highway south-east of Tamworth.
- Ogunbil Road – sealed two-lane regional road connecting to Nundle Road and traveling west/east.
- Dungowan Dam Road – unsealed two-lane local road connecting to Ogunbil Road and traveling east/west.
- Duri-Dungowan Road – sealed two-lane local road connecting to Nundle Road and traveling generally east/west.
- Back Woolomin Road – unsealed two-lane local road connecting to Duri-Dungowan Road and traveling northwest/southeast.
- Dungowan Creek Road – sealed two-lane local road connecting to Nundle Road and Ogunbil Road and traveling northwest/southeast.

Key intersections that would be used by project traffic include:

- New England Highway/Nundle Road/Railway Street.
- Nundle Road/Back Kootingal Road/O'Briens Lane.
- Nundle Road/Duri-Dungowan Road.
- Nundle Road/Ogunbil Road.



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Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

Primary transport route and key intersections

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 14.1

EMM creating opportunities

14.1.2 Crash history and road safety

Crash data from the Transport for NSW (TfNSW) Centre for Road Safety interactive history database between 2014 and 2018 was reviewed for the proposed haulage route. The crash history data showed that there were 21 recorded crashes on the transport route during this period. The crash history comprised 2 fatalities, 6 resulting in serious injury, 8 resulting in moderate injury, 1 resulting in minor injury and 4 non-casualty incidents. It is noted that almost half of all crashes were caused by speeding and approximately 30% involved a truck.

A safety inspection of the primary transport route between Nundle Road at New England Highway and the new Dungowan Dam found that the existing road safety conditions are generally good along most sections of this route, aside from a limited number of potential issues including the narrow width of Dungowan Dam Road and Ogunbil Road, some deficient safety barriers and unprotected edge drop offs.

14.1.3 Public transport and facilities

There are public bus services connecting the Tamworth CBD and surrounding suburbs. However, these do not extend to the roads in the vicinity of the project construction footprint, which would be used by construction traffic. Nemingha Public School, located on Nundle Road in the vicinity of the Nundle Road/O'Briens Lane/Back Kootingal Road intersection, is serviced by school buses that run two morning services and three services in the afternoon. There are also some secondary school bus services operating via the proposed transport route. Bicycle and pedestrian facilities are limited in the vicinity of the project.

14.2 Assessment overview

The assessment was prepared in accordance with the requirements of the NSW Roads and Traffic Authority (RTA) (now TfNSW) (2002) *Guide to Traffic Generating Developments*. The assessment considered:

- Mid-block capacity for roads along the transport route.
- Intersection performance, geometry and sight distances.
- Impacts on public transport, pedestrians and cyclists.
- Impacts during pipeline construction.

The assessment focuses on construction phase impacts, as the operational traffic volumes would be minimal and are not expected to impact the existing road network.

14.3 Predicted construction impacts

14.3.1 Mid-block capacity

The existing and proposed project hourly traffic volumes and their impact on mid-block capacity and level of service (LOS) for roads along the haulage route were calculated based on traffic surveys completed in 2020 and are presented in Table 14-1. With the addition of the proposed construction traffic, all the key road sections would remain at the same LOS.

Table 14-1 Mid-block capacity LOS

Location	Traffic Situation	Traffic volumes	Heavy vehicle percentage	LOS
Nundle Road at New England Highway (60 km/h)	Existing	508 (AM)/492 (PM)	6.5% (AM)/5.9% (PM)	C
	Proposed	552 (AM)/536 (PM)	9.6% (AM)/9.1% (PM)	C
Nundle Road at O'Briens Lane (60 km/h)	Existing	506 (AM)/502 (PM)	5.1% (AM)/5.8% (PM)	C
	Proposed	550 (AM)/546 (PM)	8.4% (AM)/9.0% (PM)	C
Nundle Road at Duri-Dungowan Road (80 km/h)	Existing	141 (AM)/116 (PM)	5.0% (AM)/6.9% (PM)	A
	Proposed	185 (AM)/164 (PM)	14.6% (AM)/19.5% (PM)	A
Ogunbil Road at Nundle Road (60 km/h)	Existing	126 (AM)/118 (PM)	6.3% (AM)/9.3% (PM)	A
	Proposed	163 (AM)/155 (PM)	16.0% (AM)/18.7% (PM)	A

14.3.2 Intersection performance

Intersection capacity assessment using SIDRA intersection modelling software has been undertaken for all key intersections. The SIDRA modelling confirmed that all key intersections would continue to operate satisfactorily with overall intersection LOS C or better. With construction traffic, all the key intersections would remain at the same LOS. The predicted intersection performance is provided in Table 14-2 below.

Table 14-2 Predicted intersection performance

Intersection	Performance (LOS)			
	AM Peak		PM Peak	
	Existing	Predicted	Existing	Predicted
New England Highway/Nundle Road/Railway Street	B	B	C	C
Nundle Road/Back Kootingal Road/O'Briens Lane	A	A	A	A
Nundle Road/Duri-Dungowan Road	A	A	A	A
Nundle Road/Ogunbil Road	A	A	A	A

14.3.3Intersection turning lanes

Priority-controlled intersection operations were also assessed against intersection design standards (Austroads 2017a) *Guide to Road Design Part 4, Intersections and Crossings General*. All intersections turn treatments were found to comply with the Austroads warrant intersection design standards and no further intersection treatment is required.

14.3.4Road safety

Road safety was raised as a key issue through community stakeholder engagement for the project. Stakeholders raised sight distances and road quality across the transport route as areas of concern.

Sight distances were estimated and assessed for the intersections at New England Highway/Nundle Road/Railway Street and Nundle Road/Duri-Dungowan Road. The sight distances to the left and right of both intersections meet the minimum requirement stipulated in the *Austroads Guide to Road Design Part 4A (Unsignalised and Signalised Intersections)* (Austroads 2017b).

A road safety audit (RSA) was completed for the project transport route and is provided as Annexure B to the TIA (Appendix S). The RSA identified several road safety actions that would be undertaken including:

- An alternative road layout with appropriate safety barriers would be provided at the Ogunbil Road/Nowendoc Road/Dungowan Dam Road intersection.
- Dungowan Dam Road will be resheeted and widened.
- Where one lane sections are unavoidable along Dungowan Dam Road, a lower speed limit and Traffic Control will apply to these sections.
- Additional safety barriers will be installed at a number of locations along Dungowan Dam Road, at creek edges and where there are steep slopes at the road edge.
- Along the majority of the primary transport route between Nemingha and the new Dungowan Dam, where speed limits are posted at 100 km/h, the maximum speed limit would be reduced to a maximum of 80 km/h for the duration of construction.

14.3.5 Pipeline construction

Along the pipeline route, the potential traffic impacts would primarily be limited to locations where the project construction activities interact with existing roads. At these locations there may be temporary disruptions to traffic flows through lane or road closures or other access impacts.

It is anticipated that throughout pipeline construction there would be approximately 10 light vehicles and five heavy vehicles per day. For local roads potentially affected by the pipeline construction traffic (Duri-Dungowan Road, Back Woolomin Road and Dungowan Creek Road), the forecast traffic increases are likely to be noticeable but would have minimal impact on traffic flow conditions or safety standards for these roads.

Where the pipeline route traverses private property, there would be a range of potential rural property access issues and impacts to be considered. Access agreements would be negotiated with rural property landowners impacted by the pipeline construction activity which would detail any agreed restrictions to access (i.e. along tracks, across paddocks etc).

14.3.6 Impacts on public transport, pedestrians and cyclists

The project is located in a remote area with no general public transport coverage. Pedestrian and cycling infrastructure is not provided in the vicinity of the construction footprint. Therefore, no impacts to public transport, pedestrians or cyclists are expected.

14.3.7 Transportation of dangerous goods

For any transportation of dangerous goods, approval would be sought from National Heavy Vehicle Regulator and all transport would be in accordance with the Australian Dangerous Goods code.

14.4 Management and mitigation

Project related traffic impacts are expected to be suitably managed with the implementation of management and mitigation measures, which would be documented in the TMP as part of the CEMP. This includes addressing community stakeholder concerns associated with sight lines and road quality as identified in Section 14.3.4. The TMP would include, but not be limited to:

- Identify haulage routes and communicate, along with site access requirements and restrictions, to all relevant drivers.
- Measures to maintain access to local roads and properties.
- Communicate changes to roads or paths to emergency services, public transport operators, other road user groups and any other affected stakeholders.
- Site specific traffic control measures (including signage) to manage and regulate traffic movement.
- Measures to maintain pedestrian and cyclist access.

- Requirements and methods to consult and inform the local community of impacts on the local road network.
- Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads.
- A response plan for any construction traffic incident.
- Consulting with the locality school bus operators to ensure that construction traffic will be appropriately managed when travelling during school bus operating times.
- Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic.
- Monitoring, review and amendment mechanisms.
- Ensure all stakeholders are considered during all stages of the project.

A Road Condition Report would be prepared before construction commences in consultation with the relevant road authorities. The Road Condition Report would contain details of the condition of roads potentially used during construction and would be used as the basis for reinstating roads to their condition before construction commenced after the completion of construction.

Road safety measures would also be taken based on the RSA (SMEC 2020) including reducing the posted speed limit along the transport route between Nemingha and the new Dungowan Dam from 100 km/h to a maximum 80 km/h for the duration of construction of the project.

Detailed safeguards and mitigation measures are provided in the TIA (Appendix S) and Appendix E.

14.5 Summary and conclusion

The traffic impact assessment considered the potential for the project to impact on traffic flow, intersection performance, road safety, public transport and property access. The assessment found that impacts would only occur during construction and there would be no potential impacts to public transport, pedestrian and cyclist movements. During construction, negligible impact to traffic flow on major roads is expected. The LOS of all key road sections and key intersections would not be affected by construction traffic. Turn treatments at key intersections were found to comply with the relevant guidelines.

Some road safety actions would be taken along the transport route in accordance with the RSA findings, including a reduction in speed limits between Nemingha and the new Dungowan Dam as well as road upgrades and traffic management for Dungowan Dam Road. A detailed TMP would be implemented throughout construction. At the completion of construction, roads within the transport route would be returned to their original condition.

Overall traffic impacts of the project are expected to be minimal and can be managed with the implementation of suitable management and mitigation measures.

CHAPTER 15

Waste

15 Waste

This chapter presents a detailed summary of the Waste Management Assessment, which identifies waste generated by the project, its impact on the surrounding environment and management and mitigation measures to address any potential impacts. The detailed technical report for the Waste Management Assessment is provided in Appendix T. The relevant waste SEARs and where they are addressed, are summarised in Appendix A.

15.1 Assessment overview

The assessment considered the different types of wastes that would be generated by the project, as classified in the POEO Act and *Waste Classification Guidelines: Part 1 Classifying Waste* (NSW EPA 2014).

The assessment was prepared with consideration of the SEARs and the following legislation and strategies:

- NSW *Waste and Sustainable Materials Strategy 2041 Stage 1: 2021–2027* (NSW EPA 2021).
- NSW *Protection of the Environment Operations Act 1997*.
- NSW *Protection of the Environment Operations (Waste) Regulation 2014*.
- *Waste Classification Guidelines* (NSW EPA 2014).

The project approach to waste management would be consistent with principles of the circular economy outlined by NSW EPA (2021a) and would incorporate management measures to ensure waste is appropriately reduced, reused, recycled or disposed of. The primary aim of waste management for the project would be to avoid and minimise the generation of waste, followed by the reuse of any waste material produced. This approach also addresses community stakeholder issues raised during consultation associated with reducing and reusing waste where feasible.

During construction of the project, waste generated would include general liquid waste, general solid waste (non-putrescible), general solid waste (putrescible), hazardous waste, spoil and potential for special waste such as spoil containing contaminated material. It is expected that minimal waste would be generated during the project’s operation.

The amount of waste to be generated has been identified in the Waste Management Assessment and would be further refined during the detailed design phase and documented in a CEMP. It is anticipated that the key waste streams would include waste from the existing Dungowan Dam decommissioning (including concrete and up to 300,000 m^3 of spoil), vegetation clearing from within the construction footprint and inundation area (up to 8,000 tonnes of vegetative material) and general construction waste. These waste streams are described in the following sections, including any potential impact to the surrounding environment.

15.2 Predicted impacts

A strategy for management of the project's waste streams was prepared based on the estimated volumes likely to require management. The following sections describe the types and source of wastes that would be generated by the project as well as the corresponding management of each waste stream.

15.2.1Construction waste

Multiple types of waste would be generated at each construction area. The waste predicted to be generated by the project and proposed management of each waste type is outlined in Table 15-1.

Table 15-1 Construction waste sources and management

Waste classification	Waste source, volumes and management
General liquid waste	
Grey water and sewerage	Portable toilets would be utilised during the construction stage at each construction area, for which sewage would be collected by a licenced waste contractor. Any discharge to the existing sewage system would be agreed with Tamworth Regional Council. The location and volumes required for liquid waste management would be confirmed in the detailed design of the project.

Waste classification	Waste source, volumes and management
General solid waste (non-putrescible)	
Vegetation	Vegetation clearance would be required within the new Dungowan Dam reservoir area as well as for site establishment of permanent and ancillary infrastructure. In total it is estimated that the following volumes of vegetation waste would be generated by the project: • 5,500 t woody material from tree removal. • 1,400 t non-woody material. • 1,100 t weed infested material requiring treatment. Vegetation would be mulched and reused where possible, otherwise it would be temporarily stockpiled within the construction footprint and inundation area for future use, sale or disposal. Where vegetation waste disposal is required, the residual waste would be subject to controlled burning. Any pile burn required would be provided a hazard reduction certificate by the NSW Rural Fire Service and would be attended at all times by staff for control purposes.
Asphalt waste	Although most of the proposed road upgrades, including Dungowan Dam Road, would be unsealed roads there may be some minor generation of asphalt waste, which would comprise a mixture of bitumen and aggregate. Asphalt can be recycled and reused for road construction. Rejected or excess asphalt would be collected by an appropriately qualified waste contractor for recycling.
VENM/ENM	Virgin Excavated Natural Material (VENM) and Excavated Natural Material (ENM) would be excavated during construction of each project element. In total up to 1.9 million m^3 of excavated material would be generated by the spillway excavation, the majority of which would be re-used for the embankment. The full height embankment breach excavation would generate approximately 300,000 m^3 of spoil materials that would be managed as part of the existing Dungowan Dam decommissioning. Spoil material from the decommissioning would be placed in the following locations: • Spoil from the embankment breach would be used to form the channel downstream of the embankment toe. • Spoil would then be used to fill in the redundant spillway structures on the left abutment of the existing dam. • Any excess spoil would be placed in a profiled placement area within the former inundation area of the existing dam and rehabilitated.
Recyclables	The quantity of recyclables would be confirmed through detailed design. Recyclables would be stored in designated labelled and covered recycling areas and would be collected for recycling or disposal by an appropriately qualified waste contractor.

Waste classification	Waste source, volumes and management
General solid waste (putrescible)	
Food waste	There is potential for food waste to be generated during the construction phase of the project, from the accommodation camp and construction compounds. The quantity of food waste would be confirmed through detailed design. Food waste generated would be segregated where possible, and deposited in large waste receptacles such as dumpsters, which would be covered and collected as required by a licensed waste removal contractor.
Concrete Batching plant	
Concrete washout waste and cementitious wastewater	The operation of the onsite concrete batching plant, during the construction phase of the project, would generate concrete washout waste and cementitious wastewater. The quantity of concrete washout would be confirmed through detailed design. Management measures would be included in the CEMP and SWMP to ensure concrete washout waste and cementitious wastewater is captured and appropriately recycled or disposed of and to ensure wastewater does not enter surface water runoff and pollute receiving waterways.
Hazardous Waste	
Chemical containers, grease/oil drums and oil filters	All hazardous wastes generated at the construction areas would be classified, stored in sealed containers in a bunded area and then removed and disposed of in accordance with appropriate regulations and guidelines and best practice for the removal of these materials. Hazardous materials would only be removed by suitably qualified and licensed contractors and disposed at an appropriately licenced waste disposal facility. The quantity of hazardous wastes would be confirmed through detailed design.
Special waste	
Spoil which contains contaminated material such as NOA	The project is only expected to encounter minor quantities of asbestos containing material if at all. A site-specific asbestos management plan would be prepared in accordance with the measures recommended in the Contamination Preliminary Site Investigation (Appendix R). The quantity of asbestos containing material would be determined during construction.

