APPENDIX

B1

DUNGOWAN DAM AND PIPELINE EIS

Detailed project description

NSW GOVERNMENT

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Appendix B1 - Detailed project description

Dungowan Dam and pipeline project

Prepared for Water Infrastructure NSW

May 2022

Appendix B1 - Detailed project description

Dungowan Dam and pipeline project

Water Infrastructure NSW

J200042 RPT-NN-00044 - Detailed project description

May 2022

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1 Project overview

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 Water Treatment Plant (WTP). The existing pipeline from Dungowan Showground to the Calala WTP is not part of the Dungowan Dam and pipeline project.

A summary of project elements is provided in Table 1.1. Subsequent chapters of this appendix provide a detailed description of these project elements (Chapter 3 to Chapter 6), the construction (Chapter 7) and operation (Chapter 8) of the project.

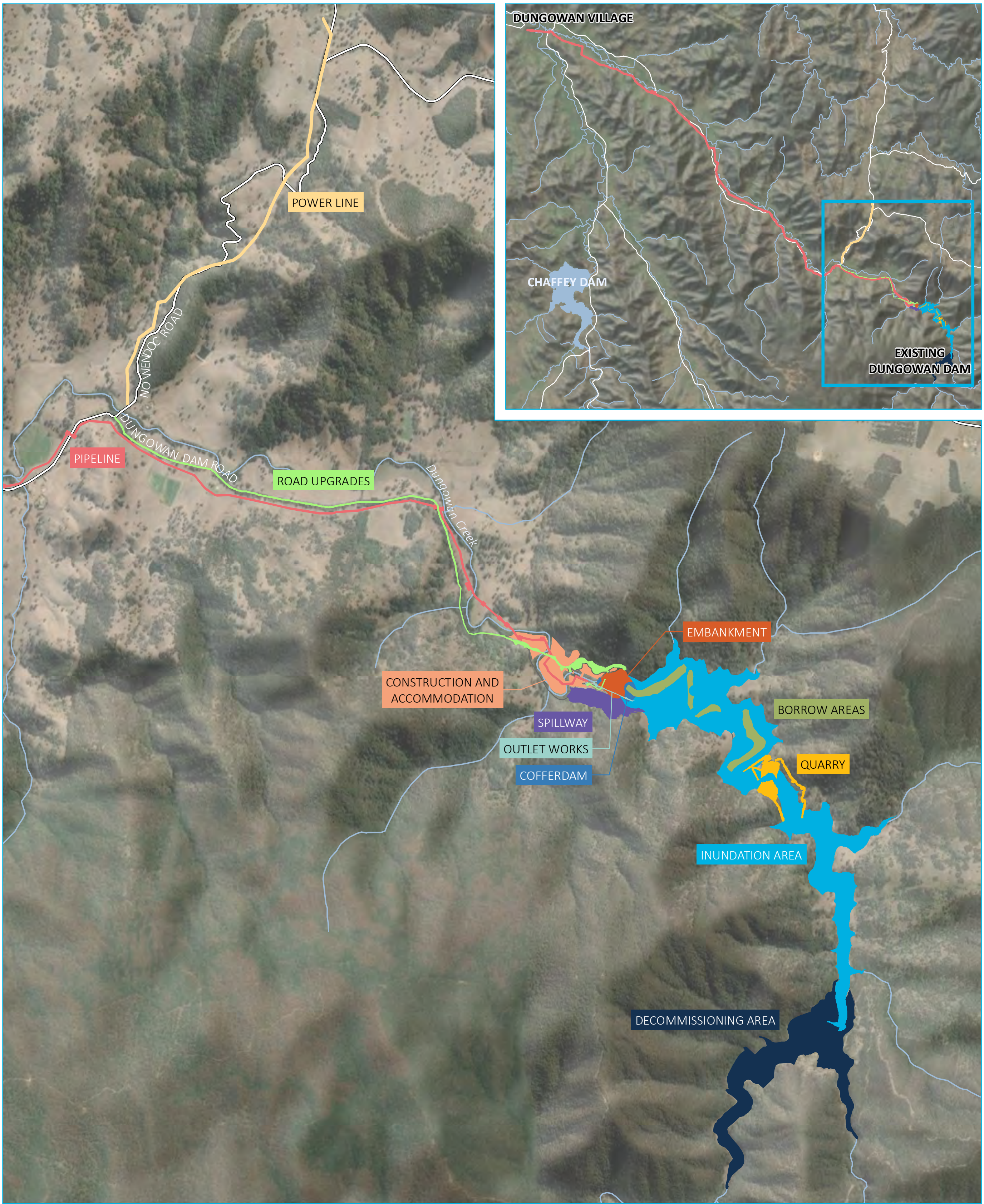
Table 1.1 Overview of the project

Project element	Summary of the project
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 660.2m 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 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.
	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 existing Dungowan Dam.

Table 1.1 Overview of the project

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	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. 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 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.

The description of the project is based on the concept design prepared by SMEC (2021) with the detailed design process currently underway. As such, while the key design elements are generally fixed, there are certain components of the project that may undergo some refinement (such as construction methodology) and micro-siting of the project infrastructure following further investigation and design.



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

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GDA 1994 MGA Zone 56
N

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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
Project description
Figure 1.1

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2 Project areas

In outlining the project, a project footprint has been defined to facilitate the assessment of direct impacts:

- 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.

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 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.

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.

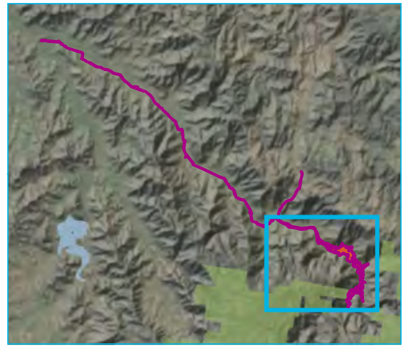
Impact areas for each key project element within the defined construction footprint (315 ha) and operational footprint (158 ha) are described in Table 2.1, noting that some overlap exists between the impact areas and as such the sum of the parts does not equal the total disturbance area for the project (315 ha).

Table 2.1 Project impact areas

Project impact areas	Area of impact (ha)	Definition
Construction		
Dam infrastructure	25	Area required to build the proposed permanent dam infrastructure including the spillway, embankment, cofferdams, diversion and outlet channel.
Pipeline	70	The replacement pipeline alignment, supporting infrastructure and adjacent work areas required to construct it.
Tree clearing within inundation area	54	The area within the reservoir where tree clearing is required. Note that trees would be cleared to stump height which would limit soil/ground disturbance.
Quarry and borrow areas	19	The quarries and borrow areas required to provide construction materials.
Defined construction ancillary areas	15	Areas required for activities supporting the project construction including the accommodation camp and construction compound.
Undefined (potential) construction ancillary areas	63	Area within the future inundation area that is outside the defined quarry, borrow and tree clearing areas but may be utilised during construction for access roads, laydown areas, stockpiles etc.
Powerline	8	The powerline upgrade adjacent to Nowendoc Road and the adjacent work areas required to construct it.
Dungowan Dam Road upgrade	6	The section of Dungowan Dam Road that would be upgraded between Ogunbil Road and the proposed embankment.
Decommissioning area	59	The area required for decommissioning and rehabilitation of the existing Dungowan Dam.
Operation		
Inundation area	130	The area that would be inundated by the reservoir up to the FSL.
Dam infrastructure	19	The proposed permanent dam infrastructure including the spillway, embankment, outlet works and permanent access roads.
Decommissioned existing Dungowan Dam	5	The remaining infrastructure following decommissioning and rehabilitation of the existing Dungowan Dam.
Powerline	8	The operational easement for the powerline upgrade adjacent to Nowendoc Road.
Pipeline	1	The operational footprint of the replacement pipeline, comprising control valve buildings and other ancillary surface elements (ie. scour valves, air valves and isolation valves)

Note. Overlap exists between the impact areas and as such the sum of the parts does not equal the total disturbance area for the project (315 ha).

The project construction footprint is shown in Figure 2.1 and the operational footprint in Figure 2.2.



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

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

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Construction footprint

Dungowan Dam and pipeline project
Project description
Figure 2.1a

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

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

Construction footprint

Dungowan Dam and pipeline project
Project description
Figure 2.1b

creating opportunities

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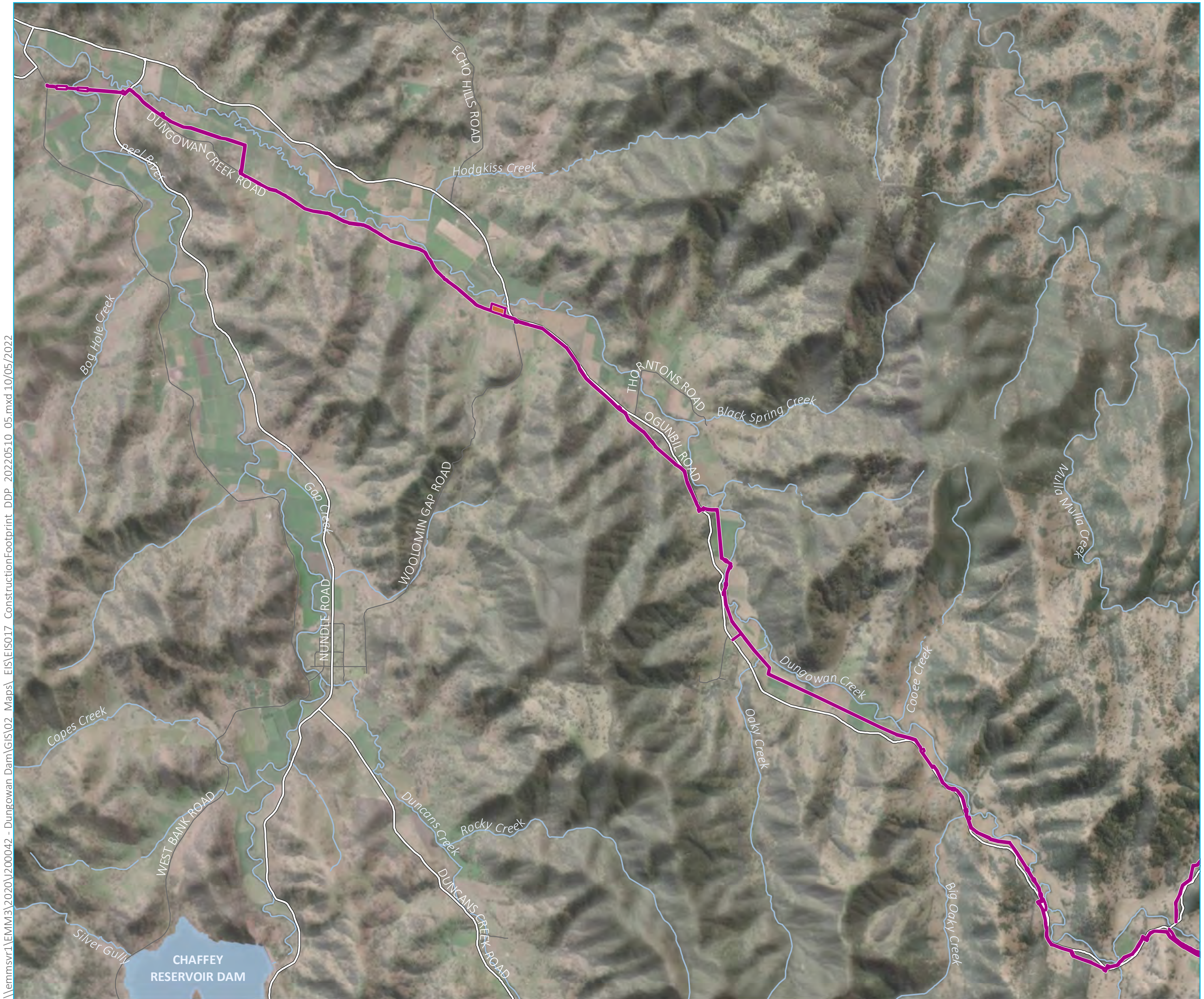

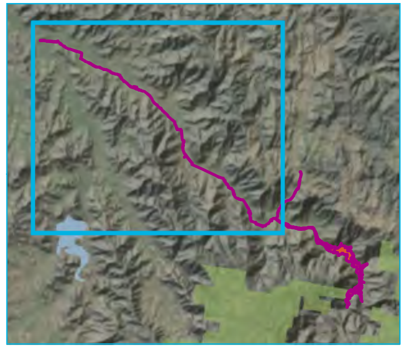

KEY
- Project footprint
- Construction footprint
- Major road
- Minor road
- Named watercourse
- Named waterbody

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

Construction footprint

Dungowan Dam and pipeline project
Project description
Figure 2.1c

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

Operational footprint

Dungowan Dam and pipeline project
Project description
Figure 2.2a

creating opportunities

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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 0.5 1 km

GDA 1994 MGA Zone 56

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Operational footprint

Dungowan Dam and pipeline project
Project description
Figure 2.2b

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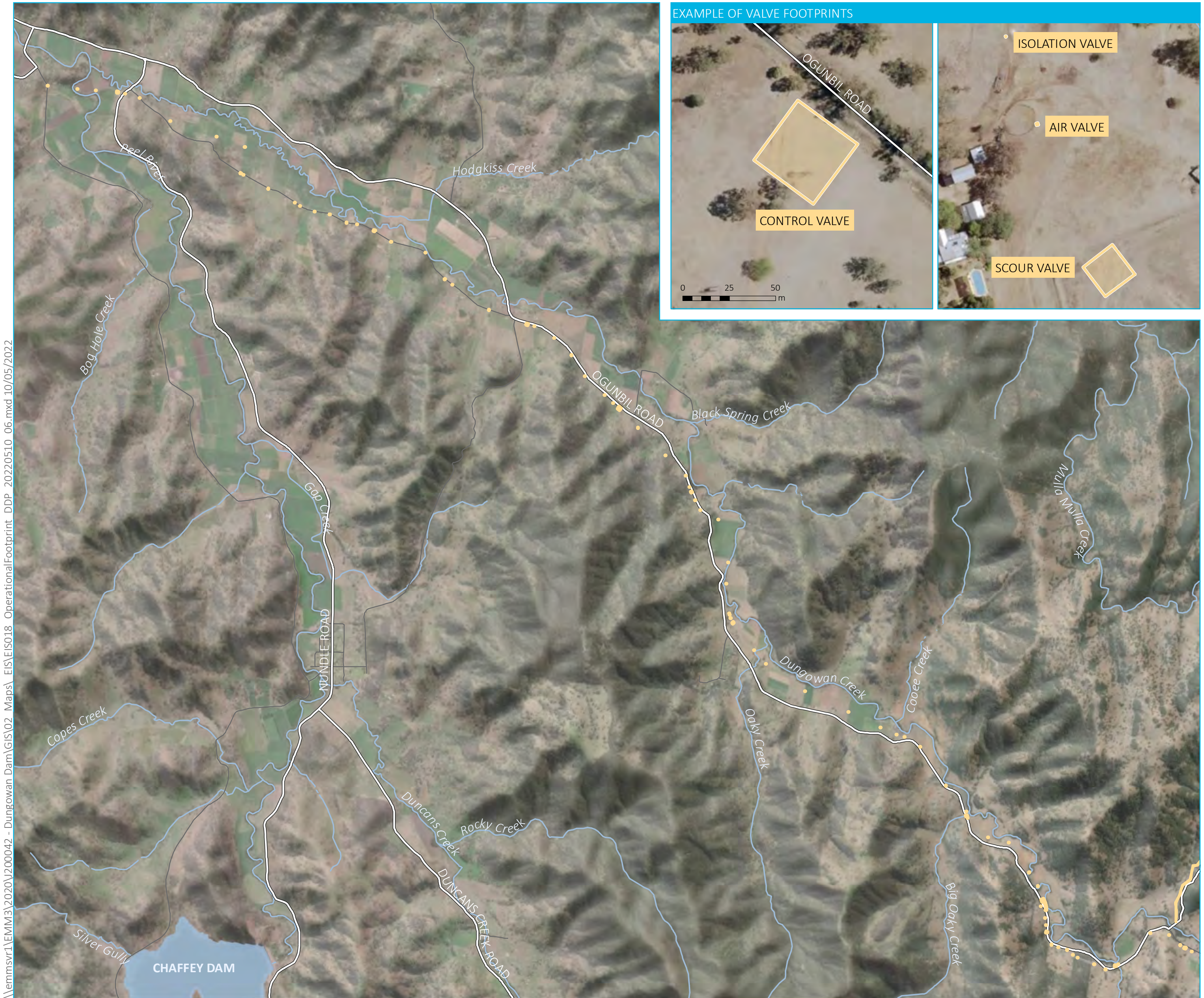

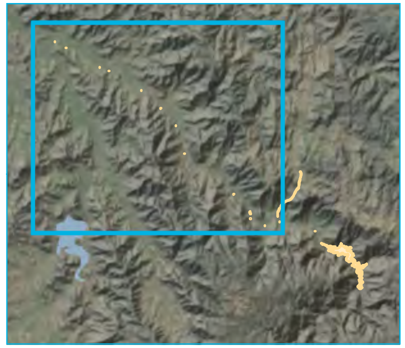

KEY
- Operational footprint
- Major road
- Minor road
- Named watercourse
- Named waterbody

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

0 1 2 km
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Operational footprint

Dungowan Dam and pipeline project
Project description
Figure 2.2c

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3 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 the following components:

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

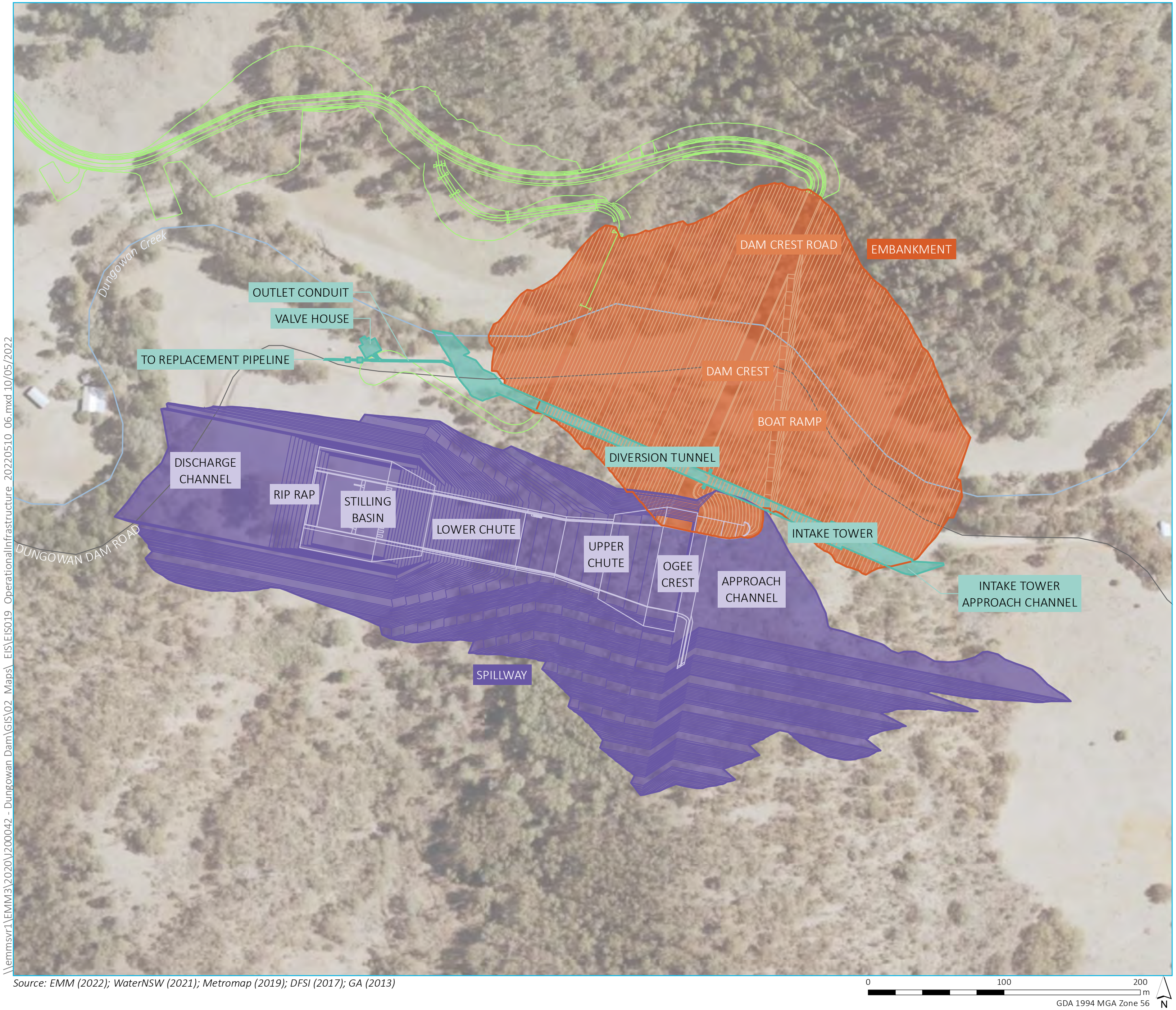
Dam safety and stability has been considered through the concept design and a dam safety assessment is provided in the EIS. Key design characteristics for the dam are summarised in Table 3.1. An overview of the Dungowan Dam operational infrastructure is provided in Figure 3.1.

Table 3.1 Dungowan Dam – key design characteristics

Design characteristic	Value
Embankment	
Crest elevation	672.3 mAHD
Maximum embankment height (measured at downstream toe)	58 m
Total embankment length	270 m
Full supply level (FSL)	660.2 mAHD
Minimum operating level (MOL)	620.0 mAHD
Crest width	10 m
Upstream rockfill embankment face slope	3.0H:1V
Downstream rockfill embankment face slope with benches	2.5H:1V
Upstream earth core slope	0.25H:1V
Downstream earth core slope	0.25H:1V
Total storage volume to FSL	22.5 GL
Active storage volume to FSL (above Minimum Operating Level)	22.2 GL
Embankment material volume	1.94 M m^3
Spillway	
Width	60 m at ogee crest, 40m at spillway chute
Peak outflow	5,244 m^3/s
Peak Headwater Level	671.74 mAHD
Outlet works	
Intake tower height	50 m

Table 3.1 Dungowan Dam – key design characteristics

Design characteristic	Value
Multiple (eight) intake port dimensions	1.2 m x 2.0 m
Outlet conduit	1.2 m diameter



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

Operational infrastructure

Dungowan Dam and pipeline project
Project description
Figure 3.1

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3.1 Cofferdam

Cofferdams would be established both upstream and downstream of the embankment (refer Figure 3.2) to allow the diversion of Dungowan Creek and to provide a relatively dry working environment during the construction of the dam infrastructure.

The upstream cofferdam would be an embankment with a maximum height of about 20 m. The crest of the upstream cofferdam would be 5 m wide and, like the main embankment, would have a low permeability clay core. The cofferdam core trench would be excavated to a moderately weathered rock horizon. Single stage filters would be placed upstream and downstream of the core. The upstream coffer dam is part of the upstream toe of the main embankment.

A downstream cofferdam would also be required to protect the downstream side of the dam from fluctuations in the tailwater water level at the outlet from the diversion tunnel (Section 3.2). The downstream cofferdam would be much smaller than the upstream cofferdam, at 5 m high at its maximum height. The downstream cofferdam would be constructed as part of the downstream toe of the main embankment and mainly comprise rockfill, with a temporary liner to the downstream face.

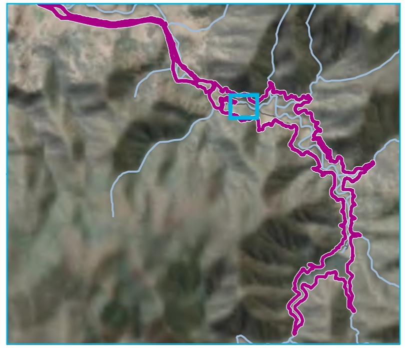
3.2 Diversion

Diversion of Dungowan Creek during construction of the dam would be required to transfer normal river and flood flows through the construction site. A diversion tunnel would be provided within the left abutment and is shown in Figure 3.2.

Upstream of the diversion tunnel an approach channel would be required to convey flow into the diversion tunnel. The approach channel would comprise reinforced concrete training walls and base slabs and incorporate the stoplog slots for the eventual closure and plugging at the base of the tower.

The diversion tunnel would also be used to accommodate a temporary bypass pipeline during the construction works to enable the continued supply of 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.

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.



KEY

- Project footprint
- Cofferdam
- Diversion channel
- Diversion tunnel
- Intake tower
- Temporary bypass pipeline

Existing environment

- Minor road
- Named watercourse

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

0 50 100 m
GDA 1994 MGA Zone 56
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Diversion and cofferdam infrastructure

Dungowan Dam and pipeline project
Project description
Figure 3.2

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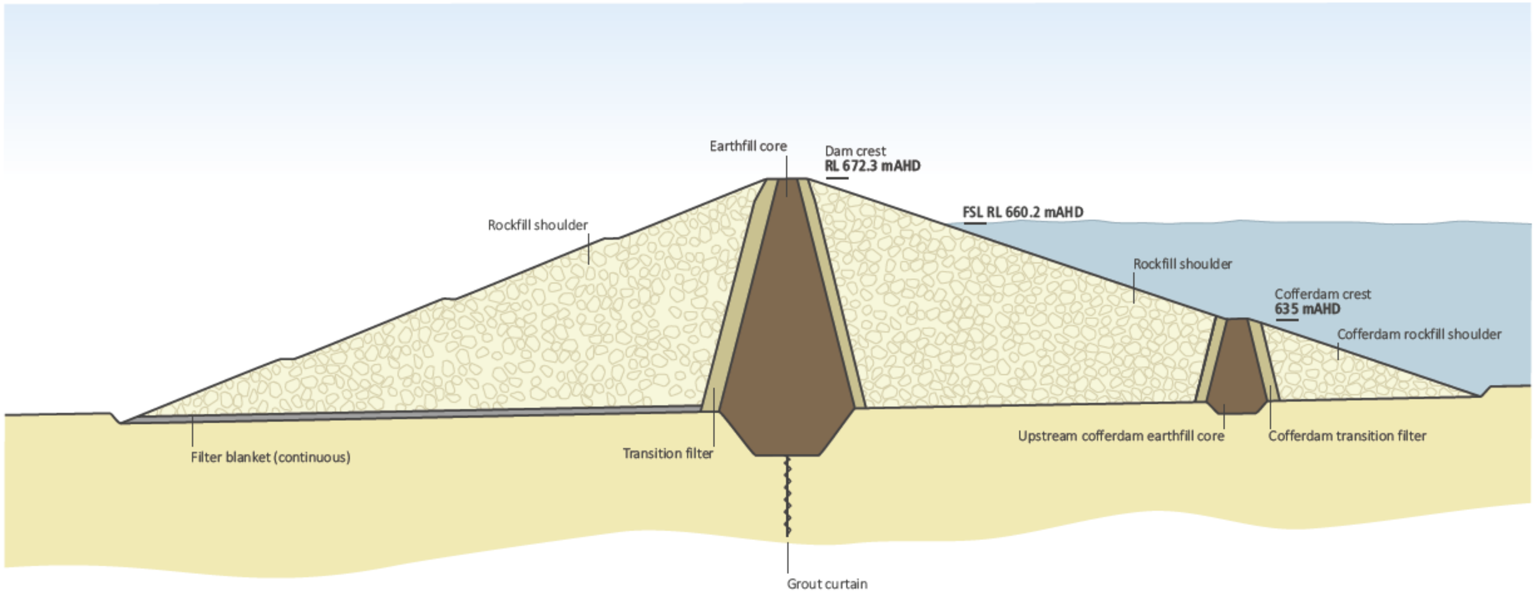
3.3 Dam wall embankment

The dam wall would consist of an earth and rockfill embankment built across Dungowan Creek and include the following elements:

- a central low permeability clay core
- separation filters on the upstream and downstream sides of the core
- rockfill shoulders on the upstream and downstream sides of the core to provide stability
- blanket filters under the downstream rockfill shoulder to control seepage
- rip rap placed on the upstream face to provide erosion protection against wave action
- crest capping and bitumen sealed road to protect the core and provide access to the dam facilities.

A cross-section showing the key elements of the dam wall embankment is provided in Figure 3.3.



Dam wall embankment elements

WINSW

Dungowan Dam project description

Figure 3.3

Figure 3.3 Dam wall embankment elements

3.4 Spillway

A spillway would be constructed on the left abutment of the dam wall embankment to provide the controlled release of flows when the reservoir is full. The spillway would comprise the following elements:

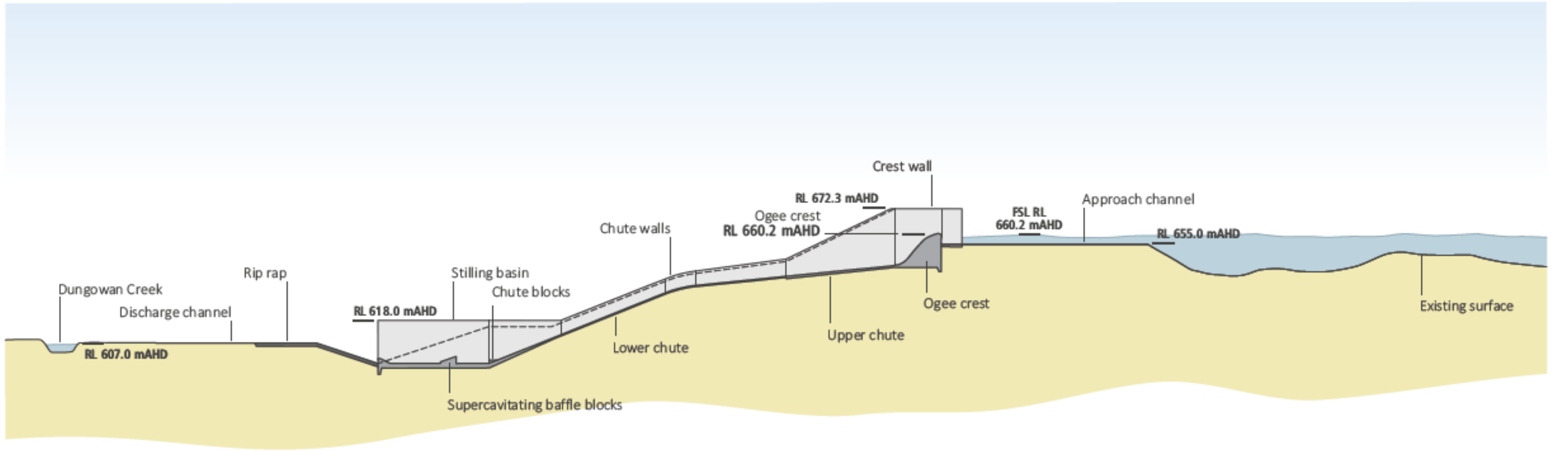
- an unlined approach channel;
- a hydraulically shaped sill (ogee crest), mass concrete control structure;
- an upper concrete-lined chute;
- a steeper, lower concrete-lined chute;
- a concrete stilling basin; and
- a discharge channel lined with grouted riprap (rock protection).

The spillway would generally comprise reinforced concrete walls and invert slabs to the chute, with the exception being the ogee crest spillway and side walls, which would largely be mass concrete (only nominal reinforcing to mitigate thermal effects). The spillway would be anchored to the foundation by a network of passive anchors along with an underdrainage system which would reduce uplift and increase structural stability.

The approach channel would be established to a depth of about 5 m below FSL with a varying width up to 70 m to provide optimal entrance conditions for the spillway. The upper chute, immediately downstream of the crest, would have a longitudinal grade of 10% and converging side walls. Immediately downstream of the narrowing spillway chute is the beginning of the 15 m long vertical curve which transitions the longitudinal slope from the gentle upper chute to the steeper lower chute with grade ranging between 40% to 50%.

Flow from the lower chute enters the stilling basin where the velocity would be dissipated before discharging into Dungowan Creek. The stilling basin consists of a 40 m wide and 54 m long United States Bureau of Reclamation (USBR) design, which is at the downstream end of the lower spillway chute and serves to reduce the speed of the flood flow and hence, erosion of the creek bed.

The proposed spillway elements are shown in Figure 3.4.



Spillway elements
WINSW
Dungowan Dam project description
Figure 3.4

Figure 3.4 Spillway elements

3.5 Outlet works

The outlet works would be required to enable water to be drawn from the reservoir for water supply and environmental releases. The outlet would also allow the reservoir level to be lowered if required to achieve operational safety. The key elements of the outlet works are:

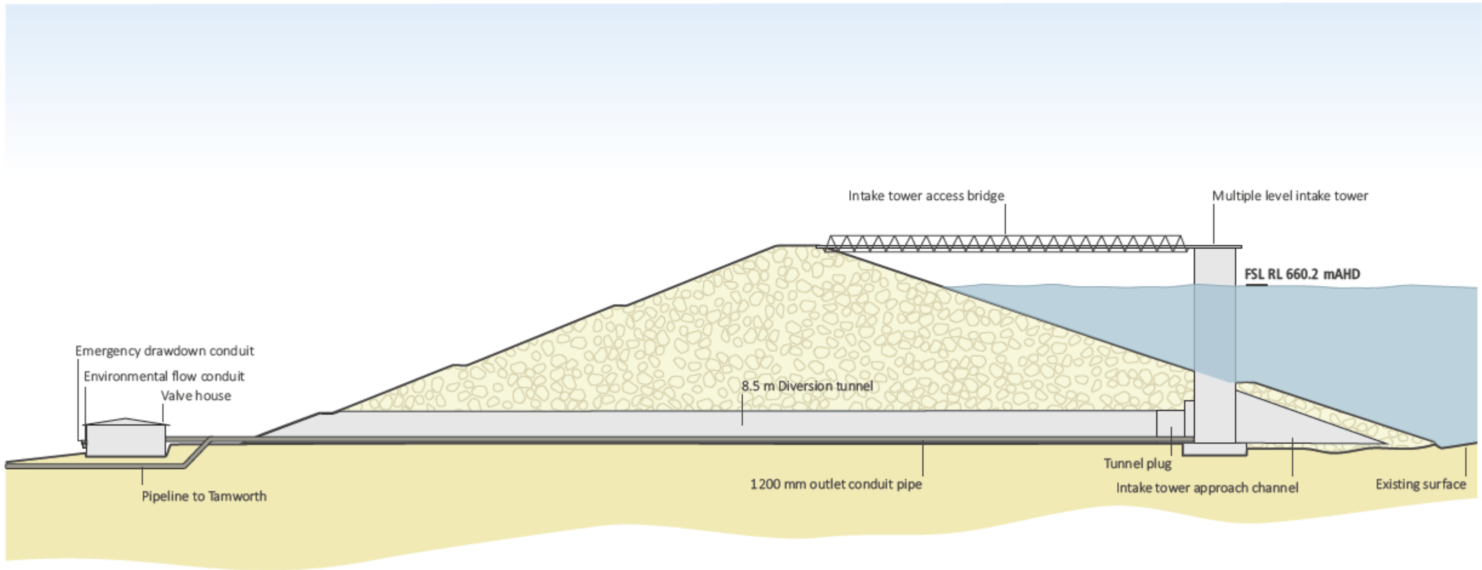
- multi-level intake tower - the tower provides the ability to selectively draw from different depths of the reservoir;
- outlet conduit - conveys water from the intake tower beneath the embankment; and
- valve house – provides the ability to control the outflow of the reservoir water and direct it to the relevant discharge point (ie Dungowan Creek or to the replacement pipeline).

The outlet works would be established within the left abutment and would be integrated with the diversion tunnel (Section 3.2). The intake tower would consist of a 'wet well' tower about 50 m high with intake portals through the concrete wall at multiple levels and flow controlled by gates at each level. The intake tower would comprise eight ports of about 1.2 m wide by 2.0 m high to enable water intake between MOL and FSL. The port sizing and spacing was selected to manage the project's cold water pollution impacts. Water would fill the tower through the selected intake(s) and charge the outlet conduit at the base of the tower. A guard gate within the tunnel immediately downstream of the tunnel plug would shut down flows to the outlet conduit, forming upstream control within the tunnel. The outlet conduit is a pipe beneath the embankment within the diversion tunnel (required for construction purposes but retained during operation). The pipe would be about 1,200 mm in diameter and has been designed to convey water for environmental flows, future water supply needs and operational drawdown.

The valve house pipework, valves and control system provide the ability to regulate the outflow of the reservoir water and direct it to the relevant discharge points. The valve house would comprise the following pipework to facilitate downstream releases:

- outlet conduit – entering the valve house from the outlet tunnel;
- emergency drawdown pipeline – the drawdown pipeline enables the drawdown of the reservoir for operational safety and larger environmental contingency allowance releases; and
- environmental flow pipe – enables release of environmental flows to Dungowan Creek.

The outlet works are shown in Figure 3.5.



Outlet works elements
WINSW
Dungowan Dam project description
Figure 3.5

Figure 3.5 Outlet works elements

4 Pipeline infrastructure

The existing Dungowan pipeline (between Dungowan Dam and Dungowan Showground) 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, that was replaced in 2022. The tie in point is located near the Dungowan Showground.

The new Dungowan Dam pipeline would provide augmented capacity to deliver about 71 ML/day. The new Dungowan Dam pipeline is shown in Figure 4.1 and would comprise the following elements:

- 31.6 km of high-density polyethylene (HDPE) pipe between 710 mm to 900 mm internal diameter;
- valve infrastructure to control flows, pressure and facilitate maintenance and emergency management; and
- communications and power infrastructure to facilitate the control of water flows and information transfer from Dungowan Dam.

During construction of the new Dungowan Dam and replacement delivery pipeline, a temporary bypass pipeline would be established through the dam construction area to ensure continued supply of water from the existing Dungowan Dam to the Calala WTP. Further details of the temporary bypass pipeline are provided in Section 3.2.

Once the new Dungowan Dam and pipeline are commissioned, the existing pipeline and temporary bypass would be decommissioned. Intake infrastructure to the pipeline forms part of the proposed dam outlet works and would include screening, flow isolation, flow monitoring and associated control system.