15.2.2 Operational waste

There would be minimal waste generated during the operational phase of the project. This is primarily because once operational, the new Dungowan Dam and pipeline would not require a significant operational workforce to function. Any waste generated during operation would be disposed off-site by a suitably licensed waste disposal contractor.

15.3 Management and mitigation

The primary measure required to manage the project waste is to prepare and implement a Waste Management Plan (WMP). The WMP would include but not be limited to:

- Measures to avoid and minimise waste associated with the project.
- Volume and classification of wastes and management options (re-use, recycle, stockpile, disposal).
- Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions.
- Procedures for storage, transport and disposal.
- Monitoring, record keeping and reporting.
- Details of resource recovery for construction materials.
- Spoil management measures and emplacement locations and designs.
- Procedures for management of unexpected waste.

Detailed safeguards and mitigation measures are provided in the Waste Management Assessment (Appendix T) and Appendix E.

15.4 Summary and conclusion

Key waste streams that would be generated by the project include waste from the existing dam decommissioning (including concrete and spoil), vegetation clearing from within the new Dungowan Dam construction footprint and inundation area and general construction waste. Waste would be minimised and re-used during the project construction where practical. A WMP would be prepared and implemented as part of the project CEMP.

CHAPTER 16

Noise and vibration

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16 Noise and vibration

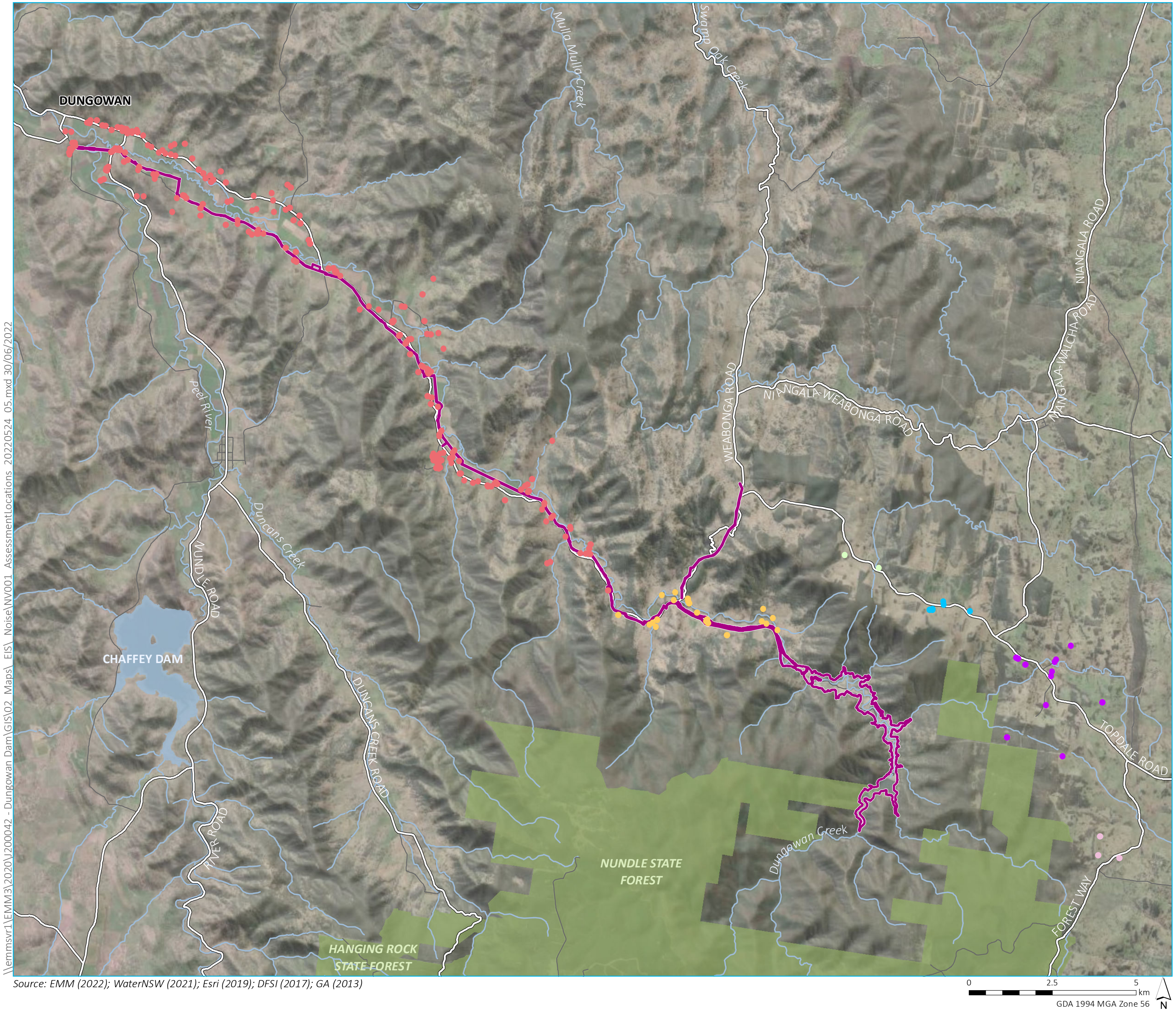
A detailed summary of potential noise and vibration impacts of the project are assessed in this section. A detailed technical Noise and Vibration Impact Assessment (NVIA) is also provided in Appendix U. The NVIA was prepared in accordance with the relevant assessment requirements, guidelines and policies and provides recommendations for appropriate management and mitigation measures.

The relevant noise and vibration SEARs and where they are addressed are summarised in Appendix A.

16.1 Existing environment

Sensitive receivers, which have the potential to be affected by noise from the project are residential receivers surrounding the inundation area and the pipeline alignment. Due to the large number of residential assessment locations, noise catchment areas (NCAs) were applied to provide a logical grouping of receivers affected by the same construction works. The NCAs and sensitive receivers assessed are shown in Figure 16-1.

Based on recent nearby long-term unattended noise monitoring undertaken for the approved pipeline between Dungowan Showground and Calala, it is expected that the rural residential areas in the vicinity of the project would be below the *Noise Policy for Industry* (EPA 2017) (NPfI) minimum background noise levels. As such, the NPfI minimum background noise levels have been applied for the purposes of the NVIA. This is a conservative assumption, leading to the most stringent noise criteria available being applied.



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Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

Noise assessment locations

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 16.1

creating opportunities

16.2 Assessment overview

The assessment considered the potential impacts of construction, operational and road noise and vibration generated by the project.

Noise associated with construction of the project was assessed in accordance with the NPfI and with reference to the *Interim Construction Noise Guideline* (ICNG) (DECC 2009) and *Assessing vibration: a technical guideline* (DEC 2006). The assessment of construction noise addressed two different types of construction:

- Dynamic construction – the pipeline, powerline and road upgrades areas would generate transient construction noise, with works progressing along the relevant alignments.
- Static construction – dam infrastructure, ancillary construction infrastructure and dam decommissioning areas are static areas that have the potential to generate noise from relatively consistent locations throughout the construction period.

Operational noise impacts were assessed in accordance with the NPfI. The potential impacts of traffic noise resulting from construction and operational related traffic on public roads was assessed against criteria defined in the *Road Noise Policy* (RNP) (DECCW 2011)).

The potential impacts of blasting activities during construction were also considered with respect to the Australian and New Zealand Environment Council (ANZEC) guidelines, *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*.

16.3 Predicted construction impacts

The main noise impacts are predicted to occur during dynamic construction works for the pipeline installation and Dungowan Dam Road upgrade. Static construction works associated with the new Dungowan Dam construction are expected to comply with noise management criteria at all sensitive receivers. There are some impacts predicted from road noise and pipeline construction activities during construction, which would require mitigation.

16.3.1Dynamic construction works

Construction of the pipeline, powerline and road upgrade are expected to be transient, progressing along each respective alignment.

Residential receivers within approximately 30 m of pipeline and powerline construction activities may experience levels above the ‘highly affected’ noise management level (NML) of 75 dB $L_{Aeq,15\ minute}$. There are 23 residences located on Ogunbil Road within 30 metres of the pipeline construction area.

Residential receivers within approximately 730 m of pipeline construction activities may experience levels above the standard hours construction NML of 45 dB $L_{Aeq,15\ minute}$.

Residential receivers within approximately 90 m of the Dungowan Dam Road upgrade works may experience levels above the 'highly affected' NML of 75 dB $L_{Aeq,15\ minute}$. There are four residences within 90 m of the road upgrade works area. Residential receivers within approximately 1,300 m of the Dungowan Dam Road upgrade works may experience levels above the standard hours of construction NML of 45 dB $L_{Aeq,15\ minute}$.

The exposure period to such activities and corresponding noise levels would be minimised and construction programming would be further developed in construction documentation. It is not expected that receivers would experience noise above the 'highly affected' NML for more than five days. This is due to the transient nature of the works and the fact that the modelled predictions assume simultaneous operation of plant and equipment at the nearest locations to the relevant sensitive receptors, resulting in actual construction noise levels generally being less than those predicted for the majority of the time.

Due to the considerable distances between the static and dynamic construction areas, the likelihood of cumulative noise increasing noise levels above the predictions provided is considered unlikely.

16.3.2 Static construction works

Noise emissions from static construction works are predicted to comply with NMLs at all residential assessment locations both during and outside standard construction hours, where relevant. This is due to the intervening topography and large separation distances between the construction areas and receiver locations.

16.3.3 Construction road noise

The impacts of construction road noise were assessed for residences nearest the transport route, in accordance with the *Road Noise Policy* (RNP) (EPA 2011). The predicted road traffic noise levels are presented in Table 16-1.

Table 16-1 Predicted road traffic noise levels during construction

Road section	Distance to nearest receiver	Period	RNP criteria	Predicted road traffic noise level, dB	Increase due to project, dB
New England Highway	14 m	Day	60 $L_{Aeq,15\ hour}$	69 $L_{Aeq,15\ hour}$	0.3
		Night	55 $L_{Aeq,9\ hour}$	64 $L_{Aeq,9\ hour}$	0.7
Nundle Road	15 m	Day	60 $L_{Aeq,15\ hour}$	67 $L_{Aeq,15\ hour}$	1.7
		Night	55 $L_{Aeq,9\ hour}$	63 $L_{Aeq,9\ hour}$	3.0
Ogunbil Road	15 m	Day	60 $L_{Aeq,15\ hour}$	62 $L_{Aeq,15\ hour}$	2.7
		Night	55 $L_{Aeq,9\ hour}$	58 $L_{Aeq,9\ hour}$	4.7
Duri-Dungowan Road	15 m	Day	60 $L_{Aeq,15\ hour}$	59 $L_{Aeq,15\ hour}$	0.4
		Night	55 $L_{Aeq,9\ hour}$	50 $L_{Aeq,9\ hour}$	1.0
Dungowan Dam Road	75 m	Day	55 $L_{Aeq,1\ hour}$	53 $L_{Aeq,1\ hour}$	-
		Night	50 $L_{Aeq,1\ hour}$	53 $L_{Aeq,1\ hour}$	-
Back Woolomin Road	18 m	Day	55 $L_{Aeq,1\ hour}$	60 $L_{Aeq,1\ hour}$	-
		Night	50 $L_{Aeq,1\ hour}$	60 $L_{Aeq,1\ hour}$	-
Dungowan Creek Road	18 m	Day	55 $L_{Aeq,1\ hour}$	60 $L_{Aeq,1\ hour}$	-
		Night	50 $L_{Aeq,1\ hour}$	60 $L_{Aeq,1\ hour}$	-

As shown above, road noise levels are predicted to exceed the RNP criteria for several road sections during construction. However, most exceedances occur where road noise impacts are already experienced due to existing background noise levels. The project would only result in marginal increases on Nundle and Ogunbil Roads, which require further consideration of feasible and reasonable mitigation measures.

The road traffic noise results are considered conservative as they are based on heavy vehicle movements during the peak construction scenario and are assessed against the RNP criteria, which are designed for permanent scenarios and not temporary impacts related to construction activities.

16.3.4 Construction vibration

The main construction activities with the potential to generate vibration include the bulk earthworks for the new Dungowan Dam infrastructure and the installation of the pipeline infrastructure.

The nearest residential facades are located approximately 20 m or greater from the project, along the pipeline alignment. The most vibration intensive item of plant to be used close to residences would be a small sized excavator or vibratory roller. Hence, the risk of cosmetic damage is low given the relevant safe-working distances.

The Ogunbil shearing sheds (which are of local heritage significance) are approximately 7 m from the pipeline alignment. Given the possibility for vibration generating equipment to be operated with close proximity to these façades, equipment specification and construction methodology would be chosen to minimise potential vibration impacts on these buildings.

Allowing for the known separation distances between construction activities and nearest receptors, it is unlikely that the project would cause vibration impacts at any surrounding receivers.

The potential for vibration impacts to other public and private assets including the existing Dungowan dam pipeline was also considered given the possibility for vibration generating equipment of the project to be operated within close proximity. Equipment specification and construction methodology will be chosen to minimise potential vibration impacts during construction. Planning for vibration intensive works would consider the relevant safe working distances, options for alternative equipment and vibration monitoring to be implemented.

16.3.5 Blasting

Blasting would be carried out for several elements of the project, including for the dam infrastructure and proposed quarries. The nearest sensitive receiver to blasting activities is approximately 1,900 m from where blasting is likely to be required for the spillway. Blast overpressure and vibration levels are predicted to comply with relevant vibration criteria at this residence with the use of a maximum instantaneous charge (MIC) of up to 4,850 kg. These quantities of MIC are not expected to result in any significant constraints to blasting in the spillway area.

When blasting in the relevant quarrying areas, MICs of up to 20,000 kg would result in overpressure and vibration levels remaining below the criteria at the nearest residences. These quantities of MIC are unrealistically high and not expected to result in any constraints to blasting in the quarrying areas. Much lower MIC quantities are likely to be adopted in reality.

16.4 Predicted operational impacts

16.4.1 Operational infrastructure

Noise levels have been predicted for a peak operating scenario for the operational maintenance of the new Dungowan Dam. Noise emissions from operations are predicted to comply with point noise trigger levels (PNTLs) at all residential assessment locations during all relevant periods. This is due to the intervening topography and the large separation distances between the works areas and receiver locations.

During emergency events, an emergency diesel generator and drawdown valve may be operated, with the potential to generate some short-term noise impacts. Notwithstanding, these events are anticipated to be very uncommon and would not result in impacts requiring mitigation.

Operation of two pipeline control valves at Dungowan and Ogunbil would also be a source of noise during the operation phase of the project. The control valves would be located inside enclosures that would be engineered to ensure compliance with relevant operational noise limits. A maximum sound power level of L_{Aw} 92 dB would apply to the Dungowan control valve site and at the Ogunbil site a maximum level of L_{Aw} 82 dB would apply to ensure compliance with the relevant PNTLs at the nearest residences.

16.4.2 Operational traffic

Operational road traffic would consist of 1–2 light vehicles and a light truck, conducting routine maintenance around the dam site on an as-needed basis. Traffic associated with operational maintenance of the pipeline is also expected to be minimal. These traffic volumes would be similar to the operational traffic for the existing Dungowan Dam and are not expected to be noticeable above the existing traffic on the local road network. As such, adverse noise impacts from operational road traffic are considered to be negligible.

16.4.3 Operational vibration

Vibration from operational activities is not expected and given the separation distance between the nearest residences to the project infrastructure, ground-borne vibration from infrastructure and equipment is not expected to be perceptible.

16.5 Management and mitigation

The project noise and vibration impacts are expected to be suitably managed with the implementation of mitigation measures. Detailed safeguards and mitigation measures are provided in the NVIA (Appendix U) and Appendix E.

Management and mitigation measures to address noise and vibration impacts would be consolidated and implemented through a construction Noise and Vibration Management Plan (NVMP) as part of the CEMP. The NVMP would generally follow the approach in the *Interim Construction Noise Guideline* (DECC, 2009) and identify:

- All potential significant noise and vibration generating activities associated with the activity.
- Feasible and reasonable mitigation measures to be implemented.
- A monitoring program to assess performance against relevant noise and vibration criteria.
- Arrangements for consultation with affected neighbours and sensitive receivers, including notification of works to be completed and complaint handling procedures.
- Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.
- Arrangements relating to vibration generated by blasting.