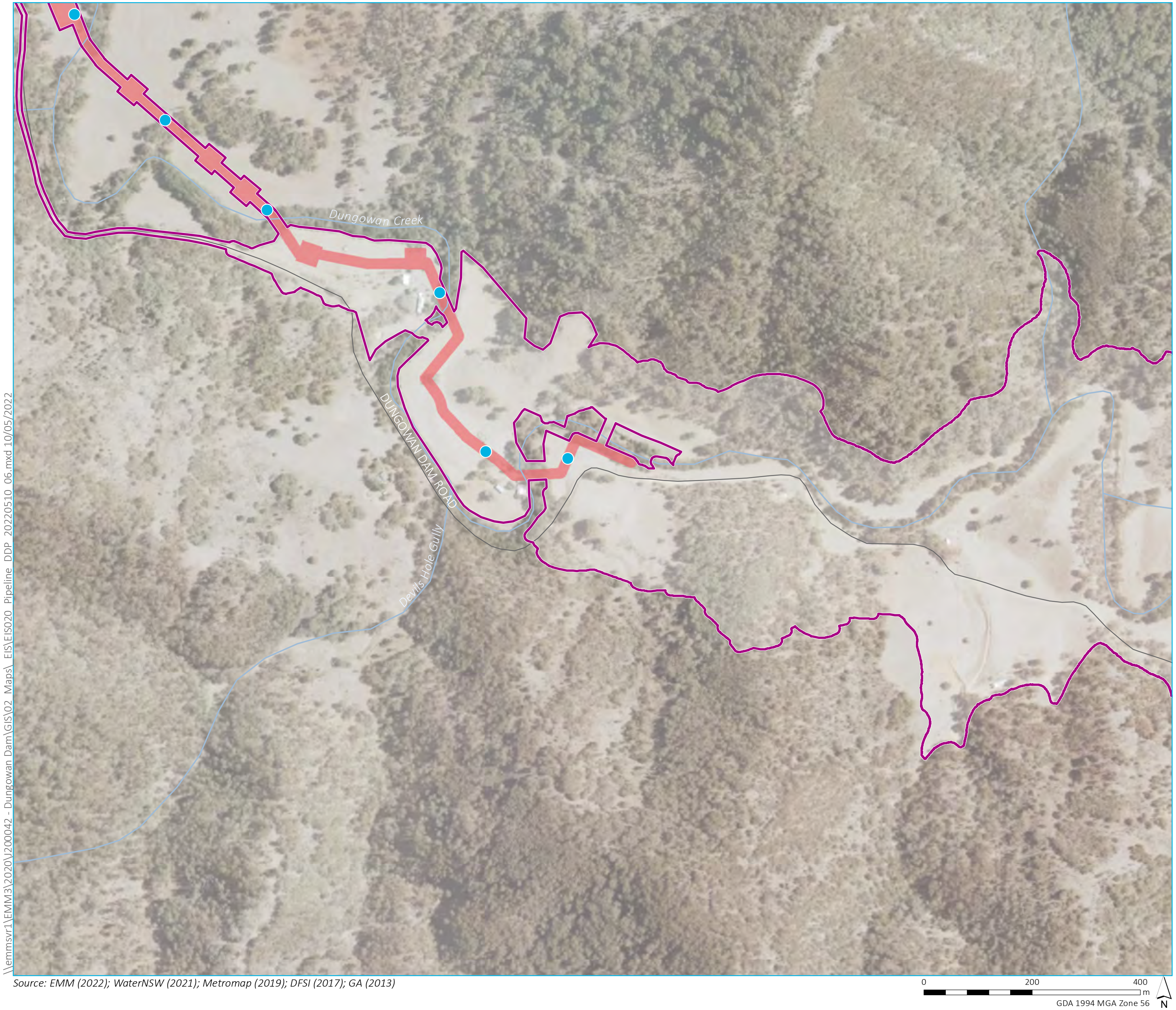
4.1.1 Pipeline design

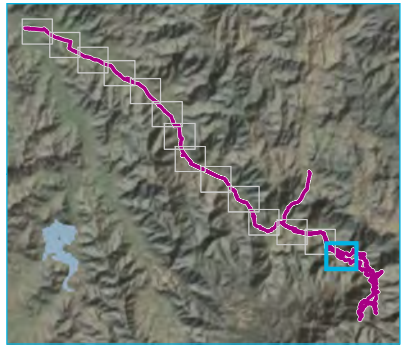
Analysis undertaken as part of investigations for the concept design showed that the existing average day demand for the Dungowan system is about 18 ML/day. Factoring in a high growth scenario for the region until 2041 and based on a supply over 22 hours per day, a design flowrate of 71 ML/day has been adopted for the proposed Dungowan system. Based on the available static head and the design flowrate, the pipe size for the pipeline will be between 710 mm and 900 mm internal diameter.

The type of pipelines typically used in Australia for large diameter water pipelines include:

- mild steel cement lined (MSCL), externally coated with medium density polyethylene and internally cement lined;
- ductile iron cement lined (DICL);
- high density polyethylene (HDPE); and
- glass-fibre reinforced plastic (GRP).

The concept design and final design is based on a HDPE pipeline. This type of pipeline is durable, cost effective and robust for high pressure operations required for the project.





KEY
Project footprint
Air valve
Pipeline construction footprint
Existing environment
Minor road
Named watercourse

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

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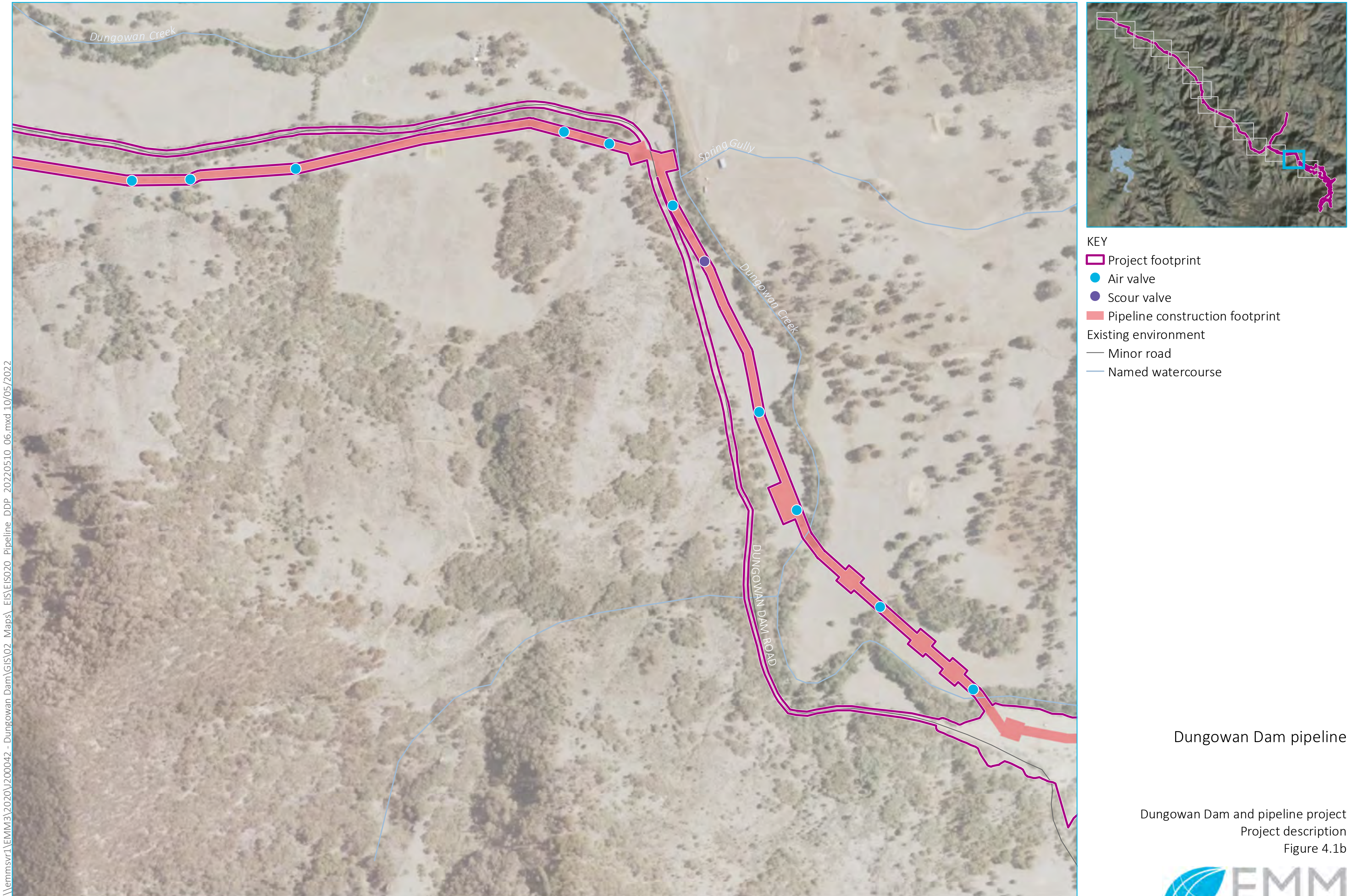
Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1a

EMM
creating opportunities



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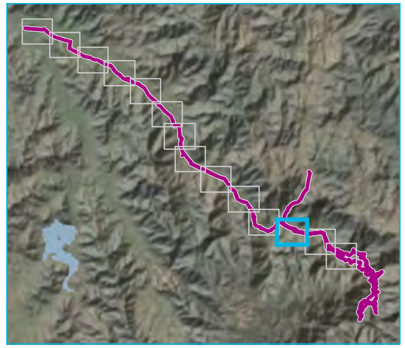
Source: EMM (2022); WaterNSW (2021); Metromap (2019); DFSI (2017); GA (2013)

Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1b

EMM
creating opportunities



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

Existing environment
- Major road
- Minor road
- Named watercourse

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

0 200 400
m
GDA 1994 MGA Zone 56
N

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Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1c

EMM
creating opportunities

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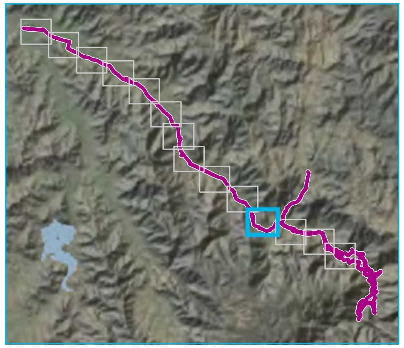
Source: EMM (2022); WaterNSW (2021); Metromap (2019); DFSI (2017); GA (2013)



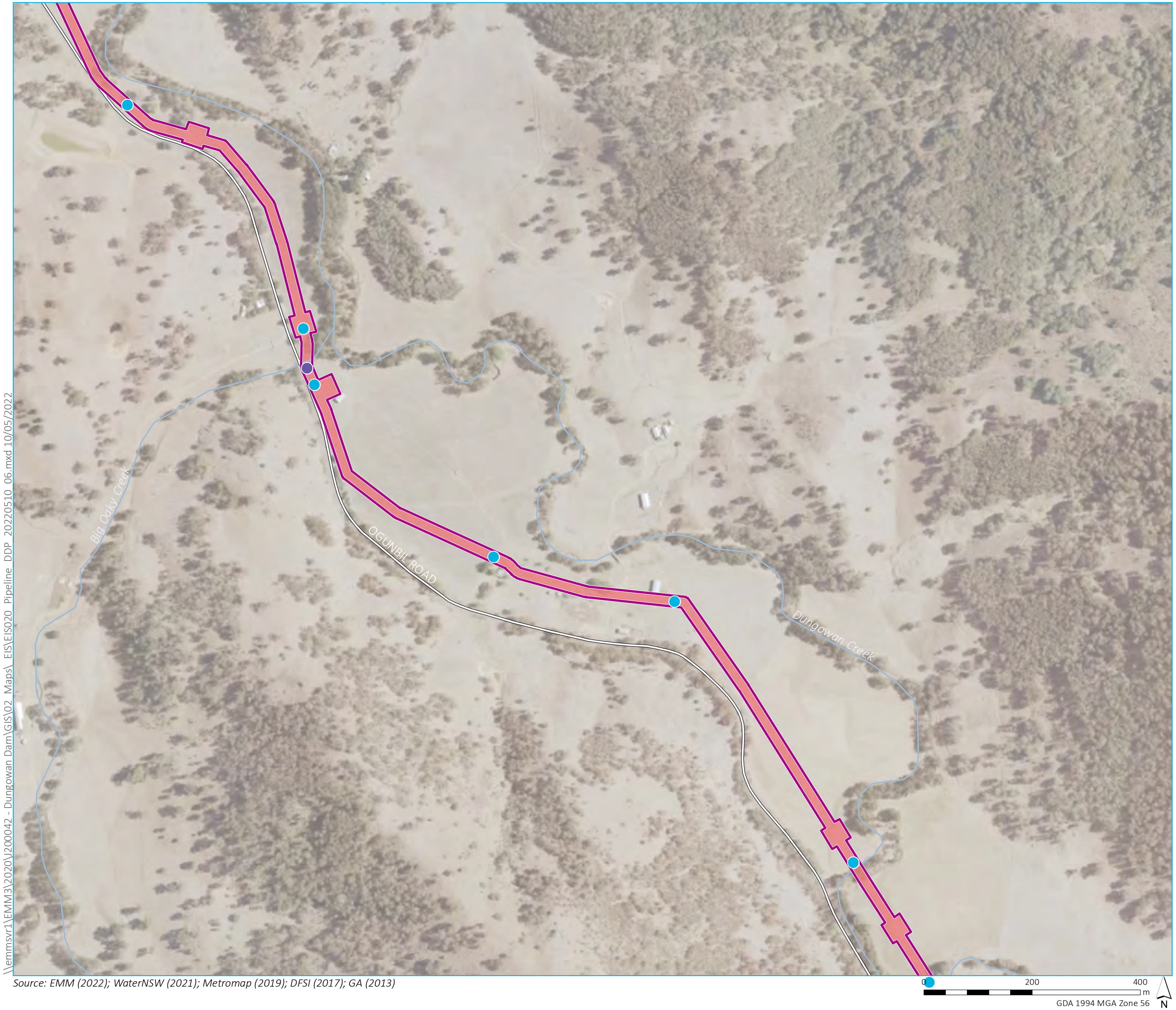
KEY
- Project footprint
- Air valve
- Control valve
- Scour valve
- Pipeline construction footprint
- Control valve footprint

Existing environment
- Major road
- Named watercourse

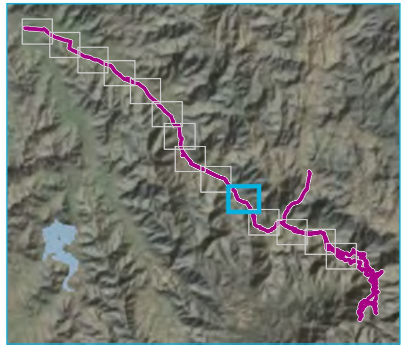
Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1d

EMM
creating opportunities



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



KEY

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

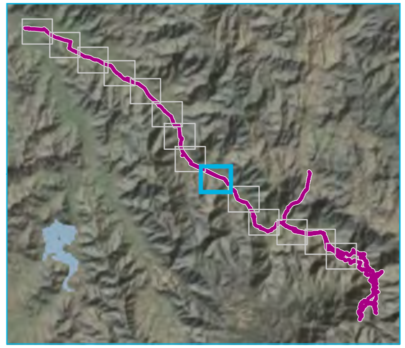
Existing environment

- Major road
- Named watercourse

Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1e

\\emmsvr1\EMM3\2020\200042 - Dungowan Dam\GIS\02 Maps\ EIS\EIS020 Pipeline DDP 20220510 06.mxd 10/05/2022



KEY
- Project footprint
- Air valve
- Isolation valve
- Pipeline construction footprint

Existing environment
- Major road
- Named watercourse

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

0 200 400 m

GDA 1994 MGA Zone 56

N

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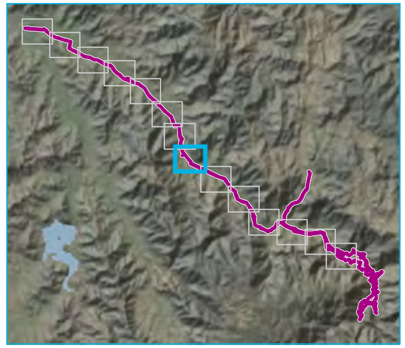
Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1f

EMM
creating opportunities



KEY

Project footprint

Air valve

Isolation valve

Scour valve

Pipeline construction footprint

Existing environment

Major road

Minor road

Named watercourse

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

0 200 400 m

GDA 1994 MGA Zone 56

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Dungowan Dam pipeline

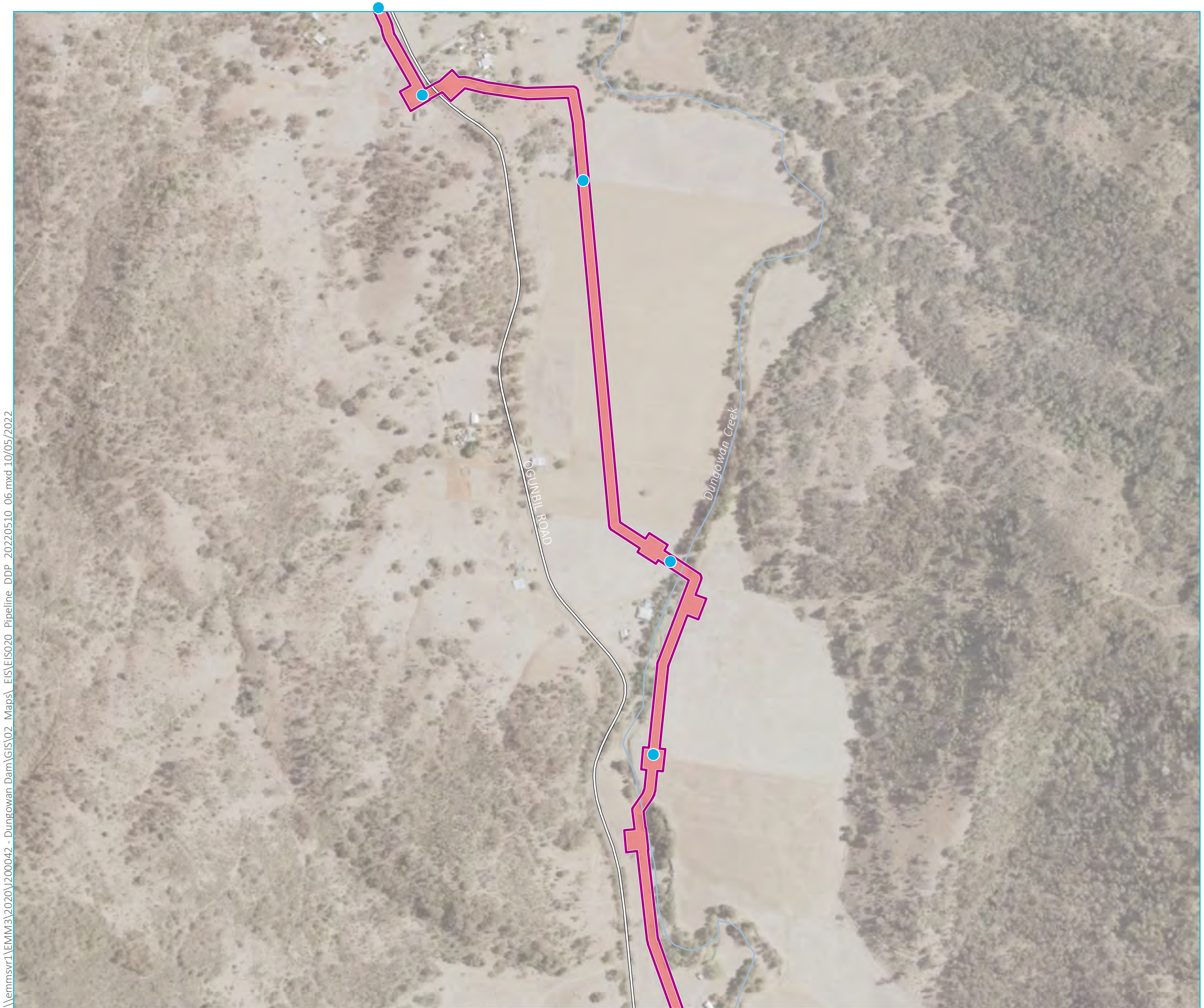
Dungowan Dam and pipeline project

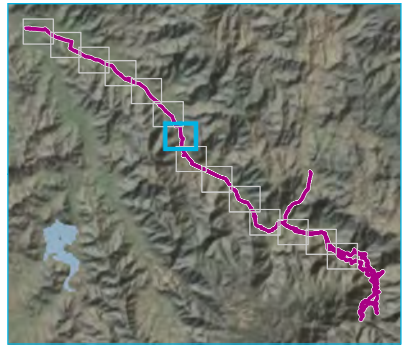
Project description

Figure 4.1g

EMM

creating opportunities





KEY
Project footprint
Air valve
Pipeline construction footprint
Existing environment
Major road
Named watercourse

Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1h

EMM creating opportunities

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

0 200 400 m
GDA 1994 MGA Zone 56
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KEY

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

Existing environment

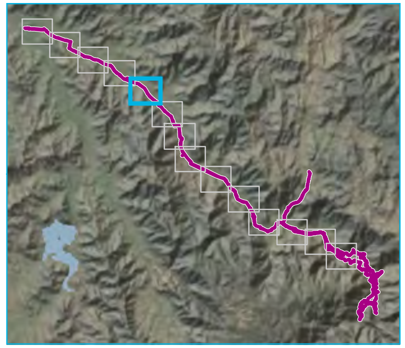
- Major road
- Minor road
- Named watercourse

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

Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1i

EMM creating opportunities



KEY
- Project footprint
- Air valve
- Control valve
- Scour valve
- Pipeline construction footprint
- Control valve footprint
- Compound/laydown area

Existing environment
- Major road
- Minor road
- Named watercourse

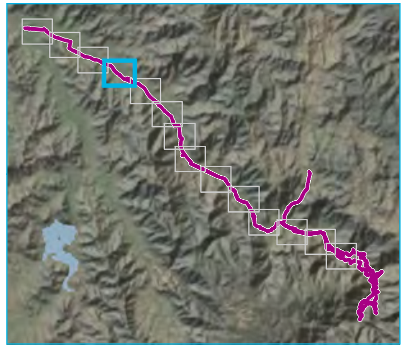
\\emmsvr1\EMM3\2020\J200042 - Dungowan Dam\GIS\02_Maps_EIS\EIS020_Pipeline_DDP_20220510_06.mxd 10/05/2022

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

Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1j

creating opportunities



KEY
- Project footprint
- Air valve
- Isolation valve
- Pipeline construction footprint
- Compound/laydown area

Existing environment
- Major road
- Minor road
- Named watercourse

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

0 200 400 m

GDA 1994 MGA Zone 56

N

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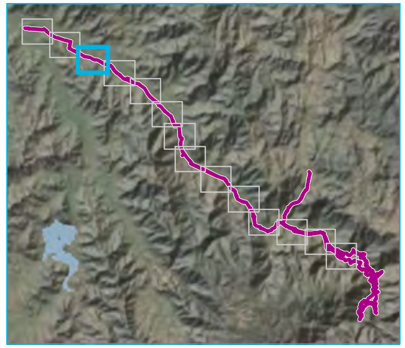
Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1k

EMM
creating opportunities



KEY
Project footprint
Air valve
Scour valve
Pipeline construction footprint
Existing environment
Major road
Minor road
Named watercourse

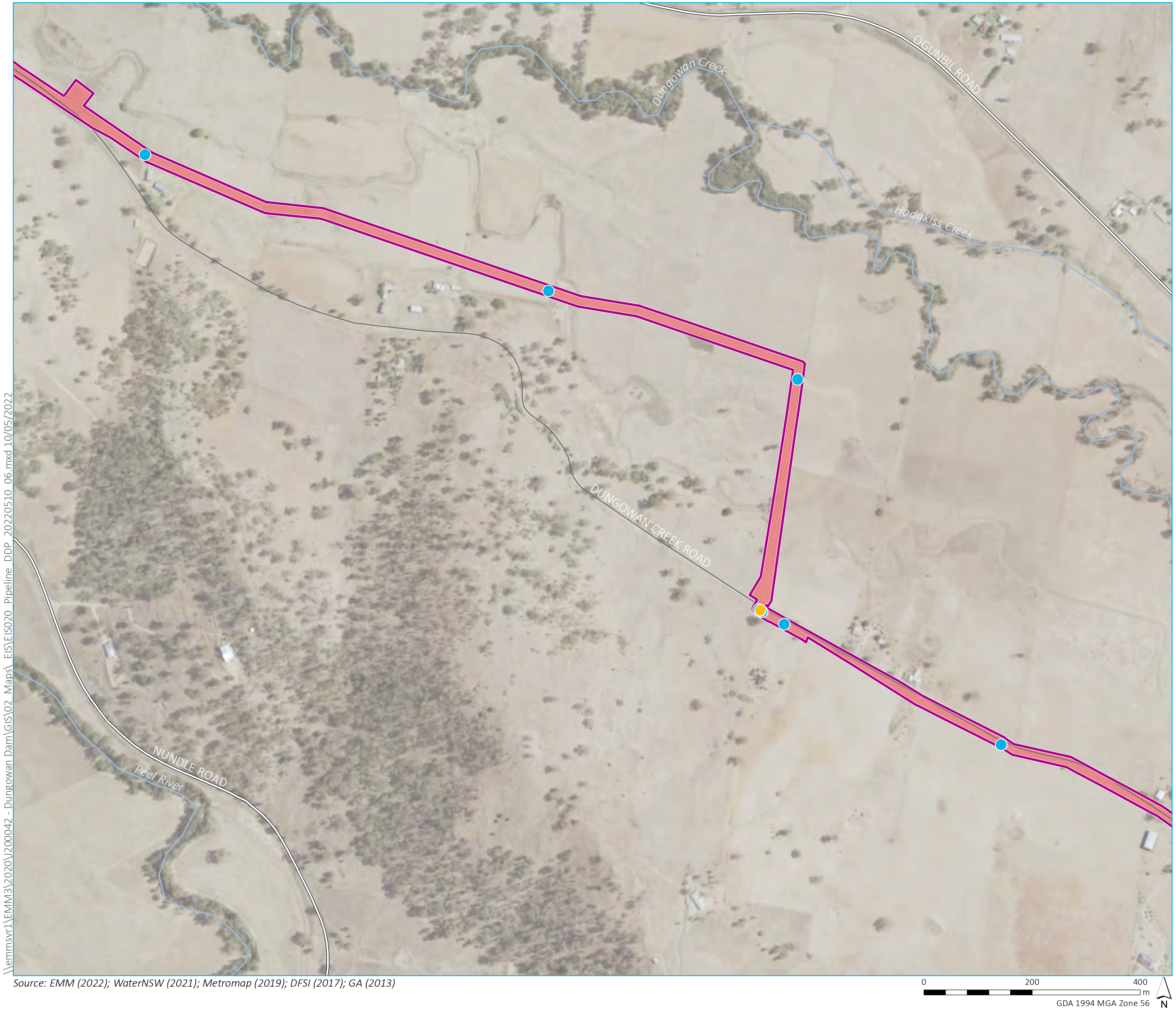
Source: EMM (2022); WaterNSW (2021); Metromap (2019); DFSI (2017); GA (2013)

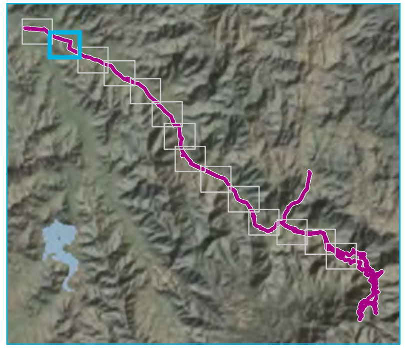
\\emmsvr1\EMM3\2020\J200042 - Dungowan Dam\GIS\02_Maps_EIS\EIS020_Pipeline_DDP_20220510_06.mxd 10/05/2022

Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1l

EMM
creating opportunities





KEY

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

Existing environment

- Major road
- Minor road
- Named watercourse

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

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Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1m

EMM creating opportunities

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

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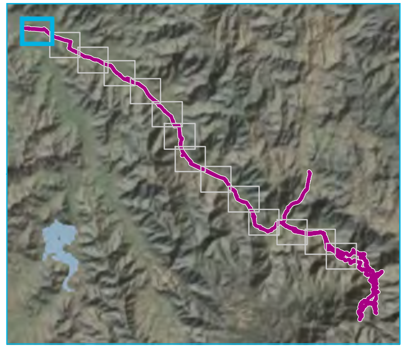

KEY

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

Existing environment

- Major road
- Minor road
- Named watercourse

Dungowan Dam pipeline

Dungowan Dam and pipeline project
Project description
Figure 4.1n

EMM
creating opportunities

4.1.2 Valves

Valve infrastructure is required along the length of the replacement pipeline to control flows, pressure and facilitate maintenance and emergency management. The types of valves required are listed below.

- Control valves. Due to the elevation difference of about 300 m between the new Dungowan Dam and Calala WTP, control valves would be installed in two above ground buildings along the pipeline to reduce pressure. Control valves would be housed in approximately 8.1 m x 6.4 m x 3.5 m high Colourbond sheds surrounded by security fencing. An example of the proposed control valve structure is shown in Photograph 4.1.

- Isolation valves would be installed at 5 km intervals to allow sections of the pipeline to be isolated for repair and maintenance.

- Scour valves are also required at the low points of the pipeline to release water in the event of emergencies or maintenance. Such events are not common and only expected to be utilised to release water in rare circumstances.

- Air valves would be installed along the pipeline at high points and maximum spacings of approximately 800 m to facilitate release of accumulated air or inflow of air when the pipe is drained during scouring operation.

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 valves would typically be up to approximately 1.5 m^2 in size and would be required to be accessed throughout operation. A typical air valve arrangement with both above and ground level infrastructure is shown in Figure 4.2.

The proposed locations of the control, scour, isolation and air valves are detailed in Figure 4.1.

Photograph 4.1 Example of control valve structure

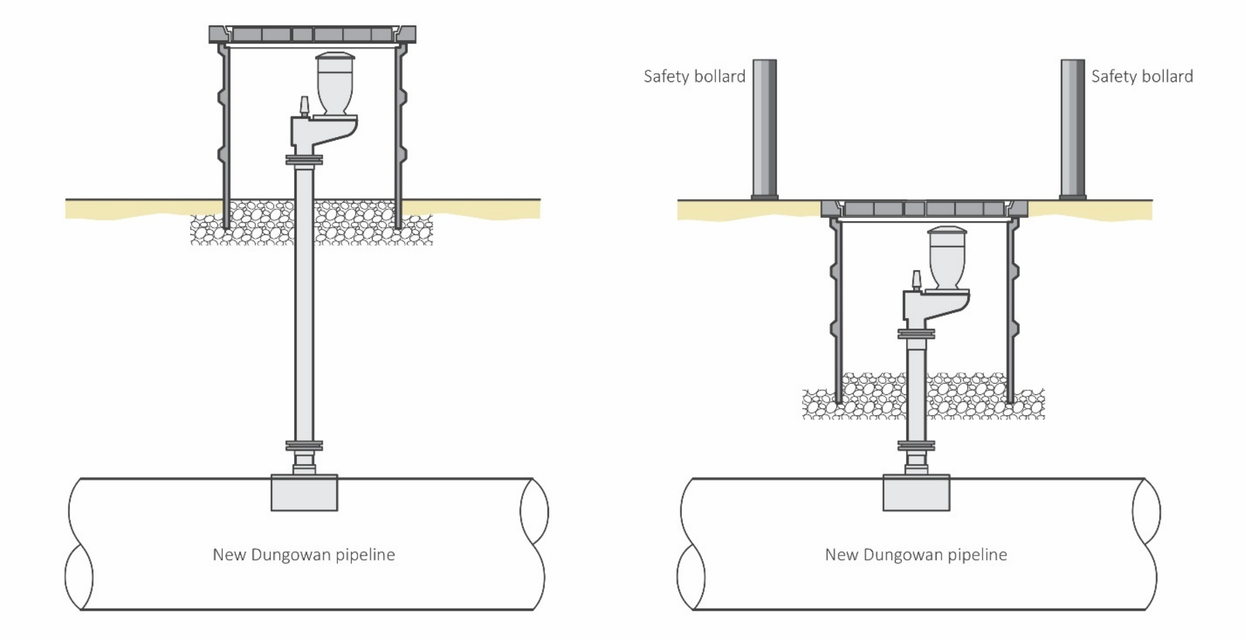

Figure 4.2 Typical air valve arrangements

4.1.3 Customer connections

The current 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. These existing customers would continue to be supplied raw water through the replacement pipeline, either through tapping into existing customer connections (ie 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 connection points 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 20mm copper pipe running directly from the replacement raw water pipeline to an above ground meter assembly located on private property. A typical connection arrangement is provided in Figure 4.3.

The existing raw water pipeline would remain in situ but would not be utilised to supply raw water once the replacement pipeline is commissioned.

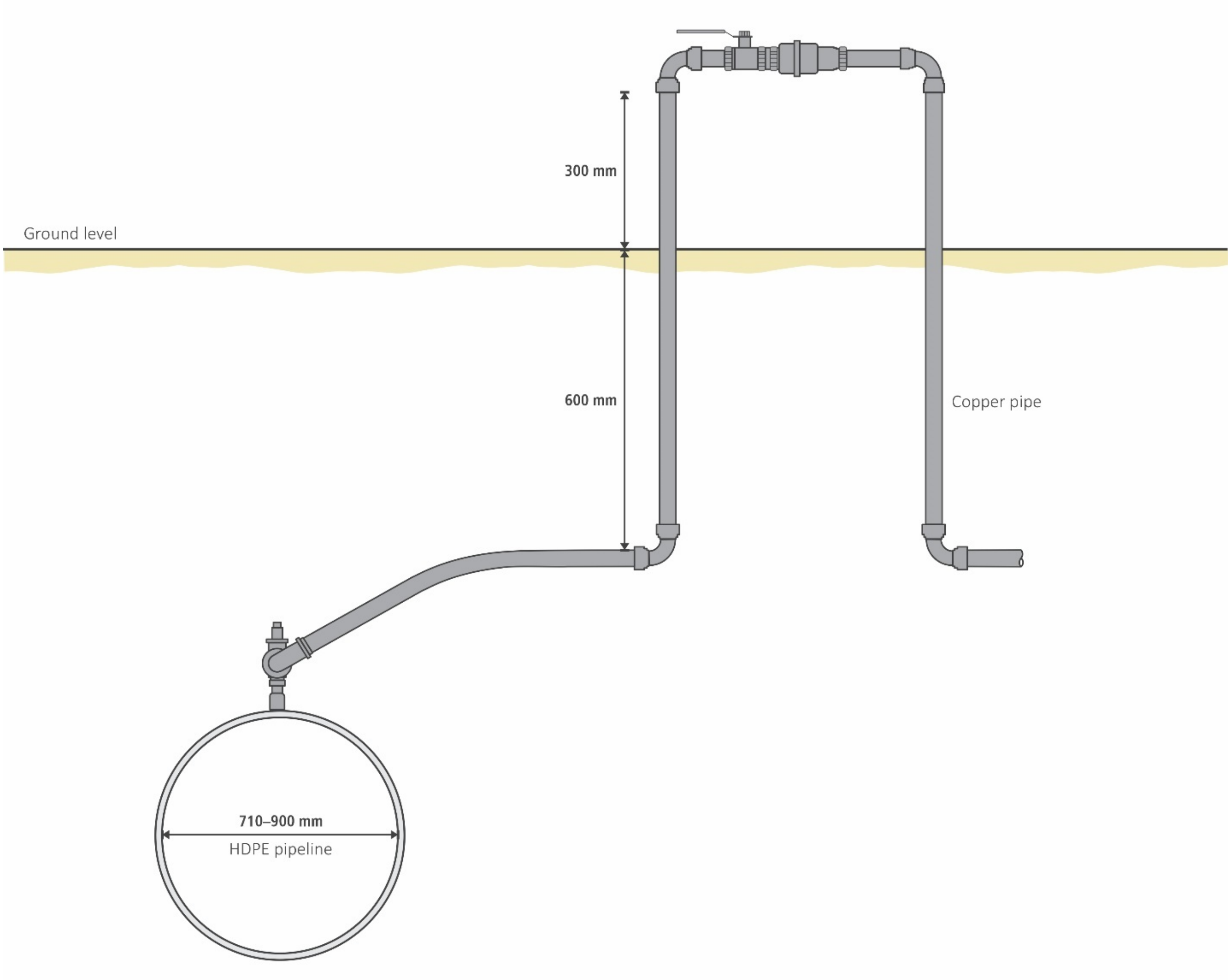

Figure 4.3 Typical customer connection arrangement

5 Ancillary infrastructure and works

5.1 Construction ancillary infrastructure

Several ancillary facilities and activities are required to enable the construction of the permanent infrastructure described in the previous sections. This section provides a description of the temporary infrastructure and activities proposed to enable the construction of the project.

5.1.1 Accommodation camp

An accommodation camp is proposed to provide accommodation for about 140 workers. The accommodation camp would be adjacent to the dam construction compound, with both facilities having a combined footprint of about 12.5 ha. The accommodation camp would be operational throughout the project construction and would provide facilities for the overnight accommodation of workers including: 140 single storey units, central facilities, stormwater detention/quality treatment, maintenance areas, bus and car parking. Further details regarding the project workforce are provided in Section 7.8.2.

The accommodation camp area would be cleared of vegetation and earthworks would include cut and fill to ensure a level site area. Once the camp is no longer required for the project construction it would be de-commissioned and rehabilitated. The proposed accommodation camp is shown in Figure 5.1.

5.1.2 Construction compounds

A construction compound would be located adjacent to the dam wall embankment to support the project's construction activities. 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.

The dam construction compound area would be cleared of vegetation and earthworks would include cut and fill to ensure a level site area. Once the construction compound is no longer required for the project construction it would be de-commissioned and rehabilitated.

The proposed construction compound would be sited adjacent to the dam wall and is shown in Figure 5.1.

A construction compound has also been identified for potential use by the pipeline construction contractor and is detailed in Figure 4.1k. 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 materials, equipment or pipe sections.

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

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Construction compound and accomodation camp

Dungowan Dam and pipeline project
Project description
Figure 5.1

EMM creating opportunities

5.1.3 Construction materials

Construction materials would be sourced from a combination of the following locations:

- re-use of excavated material generated during establishment of the project infrastructure including the spillway, embankment foundations and pipeline trench;
- existing commercial sources;
- two quarries within the proposed inundation area; and
- four soil and clay borrow areas within the proposed inundation area.

In total about 2.1 million m^3 of construction materials would be required with the majority to be sourced from the excavation for the spillway. The final sources of construction materials would be determined through further geotechnical investigations, with the re-use of material generated by the project excavations being the preferred source for all construction materials. Specialised materials from existing commercial sources and the two dedicated new quarries would be used to supplement excavated material volumes as required. The following section provides a description of the proposed new quarries.

i Quarries

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 and are shown in Figure 5.2. The proposed quarries would provide up to a total of about 240,000 m^3 of construction materials. It is expected that only one of the quarries is needed for the project, however further geotechnical investigations are required to identify which of the quarries would be used. Quarrying would occur over about two years with an average production of about 10,000 m^3 per month.