- Consideration and selection of construction equipment and machinery that minimises noise (as also identified by landowners during consultation).
- Site specific mitigation and management measures outlined in the NVIA.

16.6 Summary and conclusion

Construction noise levels are assessed within the NVIA as complying with the required NMLs during static construction works of the project at all times. However, there are potential noise exceedances of the NMLs during pipeline construction and road upgrades. These exceedances would generally be short-term only (expected to be no more than five days for any receiver) due to the transient nature of the works. The project would also result in temporary road traffic noise increases on Nundle and Ogunbil Roads during construction.

Site specific and general management measures are recommended to mitigate the predicted impacts, which would be implemented through a construction NVMP.

Operational impacts would not result in any regular noise and vibration generating activities and impacts on noise levels, road noise and vibration during operation are expected to be negligible.

CHAPTER 17

Air quality

17 Air quality

This chapter provides a detailed summary of the assessment of the project impacts upon air quality. A detailed technical Air Quality and Greenhouse Gas Assessment (AQGHGA) is provided in Appendix V. The relevant air quality and greenhouse gas emissions SEARs and where they are addressed, are summarised in Appendix A.

17.1 Existing environment

17.1.1Ambient air quality

The local air quality environment is influenced by local traffic, agricultural activities, erosion, household wood heaters, bushfires, pollen from grass and trees and long-range transport of fine particles into the region.

Background air quality for the project area was based on the closest weather station with available data, which is located at Tamworth, approximately 50 km north-west of the project. The air quality in Tamworth is generally considered to be good as it complies with annual air quality standards in most years. Some exceedances of the air quality standards were noted for 24-hour average particulate matter less than 10 microns (PM_{10}) and $PM_{2.5,}$ which are typically caused by smoke from bushfires/hazard reduction burns or regional dust storms. The adopted air quality data from Tamworth is expected to provide a conservatively high background for the assessment due to Tamworth’s higher population density compared to the project area and a corresponding greater intensity of emission generating activities.

The primary air pollutants relevant to the project construction and included in dispersion modelling are PM_{10}, $PM_{2.5}$ and Total Suspended Particulates (TSP). Of these, the Tamworth air quality monitoring station (AQMS) provides records of PM_{10} and $PM_{2.5}$. Baseline levels of PM_{10} and $PM_{2.5}$ were adopted based on records from 2018, which are considered to provide conservatively high background data concentrations primarily due to intensifying drought conditions contributing to local and regional dust storms. Records from 2019 were not used to establish the baseline conditions due to the influence of extensive bushfire events in November and December 2019. TSP concentrations are not measured at the Tamworth AQMS. In the absence of local measurements, annual average TSP concentrations were derived from the PM_{10} data.

The following background values were adopted:

- 24-hour PM_{10} concentration – daily varying with the highest concentration that is not already above the impact assessment criteria is 47.4 µg/m³.
- Annual average PM_{10} concentration – 20.1 µg/m³.
- 24-hour $PM_{2.5}$ concentration – daily varying with a maximum of 24.2 µg/m³.
- Annual average $PM_{2.5}$ concentration – 8.3 µg/m³.
- Annual average TSP concentration – 50.1 µg/m³ assuming PM_{10} is 40% of TSP.

17.2 Assessment overview

17.2.1Methodology

The air quality assessment was prepared in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA 2016), which comprised assessment of the new Dungowan Dam, pipeline and powerline construction and decommissioning the existing dam.

The assessment of emissions from the new dam construction involved dispersion modelling. This was based on key emissions sources and pollutants applicable to the construction of the project, including fugitive dust from material extraction, handling, processing and movement, and wind erosion of exposed surfaces. The relevant pollutants assessed in the dispersion modelling were PM_{10}, $PM_{2.5}$ and TSP.

The pipeline and powerline construction and the decommissioning of the existing dam activities were considered to be low risk in nature and the air quality impact of these activities were assessed using a qualitative assessment approach. The assessment of these activities was in accordance with the *Guidance on the Assessment of Dust from Demolition and Construction* (GADDC) (IAQM 2014) and considered the potential for impacts resulting from earthworks, construction and vehicle movements during the pipeline and powerline construction and decommissioning of the existing dam.

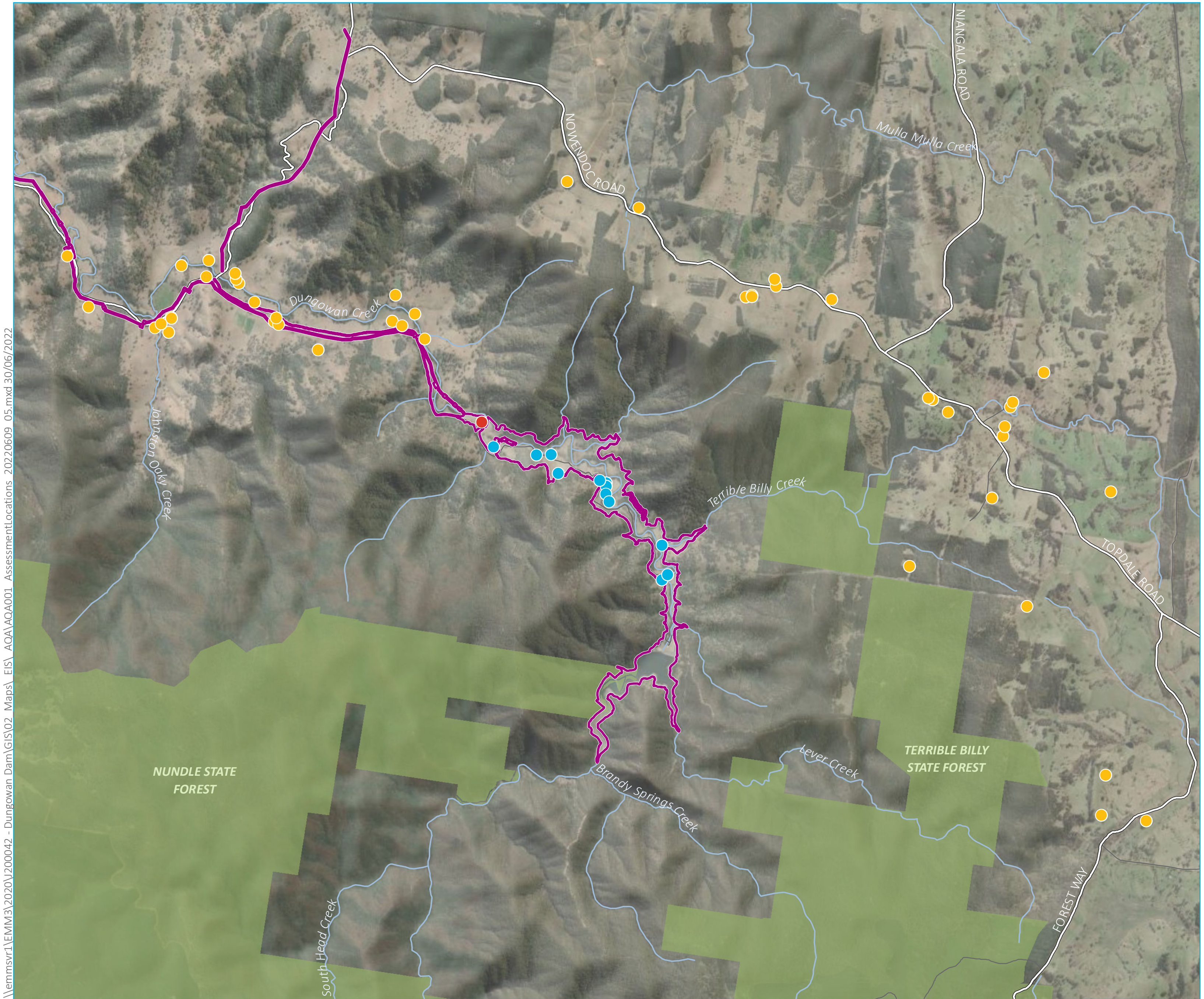
A greenhouse gas (GHG) assessment was prepared for the project construction and operation in accordance with the *GHG Protocol Corporate Accounting and Reporting Standard* (Bhatia et al 2010).

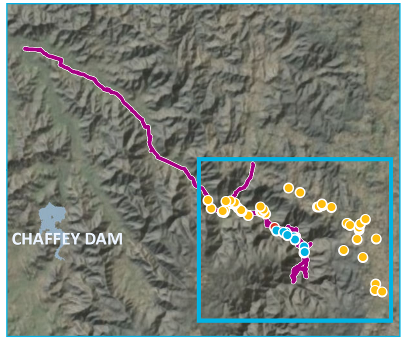
17.2.2Receptor choice

Receptors within approximately 10 km of the new Dungowan Dam infrastructure construction were selected as discrete model prediction locations, due to the higher risk of air quality impacts from dam construction activities. The closest properties within the inundation footprint were not assessed, as they are vacant and would remain so throughout the project construction.

The proposed location for the construction camp is approximately 500 m from the new Dungowan Dam wall embankment and would be the closest occupied receptor to the dam construction. The location of receivers considered in proximity to the new Dungowan Dam construction works are shown in Figure 17-1.

Based on the low-risk nature of the pipeline, powerline and dam decommissioning activities, a 350 m screening criteria was applied to determine potentially affected receptors. 86 individual residences were estimated to be within 350 m of the construction footprint for the pipeline and one additional residence within 350 m of the powerline footprint. No residential receptors were located within 350 m of the existing dam.





KEY
Project footprint
Assessment location
Vacant
Accommodation camp
Occupied
Existing environment
Major road
Minor road
Named watercourse
State forest
Named waterbody

Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

0 2.5 5 km
GDA 1994 MGA Zone 56
N

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Assessment locations for modelling

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 17.1

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17.3 Predicted construction impacts

17.3.1 New Dungowan Dam construction emissions

Dispersion modelling predicted that the highest impacts would occur at the receptors within the inundation area, all of which are vacant and would remain so throughout construction. Other than these receptors, the highest predicted emission impacts occur at the accommodation camp.

When background concentrations are added to the project emissions, there are no additional exceedances of the 24-hour average impact assessment criteria for PM_{10} and $PM_{2.5}$ at any receptor outside of the inundation area, including the accommodation camp. Similarly, there were no predicted exceedances of the annual average impact assessment criteria for PM_{10}, TSP and dust deposition.

The annual average background $PM_{2.5}$ concentration (8.3 µg/m^3) is already above the impact assessment criterion, therefore it is difficult to assess compliance based on cumulative predictions. The annual average $PM_{2.5}$ concentration at the accommodation camp is 1.8% of the impact assessment criterion, which is slightly above screening criteria used to assess significance. For all other receptors (not within the inundation area), the annual average $PM_{2.5}$ concentration is 0.3% of the impact assessment criterion and can be considered insignificant.

Vegetation waste disposal may require controlled burning under suitable conditions. A screening level modelling assessment found that open burning has the potential to add additional days over the impact assessment criteria for 24-hour average PM_{10} and $PM_{2.5}$. Therefore, mitigation and management of these potential impacts will be required during construction, as outlined in Section 17.5.

17.3.2 Pipeline and powerline construction

Through a qualitative assessment of the scale and nature of the pipeline and powerline works and considering the sensitivity of the surrounding environment, a low to medium risk rating was identified for dust soiling, human health and ecological impacts from uncontrolled emissions. With the implementation of recommended dust mitigation measures, the risk of dust soiling or human health and ecological impacts would be further reduced.

17.3.3 Decommissioning existing dam

A screening assessment for decommissioning of the existing dam found that the risk of dust impacts would be negligible, and no further assessment was required, as the works would occur at a suitable distance from the closest residential and ecological receptors.

17.3.4 Odour

There are no significant sources of odour for the construction phase of the project that would generate off-site nuisance odour impacts. Vegetation that is removed would be appropriately managed prior to becoming an odour source, as detailed in the Waste Management Assessment (Appendix T).

Potential odour may be generated following the filling and operation of the reservoir due to aquatic microbiota. However, operational management measures to maintain the quality of the water in the reservoir would also control potential odour from the reservoir surface. Regular monitoring of water quality within the reservoir would ensure water quality does not deteriorate to the point that odour would become an issue. Operational water quality management measures are outlined in the Surface Water Assessment (Appendix F).

17.3.5 Greenhouse gas assessment

GHG emissions during construction would include Scope 1 emissions associated with the combustion of fuel (diesel) by onsite plant and equipment and emissions released from explosive use for rock extraction. Although not a direct source of GHG emissions, vegetation stripping and tree removal during construction would result in the loss of a carbon sink and is categorised as a Scope 1 emission source for the construction phase. The disposal or use of cleared vegetation also results in GHG emissions.

Scope 2 emissions during construction would be limited to consumption of electricity by site offices and the accommodation camp. Scope 3 emissions would occur from offsite production of construction materials such as aggregate and steel and emissions from the combustion of fuel when transporting materials and staff.

A summary of predicted GHG emissions for construction is provided in Table 17-1.

Table 17-1 Summary of Scope 1, 2 and 3 emissions for construction (t CO2-e)

Source	Scope 1	Scope 2	Scope 3	Basis
Onsite fuel consumption	4,389		225	Per annum
Explosives	22.8			Per annum
Vegetation stripping and removal of trees	17,444			Lifeline (loss of carbon sink)
Electricity use	109.8			Per annum
Employee travel to site (bus)		970	144	Per annum
Transport of vegetation to landfill				Total for construction period
Decomposition of vegetation/trees in landfill			1,990.4	Lifeline, decomposition over decades
Raw materials – extraction and transport of sand/gravel			5,863	Total for construction period
Raw materials – production and transport of steel	4,389		225	Total for construction period
Raw materials – production and transport of cement			27,633	Total for construction period
Waste			112	Per annum
Total	**24,194**	**970**	**36,013**	

Annual average GHG emissions (Scope 1) generated during construction represent approximately 0.005% of total GHG emissions for NSW and 0.001% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2018. The comparison does not include vegetation removal, which represents loss of a carbon sink and is not expressed on a per annum basis. It is expected that the project rehabilitation including revegetation of the existing Dungowan Dam inundation area would minimise this impact.

17.4 Predicted operational impacts

Impacts during operation of the project are expected to be negligible and the operational assessment was limited to GHG estimates.

GHG emissions during the operation phase of the project include direct (Scope 1) emissions associated with the combustion of fuel and indirect (Scope 2) emissions associated with electricity use for operation of the new Dungowan Dam and pipeline. There would also be GHG emissions from the decomposition of carbon in submerged soil and vegetation within the inundation area and very minor Scope 3 emissions from waste generated during operation.

A summary of predicted GHG emissions during operations is provided in Table 17-2 below.

Table 17-2 Summary of Scope 1, 2 and 3 emissions for operations (t CO2-e)

Source	Scope 1	Scope 2	Scope 3	Basis
Fuel consumption	54.4		2.8	Per annum
Electricity use		298.4	44.2	Per annum
Waste			1.8	Per annum
Decomposition of vegetation from operation of reservoir	1,789			Per annum
Total	**1,843**	**298.4**	**46.0**	

Annual average GHG emissions (Scope 1 and Scope 2) generated during operation, including emissions from storage of water in the inundation area, represent approximately 0.002% of total GHG emissions for NSW and 0.0004% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2018.

17.5 Management and mitigation

The project air quality impacts and GHG emissions are expected to be suitably managed with the implementation of mitigation measures detailed in the AQGHGA and also in Appendix E. Management and mitigation measures to address air quality impacts would be documented and implemented in an Air Quality Management Plan (AQMP) as part of the CEMP. The AQMP would include, but not be limited to:

- Potential sources of air pollution.
- Air quality management objectives consistent with any relevant published EPA and/or EES/DPE guidelines.
- Mitigation and suppression measures to be implemented.
- Methods to manage work during strong winds or other adverse weather conditions.
- Storage of materials that have the potential to result in dust generation would be minimised within project sites at all times.
- A progressive rehabilitation strategy for exposed surfaces.
- Monitoring of air quality within the project area.

17.6 Summary and conclusion

The AQGHGA considered dispersion modelling of construction impacts from the new Dungowan Dam. The modelling predicted that highest impacts would occur at the project accommodation camp and that no additional exceedances of relevant air quality criteria would occur to receptors outside the project footprint.

A qualitative assessment of pipeline and powerline construction found a low to medium risk of dust soiling impacts, human health impacts and ecological impacts from uncontrolled emissions during construction. Mitigation measures would be implemented to minimise these impacts. Only negligible impacts to air quality are expected during existing dam decommissioning as all activities are suitably distant from residential and ecological receptors.

The assessment documented the direct and indirect GHG emissions of the project in construction and operation.

Overall the air quality and greenhouse gas impacts of the project were found to be minor and would be managed through construction with the implementation of an AQMP containing suitable mitigation measures.

CHAPTER 18

Visual

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18 Visual

This chapter presents a detailed summary of the Visual Impact Assessment (VIA), which identifies potential visual impacts of the project and management measures to address any potential impacts. The detailed technical report for the VIA is provided in Appendix W. The relevant SEARs and where they are addressed, are summarised in Appendix A.

18.1 Existing environment

Receptors with potential to experience visual impacts were identified based on the social, landscape and heritage context in combination with the visual catchment of the project.

18.1.1Social, landscape and heritage context

Local community facilities, rural residences, tourist sites and roads with potential views of the works were identified as potential receptors. There are no major urban centres within a 20 km radius of the project. However, several small villages and rural localities are within proximity, including Dungowan village, Ogunbil and Woolomin. Landscape areas including protected areas, State forests and recreational areas were considered potential receptors for visual impacts. There are two main landscape character units (LCUs):

- Landscape Character Unit 1 (LCU 1): Valley floor, comprising the relatively cleared and modified landscape along the valley floor.
- Landscape Character Unit 2 (LCU 2): Peaks and ridges, comprising the more heavily timbered peaks and State Forest areas.

Heritage sites and locations with cultural values were also considered based on the findings of the Aboriginal Cultural Heritage Assessment (Appendix J) and the Statement of Heritage Impact (Appendix K).

18.1.2Visual catchment and receptors

A visual catchment for the project was determined following a desktop study of the surrounding environment and modelling an area of theoretical visibility. The project's area of theoretical visibility is provided in Annexure A of the VIA technical report (see Appendix W). The receptors identified and considered as the VIA locations are shown in Figure 18-1 and Figure 18-2 below.

Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

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Visual impact assessment locations – receptor ID # 1 and 3-14

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 18.1

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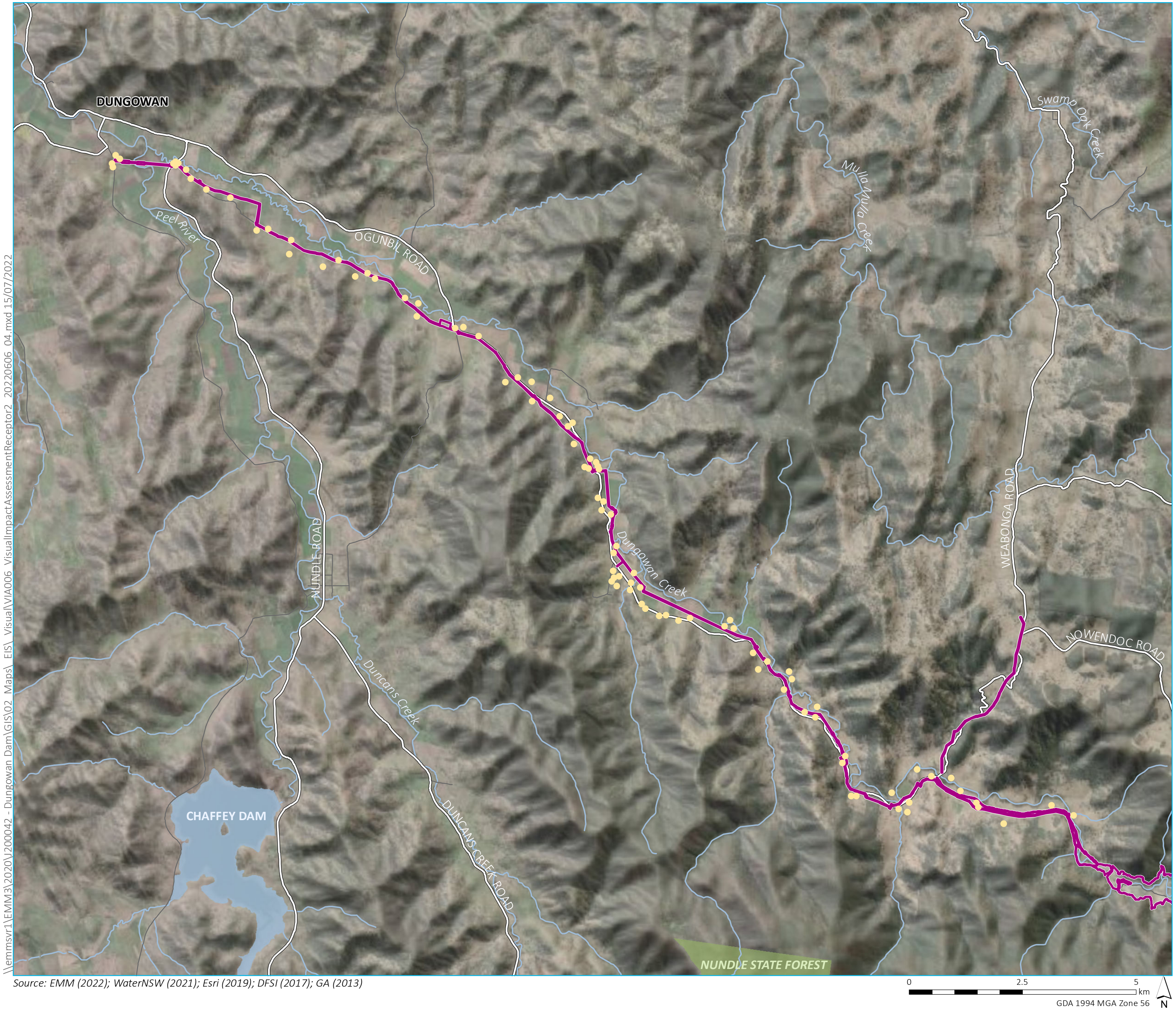

Source: EMM (2022); WaterNSW (2021); Esri (2019); DFSI (2017); GA (2013)

KEY

Project footprint

Receptor ID #

2 | Rural residences on Dungowan Dam Road, Ogunbil Road, Dungowan Creek Road and Nundle Road

Existing environment

Major road

Minor road

Named watercourse

Named waterbody

State forest

Visual impact assessment locations - receptor ID #2

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 18.2

EMM creating opportunities

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18.2 Assessment overview

The study method adopted for the VIA follows the *Guidelines for Landscape and Visual Impact Assessment* (3rd edition) prepared by the UK Landscape Institute and the Institute of Environmental Management and Assessment (2013) (GLVIA). The assessment predicted visual impacts according to two key variables:

- The visual effect.
- The sensitivity of the receptors to the visual effect.

Visual effect is concerned with the development or activities and the extent to which they will contrast to or integrate with the existing landscape. It also considers the magnitude of the change including the size or scale of the change, the duration of the change, and reversibility of the change. It also considers design elements such as form, shape, texture and line relative to the host landscape.

Visual sensitivity is concerned with the people or locations likely to have visibility of the development. It considers the nature of the receptors and considers factors such as the planar distance between the receptor and the proposed development, relative elevations, the relationship of the receptor to the development, and any intervening or mitigating factors such as vegetation. When combined, those two variables determine the significance of the overall visual impact.

18.3 Predicted impacts

18.3.1Visual impact assessment

A visual effect rating was assigned to each of the project elements based on the combined variables of contrast, integration and magnitude of the change. The analysis identified:

- Dam infrastructure and the reservoir are elements rated as having a **high** overall visual effect.
- Borrow and quarry areas and the construction camp and compounds are elements rated as having a **moderate** overall visual effect.
- The pipeline, powerline, road upgrades and the decommissioning works are elements rated as having a **low** overall visual effect.

The visual impacts of the project were assessed for each receptor. The assessment considered the visual sensitivity of the receptors together with the works that would be visible and their visual effects. Visualisations were prepared for some select viewpoints to show potential views of permanent infrastructure and are provided as part of the technical report in Appendix W. A summary of the predicted visual impacts is provided in Table 18-1. The visual impact at the majority of receptors is nil or low, with the exception of rural residences with temporary views of pipeline construction or potentially permanent views of the powerline which is considered to be a low-moderate visual impact.

Table 18-1 Summary of visual impacts

Receptors	Potentially visible project elements	Visual impact
1: Rural residence: 309 Dungowan Dam Road	Construction stage: construction camp and compounds, roads, pipeline Operational stage: dam infrastructure, roads	Nil
2: Rural residences on Dungowan Dam Road, Ogunbil Road, Dungowan Creek Road and Nundle Road	Construction stage: pipeline, roads Operational stage: roads	Moderate–low
3: Rural residences on Nowendoc Road and Weabonga Road	Construction stage: pipeline, roads Operational stage: electricity powerlines, roads	Construction: Nil Operation: Low–moderate
4: Minor road: Dungowan Dam Road	Construction stage: pipeline, borrow pits and quarries, construction camp and compounds Operational stage: dam infrastructure, Reservoir, Roads	Low
5: Minor roads: Ogunbil Road, Dungowan Creek Road and Nundle Road	Construction stage: pipeline	Low
6: Minor roads: Weabonga Road, Nowendoc Road (Including local heritage item Port Stephens Cutting)	Operational stage: electricity powerlines	Low
7: Minor roads: Pearsons Trail	Construction stage: decommissioning works (existing dam)	Low
8: Minor roads: Terrible Billy Fire Trail	Operational stage: reservoir	Low
9: Forestry land	Construction stage: borrow pits and quarries, construction camp and compounds, decommissioning works (existing dam) Operational stage: dam infrastructure, reservoir	Low
10: Broadacre rural land	Construction stage: pipeline, roads Operational stage: electricity powerlines, roads	Low
11: Dungowan Memorial Hall	Construction stage: pipeline	Construction: Low Operation: Nil
12: Ogunbil Brick Shearing Shed and Silo	Construction stage: pipeline	Construction: Low Operation: Nil
13: Dungowan Station Homestead (also referred to as Cadell's Dungowan Station)	Construction stage: pipeline	Construction: Low Operation: Nil
14: Travelling Stock Reserves	Construction stage: pipeline	Construction: Low Operation: Nil

18.3.2 Dark sky considerations

The project will involve construction of 11 km of pipeline within the area subject to the *Dark Sky Planning Guideline* (NSW DPE 2016), which provides technical information for appropriate lighting design within 200 km of the Siding Springs Observatory. The construction activities required within the *Dark Sky Planning Guideline* area would have appropriately designed lighting and are expected to have only negligible light spill impacts. During operation minimal lighting would be required and negligible impact is expected.

Dust emissions during construction are also a relevant consideration for their potential to influence light scatter. The assessment found that there would be minimal dust emissions during construction with negligible opportunity for dust to influence light scatter or impact observing conditions for any observatory.

18.4 Management and mitigation

Overall, the visual impacts of the project are considered acceptable and can be managed with standard construction practices. The potential for visual impacts during construction will be minimised as far as practical through the implementation of construction management measures. Measures that would be implemented to further mitigate the project's visual impact are summarised in Table 18-2.

Table 18-2 Summary of visual mitigation measures

Impact	Mitigation #	Environmental management measures	Timing
Visual impacts from pipeline and road construction	VIS01	The siting of works compounds for the storage of materials and plant should consider avoiding any location immediately adjacent to residential dwellings, particularly if those premises do not have the advantage of existing screening by landscaping etc.	Construction
Powerline introduced into landscape and views from residences and transient receptors	VIS02	The final alignment of the proposed electricity powerline should be selected to avoid or minimise vegetation clearance.	Construction
Removal of screening and views of borrow pits and quarry areas	VIS03	Retain mature vegetation, as far as operationally feasible, around the perimeter of the excavation areas.	Construction
Light spill from extended construction hours	VIS04	Where extended construction hours occur in darker evening or night-time periods, the task lighting direction will be towards the ground below the horizontal plane.	Construction

18.5 Summary and conclusion

The VIA has assessed the visual impacts to key sensitive receptors and concluded that the project would have moderate–low, low and negligible impacts on nearby receptors. The main visual impacts of the project are associated with the (temporary) construction of the pipeline, road upgrades and the permanent installation of powerlines and their impacts on views from rural residences and minor roads. The dam infrastructure and reservoir would not be visible from any nearby residences and the main (transient) views would be from minor roads and forestry land.

Overall, the visual impacts of the project are considered acceptable and can be suitably managed with standard construction management measures. Some additional measures have been recommended to further minimise residual visual impacts of the project, which would be implemented during detailed design and construction.

CHAPTER 19

Climate change

19 Climate change

Climate change can pose significant long-term risks to infrastructure through changes in temperature, rainfall and the increased occurrence or intensity of extreme weather events. This chapter provides a detailed summary of the potential impacts of climate change on the design, construction and operation of the project. A detailed Climate Change Risk Assessment (CCRA) is included and informs the Climate Change Adaptation Plan (CCAP) provided in Appendix X.

The impact of climate change on flow regimes is discussed in detail in the Surface Water Assessment (Appendix F) as well as other technical reports subject to changed flow regimes as a result of the new Dungowan Dam operation. The climate change projections discussed in this chapter are consistent with the considerations of the Surface Water Assessment.

19.1 Existing environment

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) climate projections have been used to offer insight into regional changes to the climate system in NSW. These projections are based on the Representative Concentration Pathways (RCP) emissions scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) in the *Fifth Assessment Report* (IPCC, 2014). The analysis uses the RCP 8.5 for the near (2030) and far future (2090) in the Central Slopes Cluster (land west of the Great Dividing Range from southern Queensland to the central-west of NSW, including the Tamworth LGA) to provide climate change projections from the start of operational phase of the project to towards the end of the projects forecast useful life (100 years).

The RCP 8.5 scenario is characterised by rapid increases in emissions through the early-mid 2000s. Under this scenario, atmospheric CO_2 levels reach 950 ppm by 2100 (compared with approximately 414 ppm in early 2020). This scenario represents the worst-case, high emissions and rapid global development scenario. Projections for 2090 include the period from 2080 to 2099 and are the furthest projections available for the region at the time of this study.

A summary of the climate projections relevant to the project area are provided in Table 19-1.

Table 19-1 Summary of climate projections relevant to the project area

Event	Tendency	Confidence
Temperature and heatwaves	Average temperature will increase as well as the number of hot days and heat waves	Very high confidence
Extreme rainfall	Increase in the intensity of extreme rainfall	High confidence
Winter rainfall	Decreasing winter rainfall	High confidence
Spring rainfall	Decreasing spring rainfall	Medium confidence
Drought	Time spent in drought will increase	Medium confidence
Flooding and rainfall intensity	Intensity of rainfall will increase with the scale of changes unknown.	High confidence
Relative humidity	A decline in winter and spring relative humidity	High confidence
Bushfire	A harsher fire weather regime is projected	High confidence
Cyclones	Decrease in the formation of tropical cyclones	Medium confidence

Source: CSIRO, 2016

19.2 Assessment overview

The assessment investigated the project's exposure and vulnerability to projected climate change variables, in line with the risk management approach in the Australian Standard *Climate change adaptation for settlements and infrastructure* (AS 5334-2013). This involved an in-depth analysis of historic climate and future projections relevant to the project area. A multi-disciplinary CCRA workshop was undertaken to present the climate analysis and assess the potential impact of these projected future climate scenarios on the project assets. In the CCRA workshop, climate risks were identified as well as potential adaptation actions. The key output of the workshop was a climate risk register (Annexure C of Appendix X) that provides a comprehensive list of the project's climate risks and corresponding opportunities for mitigating risks through adaptation actions.

19.3 Predicted construction impacts

Most of the climate risks identified would not occur during the construction of the project as they relate to long-term changes that would have a greater impact during the operational phase. Four risks were identified during the construction period, relating to a projected 'increase in frequency of very hot days' and 'increased extreme rainfall intensity and resultant flooding'. Whilst these projected climate change impacts are considered 'high confidence', all were evaluated as low risk, not requiring further measures for adaptation.