Rock would be quarried using drill and blast techniques with materials then crushed, screened and stockpiled in the quarry pit. Details of blasting procedures to be implemented during construction are provided in the noise and vibration impact assessment appended to the EIS. Materials sourced from the quarry would be hauled by trucks using the project access roads to the construction sites.

ii Borrow areas

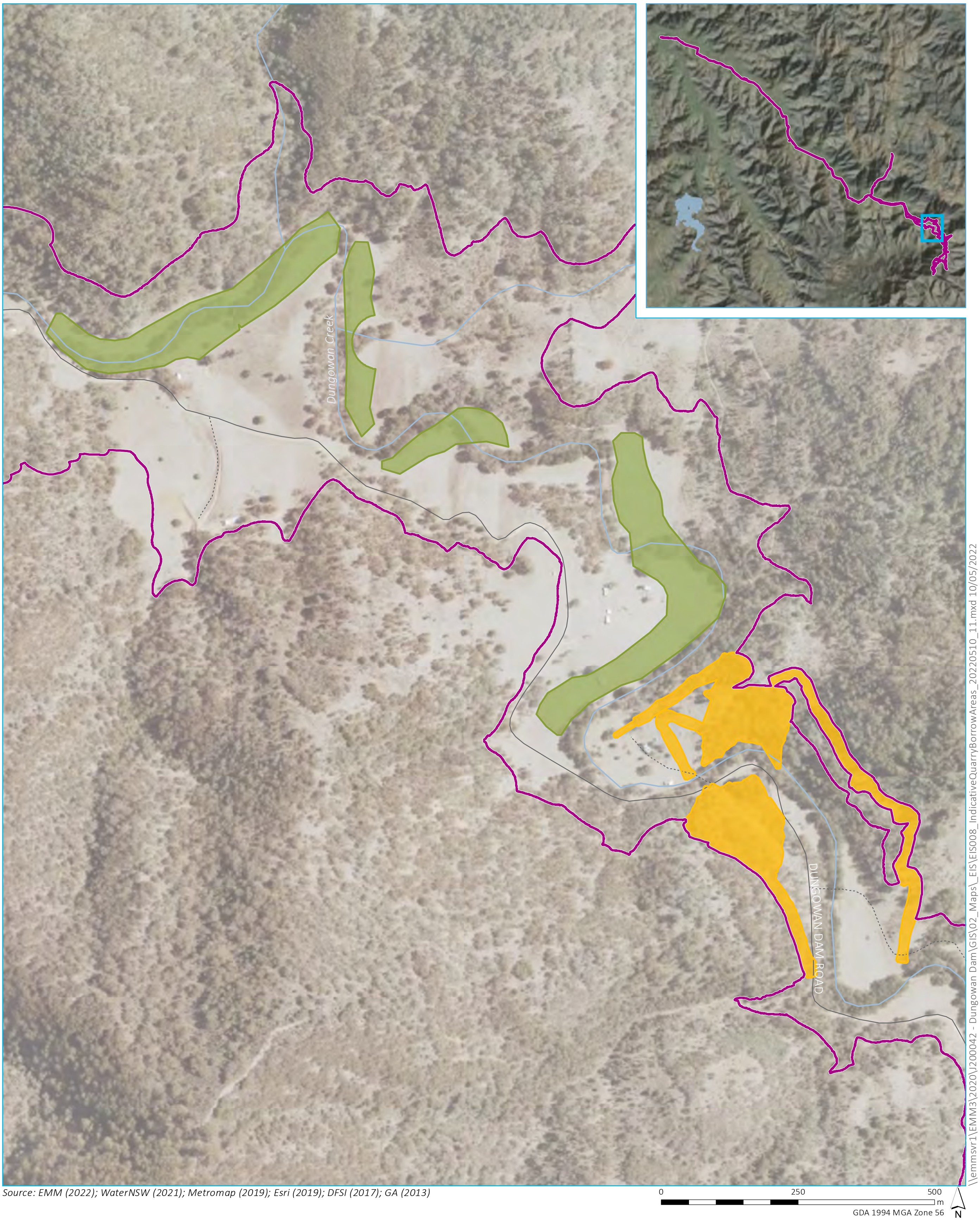
Up to four borrow areas would provide low permeability material (silt and clay) for the project construction. The borrow areas have been sited entirely within the inundation area to reduce the project footprint and associated impacts. The borrow areas are shown in Figure 5.2. The borrow areas would provide up to about 200,000 m^3 of construction materials. Silt and clay would be excavated and stockpiled before transport to the construction sites. The materials from the borrow areas would primarily be used in the embankment core.

5.1.4 Construction utilities supply

Raw water would be required during construction for the embankment and spillway works and operation of the concrete batching plant. Water for construction would be stored in temporary ponds in the future inundation area until the upstream coffer dam is constructed. Water would then be stored behind the upstream cofferdam. It is assumed water would initially be required from the existing Dungowan Dam, but the majority would be from rainfall captured behind the coffer dam. Water would be sourced from upstream of the cofferdam via a temporary intake pipeline that would be reticulated throughout the construction footprint. An estimate of the project’s water use is provided in Section 7.8.4iv.

Drinking water would be required for the workforce at the accommodation camp and construction compounds. The 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 to provide construction power where construction areas are not yet connected to the main power supply.



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

KEY

- Project footprint
- Borrow areas
- Quarry

Existing environment

- Minor road
- Vehicular track
- Named watercourse
- Named waterbody

Indicative quarry and borrow areas

Dungowan Dam and pipeline project
Project description
Figure 5.2

EMM
creating opportunities

5.2 Access roads

New access roads and access road upgrades are required to allow construction and operational access to the project. The following sections provide a description of the proposed new and upgraded access road works.

5.2.1 Dungowan Dam Road

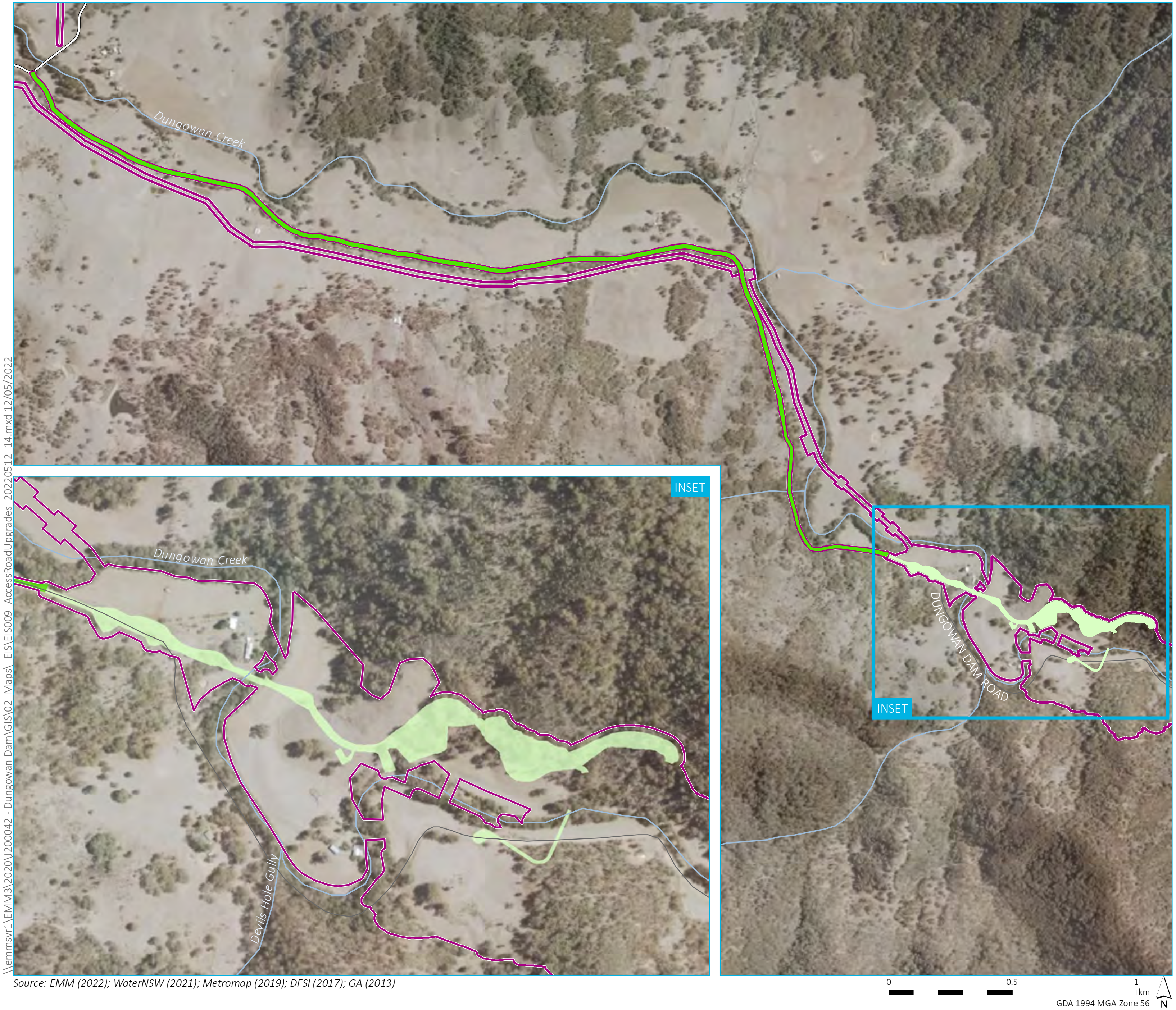
Dungowan Dam Road would be the main access and haul road for the construction and operation of the new Dungowan Dam. Upgrading and widening of Dungowan Dam Road from Ogunbil Road to the proposed new dam access road would be required to ensure the safe use by construction vehicles and local residents. The road upgrade would involve widening to 8 m where practical along about 3.5 km of the 5 km length of road. In the sections where the road cannot be widened, sight distance would be improved and pull over areas would be established. The entire length of the road may also be re-surfaced to mitigate dust and damage to the road. This road upgrade is shown in Figure 5.3.

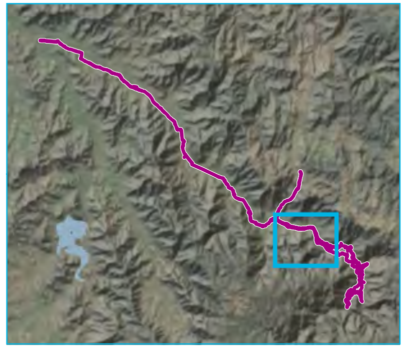
5.2.2 Dam crest access road

A new road would be constructed to provide permanent access to the proposed dam crest. The new road would provide private access only and would cross Dungowan Creek downstream of the dam site to allow access from the right (northern) abutment of the dam. The permanent access would require a bridge over the creek and a two-way, two lane, sealed road to the dam crest suitable for heavy vehicles. Access to the left abutment of the dam and spillway would be via the dam crest and intermediate berms (benches) on the downstream face of the dam. The new dam access road is shown in Figure 5.3.

5.2.3 Temporary access to existing Dungowan Dam

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 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 as described in Section 6. 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.





KEY
- Project footprint
- Road upgrade
- New access road

Existing environment
- Major road
- Minor road
- Named watercourse
- Named waterbody

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

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Proposed access road upgrades

Dungowan Dam and pipeline project
Project description
Figure 5.3

EMM creating opportunities

5.3 Services provision and relocation

5.3.1 Power

Permanent electrical supply would be required for the new Dungowan Dam operational infrastructure. Power would be supplied to the valve house and to the dam crest from existing 11 kV overhead powerlines on Dungowan Dam Road.

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 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.

Discussion with Essential Energy is ongoing to confirm connection requirements. However, the preferred option for maintaining power supply to the Niangala area is by establishing a new 11 kV overhead line including a new easement and access track (approx. 4.2 km) and connecting it with the existing overhead line to the Niangala area (approx. 13.2km). The existing overhead line would potentially require some minor upgrade works including re-stringing of new overhead wiring and replacement of some poles. The powerline upgrades are shown in Figure 5.4.

5.3.2 Communications

A fibre optic cable to provide communications to the proposed dam would be established within the alignment of the replacement pipeline (ie within the same trench). A backup communication system based on 4GX would also be provided at each of the control valve buildings, which would include aerials up to 10m high.

This system would provide a communications interface between the WaterNSW control system and the Tamworth Regional Council control system that would transfer information such as flows from each source and water quality information.

5.3.3 Water

During construction of the new Dungowan Dam and replacement pipeline, a temporary bypass pipeline (Section 3.2) would be established through the dam construction area to ensure the continued supply of water from the existing dam to downstream customers.

Interruptions to the supply of raw water to customers would be limited to around three periods of about 24-48 hours. These periods would be the connection of the existing pipeline to the replacement pipeline just downstream of the new dam embankment, connection of temporary bypass pipeline and the connection of the dam outlet conduit to the replacement pipeline during dam commissioning.

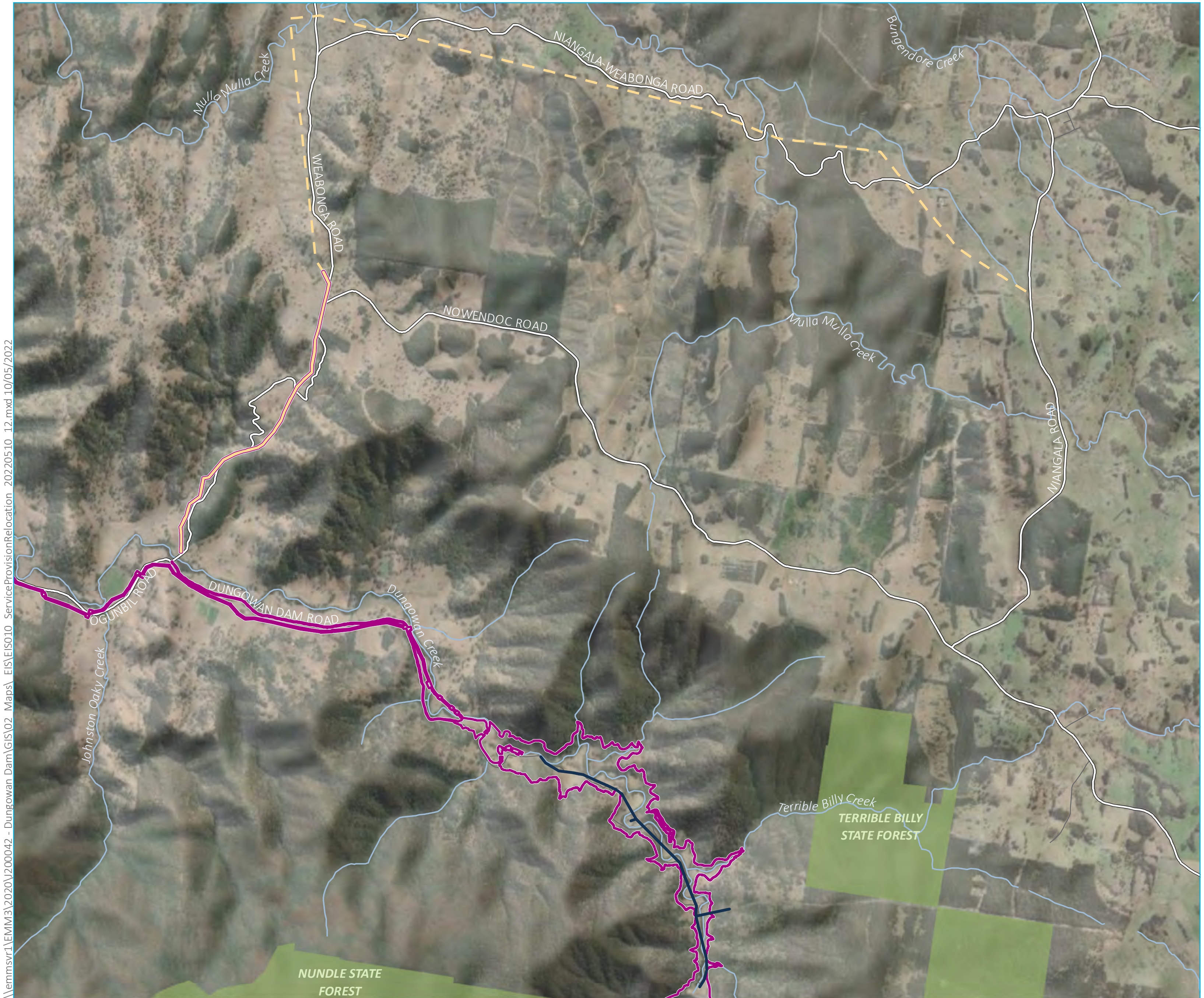
5.4 Supporting infrastructure

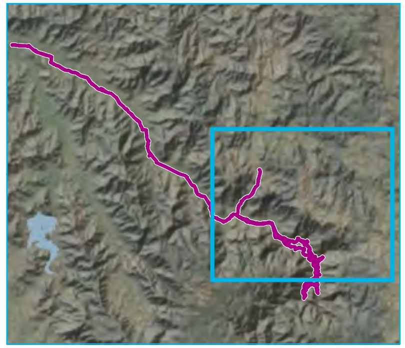
5.4.1 Site security

The primary purpose of the dam is for potable water supply. Public use and access to the dam would not be permitted and there would be no public facilities available at the new Dungowan Dam site. Access to the site would be restricted to WaterNSW staff and their contractors by a fence at all access points.

5.4.2 Boat ramp

A boat ramp would provide operational and maintenance staff access to Dungowan Dam and would consist of a single lane concrete access ramp located on the upstream face of the embankment adjacent the spillway approach channel. The boat ramp is shown in Figure 3.1.





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

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Project footprint
- Existing power line to be decommissioned
- Potential upgrade to existing overhead powerline
- Power line footprint

Existing environment

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

Indicative service provision and relocation

Dungowan Dam and pipeline project
Project description
Figure 5.4

EMM
creating opportunities

6 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 (Photograph 6.1 and Photograph 6.2), which would effectively restore run of river flows. Decommissioning work would not start until the new Dungowan Dam is substantively complete.

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; and
- rehabilitate the catchment within the inundation area of the existing dam below the FSL (682.8 mAHD).

The indicative decommissioning works are shown in Figure 6.1.

Photograph 6.1 Existing Dungowan Dam upstream face of embankment

Photograph 6.2 Existing Dungowan Dam spillway chute and downstream face of embankment

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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
Project description
Figure 6.1

EMM
creating opportunities

6.1 Full height breach

The full height breach would involve excavating the existing embankment to the natural creek bed level. The primary purpose of the full height breach is to eliminate the upstream pool created by the existing dam, thus eliminating the potential dam safety risk of cascade failure.

Key features of the full height breach channel required to decommission the existing dam include:

- 70 m wide channel with an approximate longitudinal slope of 1V:60H;
- upstream invert level of 659 mAHD with downstream invert level of 655 mAHD at the creek (about 120 m downstream of the existing stilling basin);
- 1V:2.5H cut face slopes back to natural surface or backfilling of low points to blend channel into valley profile;
- excess material to be profiled in a stockpile upstream, rehabilitated within the old reservoir (Section 6.4);
- topsoil and grass protection on the channel floor and batters; and
- minor rock protection in critical sections of the channel.

The design of the embankment breach has been developed to restore the original shape and geometry of the valley, which was interpreted from the original design drawings of the existing dam. The embankment breach would restore run of the river flows, resulting in the water levels within the embankment breach channel rising and falling with variations in the creek flow. Erosion protection would include grassing the channel and providing some relatively small sized rock in critical areas. Stripping and reuse of the upstream rip rap layer on the existing embankment would be completed to provide erosion protection in the channel.