19.4 Predicted operational impacts

Most of the climate risks identified would occur during the operational phase of the project. The risk assessment identified 11 high priority climate-related risks for the long term (2090), as well as six high priority risks for the short term (2030). Risks were predominantly direct risks; however six indirect risks were also identified. The elements of the project associated with the highest number of priority risks included water quality, power supply, the reservoir, dam operations and the embankment. Direct risks included damage to infrastructure elements from floods and storms as well as impacts from bushfires. Indirect risks were mainly associated with damage to the electricity network.

The identified risks have been broken down into a series of priority risk areas, which would be addressed through the design and delivery of the project. The priority risk areas and their respective impacts on the project across its lifecycle are summarised in Table 19-2 below.

Table 19-2 Summary of priority risk areas

Priority risk area	Key risks identified
Maintenance of water quality for downstream users and the environment.	• Increasing temperatures and drought conditions leading to increased water column stratification and the resultant downstream environmental impacts from cold water pollution. • Increased frequency and severity of algal blooms due to both heatwave and drought conditions, with both environmental and human health impacts for downstream users.
Operational impacts from climate-related blackouts.	• Increase in bushfire and storm intensity was identified as potentially increasing hazards such as the burning or destruction of power and communications lines, leading to important service delivery impacts for the new Dungowan Dam.
The impacts of more frequent severe drought and reduced inflows and increased water demand on long-term water supply.	• Downstream local environmental impacts due to reduced water availability for the environment. • Service disruption due to reduced ability to deliver water under severe drought conditions. • Increased water demands from town water supply and irrigation in conjunction with drought conditions was also identified as a key long-term risk.

Example adaptation actions were identified for each of the priority risk areas. A summary of the example adaptation actions that could minimise these risks is provided in Table 19-3.

Table 19-3 Example adaptation actions to minimise climate change risks

Impacts	Example adaptation actions
Water quality impacts	
Bushfire impacts	Ensure vegetation is monitored over time through fire surveys, lidar and aerial imagery to ensure fire risk is understood and managed. Conduct fuel reduction burns in collaboration with the SES and NSW Fire for parts of the catchment that become vulnerable to bushfire impacts.
	After fire events, consider installation of appropriate sediment and erosion controls in tributaries leading to the dam and conduct autumnal post fire planting for soil stabilisation. Also investigate spray options for grass seed to reduce fuel loads in summer.
	Select intake from which to draw water to avoid floating debris being drawn into water supply. Monitor reservoir debris regularly.
Algal blooms	Conduct regular maintenance. Implement approaches to reduce the likelihood and remedy algal blooms through reducing organics from entering the reservoir through fuel reduction burns and ample understorey to filter water entering the reservoir.
	If raw water quality deteriorates due to hotter future conditions to an extent it would affect the permitted uses of raw water customers, further water quality improvement options would be investigated.
Power supply impacts	
Bushfire	Review opportunities to ensure vegetation is monitored over time (e.g. through fire surveys, lidar and aerial imagery) to ensure fire risk is understood and managed.
	Review opportunities to conduct fuel reduction burns in collaboration with the SES and NSW Rural Fire Service.
	During detailed design, consider the need for fire resistant pylons and buried power cables to reduce powerline exposure to local bushfire impacts.

Impacts	Example adaptation actions
Water supply	
Droughts and increased temperatures	Enact water restrictions in accordance with Tamworth Regional Council drought management plans to reduce water demand during drought periods.
	Work with DPE Water to update the water sharing plan for the Peel Valley to consider the implications of climate change on drought conditions.
	Consider implementation (with relevant stakeholders) of water restrictions that take effect in times of drought and extended low rainfall. Review and update the Tamworth Regional Council Drought Management Plan to consider revised arrangements for the implementation of water restrictions.
	Water restrictions to take effect in times of drought and extended low rainfall. Review and update the Tamworth Regional Council Drought Management Plan to consider revised arrangements for the implementation of water restrictions.

19.5 Management and mitigation

The management and mitigation measures that would be implemented to address climate risks are summarised in Table 19-4.

Table 19-4 Summary of mitigation measures

Measure #	Mitigation measure	Timing
CC1	Review and consider the adaptation actions that have been provided in Table 19-3 and identify where specific design changes are required, which may be addressed at the detailed design stage.	Design
CC2	Take steps to identify and integrate relevant adaptation actions into operational requirements, as well as ensuring the ongoing monitoring and review of the climate adaptation risk register through design, construction and operational phases.	Design Construction Operation
CC3	Monitor any potential changes in the IPCC's RCP scenarios and localised projections for the project area to continually update the ratings of identified risks associated with a changing climate.	Construction Operation

19.6 Summary and conclusion

Climate risks to the project were identified, with 11 high priority climate-related risks identified for the far future (2090). The main source of risk to the asset was temperature, followed by the impacts of storms. The elements of the project associated with the highest number of priority risks were water quality, power supply, the reservoir, dam operations and the embankment.

The following priority climate risk areas were identified:

- Maintenance of water quality for downstream users and the environment.
- Operational impacts from climate-related blackouts.
- The impacts of more frequent severe drought and reduced inflows and increased water demand on long-term water supply.

Mitigation measures have been identified for further consideration in project design and operation to enhance the projects resilience to the effects of a changing climate.

CHAPTER 20

Sustainability

20 Sustainability

This chapter provides a detailed summary of the material sustainability issues for the project, ecologically sustainable development (ESD) approaches, Infrastructure Sustainability (IS) rating estimated scores, and recommended pathway for sustainability implementation that will be incorporated into the future design, construction and operation of the project. A detailed technical Ecologically Sustainable Development Pathway report has been prepared for the project and is provided in Appendix Y. The relevant ESD SEARs and where they are addressed are summarised in Appendix A.

20.1 Assessment overview

The sustainability assessment has been undertaken for the project to inform the effective and efficient use of resources.

A materiality assessment was conducted to identify the most important sustainability issues for the project, utilising a stakeholder survey approach covering sustainability themes across both the IS rating tool and the SEARs. Following design refinement and completion of initial environmental assessments, the materiality assessment was reviewed.

The project considered IS rating and environmental production declaration approaches to develop assessment criteria for the assessment. The IS rating was determined to be the most suitable ESD pathway for the project as it drives the development of the project towards achieving sustainability outcomes, addresses key material issues and aligns with the strategic direction of the NSW government. An IS target development and gap analysis process workshop was undertaken with key stakeholders to determine estimated IS scores in accordance with the IS rating scheme. The assessment used the IS Rating Tool V1.2.

20.2 Sustainability target development

The assessment identified the project's material sustainability issues of highest priority based on available information about the project, such as asset life, climate vulnerability, energy, water and material intensity and proximity to pollution receivers. Each issue was assigned a credit score of either 'Scoped out' (0), 'Low materiality' (1), 'Moderate materiality' (2) or 'High-Very high materiality' (3–4).

Credit scores were weighted to reflect the credits relative significance and overall contribution to the sustainability performance of the project based on the default distribution of ratings points across the 44 credits assessed. The weighted distribution considered a higher than standard weighting for climate, water use and water discharge, ecology and habitats, heritage values and stakeholder engagement. Most other credits, including energy, were weighted lower than standard.

IS Ratings were determined for two scenarios – the business as usual (BAU) and the stretch target. The assessment identified a BAU score of 42 was achievable. A stretch target score of 67 was determined based on increased investment and optimal management of contractor performance. The BAU and stretch target scores are illustrated below in Figure 20-1.

A minimum rating target of 61 was deemed achievable by the project through increased investment in sustainability and optimal management of contractor performance.

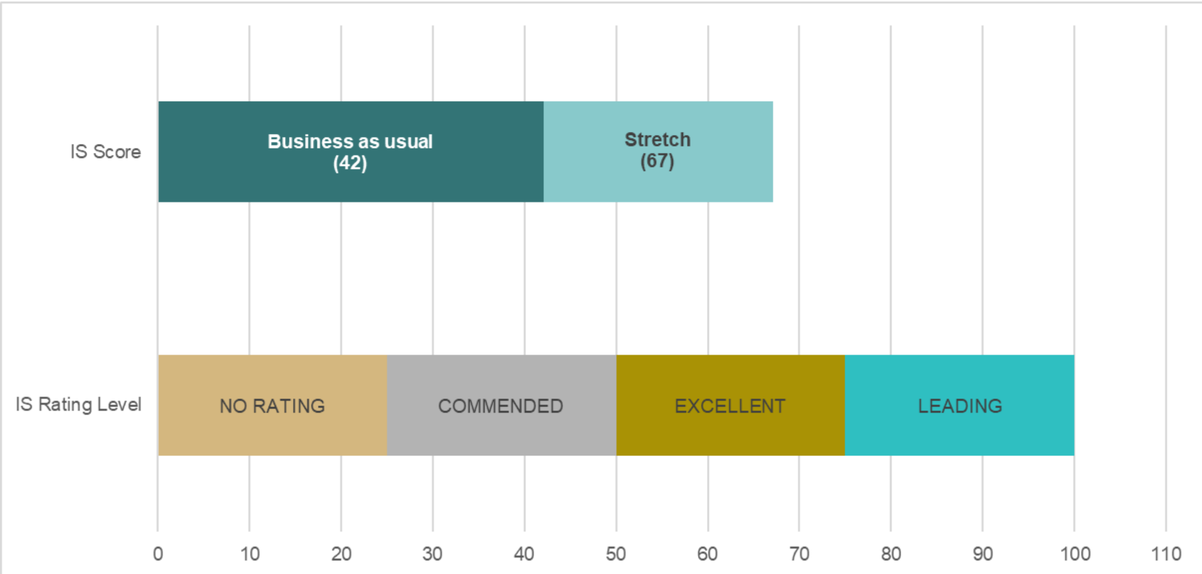


Figure 20-1 Summary of potential target IS scores.

20.3 Recommendations

ESD principles may be incorporated into the design and ongoing construction and operation of the project through focused design considering environmental impacts, by implementing sustainability initiatives to improve resource efficiency and through a gap analysis against IS ratings as a holistic sustainability rating tool. It is recommended that the project target an 'Excellent' rating under the IS Design and As-built rating tool. A score of 51 is sufficient to achieve the 'Excellent' rating, however the assessment recommends to include a 10-point buffer above the minimum of 51. Therefore, a score of 61 has been adopted as the minimum rating target for the project.

CHAPTER 21

Cumulative impacts

21 Cumulative impacts

This chapter provides an assessment of the project's potential to generate cumulative impacts in the region. The assessment has been completed with reference to the *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE 2021e).

21.1 Assessment overview

The *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE 2021e) defines two broad assessment approaches, comprising:

- Incremental types – including impacts of the project to the existing baseline condition of each relevant assessment matter (e.g. air quality, odour, noise, water, biodiversity, heritage, traffic, employment and workforce) and the combined effect of the different impacts of the project. Consideration of incremental impacts is standard practice and is addressed in the individual technical reports (appended to the EIS) and chapters and the project justification (Chapter 22 of this EIS).
- Cumulative types – impacts of the project together with the impacts of other relevant future projects on specific issues within an identified area, and the combined effect of the different cumulative impacts of the project with other cumulative impacts of the relevant future projects within an identified area. The assessment of issue-specific cumulative impacts is presented in this chapter.

The closest future project (Hills of Gold Wind Farm) is 25 km from the project (Figure 18-1), and the Chaffey Dam pipeline project related development interacts with the project at a catchment scale, so impacts are somewhat more limited to those at a regional scale, rather than specific areas. The cumulative impact assessment is largely qualitative due to a range of uncertainties including the level of detail available for future projects, the likelihood that those projects will proceed, and the uncertainty of timing of future projects.

Where relevant, consultation has been carried out with proponents of a future project where cumulative impacts have greater certainty. Specifically, consultation with WaterNSW, HunterH20 and DPE has been carried out throughout the project development to ensure cumulative impacts associated with the Chaffey Dam pipeline project on the Peel River system are appropriately modelled and considered in the EIS (refer Chapter 5 for further details on consultation).

21.2 Screening of future projects

The *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE 2021e) are part of the Rapid Assessment Framework introduced in 2021, aimed at improving the assessment of major projects in NSW. The scoping phase for the Dungowan Dam and pipeline project (lodged in March 2020) preceded the implementation of these guidelines and as such, a scoping assessment for cumulative impacts was not performed at the time. The EIS has therefore performed a screening exercise of future projects aligned to the scoping assessment presented in the guidelines (see Table 21-1 and Table 21-2), focusing on key matters that could be materially affected, to inform the cumulative impact assessment (Section 21.3).

The project is located within the Tamworth Regional LGA and has been assessed with consideration of the relevant strategic plans and policies for the region (see Chapter 2). Water security and drought resilience is a key objective for the region given the predominant agricultural land use, growing population and a changing climate. The cumulative impact assessment has reviewed other future projects (on the DPE Major Projects Planning Portal[8]) within the Tamworth region that have potential to interact with the Dungowan Dam and pipeline project. This review is summarised in Table 21-2 with potential and approved future projects shown on Figure 21-1. Water Infrastructure NSW are currently completing construction of the replacement pipeline from Dungowan Showground to Calala, however there would be no concurrent construction and operational impacts are negligible and as such cumulative impacts are not considered further. The greatest potential for cumulative impacts of future projects and the Dungowan Dam and pipeline project are related to:

- Chaffey Dam pipeline – operation of the new Dungowan Dam will influence the operational frequency of the Chaffey Dam pipeline and requires changes to the relevant WSPs. Cumulative impacts relating to aquatic and terrestrial biodiversity are linked to the changes to flow within the Peel River downstream of Chaffey Dam.
- Renewable energy projects, which have the potential to have construction periods that overlap with the project construction and have substantial workforce requirements that may result in combined cumulative socio-economic impacts on the same region. These projects are associated with the New England Renewable Energy Zone and are the Middlebrook Solar Farm, Bendemeer Solar Farm, Thunderbolt Wind Farm and Hills of Gold Wind Farm.

All other projects identified in Table 21-2 are unlikely to result in any key interaction due to the distance, nature and scale of the project (i.e. no operational interaction), and/or timing of the project's construction, noting that the project is estimated to start construction in 2023, if approved. The projects reviewed are limited to those within the Tamworth LGA, as project impacts and interactions with the surrounding environment, in particular on water and local social setting, beyond this area is negligible.

[8] DPE Major Planning Portal projects as listed on 15 August 2022

Table 21-1 Key for cumulative impact scoping

Key	
Detailed assessment	The project may result in significant impacts on the matter, including cumulative impacts. Detailed assessment is characterised by: • Potential overlap in impacts between a future project and the proposed project. • Potential for significant cumulative impacts as a result of the overlap, requiring detailed technical studies to assess the impacts. • Sufficient data is available on the future project to allow a detailed assessment of cumulative impacts with the proposed project for the relevant matter. • Uncertainties exist with respect to data, mitigation, assessment methods and criteria.
Standard assessment	The project is unlikely to result in significant impacts on the matter, including cumulative impacts. Standard assessments are characterised by: • Impacts are well understood. • Impacts are relatively easy to predict using standard methods. • Impacts are capable of being mitigated to comply with relevant standards or performance measures. • the assessment is unlikely to involve any significant uncertainties or require any detailed cumulative impact assessment.
N/A	No potential overlap in impacts between a future project and the proposed project that would warrant any consideration in the cumulative impact assessment.

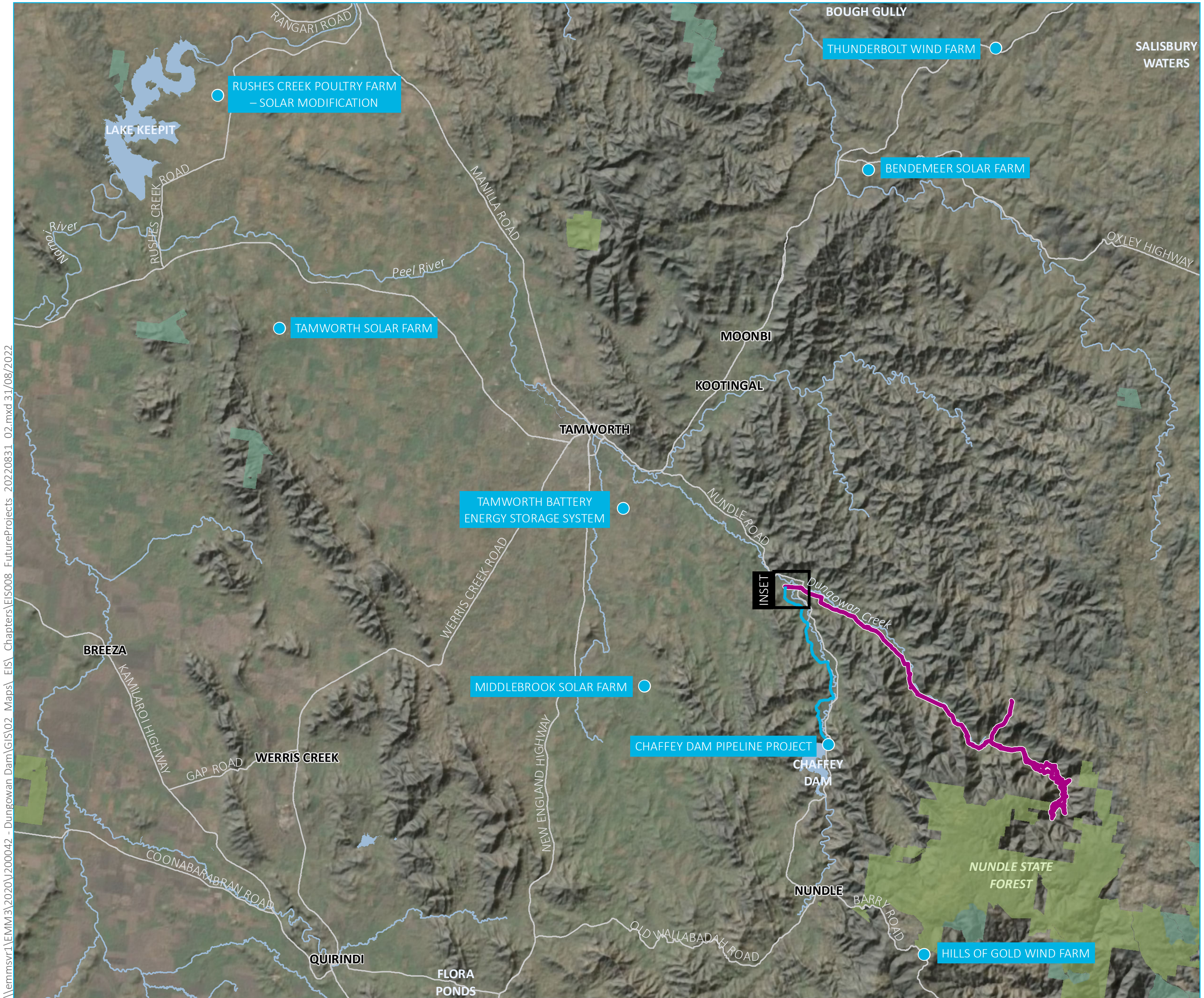
Table 21-2 Cumulative impact scoping table

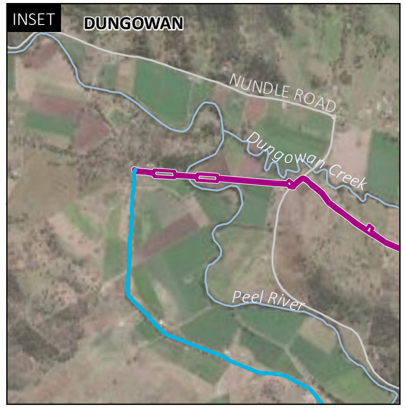
Future project	Approx distance from project	Project status / Indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Water	Biodiversity	Heritage	Traffic and transport	Social	Economic
Chaffey Dam pipeline (SSI-46313959)	Overlapping project footprint	Related development – Existing asset seeking approval for continued operation ~estimated 2023.	• Altered flow regime of the Peel River. • Changes to geomorphology in Peel River tributaries. • Water quality.	• Changes to hydrological conditions downstream of Chaffey Dam.	• Negligible changes to cultural flows.	• No traffic impacts generated from Chaffey pipeline.	• No construction or employment requirements. • Growth and water supply to Tamworth region.	• Growth and water supply to Tamworth region.
	Relevant area: Peel River between Chaffey Dam and Tamworth							
Tamworth Solar Farm (SSD-9264)	80 km north west of the project	Approved project – Estimated commissioning in 2022	• Projects have sufficient separation distance. • Water sourced from existing connections or truck.	• Projects have sufficient separation distance. • Mostly cleared.	• Projects have sufficient separation distance.	• No overlap in transport route from New England Highway.	• ~200 construction workers, 2 operational staff.	• No economic overlap.
	Relevant area: New England Renewable Energy Zone (REZ)							

<table>
<tr><th rowspan="2">Future project</th><th rowspan="2">Approx distance from project</th><th rowspan="2">Project status / Indicative timing</th><th colspan="6">Potential overlap between impact of other projects on the same assessment matter</th></tr>
<tr><th>Water</th><th>Biodiversity</th><th>Heritage</th><th>Traffic and transport</th><th>Social</th><th>Economic</th></tr>
<tr><td rowspan="2">Rushes Creek Poultry Farm – Solar Modification (SSD-7704-Mod-4)</td><td>100 km north west of the project</td><td>Changes to existing project – no timing provided</td><td rowspan="2">• Projects have sufficient separation distance.
• Existing water sourced from Namoi River.</td><td rowspan="2">• No information.</td><td rowspan="2">• No information.</td><td rowspan="2">• No overlap in transport route from New England Highway.</td><td rowspan="2">• No information
• Projects have sufficient separation distance.</td><td rowspan="2">• No information.</td></tr>
<tr><td colspan="2">Relevant area: New England Renewable Energy Zone (REZ)</td></tr>
<tr><td rowspan="2">Tamworth Battery Energy Storage System (SSD-23830229)</td><td>50 km north west of the project</td><td>Project under assessment (EIS in prep) – 12 months construction and scheduled completion in 2023.</td><td rowspan="2">• No water directly sourced from Peel Valley (tanker only).</td><td rowspan="2">• Projects have sufficient separation distance.</td><td rowspan="2">• Projects have sufficient separation distance.</td><td rowspan="2">• No overlap in transport route from New England Highway.</td><td rowspan="2">• Up to 150 construction workers.
• No operational staff.</td><td rowspan="2">• No economic overlap.</td></tr>
<tr><td colspan="2">Relevant area: New England Renewable Energy Zone (REZ)</td></tr>
</table>

Future project	Approx distance from project	Project status / Indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Water	Biodiversity	Heritage	Traffic and transport	Social	Economic
Middlebrook Solar Farm (SSD-10455)	40km west north west of the project	Project under assessment (EIS in prep) – 12–24 months construction period. Indicative timing not provided.	• No water directly sourced from Peel Valley (tanker only).	• Potential White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands – uncertain classification and impacts.	• Projects have sufficient separation distance.	• No overlap in transport route from New England Highway.	• ~400 construction workforce, 12 operation jobs.	• No economic overlap.
	Relevant area: New England Renewable Energy Zone (REZ)							
Bendemeer Solar Farm (SSD-36651552)	60km north of the project	Project under assessment (EIS in prep). Construction expected to commence late 2023 and commissioned in late 2024.	• Projects have sufficient separation distance. • No information.	• White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands – uncertain impacts.	• Projects have sufficient separation distance.	• No overlap in transport route from New England Highway.	• ~250 construction workforce, 10 operation jobs.	• No economic overlap.
	Relevant area: New England Renewable Energy Zone (REZ)							

Future project	Approx distance from project	Project status / Indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Water	Biodiversity	Heritage	Traffic and transport	Social	Economic
Thunderbolt Wind Farm (SSD-10807896)	75km north of the project Relevant area: New England Renewable Energy Zone (REZ)	Project under assessment (RTS) – 24–28 months construction commencing Q1 2024.	• No water directly sourced from Namoi River catchment.	• 8.56ha of White Box Yellow Box Blakely's Red Gum Grassy Woodland. • 5.66ha of heavily grazed Derived Native Grassland.	• Projects have sufficient separation distance.	• No overlap in transport route from New England Highway.	• ~190 construction workforce, 9 operation jobs.	• No economic overlap.
Hills of Gold Wind Farm (SSD-9679)	25km south west of the project Relevant area: New England Renewable Energy Zone (REZ)	Project under assessment (Assessment) - 18–24 months construction period. Determination anticipated Q4 2022 – likely construction in 2023.	• Estimated 55ML construction water may be sourced from Tamworth Regional Council, groundwater or surface water source (Chaffey Dam or Peel River). Minimal volume.	• 6.07ha of White Box Yellow Box Blakely's Red Gum Woodland and derived native grassland.	• Sites associated with Peel River will be collected or salvaged.	• No overlap in transport route from New England Highway.	• 615 FTE construction. • 76 FTE operation (16 site jobs).	• No economic overlap.





KEY

- Project footprint
- Future projects within the Tamworth region
- Chaffey Dam pipeline
- Major road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest

Source: EMM (2022); WaterNSW (2021); DFSI (2017); GA (2013)

0 10 20 km
GDA 1994 MGA Zone 56
N

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Future projects within the Tamworth region

Dungowan Dam and pipeline project
Environmental Impact Statement
Figure 21.1

EMM creating opportunities

21.3 Assessment of cumulative impacts

Potential cumulative impacts associated with the project have been addressed in the relevant specialist assessments as part of an incremental type assessment and the relevant key findings are summarised in this EIS. Detailed cumulative assessment has been undertaken where potential for impact has been identified through the cumulative scoping assessment (Table 22-2). The key matters that may be materially affected by cumulative impacts are changes to water, biodiversity and social impacts.

21.3.1 Water

There are unlikely to be any cumulative impacts with the identified future energy projects, as available information indicates these projects would largely not require water sourced directly from the Peel River and would rely on potable supply. As such, potential indirect cumulative impacts are likely to be beneficial as a result of improved water security provided by the Dungowan Dam and pipeline project.

The existing Chaffey Dam pipeline, which was constructed for temporary drought relief, is currently seeking approval for operation whenever Chaffey Dam is below 20% capacity. The cumulative effects of the new Dungowan Dam operation and Chaffey Dam pipeline operation were assessed using regional water modelling (see Annexure A of Appendix F) and have also been separately considered with regard to any changes to geomorphology, ecology and other interdependent environmental aspects.

21.3.1.1 Flow modelling

The key aspects of the Chaffey Dam pipeline operation are:

- Operation during severe drought when the aquatic ecosystem is likely to be stressed.
- Reduction in the frequency of run-of-river transfers from Chaffey Dam to Tamworth for town water (as water would be transferred by the pipeline).
- Maintenance of the minimum 3 ML/day release from Chaffey Dam as required by the water sharing plan.

The trigger for operation of the Chaffey Dam pipeline would be when Chaffey Dam water levels fall below 20%, which is also the trigger for level 5 water restrictions in Tamworth. The time spent in level 5 water restrictions would change as a result of the operation of the new Dungowan Dam, as follows:

- Current demand and climate:
  - Around 4% of the time with the existing Dungowan Dam, falling to 1% of the time following construction of the new Dungowan Dam.
- Future climate and +20% demand:
  - Dry climate: Around 56% of the time with the existing Dungowan Dam, falling to 49% of the time following construction of the new Dungowan Dam.

- Median climate: Around 20% of the time with the existing Dungowan Dam, falling to 12% of the time following construction of the new Dungowan Dam.
- Wet climate: Around 16% of the time with the existing Dungowan Dam, falling to 8% of the time following construction of the new Dungowan Dam.

The construction of the new Dungowan Dam would therefore reduce the frequency and period of time that Chaffey Dam pipeline would need to be operational. This means that whatever environmental and ecological effects that may be attributed to Chaffey Dam pipeline operation (e.g. reduction in pool flushing flows) would reduce in frequency when the Dungowan Dam and pipeline project is operational.

Modelling of Chaffey Dam pipeline operation described within this EIS was completed prior to finalisation of the Chaffey Dam pipeline EIS. The Chaffey Dam pipeline EIS may contain updated modelling of pipeline operation and effects.

21.3.1.2 Geomorphology

The Chaffey Dam pipeline has already been constructed and the disturbed land rehabilitated, and so impacts due to pipeline operation are limited to the changes in Peel River flow. In general, changes to flow can cause geomorphic change, including:

- Increased frequency of high flows leading to increased bed material mobilisation.
- Increased frequency of low flows potentially leading to increased deposition.

The changes in the flow regime due to Chaffey Dam pipeline operation would occur during low flow periods when bed and bank movement is not expected. The frequency of operation would be low (i.e. 2–3% of the time), and meaningful changes to sediment deposition is not expected to occur during these periods. Chaffey Dam pipeline operation would not create high flow events in the river and therefore would not create risk of bed or bank mobilisation.

As there are expected to be negligible geomorphological effects from Chaffey Dam pipeline operation, it follows that the cumulative effects of Chaffey Dam pipeline operation with the Dungowan Dam and pipeline project are equivalent to the effects of the project alone.

21.3.1.3 Catchment operation and water sharing

Modelling completed for the Dungowan Dam and pipeline project indicates that within the Upper and Lower Namoi:

- There will be no meaningful impact to water resources in the Upper and Lower Namoi.
- Total diversions will be managed to remain within the LTAAEL as required by the water sharing plan.
- There would be no change to the delivery of EWRs within the Upper and Lower Namoi.

21.3.2 Biodiversity

Potential cumulative impacts on biodiversity may be caused by:

- Changes to flows within the Peel River.
- Direct and indirect impacts to threatened species and communities due to removal of native vegetation.

The flow modelling of cumulative impacts on the Peel River shows that the operation of the project will reduce the frequency of operation of the Chaffey Dam pipeline, and as such would also reduce the frequency of any environmental impacts associated with its operation.

All future projects with the exception of the Chaffey Dam pipeline are at sufficient separation distance such that there are no direct local cumulative impacts on biodiversity (i.e. future projects are not predicted to result in changes to Peel River flows and would not impact the same threatened species or communities within the local environment). However, there is potential for combined cumulative impacts on threatened species and communities at a regional scale.

When considering the cumulative impacts of the project with the Chaffey Dam pipeline, the *Aquatic Ecology Assessment* (Austral Ecology 2022) identified a number of risks, which include possible impacts to stygofauna, altered flows on fish passage, reduction of flows, and risk to Lower Darling EEC as a result of changes to river hydrology. However, as the operation of the new Dungowan Dam would reduce the period of time that Chaffey Dam pipeline would be in use (as described in Section 21.3.1), cumulative impacts to aquatic values such as fish passage, cumulative impacts to reproductive and survival success of native fish species (i.e. Murray Cod) are not expected to be significant and considered negligible. Outcomes for fish passage are in fact likely to improve across the Namoi, due to the implementation of project offset agreements that would enhance multiple other waterways downstream of the project.

Consideration of regional scale cumulative impacts have been considered as part of the significance assessments carried out as part of the BDAR (Appendix H) and Aquatic Ecology Assessment (Appendix I). Further to this, a review of impacts to native vegetation associated with future projects confirmed additional clearing would occur across the region, including of the critically endangered Box Gum Woodland community. Multiple concurrent projects could exacerbate cumulative impacts to threatened flora and fauna communities as a result of lost habitat, and have flow-on effects for vulnerable mobile species across the region.

The Dungowan Dam and pipeline project will impact on 41.64 ha of the EPBC Act listed Box Gum Woodland community. While relatively minor and small-scale clearing is proposed for future projects independently, and the combined impacts of future projects would be less than that of the Dungowan Dam and pipeline project, because impacts associated with the Dungowan Dam and pipeline project are considered significant, cumulatively the impacts are also considered significant.

21.3.3 Social

The SIA (Appendix L) details that there is a low availability of housing in the Tamworth market and describes the possibility that even a minor increase in demand could result in increased housing prices and decreased rental affordability, due to the lack of availability.

The project has capacity to accommodate all workers onsite and is unlikely to result in housing pressures. However, cumulative demand for accommodation to support concurrent construction of future projects may place pressure in particular on the city of Tamworth, as the nearest urban centre and provider of local services.