6.2 Other decommissioning activities

In addition to the main breach of the embankment, the existing dam decommissioning would include the following ancillary works:

- demolition of the intake tower;
- outlet tunnel decommissioning (by concreting/grouting);
- demolition of primary spillway gate (including salvage);
- demolition of downstream buildings;
- demolition of remaining concrete; and
- reshaping and contour abutments.

6.3 Spoil and waste management

The full height breach excavation would generate about 300,000 m^3 of material that would be disposed as part of the existing dam decommissioning. Spoil material 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; and
- any excess spoil would be placed in a profiled placement area within the former inundation area of the existing dam.

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.

Based on the bathymetric survey undertaken of the existing inundation area, the excess spoil is expected to be placed 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 6.1). 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. A typical section of the profiled placement area is presented in Figure 6.2.

Concrete rubble from the demolition works would also be disposed of in the proposed spoil placement area and would be placed in discrete layers along with embankment material and entombed in the final profiled placement area.

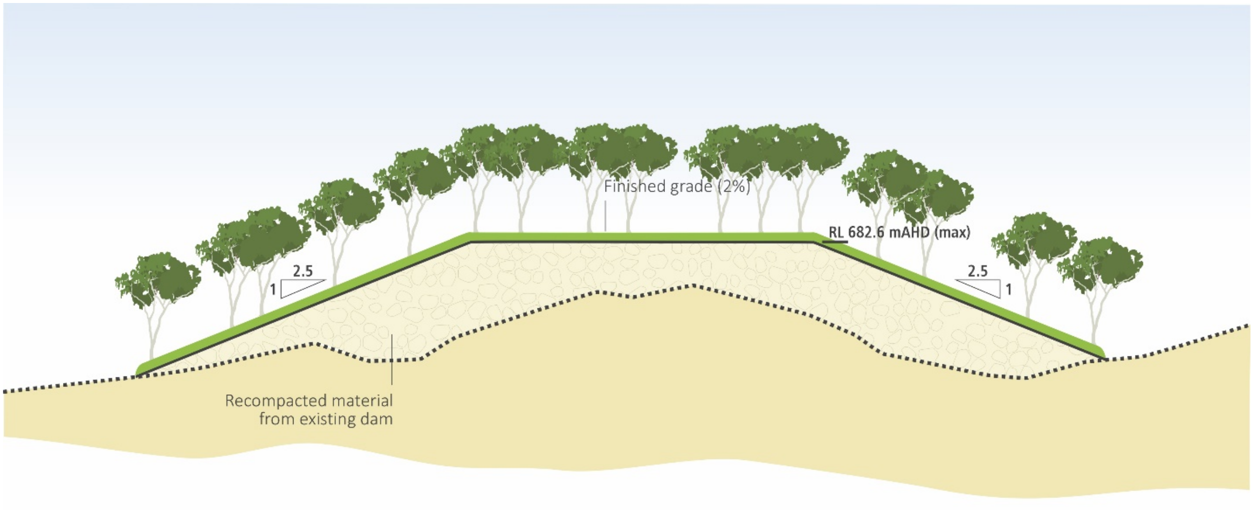


Figure 6.2 Schematic section of profiled placement area

6.4 Rehabilitation

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 existing inundation area below the current FSL of the existing dam, 682.8 mAHD. A detailed rehabilitation plan would be prepared and a total area of about 59 ha would be revegetated.

7 Construction

This section provides a summary of the main construction methods that would be used to establish the project.

7.1 Construction staging and sequencing

The key steps to constructing the new Dungowan Dam and pipeline include:

- relocating services and structures affected by the FSL and construction works;
- mobilisation and construction of the ancillary infrastructure including the construction of accommodation camp, construction compounds and quarries;
- construction of the pipeline infrastructure;
- construction of access roads, coffer dams and diversion;
- construction of the embankment, spillway and outlet works; and
- decommissioning works at the existing Dungowan Dam.

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 7.1.

7.2 Mobilisation

7.2.1 Pre-construction

Prior to construction of any of the project elements, site-based pre-construction activities would be undertaken as outlined below:

- each of the project elements would be surveyed and the extent of the approved construction footprint clearly identified and marked;
- Aboriginal heritage salvage works and/or other environmental investigations or monitoring that may be required would be completed;
- environmental avoidance areas would be identified and marked within the approved construction footprint;
- geotechnical investigations likely to have no more than a minor environmental impact such as rock core drilling and test pits may be carried out within the construction footprint; and
- any ground disturbance or vegetation clearing associated with the pre-construction activities would require the installation of appropriate stormwater and diversion drainage and erosion and sedimentation control works prior to works.

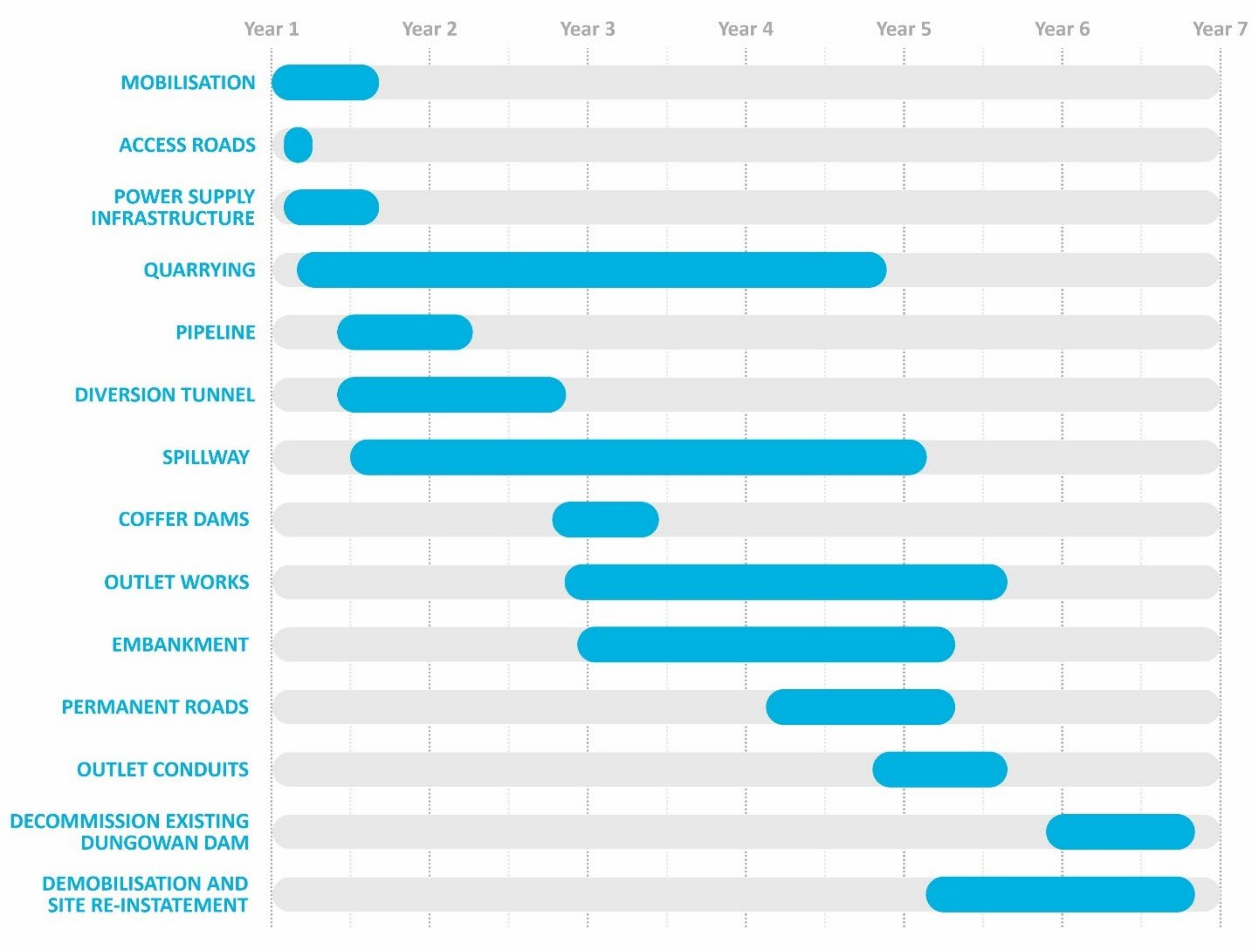


Figure 7.1 Indicative construction sequencing

7.2.2 Site establishment

Site establishment for all areas within the construction footprint may involve the following activities to establish a suitable working environment:

- vegetation clearing;
- cut and fill earthworks to provide a level site area; and
- establishing temporary construction facilities such as the accommodation camp, construction camp, laydown areas, stockpiles or access tracks.

7.3 Power supply infrastructure

7.3.1 Installation of new overhead powerlines

A new 4.2 km section of 11 kV overhead powerline would be established and would require the following works:

- clearing of a 20 m wide overhead line easement suitable for 11kV Bare Conductors in accordance with Essential Energy easement requirements;
- establishment of a 4 m wide access track for construction and maintenance access along the line easement adjacent to the centreline, where practical;

- erection of power poles, construction of footings and installation of required pole top assets such as cross arms and insulators; and
- running new conductors attaching to the new power poles and adjusting the safety clearances and segregation.

7.3.2 Potential upgrade of existing overhead assets

There is potentially a need to upgrade a 13.2 km section of existing overhead powerline. This work would involve replacement of existing conductors, pole top assets and certain poles. The potential upgrade would be completed with minimal impacts only and no significant vegetation clearing or ground disturbance would be required. Consultation with Essential Energy regarding the upgrades to existing powerlines is ongoing and would continue through the detailed design process. If any additional impacts are identified through the detailed design of the upgrades to existing assets, then they would be appropriately assessed and approved prior to the works being undertaken.

7.3.3 Decommission existing powerlines

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. The section of existing powerline that would be decommissioned is shown in Figure 5.4.

The installation of a new powerline and upgrades to existing powerlines required to maintain HV connectivity and network integrity would be carried out prior to decommissioning existing powerlines. These works would be completed at the start of the project construction and prior to commencement of works on the main dam infrastructure that require decommissioning of existing powerlines. Potentially affected landowners would be consulted during the planning process prior to the decommissioning works. Where required diesel generators would be supplied to the affected community during decommissioning works.

During decommissioning works the following activities would be carried out:

- isolate and disconnect all the circuits electrically to ensure no live parts;
- detach and remove bare conductors, pole top cross arms and accessories, pole mounted substations, transformers and other accessories;
- remove timber poles and the associated footings, all other accessories, if applicable, and reinstate the ground;
- assess pole butts for any potential asbestos material, remove following relevant guidelines;
- assess pole mounted transformers for any oil leakage, remove following relevant guidelines; and
- reinstate and clean up the site.

7.4 Pipeline construction

The replacement Dungowan Dam 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.

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.

Installation of the pipeline would involve the following general sequence:

- ensure site limits are established and fencing established where required for livestock control and safety requirements;
- progressively install environmental controls, such as erosion and sediment controls, and traffic controls;
- undertake site preparation including clearing and access track establishment;
- transport and place pipes along the alignment;
- progressively excavate the trench along the pipeline route. Excavators would dig the trench, with topsoil separated and then spoil stockpiled adjacent to the trench for backfilling after the pipeline is installed. The trench would typically be 1.35 m wide and up to 2.2 m deep. Trench boxes or terracing would be utilised for deeper trenches to protect construction personnel;
- lay the pipe within the trench and progressively install valve infrastructure. Pipes would be bedded on screened native excavated material, which would be spread along the bottom of the trench prior to pipe laying. Should imported material be required it would be VENM or certified as contaminant free;
- thrust blocks may be installed along the pipeline to ensure pipeline stability under pressure, which are likely to require cast in situ concrete;
- cover the trench and reinstate disturbed areas in accordance with trench details (depending on site conditions – refer below) and the landowner requirements and easement agreements. Any excess spoil from the trench excavation would be reused within the project footprint or disposed of to a suitably licensed facility;
- test and commission the pipeline; and
- remove fencing, and environmental controls around construction works areas once the land surface has been stabilised, and complete reinstatement.

7.4.1 Typical trench detail

Typical trench details differ depending on the installation scenario. Figure 7.2 provide an example of indicative dimensions for the installation of the HDPE pipeline within private property.

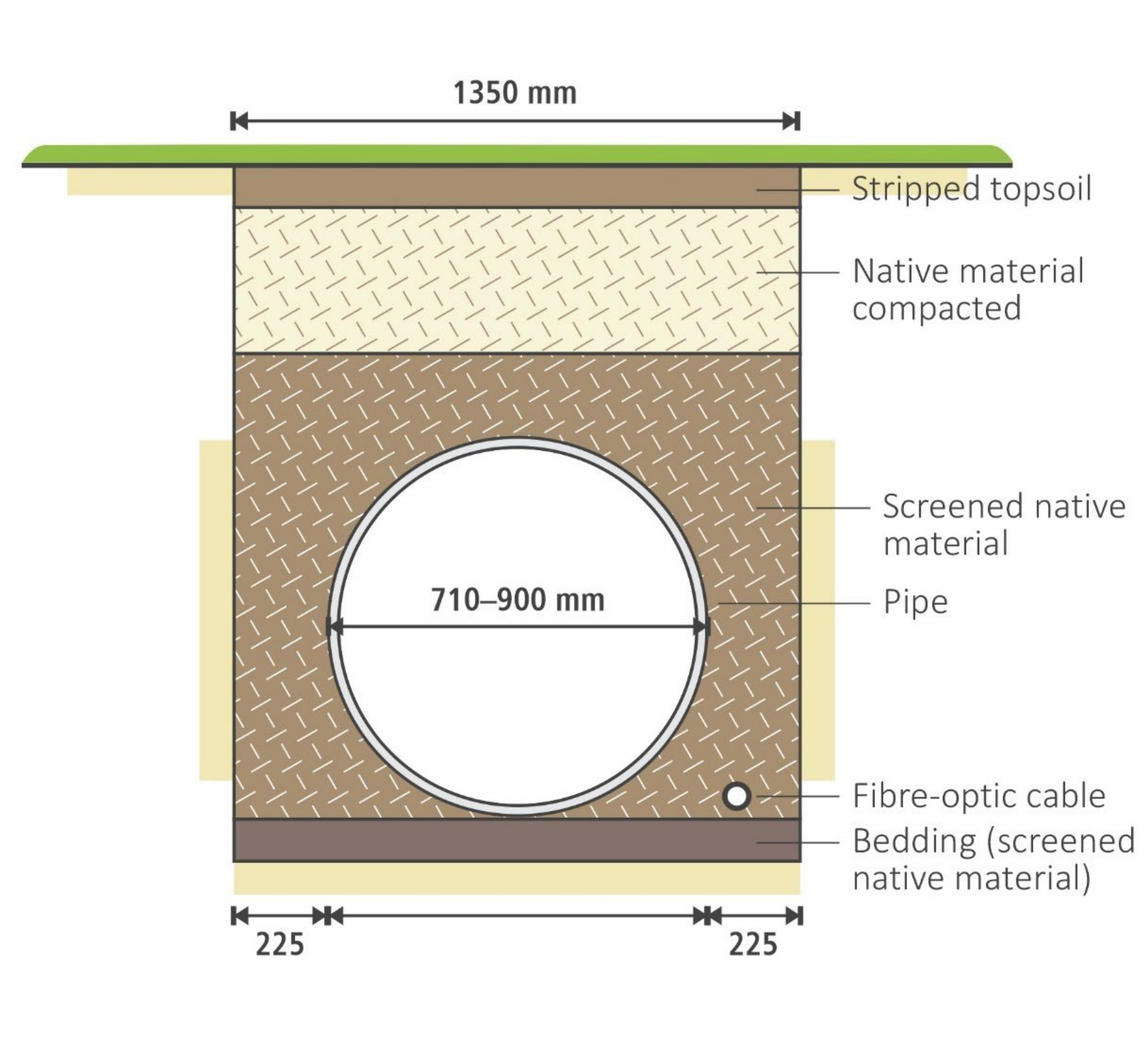


Figure 7.2 Typical HDPE pipeline trench detail – private property

7.4.2 Waterway crossing methodology

i Dungowan Creek

The pipeline would be trenched across Dungowan Creek at eight locations (Figure 4.1). Typical trench details for these crossings are shown in Figure 7.3. Construction would be managed through the use of coffer dams and temporary waterway diversions. Two typical arrangements are shown in Figure 7.4 and would be selected based on the stream flow conditions are the time of construction. The bulky bag and flume pipe arrangement would general be utilised when there is no (or minor) stream flow, while the aqua dam would be utilised when the stream is flowing.

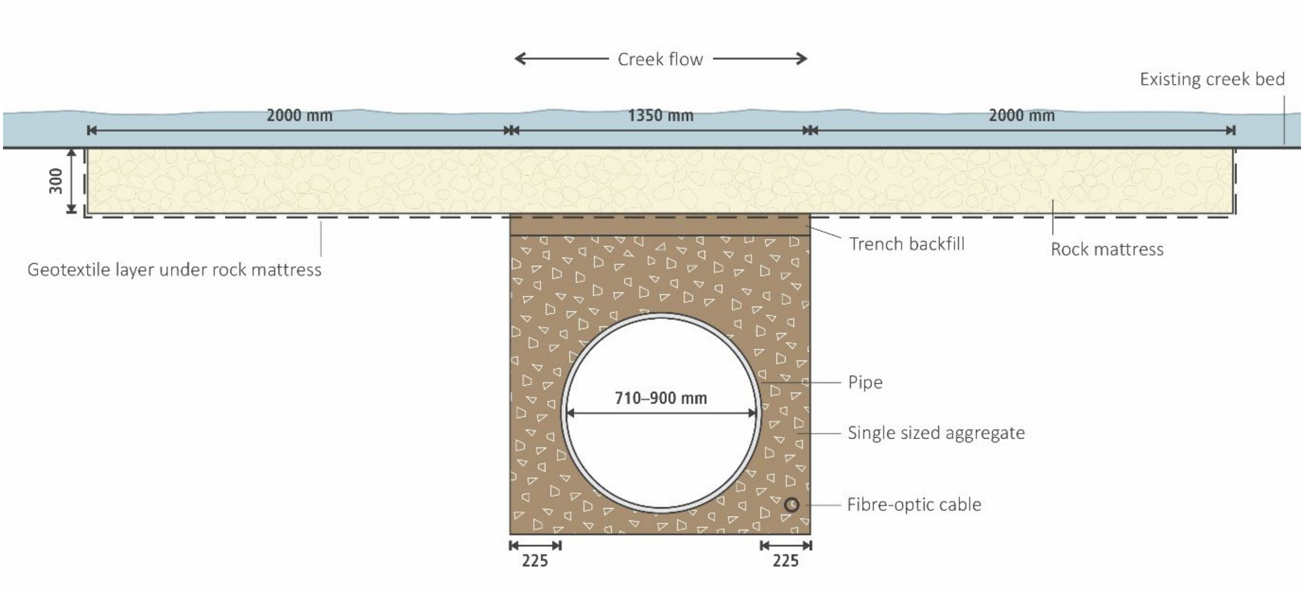


Figure 7.3 Typical trench detail – creek crossing

ii Peel River

Crossing of the Peel River for the pipeline would be undertaken using Horizontal Directional Drilling (HDD). The location of the Peel River crossing is detailed in Figure 4.1n. 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 bore geometry would involve the pipe entering and exiting at a shallow angle of around 10-12 degrees until the required depth is achieved, at which point the bore would become horizontal as it crosses beneath the river at a depth of at least 10 m below the river bed, before angling back up. The length of the bore is likely to be approximately 350 m.