The potential cumulative peak employment demands for future projects (construction phase) including Hills of Gold Wind Farm, Middlebrook Solar Farm and Bendemeer Solar Farm exceeds 1,500 full-time employees. The proportion of employees from the local area is uncertain as is the amount of onsite accommodation provided for the workforce for these projects. It's highly likely that there will be an increased demand for local housing and accommodation, as well as on other goods and services, as multiple projects are proposed for construction over the same period.

The influx of an external workforce would have indirect impacts on local services due to increased demand from workers, such as hotels, fuel and food availability as well as access to social services such as healthcare and recreation. While these impacts could include increased pressure to supply goods and services, it is also beneficial with increased opportunities for revenue for local business.

The need for skilled workers to supply construction of multiple projects may cause potential impacts on the availability of skilled workforce in the regional area, should construction periods overlap substantially. This may require additional workers to be sourced from outside the local and regional areas with flow-on impacts to accommodation and other industry sectors, as discussed above.

21.4 Conclusion

The cumulative impact assessment has identified future projects that have potential to interact with the project and reviewed available information pertaining to their environmental and social impacts. The key environmental aspects that could result in cumulative impacts with the project are water (changes to flow), biodiversity (loss of native vegetation and associated indirect impacts), and social impacts (linked to the employment and influx of workers). The combined effect of these cumulative impacts is not considered to be significant and is able to be mitigated through the implementation of respective management measures for each key matter and as proposed by each individual project. Offset agreements will be established for significant impacts to threatened species and communities and would provide for improved conservation outcomes within the region.

The project will not significantly involve any material cumulative impacts in relation to other future projects in the region. No specific additional measures are required.

CHAPTER 22

Justification

22 Justification

This chapter provides a justification and evaluation of the project as a whole, having regard to its economic, environmental and social impacts and the principles of ecologically sustainable development.

22.1 Project objectives and need

The Tamworth regional area experienced environmental, social and economic stress during the 2017–2020 drought, and it became evident that the existing town water supply system does not provide sufficient security during these extended dry climatic events. The Tamworth population was impacted with prolonged water restrictions and imminent water shortage, with flow on effects on local agriculture and businesses. The drought highlighted the immediate need for improved water reliability and security for existing and future populations, with the Tamworth population expected to grow significantly over the next 20 years.

The project was developed to satisfy the following three objectives:

- To improve water availability and security for the city of Tamworth and to enable growth.
- To provide efficient and affordable bulk water supplies to Tamworth.
- To promote environmental and social outcomes in Tamworth and the Peel Valley.

The new Dungowan Dam will increase the available water storage capacity, enabling the city of Tamworth to respond to greater climate variability. The frequency and severity of water restrictions in Tamworth would decrease following construction of the new Dungowan Dam, while water available for irrigation (i.e. average annual general security allocations) would remain unchanged. Considering both current and future demands, the project will reduce water restrictions frequency by half.

22.1.1Consistency with strategic context

The project aligns with State government policy and regional plans including the *NSW Water Strategy*, draft *Namoi Regional Water Strategy* and the *Tamworth Regional Council's 'Blueprint 100' community strategic plan*. A key focus for many of these plans and strategies are water security and resilience to ensure the region supports ongoing local industry growth and reliability for future populations. The new Dungowan Dam is identified as a key commitment to improve water security and management in the draft Namoi Regional Water Strategy and as a key project in Tamworth's Blueprint 100 to realise the quality of life aspirations of the community and to accelerate the region's aspirations for increased productivity and exports. The project is consistent with the options of the NSW Water Strategy and will specifically increase resilience to changes in water availability.

22.1.2Climate resilience

Across the Namoi region, droughts are becoming shorter and more severe than those before the 1950s. In the Peel Valley, the most recent drought (2017–2020) was one of the worst on record. Hydrology modelling for the Namoi region has considered varying climate scenarios and under the worst-case dry climate scenario (see Appendix F), the region could experience:

- Changing rainfall patterns, with reduced winter rainfall and increased summer rainfall both changing up to 35% by 2079.
- Higher evapotranspiration (average increase up to 6% by 2070).
- Higher minimum and maximum temperatures, with an average rise in temperatures of 0.7°C over the short term (2030) and 2.2°C over the long term (2060 to 2079).
- More hot days (temperatures over 35°C) across the entire New England North West region.
- Increased fire-weather conditions in summer, spring and winter and decrease in autumn.

The outcomes from the hydrology modelling highlight the urgent need to address the lack of Tamworth's town water supply security. Under a future climate and as the population grows, the existing Dungowan Dam will increasingly experience shortfalls in water supply.

The project has been developed to assist in improving water security for critical human needs in Tamworth and its surrounds, and to ensure the region is prepared for variable and extreme climate trends such as severe drought.

22.1.3 Existing infrastructure risks

The existing Dungowan Dam, which is 60 years old is recognised as not being built to current dam safety standards. This has required multiple upgrades completed over its life resulting in a sub-optimal arrangement. Similarly, the existing Dungowan pipeline is ageing and experiences regular serviceability issues. Tamworth Regional Council is subject to increased management, operation, maintenance costs and safety risks associated with the continued use of the existing Dungowan Dam and pipeline. Continuing to utilise the existing Dungowan Dam and pipeline would not address future climate risks and does not align with the three project objectives.

The new Dungowan Dam will be fitted with instrumentation to ascertain the health and performance of the dam and will comply with the NSW *Dams Safety Act 2015* and *Dams Safety Regulation 2019* (and future amendments) during its full life cycle. The new Dungowan Dam will provide a reduced public safety risk as well as reduced management, operation and maintenance costs compared to the existing arrangement.

22.2 Iterative design development

The concept for a new Dungowan Dam was first introduced in 2015. The project has been developed over several years through options investigations, design iteration, and environmental assessment. Ultimately, the project proposed for construction has been designed to avoid and minimise impacts where reasonable and feasible. The iterations to design were informed by geotechnical investigations, technical specialist studies and consultation with stakeholders including the community. The iterative design development and environmental assessment process from option analysis to preferred project is shown in Figure 21-1.

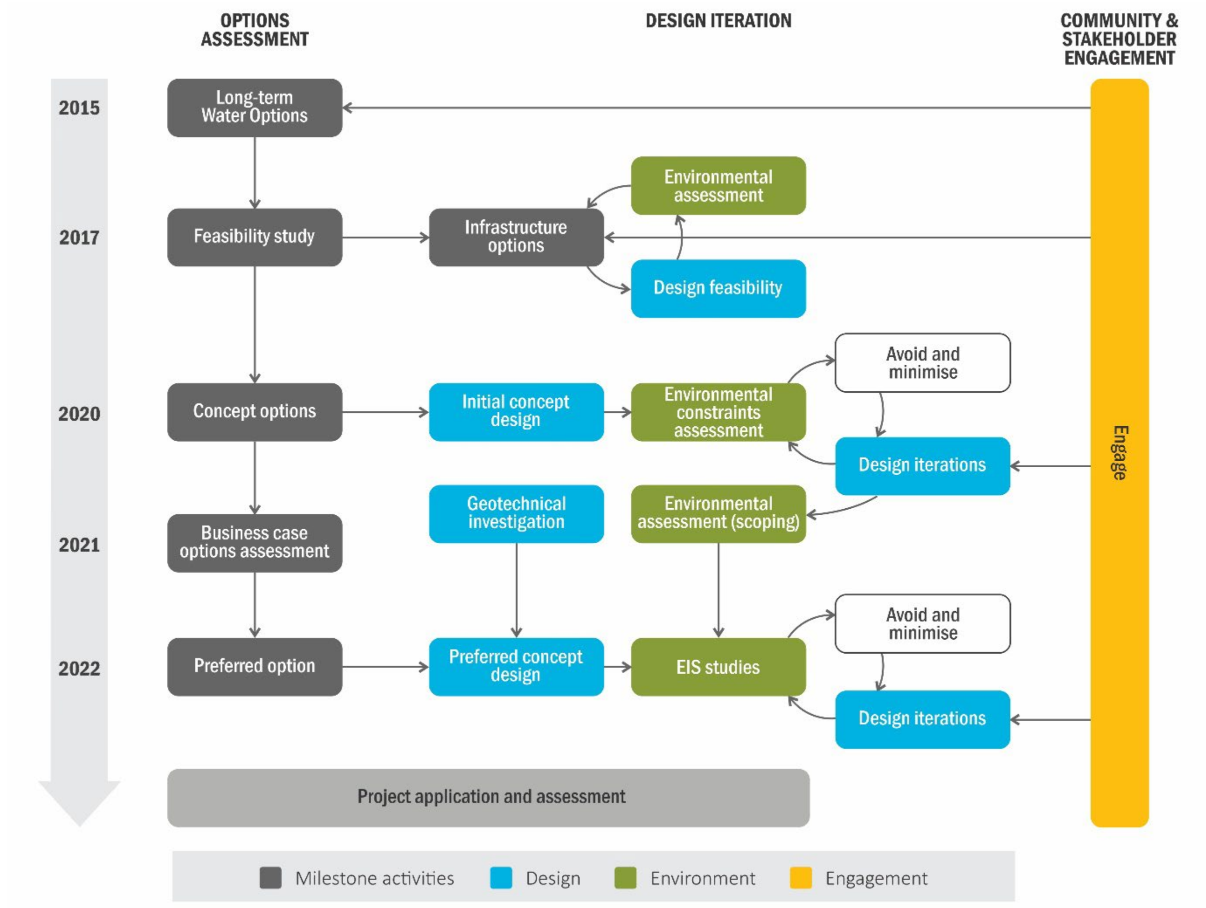

Figure 22-1 Project development process

This EIS is based on the preferred concept design for the project. A detailed design process is underway and following the appointment of a construction contractor, details of the project may change or be refined (such as construction methods). Any design changes would be subject to further environmental assessment as part of the project application and approval process.

22.3 Community engagement

Community engagement began in 2020 and included individual landowner meetings, community engagement sessions, information stalls, local business engagement, and other targeted activities to support technical studies such as Aboriginal cultural heritage engagement and social impact surveys. Feedback received from the community was documented by Water Infrastructure NSW and relevant issues communicated to the project team. A summary of the key feedback themes and how they have been incorporated into the EIS is presented in Chapter 5 of the EIS. Community views have been incorporated into the project's design and assessment, including changes to pipeline design and alignment, allowing for customer connections to the pipeline (for all landowners with a current pipeline connection and all landowners with the new pipeline running through their property), sampling and management of potential contaminated material during the existing Dungowan Dam decommissioning, ensuring real time data availability in dam safety measures, and key water security concerns incorporated into the broader water assessments and modelling.

Table 22-1 Community views and how they have been addressed

Theme	Summary
Strategic context	Asset ownership, impacts of a change in government and water availability to irrigators were raised as concerns. These issues have been addressed in Chapter 4 of the EIS, with confirmation on asset ownership and that water availability for irrigation will not change. Impacts of change in government are unable to be addressed in the EIS.
Project design	Project design queries focused on the pipeline alignment and depth. These have been addressed in the SIA and Land Use Assessments (Appendix L and Appendix P). Alignment and depth of the pipeline were informed by a MCA approach and consultation with Tamworth Regional Council, with further pipeline design refinements made following landowner consultation.
Community engagement	It was suggested the project should explore opportunities to share and educate the community with the findings of Aboriginal cultural heritage surveys. The findings of these surveys have been documented in the ACHA, with recommendations for management measures to include procedures for the curation and long-term management of recovered cultural materials, ensuring any curation remains on County and accessible for future visitation.
Economic, social and environmental impacts	Key issues relating to water and socio-economic impacts from the project were raised, in particular with regard to the assessment approach and impacts to Dungowan Creek, pricing of water and access to the new pipeline. Detailed modelling has been completed and informed the Surface Water Assessment (Appendix F). The assessment considers impacts on the Peel River the broader Namoi Valley, and local impacts to Dungowan Creek. Access and pricing of water has been addressed in the SIA (Appendix L). Road and noise impacts during construction, contamination concerns, biodiversity, biosecurity, waste, visual impacts and greenhouse gas emissions were also raised as concerns and are addressed throughout the EIS.
Project justification and evaluation	The community questioned whether further water security options and alternatives have been properly considered and whether the preferred project is the most effective option, including whether project benefits outweigh project costs. A summary Final Business Case has been released by the NSW Government and published on the project website, which details the options considered and the options assessment process used. These findings have also been summarised in Chapter 2.

22.4 Biophysical, social and economic considerations

22.4.1 Avoiding and minimising environmental impacts

The project has been developed to avoid and minimise impacts where reasonable and feasible to do so and has been informed by numerous design and technical specialist studies. The project has adopted avoidance and minimisation through design for the following:

- A large portion of the project footprint is former agricultural land, owned by Tamworth Regional Council. This avoids impacting otherwise active agricultural land.
- An access track around the perimeter of the reservoir was initially considered for maintenance, which would have resulted in significant additional clearing of native vegetation. This has been avoided by ensuring boat access will be sufficient for maintenance activities and that alternate road access is available via existing fire trails.
- Route alignments for the pipeline and powerline were refined to avoid and minimise impacts to biodiversity, in particular to reduce overall impacts to moderate and high condition native vegetation and Box Gum Woodland TEC.
- The existing Dungowan Dam was initially proposed for partial decommissioning, which would have retained some infrastructure and a pool of water potentially requiring ongoing monitoring. The design progressed and resolved to fully decommission the existing dam, therefore maximising the area of land to be rehabilitated and removing public and dam safety risks otherwise associated with remaining infrastructure.
- The identification of on-site quarrying locations to source material provides multiple benefits in reducing environmental impacts. It reduces any offsite traffic generation for the transport of material to the construction site. Quarry locations are also largely placed within the area that would be impacted by eventual inundation, therefore reducing additional disturbance impacts as much as possible. The location of quarries within the footprint were also refined to avoid Aboriginal heritage and biodiversity constraints identified during field surveys.

Where impacts could not be fully avoided, they have been minimised. Unavoidable impacts are discussed in the following sections.

22.4.2 Biophysical impacts

22.4.2.1 Construction

Construction of the project would result in 315 ha of soil disturbance over a period of approximately six years, involving land clearing, grubbing, stripping and construction of infrastructure. The key direct and indirect potential impacts to the biophysical environment include:

- Localised air emissions associated with dust generation and vegetation waste disposal.
- Soil erosion and migration into waterways.

- Exposure pathways to potentially contaminated materials.
- Direct loss of approximately 185 ha of native vegetation in varying condition, including 57 ha of Box-Gum Woodland that is consistent with the BC Act listing of which 42 ha of Box-Gum Woodland and Derived Native Grassland is consistent with the EPBC Act listing.
- Removal of riparian vegetation and dewatering activities for pipeline construction (creek crossings) presenting risk to aquatic fauna.

These impacts are generally manageable with mitigation measures. Loss of native vegetation is a residual impact, which is unable to be further mitigated and will therefore be offset in accordance with the BOS.

22.4.2.2 Operation

The management of dams and extractions for water supplies unavoidably alters the flow of water within natural rivers and creeks. A number of potential impact pathways are related to changes in hydrology within Dungowan Creek and the Peel River as a result of the project. These impact pathways have been considered and minimised through the project design and would be a key consideration throughout project construction and operational management.

Operation of the new Dungowan Dam, and the influence of the project on the operation of Chaffey Dam, would result in changes to flow regimes both in Dungowan Creek, downstream of the new Dungowan Dam, and in the Peel River, downstream of the existing Chaffey Dam. No changes are predicted downstream of Tamworth.

Predicted changes in hydrology are:

- A decrease in flows past the new Dungowan Dam for 10% of days, due to dam filling and capture of water.
- A decrease in flows from Chaffey Dam for 30% of days, due to operating the new Dungowan Dam and reducing the need for run-of-river transfers.
- A reduction in flow on 40% of days at Piallamore (downstream of the Dungowan Creek and Peel River confluence), with reductions considered to be moderately significant.