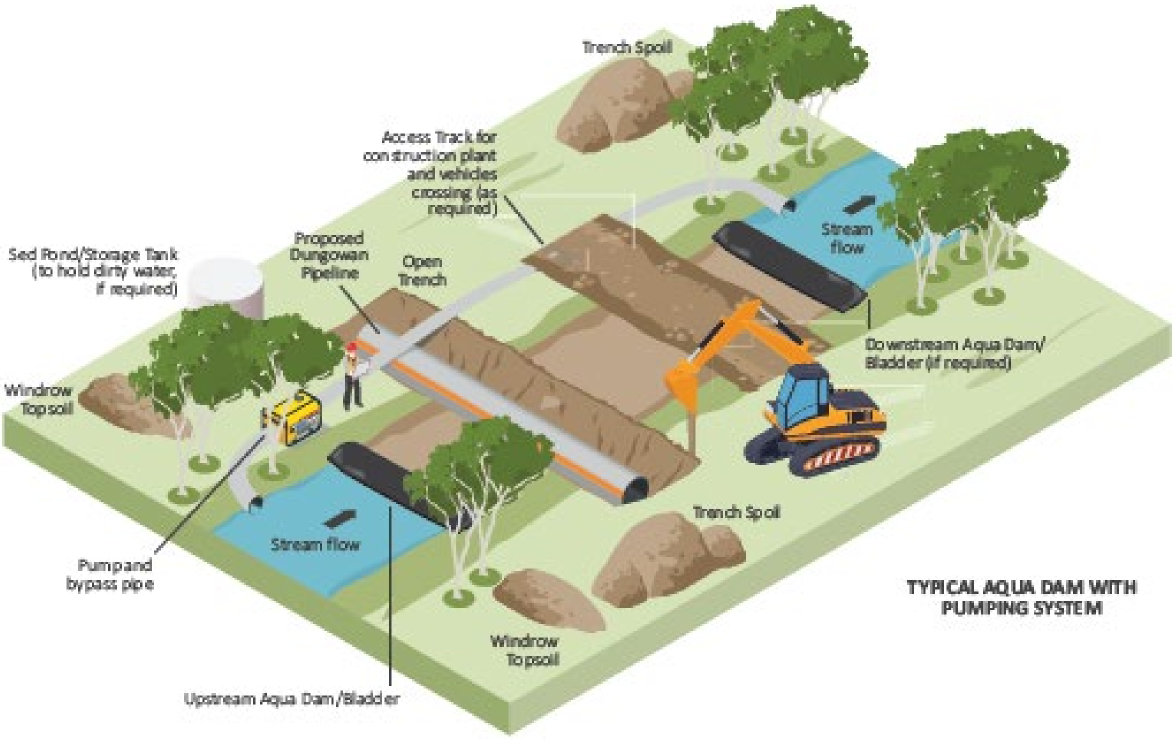


Figure 7.4 Typical creek crossing arrangements

7.4.3 Control valves

Control valve installation would require the construction of approximately 8.1 m x 6.4 m x 3.5 m high Colourbond sheds, at each of the two control valve locations, surrounded by security fencing and would involve the following general sequence:

- site establishment;
- site levelling, including some minor excavations and small retaining wall;
- installation of concrete slab;
- erection of building;
- installation of mechanical pipework and electrical equipment;
- installation road base (crushed rocks) to access the valve; and
- installation of fence/gate.

7.5 Dam construction

7.5.1 Diversion

Diversion of Dungowan Creek during construction of the dam would be required to ensure that normal river and flood flows do not impact the construction site. The diversion tunnel would be a circular horseshoe tunnel about 8.5 m in diameter and would be constructed using a combination of drill and blast techniques and road header excavation methods. Rock bolts and shotcrete would be used to provide temporary support during tunnelling. The full length of the diversion tunnel would be concrete lined to initially prevent erosion and for safety of personnel in long term operation. Permanent reinforced concrete lining of the diversion tunnel would be established with a slip form (constructed off-site) which would be continuously fed along the tunnel length. Shotcrete would be used to provide erosion protection at the downstream end of the diversion tunnel.

The diversion tunnel would also require some of the outlet works to commence prior to the cofferdam construction to enable the Dungowan Creek diversion. The outlet works would then progress to completion concurrently with the spillway and embankment construction.

Prior to cofferdam construction the following intake tower works would be completed:

- excavation to the tower footing foundation level and stockpile of the excavated material. Detailed cleaning and treatment (if required) of the foundation would then be undertaken. The intake tower access bridge footings would also be excavated concurrently;
- construction of the reinforced concrete tower base and shaft to above the level of the tunnel portal;
- construction of the reinforced concrete approach channel walls/base slab to the intake tower; and
- the remainder of the tower would then be constructed concurrently with the embankment and spillway works.

Temporary pipework and cutover works would also be undertaken prior to cofferdam construction for the Dungowan Creek diversion. These works would include:

- construction of the temporary pipework between the upstream and downstream cutover locations of the existing pipework;
- the temporary bypass pipeline would be connected to the existing pipeline upstream of the embankment and to the replacement pipeline downstream of the embankment. The pipeline would be offline for between 24-48 hours, with advanced notice provided to the downstream customers who are directly connected to the pipeline; and
- the existing pipeline would be removed from within the proposed inundation area and construction footprint.

7.5.2 Cofferdams

The construction of the cofferdams would involve the following sequence of activities:

- topsoil would be stripped by dozers and stockpiled;
- overburden and weathered rock would be stripped by dozers and excavators and stockpiled;
- cleaning of the cofferdam core contact foundation would be completed and, where required, sluice grouting and dental concrete would be used to treat any defects; and
- cofferdams would be constructed with the placement of earth fill materials in 150–250 mm layers.

7.5.3 Embankment

The bulk earthworks required to establish the dam wall embankment would involve open cut excavation of the embankment foundation and the placement of dam wall embankment materials. The primary equipment to be used during these construction activities would be bulldozers, excavators and dump trucks.

The dimensions of the embankment foundation would be refined through detailed design as further geotechnical investigations are carried out. The foundations of the shoulders would be excavated to a moderately weathered rock horizon at an estimated depth of about 3 to 5 m on the right abutment, between 4–6 m in the valley and 5 m on the left abutment. The depth to suitable foundations for the core cut-off trench would be to a slightly/moderately weathered rock profile. Cut slopes in the cut-off trench would have a slope of 1V:1H to ensure stability of the batters, and to allow adequate compaction of core material against the slopes.

Excavation of the dam wall embankment foundation would involve stripping of the topsoil and excavation of the overburden soil and weathered rock. Topsoil would be stockpiled for future re-use in project rehabilitation. Detailed cleaning would be undertaken at the foundation-core interface. Treatment of the foundation would include slush grouting and dental concrete of defects.

A concrete grout cap would then be installed, followed by percussion drilling and pressure grouting of holes to form the grout curtain which would be established beneath the dam to reduce seepage beneath the dam. The grout curtain would extend across the base of the embankment core trench, continue under the spillway and likely be deepened in the location of the diversion tunnel. The actual depth of the grout curtain is dependent on the discontinuities within the rock encountered during the drilling and grouting operation. Embankment construction would be carried out in conjunction with spillway excavation from which the majority of the embankment rockfill materials would be sourced.

The central low permeability clay core would be about 4 m wide at the crest with symmetrical side slopes of 0.25H:1V. Transition (chimney) filter layers would be established on both the upstream and downstream face of the core. Either side of the transition filter layers, rockfill shoulders would provide stability to the embankment. Blanket filters would be placed beneath the downstream shoulder to provide drainage for the chimney filters and protection against foundation “piping” failures.

Rockfill would be selectively placed such that finer material is placed against the filter materials to ensure grading compatibility. Better quality rockfill would also be selectively placed towards the base of the dam. Rip rap would be placed on the upstream face to provide erosion protection against wave action.

The central low permeability clay core would be placed successively with filter zones and placement of rockfill from the spillway excavation. All materials would be hauled to the embankment, then spread over prepared surfaces and compacted before being prepared to receive the next layer.

The embankment crest would be capped with road base, about 300 mm thick, with a bitumen seal to protect the core from vehicle movements and reduce cracking.

A cross-section showing the elements of the dam wall embankment is provided in Figure 3.3.

7.5.4 Spillway

The spillway construction would involve open cut excavation and benching followed by the establishment of the 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.

When excavation of the spillway has progressed sufficiently, construction of concrete spillway structures would commence. Curtain grouting would be completed under the ogee crest structure and foundations cleaned and blinding applied prior to placing passive anchors. Construction of the ogee crest and spillway chute would commence, followed by the stilling basin. Underdrainage would be placed within the chute excavation prior to blinding and anchors, followed by forming and pouring of the chute walls and slabs.

7.5.5 Outlet works

The outlet works would be undertaken concurrently with the embankment and spillway construction. The following construction activities would be carried out:

- installation of the intake tower and bridge piers with cast in-situ reinforced concrete;
- construction of the downstream valve house, dissipation chambers and valve pit including installation of all pipework and mechanical items (gates/valves);
- construction of the access bridge to the intake tower after completion of the embankment; and
- installation of mechanical equipment within the intake tower.

To complete the outlet works the diversion would be closed during a dry weather period to allow for the intake tower completion. Intake tower completion would involve the following works:

- installation of stoplogs across intake tower approach channel (for isolation of diversion) while the temporary pipeline remains online;
- construction of the upstream wall of intake tower within the diversion channel to block off reservoir;

- installation of the new outlet conduit within the tunnel and connection to the valve house;
- construction of the diversion tunnel concrete plug; and
- water would then be transferred from the existing Dungowan Dam to the new Dungowan Dam.

7.5.6 Inundation area

Prior to operations and filling, the inundation area would be prepared to provide optimal conditions for water storage. Vegetation within and up to 2 m above the FSL 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 to mitigate erosion from wave actions.

7.6 Decommissioning of existing Dungowan Dam

The sequence of works for the existing dam decommissioning has been designed to mitigate flood risk and avoid disruption to the provision of water. Prior to commencement of the existing dam decommissioning, the new Dungowan Dam would be established and fully functional and water would be emptied from the existing dam to the new dam. The existing dam would be emptied by either opening outlet works at the existing dam or by pumping over the dam wall. If the existing Dungowan Dam is full (6.0 GL available storage) when the transfer of water from the existing dam to the new Dungowan Dam commences, the new Dungowan Dam would fill to RL 640.5 mAHD.

The decommissioning works would then follow the sequence outlined below.

- removal of the primary spillway flap gate;
- removal of all pipework from intake tower and tunnel and repurpose tunnel as diversion;
- sawcut and removal of concrete on dam crest (including guardrail);
- stripping and stockpiling of riprap;
- excavation of a narrow breach with a 5 m base width to RL 659 mAHD at the upstream invert level (Figure 7.5);
- breach extension from 5 m to 70 m (Figure 7.5);
- placement of excavated material into spillway chutes/basins and shaping into abutments;
- selective demolition of concrete works including spillway chutes and basins concurrent with breach excavation;
- shaping and contouring breach excavation to create smooth curves;
- installation of erosion protection; and
- rehabilitation of existing dam previously inundated area.

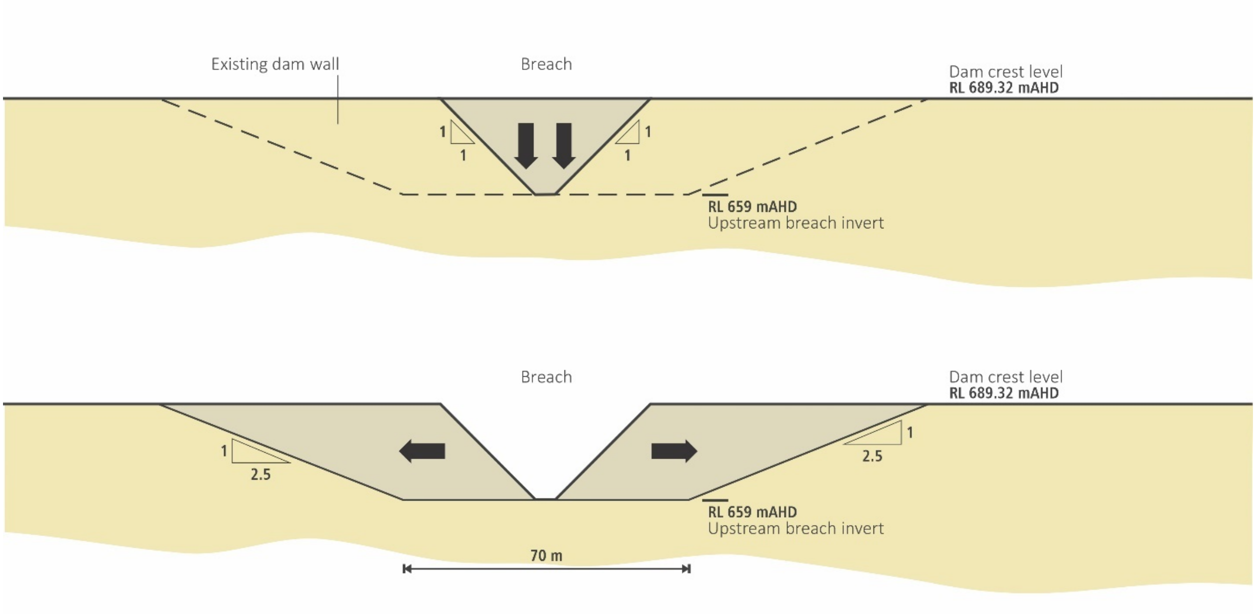


Figure 7.5 Staged breach of existing Dungowan Dam embankment

7.7 Demobilisation site and re-instatement

At the completion of construction, the temporary construction infrastructure at the accommodation camp, construction compounds and any temporary compounds established within the construction footprint would be removed. All areas disturbed during the project construction that are not required for the project's operational footprint would be rehabilitated in accordance with a rehabilitation plan that would be prepared for the project.

7.8 Construction management

7.8.1 Construction hours

Construction works would generally be conducted within the hours outlined in Table 7.1. However, it is likely that activities needed 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 7.1 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

7.8.2 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 7.6. 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 either in existing accommodation in Tamworth or in the accommodation camp described in Section 5.1.1. Buses are likely to be provided for workers to be transported to site each day.

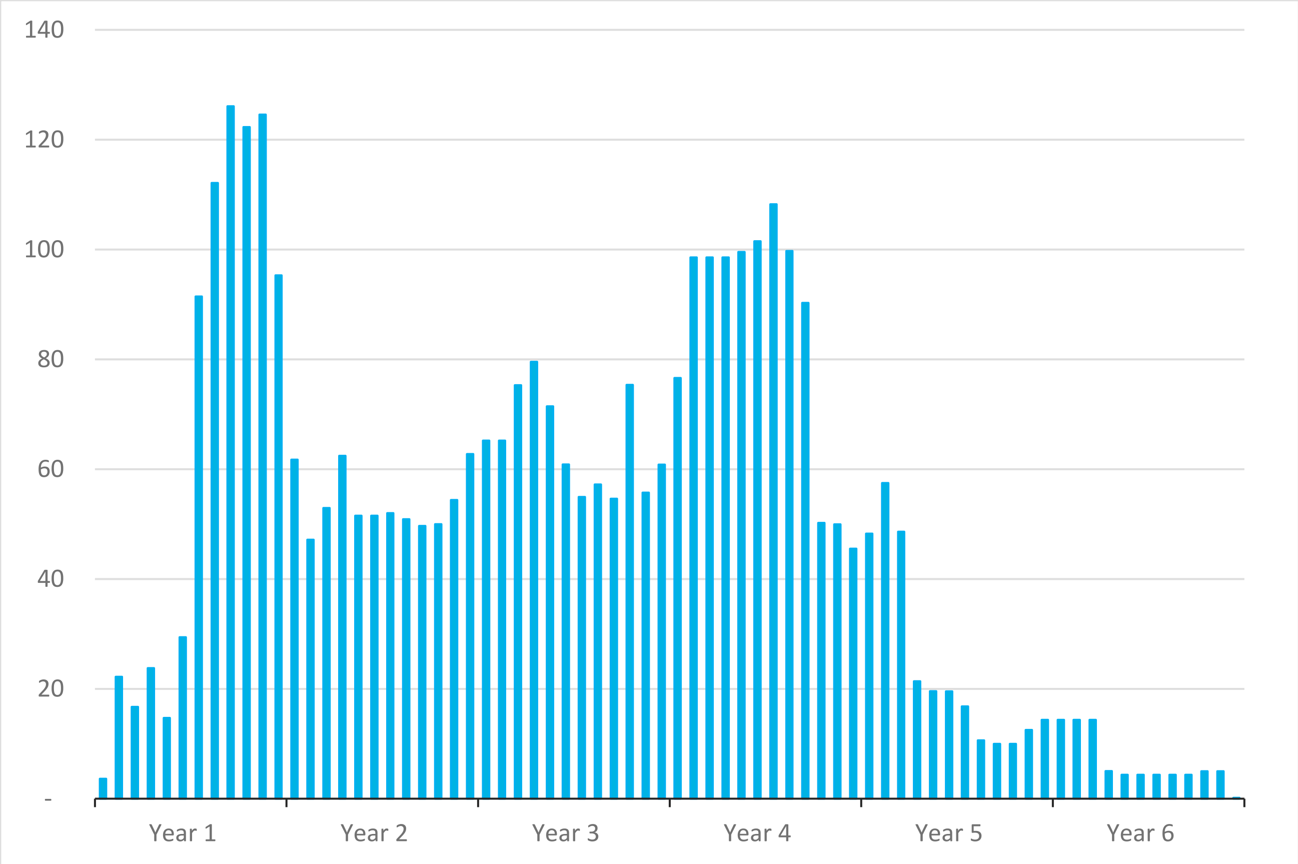


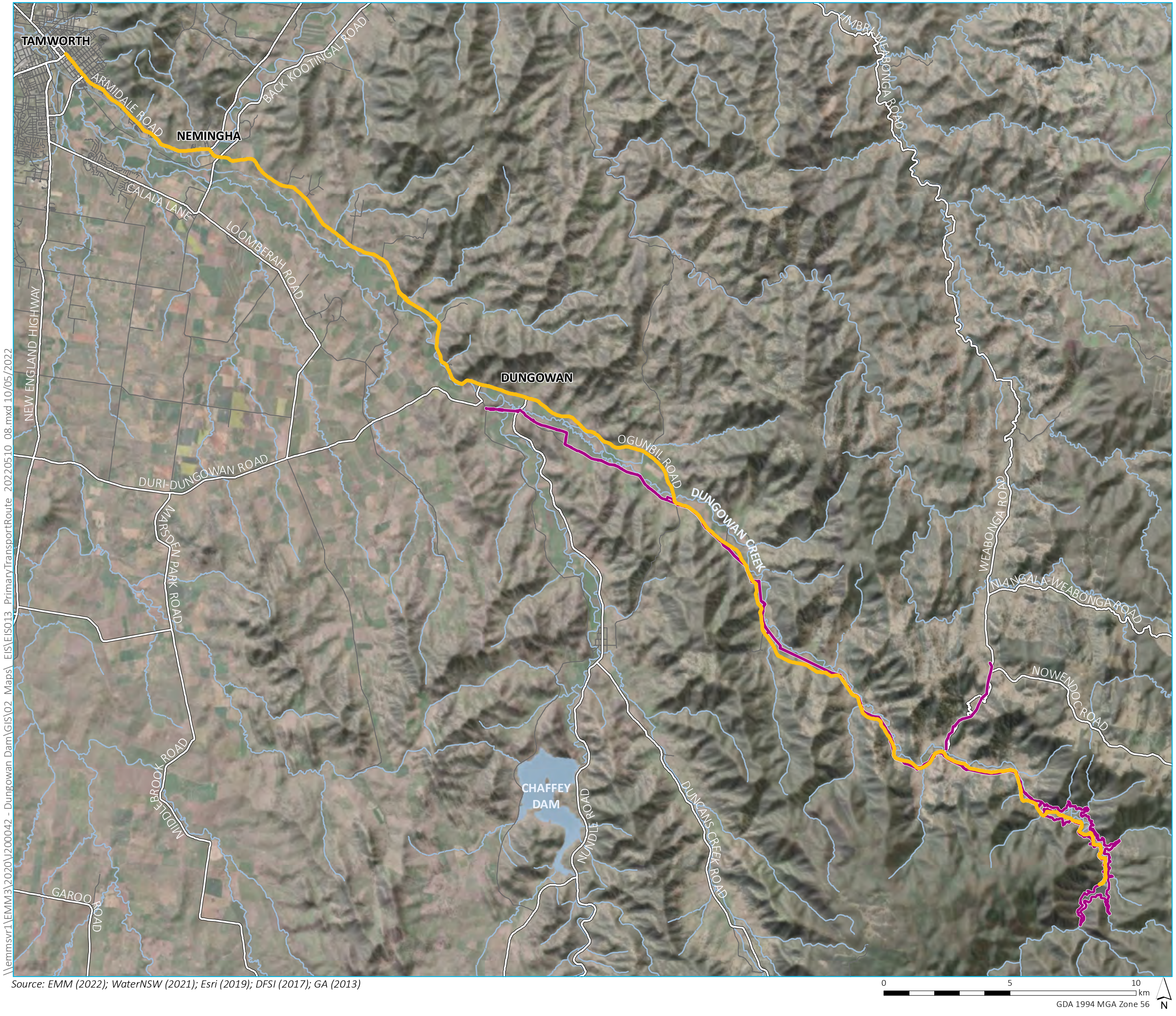
Figure 7.6 Indicative workforce histogram

7.8.3 Construction traffic and transport

i Transport route

Transport of construction materials, equipment and personnel to the project area would use one main transport route and is shown in Figure 7.7. The primary transport route follows the New England Highway to Nemingha (about 7 km south-east of Tamworth) and turns onto the Tamworth-Nundle Road to Dungowan. Vehicles would then turn off Tamworth-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.



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

Primary transport route

Dungowan Dam and pipeline project
Project description
Figure 7.7

creating opportunities

ii Construction traffic volumes

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 7.8. The traffic volumes provided are round trips or the number of vehicles visiting the site each day. Each round trip would comprise both a 'to' and a 'from' movement.

The majority of employees would either be housed in the proposed accommodation camp or transported by bus, hence only a small number of light vehicle trips would be generated. It is assumed that the peak hourly light vehicle trips would comprise 10% of the workforce and would result in approximately 13 light vehicle trips per day throughout construction.

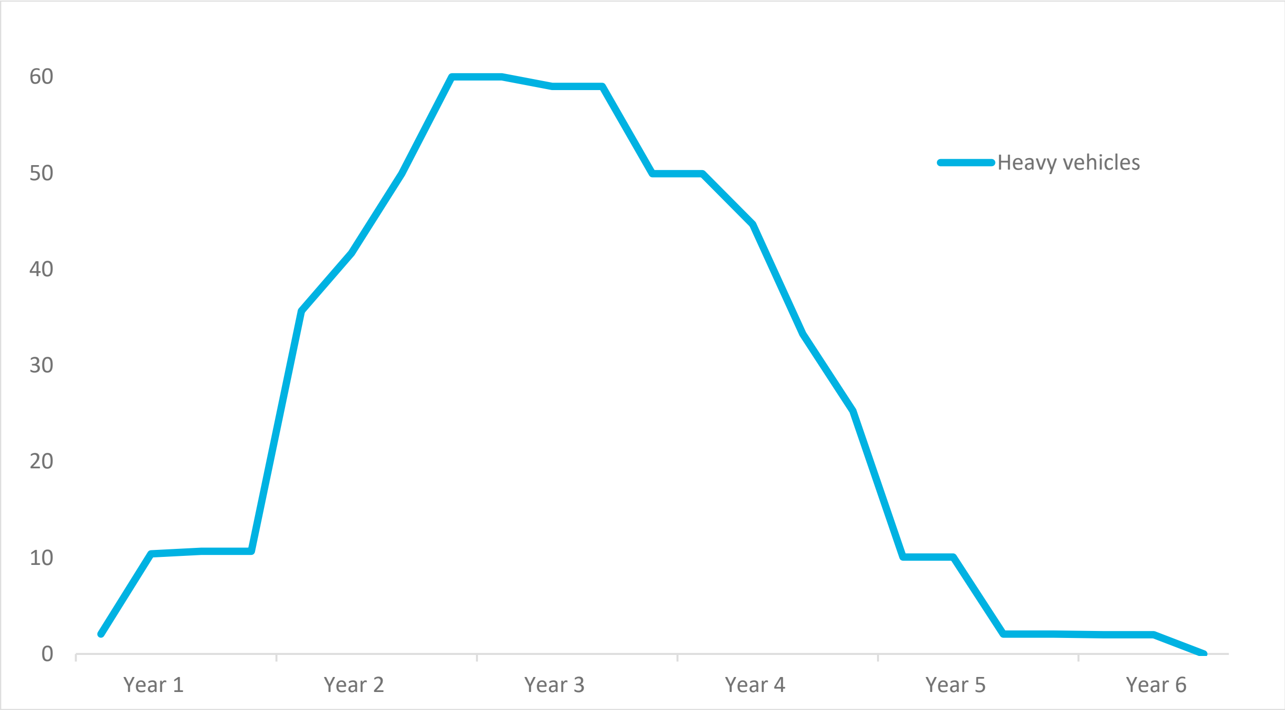

Figure 7.8 Average daily heavy vehicle traffic volumes (total trips per day)

7.8.4 Materials and handling

i Materials required

The approximate quantities and indicative sources of the materials required to construct the project are provided in Table 7.2. There is potential for some variability in the final source of construction materials, which would be further refined through ongoing geotechnical investigations and the project detailed design.

Table 7.2 Construction materials

Construction materials required	Estimated quantities (m^3)	Potential sources
Embankment Zone 1A core	324,000	Spillway excavation, embankment foundation excavation and borrow areas
Embankment Zone 2A fine filter	78,000	Commercial source
Embankment Zone 2B coarse filter	36,000	Commercial source, quarry and borrow areas
Embankment Zone 2C transition filter	60,000	Commercial source and borrow areas
Embankment Zone 3A rockfill	1,440,000	Spillway excavation
Riprap rock protection	52,000	Spillway excavation and quarry
Road base and surfacing	5,000	Commercial source
Concrete aggregate	61,000	Commercial source and quarry
Screened native material	61,000	Pipeline excavation
Total	**2,117,000 m^3**	

ii Waste management

During construction of the project, waste expected to be generated includes general liquid waste, general solid waste (non-putrescible), general solid waste (putrescible), hazardous waste and spoil. It is expected that there would be minimal waste generated during the operational phase of the project. The key waste sources that would require management are:

- Excavated material from construction of the new Dungowan Dam infrastructure including the spillway, embankment, diversion tunnel and pipeline. The geometric design of the spillway (eg spillway width, founding levels, depth of cut, alignment, proximity to main embankment) has been developed to provide a suitable material balance between the volume of material produced by the spillway excavation and the volume of material required for the main embankment. In total up to 1.9 million m^3 of the material would be generated by the spillway excavation and re-used for the embankment. Excess excavated material would be disposed to dedicated disposal areas that would be sited in the proposed inundation area. All excavated materials would be placed in dry conditions prior to inundation of the reservoir. The placement of excess spoil would follow a material testing process to ensure that materials are suitable for placement within the dedicated disposal areas.

- Excavated material from full height dam breach of the existing Dungowan Dam – the excavated material would be re-used to cover the demolished spillway areas and form the breach channel. Excess material from the dam breach would be landscaped within the existing inundation area within a profiled emplacement area.

- Demolished concrete from the existing dam – concrete structures such as the spillway and outlet tower would be demolished. The broken up concrete material would remain onsite and be entombed by the placement of the dam breach material. Reinforcing steel from the demolition may be recycled.

- Redundant electrical equipment from decommissioning existing powerlines within the new inundation area, including timber poles, pole top cross arms and accessories, pole mounted substations and bare conductors. These items would be managed along with the project's general solid waste (non-putrescible) and would be recycled or disposed of at an appropriately licenced waste facility.

- Green waste resulting from vegetation clearing for construction activities, new powerline easement and within the inundation area. The management of vegetation waste would follow the waste hierarchy outlined in the NSW "Waste Avoidance and Resource Recovery Strategy 2014-2021". It is expected that the majority, and likely all, of the vegetation waste would be re-used or recycled through the construction and rehabilitation of the project.

- Sewage and grey water generated during construction activities and at the accommodation camp. The amount of grey water and sewerage to be generated from the construction workforce would be finalised during detailed design. This would inform the quantity of portable toilets to be located at each construction area. Sewage would be collected by an appropriately qualified waste contractor.

- All chemicals and hazardous waste from the water treatment facility at the existing dam would be disposed of to an appropriately licenced facility.

The volumes of waste to be managed through project construction and further details of the project's waste management are provided in the Waste Management Assessment appended to the EIS.

iii Fuel

Diesel would be required for the operation of plant and equipment as well as some electricity generation during the project construction. Construction power would be primarily supplied via a connection to the existing 11 kV line in the construction compound. Diesel generators would only be used infrequently and temporarily where construction areas are not yet connected to the main construction power supply. At the peak of construction, the project would consume about 347,000 L diesel per month and in total about 10.9 ML would be required throughout the project.

iv Water

Water would be required during construction for the embankment and spillway works, pipeline construction, drinking water and operation of the concrete batching plant. An estimate of the project's construction water use is provided in Table 7.3.

Table 7.3 Approximate construction water use

	Embankment, spillway and pipeline works	Drinking water	Concrete batch plant
Sub Total (kL)	715,000	15,000	22,000
Total Water Use (kL)	752,000		

Water for the pipeline construction, as well as potable water supply during construction would be delivered by truck from a mains water supply in Tamworth. Non-potable water for dam construction activities would be sourced via a temporary intake pipeline upstream of the cofferdam and reticulated throughout the construction footprint. There would be a small amount of water (around 250 ML) stored in the upstream cofferdam for construction purposes.

8 Operation

8.1 Commissioning

8.1.1 New Dungowan Dam

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 MOL. This would be achieved through a combination of rainfall events and emptying the existing Dungowan Dam as described in Section 6. Dam safety and stability has been considered through the concept design and a dam safety assessment is provided in the EIS. During detailed design a dam safety emergency plan would be prepared for the new Dungowan Dam.

8.1.2 Pipeline commissioning

Pipeline commissioning would involve the following activities:

- flushing of the pipeline with raw water;
- testing and commissioning of valves and other pipeline control elements; and
- leak tests.

A plan to manage and dispose of any water used in pipeline commissioning would be developed to manage environmental impacts as part of operational documentation.

8.2 Operating Principles

8.2.1 Operations

The new Dungowan Dam and replacement pipeline would be operated by WaterNSW and TRC in accordance with final conditions of consent and as specified within the relevant Water Sharing Plan. It would be managed as part of an integrated water supply system with Chaffey Dam. 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.

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

The new Dungowan Dam's primary function is the supply of raw water to Calala WTP via the replacement pipeline. Calala WTP is owned and operated by Tamworth Regional Council. Once the water is treated at Calala WTP, it would be distributed via Tamworth Regional Council's water reticulation system. The operation of Calala WTP and the Tamworth water reticulation system is subject to separate approvals and is not addressed in this EIS. 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 (Sections 4.1.2 and 8.3.1);
- provide water via run of the river discharges to any Stock and Domestic water licence holders along Dungowan Creek; and
- provide environmental flows through translucency releases and a new Environmental Contingency Allowance (ECA) (Section 8.5).

The new Dungowan Dam and pipeline would operate in parallel with the existing Chaffey Dam to supply raw water to Tamworth.

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. If the town water reserve was not increased, additional water could be allocated to General Security licence holders under the Water Sharing Plan and this would negate the benefits of the project on water availability and security for Tamworth.

8.2.2 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 a non-infrastructure option such as a change in the Water Sharing Plan would need to be implemented. This 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 change to the Water Sharing Plan is 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.

8.2.3 Flood operations

The new Dungowan Dam would be operated in accordance with the ANCOLD and Dam Safety NSW Guidelines. 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.

The uncontrolled spillway has been designed to safely pass the PMF. Emergency monitoring and surveillance of the dam would be undertaken, however road access to the dam may be cut in floods larger than a 1 in 1,000 Annual Exceedance Probability (AEP) event. There is emergency drawdown capability built into the outlet works to allow the dam to be drawdown in the event of a 'sunny day' dam safety emergency (but unlikely for flood events).

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.

8.3 Water supply

Water for supply to Tamworth would be drawn from the reservoir at the optimal depth for water quality and temperature. Water quality in the reservoir would be consistent with WaterNSW's water quality monitoring program and would include monitoring for:

- water level in the storage;
- temperature;
- dissolved oxygen (DO);
- pH and turbidity;
- chlorophyll-a of the water at surface (an increase in the concentration of chlorophyll-a is an indication of active algae growth); and
- algal enumeration and speciation, and if required testing for specific algal toxins.

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. Water in the reservoir would then charge the tower and outlet conduit beneath the dam. Control of flow of water to Tamworth would be by locally and remotely actuated valves in the valve house.

No water treatment would be undertaken at the dam site. A spool pipe would be placed in the pipeline immediately downstream of the valve house to allow the addition of treatment facilities if required at a later date. Raw water from the dam would be transferred via the replacement pipeline to the Calala WTP for supply to Tamworth and surrounds.

8.3.1 Pipeline customer supply

The 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 (ie 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 raw water pipeline.

8.4 Maintenance and monitoring

During detailed design, an operations and maintenance manual and a dam safety emergency plan would be prepared for the new Dungowan Dam. The requirements for monitoring during the operations phase would be developed and outlined in the project's operational environmental management plan (OEMP).

8.4.1 Instrumentation and telemetry

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 Table 8.1.

Table 8.1 Instrumentation and telemetry

Name	Description
Surface survey points	The surface survey points are required to assess how the structure deforms over time. A series of surface survey points would be installed along the centreline, upstream and downstream edges of the embankment crest, along each of the downstream edges of the downstream berms and on the upstream edge of the upstream berm. Each survey point is surveyed as part of the ongoing monitoring of the dam.
Intake tower survey point	As per above, however located on the intake tower.
Survey bench marks	Four survey bench marks would be installed around the embankment. The survey bench marks set a reference network for the surface survey points. The bench marks are located off the embankment at each end of the crest and each end of the lower downstream berm.
Vibrating wire piezometer	Pore pressures within the Dungowan Dam embankment would be monitored with a combination of Vibrating Wire Piezometers (VWPs) and Pneumatic Piezometers (PPs). Piezometers would be installed within the dam core, foundations below the core and downstream shoulder, and within the filter blanket. VWP cables and PP twin tubing would be routed to a terminal box. The terminal box would receive readings from the VWPs and transmit them remotely via SCADA.
Pneumatic piezometer	
Seepage measuring weir locations	Seepage measuring locations are proposed to monitor seepage intercepted by the dam filter system, tunnel seepage and spillway underdrainage flows. A seepage weir pit would be positioned at the lowest point at the downstream toe of the embankment. Measurement of tunnel seepage would be completed manually near the end of the tunnel where the seepage is piped to a downstream pit. The spillway underdrainage system would be manually monitored via a pipe outlet arrangement where the system discharges at the end of each spillway wall.
Reservoir level gauges	The reservoir level is to be remotely monitored by a radar level transmitter fitted to the inside of the outlet tower. Level gauge boards are also proposed on the outside of the outlet tower.
Anemometer	The anemometer would monitor wind speed and provide data remotely by a radar level transmitter fitted to the outlet tower.
Rainfall gauge	A rainfall gauge is to be remotely monitored by a radar level transmitter fitted to the outlet tower or dam crest.

8.4.2 Pipeline maintenance

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 (ie 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.

8.4.3 Powerline

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.

8.5 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.

8.6 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; and
- the installation of floating or fixed large impellers.

8.7 Interaction with other water supply sources

The new Dungowan Dam and pipeline would be operated by WaterNSW and TRC in accordance with final conditions of consent and as specified within the relevant Water Sharing Plan. It would 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 and delivered via the Dungowan pipeline to Calala WTP. When the water level in Dungowan Dam reaches 3 GL, supply would switch to Chaffey Dam.
2. Chaffey Dam would supply water to Calala WTP via run of the river discharges when the water level in Dungowan Dam is 3 GL or less. There is a pipeline from Chaffey Dam which connects to the replacement pipeline from Dungowan Showground to the Calala WTP, which is proposed for use during drought periods (ie when Chaffey Dam falls below 20 percent capacity). However, at the time of preparing the EIS, there is no approval to operate this pipeline. WaterNSW is currently in the process of preparing a separate EIS to obtain approval for operation of the Chaffey pipeline. Cumulative impacts, including from the operation of the Chaffey pipeline, are detailed in the EIS.

4. If Chaffey Dam is supplying water to Tamworth and inflows to Dungowan Dam increase its level to above 3 GL, the model has assumed that both dams would supply water to Tamworth on a proportional basis until the water level in Dungowan Dam reaches 4 GL, at which point Dungowan Dam would supply 100 percent of Tamworth's daily demand. Further work would need to be undertaken to optimise the transition criteria between the two dams as proportional flows from each of the dams may not be operationally efficient for Calala WTP. However, any minor changes in these criteria would not change the outcomes of the environmental assessment in the EIS.

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

The sequence of water supply may change occasionally when:

1. Water quality in one dam is poor and for operational reasons it is preferred that water be provided from the other dam.

2. Maintenance, an incident or other activities result in either a dam or pipeline being off-line while the issues are being rectified.

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. This is to ensure that the extra water that would be held in Chaffey Dam due to the increased supply from the new Dungowan Dam is not allocated to other licence holders. This reserve level has also considered other licence allocations and these would be maintained at their existing average allocations.

8.8 Design life

The new Dungowan Dam zoned earthen and rock embankment, structural concrete elements (eg spillway, intake tower, diversion tunnel, outlet works and valve house) and pipeline would have a design life of 100 years whilst other project elements (eg roads, valves, electrical, lighting, communications, etc) would have a design life of between 15 and 50 years.

9 Future design refinements

The works described in this appendix 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. 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. For example, though the project footprint would be fixed, the actual size, space and specific use of locations within the project footprint may change as part of detailed design and construction planning. However, the nature of such variations would generally be consistent with the concept design and its environmental outcomes.

Future design refinements may also result in optimisation of the operation of the two dams and associated water supply network. This may result in minor changes to how the dams are operated. This would generally occur post-approval once detailed design is complete and further detailed modelling is completed. However, it is envisaged that the outcomes of any optimisation would be generally consistent with the concept design and its environmental outcomes.

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