The interactions of surface water with the groundwater, terrestrial and aquatic environments have been considered in the EIS and it is concluded that changes to the flow regime would:

- Have negligible impact on geomorphology.
- Not affect access to water for stock and domestic purposes.
- Not effect groundwater recharge rates or groundwater access to GDEs or other users.
- Not significantly impact vegetation health and structure of riparian communities and therefore have a negligible impact on threatened and migratory species.
- Have high risk to aquatic habitat availability using a precautionary approach, however is unlikely to have a significant impact on threatened fish species or aquatic fauna (Platypus).

Water quality during operation could be affected by high nutrient concentrations, in particular during the first few years of operation as a result of submerged vegetation and soils. The new Dungowan Dam would have a multi-level offtake to minimise cold water pollution effects as much as possible, to very minor or negligible levels and limited to a short distance downstream of the dam embankment.

There are expected to be minimal other biophysical impacts that occur as a result of the project's operation, such as localised erosion and sedimentation from flows. There would be negligible air and greenhouse gas emissions.

22.4.3 Social

Social impacts and benefits have been considered as part of the EIS. Key social impacts are primarily associated with the construction phase of the project, with many of the social benefits realised once the project is in operation. Overall, the project would provide a net social benefit to the region due to improved water security.

22.4.3.1 Construction

Social impacts experienced during construction of the project would include:

- Impacts on agricultural activity, productivity and biosecurity.
- Visual and amenity impacts due to traffic generation and noise and dust from construction vehicles, though are predicted to be temporary and minor in nature.
- Risks to public safety due to traffic generation and transport of dangerous goods.
- Increased demand for local housing, goods and services, placing pressure on local businesses and suppliers but also providing improved economic opportunities.

The leadership, management and delivery of the project is also a social impact that has been considered, with a 2022 online community survey identifying a community perception of a lack of transparency. While the results of this community survey are acknowledged, extensive community consultation has been undertaken over an extended period and all aspects of project governance has been subject to stringent independent assessment by Infrastructure NSW as part of the NSW Government infrastructure assurance process.

An adaptive approach is proposed for the project, allowing Water Infrastructure NSW to manage and respond to changing circumstances and new information over time through ongoing monitoring and periodic review of mitigation strategies, allowing for modification if required and appropriate. This adaptive approach will ensure that the management of identified social impacts minimises negative social consequences and maximises social benefits for the community.

22.4.3.2 Operation

During operation, public amenity impacts would be minimal, with traffic, noise and air quality impacts all predicted to be insignificant. Similarly, human health risks are not predicted to be significant. The reservoir and new Dungowan Dam infrastructure would not be visible from any permanent receptor. The permanent installation of powerlines while visible from rural residences and minor roads would be consistent with existing views and infrastructure in the landscape.

Public safety has been considered in the EIS and the risks of dam failure are to be suitably managed through the application of safety in design measures, monitoring and maintenance throughout the project life. Bushfire risks can also be suitably managed within operational environmental management plans, and the project would pose no overall health risk issues of concern.

There will be a small fraction of the productive land in the Tamworth Region permanently lost due to the project (158 ha). The associated loss of crop and pasture value represents only 0.01% of the gross value of agricultural production for the Tamworth Region, and these impacts would be offset by the beneficial water security provided by the project.

The operation of the new Dungowan Dam and pipeline will provide improved water security and result in social and economic benefits. These benefits include reduced water restrictions, new user access to raw water infrastructure, opportunities for agricultural sector and food production in the local and regional area, and supporting regional population growth. These benefits support the objectives of the draft Namoi Regional Strategy and the strategic directions in the draft *New England North West Regional Plan 2041*.

The SIA also considers the findings of the ACHA, where the loss of access to land and cultural sites and the intergenerational loss of material culture and opportunity and cumulative loss to material culture is considered as a high risk.

22.4.4 Cultural

22.4.4.1 Aboriginal heritage

Aboriginal participation throughout the project has been encouraged and guided by a project-specific Aboriginal Community Engagement Strategy (EMM 2021). Consultation activities, including cultural mapping, have been reported on within the ACHA, with any feedback received discussed with RAPs and considered in the development and content of the ACHA.

Through field survey and cultural mapping, 17 discrete Aboriginal sites and places were confirmed within, or near the project footprint. Of these, between four and six would be subject to direct impacts (complete or partial loss), five would be unaffected and six would be inundated by the reservoir. Several high cultural value sites have been avoided. In addition to discrete sites, areas of high artefact densities and areas more likely to include such cultural material (based on predictive models), would also be directly impacted (2.2 ha and ~42 ha, respectively) and indirectly impacted (~96 ha) due to inundation of the reservoir.

Academic studies demonstrate that submerged soil profiles within dams experience limited modification, and as such the sites and cultural deposits that would be inundated can be considered largely unaffected by the project. The majority of the cultural material documented and/or predicted to be present within the project footprint would only be minimally affected by the project.

Some change to the existing streamflow regime will occur as discussed in the EIS. Cultural flows were explored in the cultural mapping study, and while no specific values were identified, associations with Creation Ancestors, and frequent mention of fishing and hunting along the river in living memory, suggests that Dungowan Creek and Peel River are akin to Aboriginal people's views of other major river systems and play an important role in the culture of the local community. To ensure potential impacts to Aboriginal sites, objects and/or places are considered in the development of environmental water release plans and other mitigation strategies for the project, a Cultural Flow Management Plan would be developed in consultation with the RAPs.

The ACHA has involved meaningful engagement and comprehensive investigations of Aboriginal heritage values of the project area. The investigations of the project footprint have significantly improved our archaeological and scientific understanding of a previously poorly understood region. While the project would result in some intergenerational/cumulative loss to material culture, there would be numerous cultural heritage benefits such as opportunities to undertake heritage interpretation, development of narratives and visual representation of Aboriginal values, stories and places, and a specific locale for future use by Aboriginal participants and the general community (a locale that for any cultural material relocated to avoid project impacts).

22.4.4.2 Historical heritage

Consideration of places, sites and landscapes modified in the Australian historical period for purposes other than Aboriginal cultural traditions have also been assessed in this EIS.

The project landscape has historical cultural value and is locally significant for its ability to demonstrate changes to the landscape that have resulted from natural forces and human agency, both pre- and post-British settlement. This includes a landscape formerly part of a former squatting run (*Dungowan Station*), which may possess relics that relate to the historical period, and the presence of a grave and skeletal remains purported to be of an itinerant worker or swagman.

The project would have minimal impact on listed heritage items but a greater impact on the cultural landscape values in the project footprint. However, these impacts would be appropriately managed and measures would include further investigation and/or historical recording and interpretation. Overall, the project's impacts to historic heritage are considered acceptable with these measures in place.

22.4.5 Economic impacts

The local effects analysis completed for the EIS determined that the project is estimated to make up to the following annual contributions to the regional economy over the 6-year construction period:

- $263 million in annual direct and indirect regional output or business turnover.
- $94 million in annual direct and indirect regional value-added.
- 922 direct and indirect local jobs.

The input to the local economy is therefore substantial.

Community concerns raised during the pre-EIS exhibition consultation include the potential impact of price increases on residents. The impact of the project on customer water bills as a result of the project has been assessed and identifies that a minimum bill increase of approximately $50–$53 per annum could be expected for residential users. Any increases will not be applied to general security allocations. However, ultimately water prices are set by IPART and subject to a range of factors, and as such the estimated increase is only a preliminary indication.

22.4.6 Cumulative impacts

The greatest potential for cumulative impacts of future projects and the Dungowan Dam and pipeline project are related to the Chaffey Dam pipeline and renewable energy projects within the Tamworth LGA. The key environmental aspects that could result in cumulative impacts with the project are water, biodiversity, and social impacts. The findings of the cumulative impact assessment are summarised in Table 22-2.

Table 22-2 Summary of cumulative impact assessment

Cumulative impact	Summary of findings
Water	Primarily neutral or beneficial impacts. The new Dungowan Dam would reduce the frequency and period of time that Chaffey Dam pipeline would be operational. Any environmental and ecological effects attributed to Chaffey Dam pipeline operation (e.g. reduction in pool flushing flows) would reduce in frequency when the Dungowan Dam and pipeline project is operational. Negligible cumulative geomorphic effects are expected. Indirect cumulative impacts with other projects in the region are likely to be beneficial as a result of improved water security provided by the Dungowan Dam and pipeline project.
Biodiversity	Cumulative impacts to aquatic values are considered negligible. Outcomes for fish passage are likely to improve across the Namoi due to the implementation of project offset agreements that would enhance multiple other waterways downstream of the project. While relatively minor and small-scale clearing of the critically endangered Box Gum Woodland community is proposed for future projects independently, because impacts associated with the Dungowan Dam and pipeline project are considered significant, cumulatively the impacts are also considered significant. Offset strategies respond to the regional threats of threatened species and communities and any unavoidable project impacts would need to be appropriately offset by each project as required under the BC Act and EPBC Act.
Social	The potential cumulative peak employment demands for future projects exceeds 1,500 full-time employees as construction periods will likely overlap. As a result, there is likely to be an increased demand for local housing and accommodation due to the influx of workers, as well as demand for other goods and services. This demand could increase supply pressures however would also provide local business benefits.

The combined effect of these cumulative impacts is not considered to be significant. No specific mitigation measures are required by the project to address the combined effect of cumulative impacts.

22.5 Ecologically sustainable development

The principles of ESD are set out in Schedule 2 of the EP&A Regulation and in clause 3A of the EPBC Act. The project has taken into account these ESD principles as summarised in Table 22-3.

Table 22-3 Evaluation of project against ESD principles

Principle	Evaluation of project impacts against principle
Precautionary principle/ decision-making processes	A level of scientific certainty has been achieved through detailed research and field studies to establish a good understanding of the existing environment. These studies were also informed by consultation with government agencies, landowners and the community. Detailed technical assessments, combined with consultation, have informed the identification and assessment of project impacts, including the likelihood, magnitude and consequence of impacts. To allow for limitations in the assessments, the EIS has been prepared with technical methodologies supporting a conservative approach to impact assessment. This includes assessing worst-case impacts and scenarios, such as considering worst-case dry climate scenario in hydrological modelling in addition to other sensitivity analysis, estimating offset liability presuming presence of threatened species where the species could not reliably be recorded, and assuming conservative performance criteria in air and noise quality assessments. The project has been designed to avoid environmental impacts where practicable, and mitigation measures are proposed to mitigate and manage the impacts where unavoidable. No mitigation measures have been deferred due to a lack of scientific certainty. Any project-related decisions would be guided by careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment and assessment of the risk-weighted consequences of various options.
Inter-generational equity	Future generations would benefit from the improved security of the water supply to Tamworth and the surrounding area. The project responds to the challenge of climate change and has considered varying climate change scenarios in the hydrological modelling and assessment. The EIS has identified the potential environmental impacts that may occur and appropriate protection, mitigation and/or management has been identified to ensure the health, diversity and productivity of the environment would be maintained. This includes ensuring the project will provide procedures for the curation and long-term management of cultural materials recovered as part of the works and that they remain accessible to the local Aboriginal community into the future. Interpretation and archival recording of cultural sites and landscapes will also ensure existing values can be captured and shared for future generations.

Principle	Evaluation of project impacts against principle
Conservation of biological diversity and ecological integrity	Detailed biodiversity assessments have been completed for the EIS and have informed iterations of the design and project footprint to avoid and minimise impacts. As part of the existing Dungowan Dam decommissioning, the former inundation area would be rehabilitated and over time would integrate back into the surrounding ecosystem. The BDAR and Aquatic Impact Assessment were prepared in accordance with relevant legislation and have assessed the significance of effect on any threatened species, endangered communities, or their habitat. A FFMP would guide ecological management for the project and would prioritise further minimising ecological impacts and/or enhancing habitat connectivity. Any significant residual impacts on biodiversity would be offset. Decision-making for offsets has been to ensure meaningful benefits in the region, in collaboration with DPE Environment and Heritage and DPI Fisheries. For example, outcomes for fish passage are likely to improve across the Namoi as a result of the aquatic offset agreement to enhance multiple other waterways downstream of the project.
Improved valuation, pricing and incentive mechanisms	Potential for air and noise emissions have been assessed and are expected to be negligible and managed by standard management measures. Erosion, sedimentation and water quality impacts have also been assessed and would be managed during construction and operation through relevant management plans. An EPL will be obtained for the project for scheduled ancillary activities during construction however the project would not require an EPL during operation. The long term project benefits are considered to outweigh the project impacts, with incremental economic gains expected from increased water security. It is estimated that customers would experience an increase to water bills however pricing is subject to an IPART process. The project has been designed to minimise adverse environmental impacts through an option selection process that includes the consideration of environmental factors and avoidance, mitigation or management of environmental impacts where impacts may potentially occur. Any project-related decisions would consider environmental factors in a cost-effective way and be guided by the whole of life costs of providing goods and services.

22.6 Compliance and monitoring performance

The EIS has been prepared to meet the requirements of the form and content specified in the EP&A Regulation, the SEARs, and guided by the *State significant infrastructure guidelines – preparing an environmental impact statement* (DPIE 2022a). Supporting technical studies have been completed in accordance with the applicable technical requirements and guidelines and informed by consultation with relevant government agencies and other stakeholders. The statutory compliance of the EIS has been assessed in Chapter 3, Appendix A and Appendix C.

The environmental management and performance framework for the project would comprise relevant construction and operational management and monitoring plans, with specific monitoring plans required where an aspect is considered to have a higher risk of impacts (i.e. surface water, biodiversity). These are highlighted in the consolidated list of mitigation measures in Appendix E. The primary objectives of monitoring programs are to:

- Provide additional monitoring of baseline conditions.
- Assess the effectiveness of controls.
- Identify and quantify any observed impacts.
- Enable compliance with relevant consent and licence conditions to be assessed.

The project consent will rest with Water Infrastructure NSW, who will be responsible for ensuring compliance with the approved project, liaising with DPE and other regulators, and communicating outcomes with the community. Water Infrastructure NSW draws upon the environmental management framework and processes established within DPE Water, and will utilise these resources in tracking compliance.

22.7 Evaluation and conclusion

The Dungowan Dam and pipeline project has been developed to ensure the city of Tamworth is better prepared for variable climatic events. As evidenced by the most recent drought, the existing town water supply system does not provide sufficient water security. The project would provide the following key benefits:

- Improved water security for Tamworth's town water supply as Tamworth's water demand grows.
- Replacement of aging infrastructure, significantly reducing serviceability and dam safety risks.
- Substantial local opportunities during construction of the project including opportunities for Aboriginal participation in construction.

The project was developed following a robust and iterative process including detailed options analysis, design, environmental assessment and stakeholder engagement. Where reasonable and feasible, the project has aimed to avoid and minimise biophysical, social and economic impacts.

Where impacts are unavoidable, mitigation measures have been identified to reduce the likelihood, magnitude and consequences of any residual impacts. While the majority project impacts can be appropriately mitigated, there are some impacts relating to water, biodiversity and heritage requiring alternative management approaches and offsets. These alternative management approaches and offsets have been detailed in the EIS and have been informed by consultation with relevant government agencies and Aboriginal participants.

Were this project not to proceed, the existing Dungowan Dam and pipeline will continue to operate with ongoing risk to public safety and increasing maintenance costs. Future upgrades would be required at significant cost to Tamworth Regional Council and ratepayers and these upgrades would not alleviate all known safety risks. Further, should a worst-case dry climate scenario eventuate, Tamworth would not have adequate town water supply to satisfy the water needs of a growing population during a prolonged drought sequence.

The project should be approved as:

- The project supports the objectives of the NSW Water Strategy, draft Namoi Regional Water Strategy and the Tamworth Regional Council's (Blueprint 100) community strategic plan.
- The project addresses climate change and provides a resilient solution for improved water security to the region.
- Dam safety and maintenance risks associated with the existing Dungowan Dam would be removed. A new dam built to current design standards would have improved safety and maintenance outcomes.
- Project impacts can be appropriately managed and viable offset agreements have been determined in consultation with DPE Environment and Heritage and DPI-Fisheries to ensure positive conservation outcomes can be achieved within the region.
- Local economic impacts during construction would be substantial and provide over 900 direct and indirect local jobs over the six year construction period.

On balance, it is considered that the project long-term benefits of improved water security and reliability outweigh mitigated project impacts and costs. The Dungowan Dam and pipeline would meet the three project objectives and would satisfy the critical need to improve Tamworth's town water supply.

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Study team

Study team

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