Scrivener Dam Dissipator Strengthening

Environmental Impact Assessment (EIA) Report

National Capital Authority

06 June 2023

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Acknowledgement of Country

GHD acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the land, water and sky throughout Australia on which we do business. We recognise their strength, diversity, resilience and deep connections to Country. We pay our respects to Elders of the past, present and future, as they hold the memories, knowledges and spirit of Australia. GHD is committed to learning from Aboriginal and Torres Strait Islander peoples in the work we do.

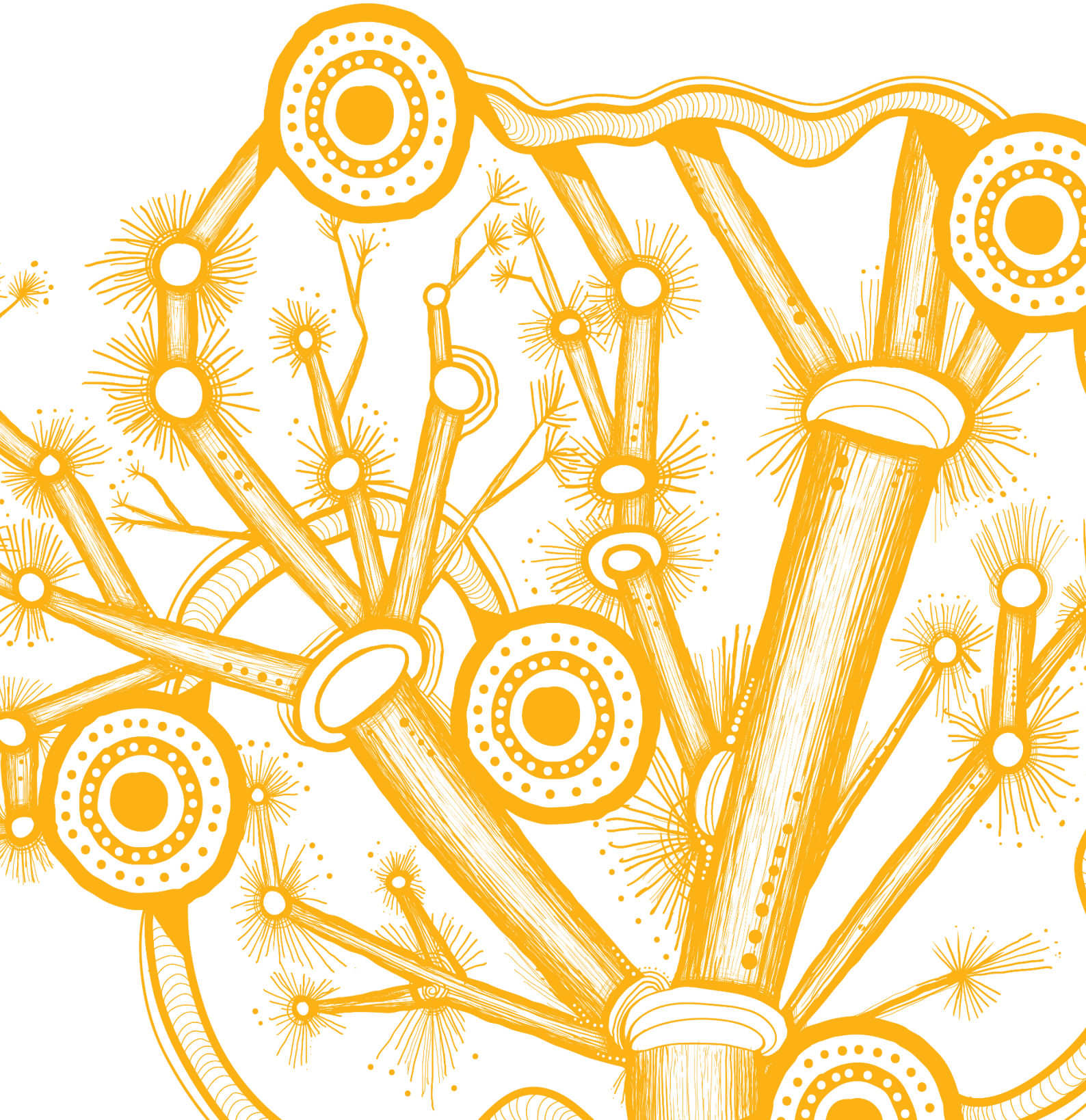


Table of Abbreviations

Abbreviation	Term
ACT	Australian Capital Territory
AEP	Annual exceedance probability
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AVTG	Assessing Vibration: a technical guideline
CEMP	Construction environmental management plan
CFU	Colony forming units
CSIRO	Commonwealth Scientific and Industrial Research Organisation
dBA	A-weighted decibel
DCCEEW	Australian Department of Climate Change, Energy, the Environment and Water
DECC	NSW Department of Environment and Climate Change
DPE	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
DPIE	NSW Department of Planning, Industry and Environment (now renamed as NSW Department of Planning and Environment)
EIA	Environmental impact assessment
EP Act	*Environment Protection Act 1997 (ACT)*
EPA	NSW Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Cth)*
EPD	ACT Environment, Planning and Sustainable Development Directorate
ESCP	Erosion and Sediment Control Plan
FSL	Full Supply Level
GHD	GHD Pty Ltd
GL	Gigalitre
ICNG	Interim Construction Noise Guideline
ID	Identification
MNES	Matters of National Environmental Significance
NCA	National Capital Authority
NCP	National Capital Plan
NSW	New South Wales
NTU	Nephelometric Turbidity unit
NVIA	Noise and Vibration Impact Assessment
PaLM Act	*Australian Capital Territory (Planning and Land Management) Act 1988*
PMST	Protected Matters Search Tool
PPA Act	*Pest Plants and Animals Act 2005 (ACT)*
RRP	Rehabilitation and revegetation plan
TCCS	Transport Canberra and City Services

Abbreviation	Term
TEC	Threatened ecological communities
TP Act	*Tree Protection Act 2005 (ACT)*
TTM	Temporary traffic management
WM Act	*Waste Management and Resource Recovery Act 2016 (ACT)*
WoNS	Weeds of National Significance

Executive Summary

The proposal

The National Capital Authority (NCA) proposes to upgrade and strengthen the Scrivener Dam dissipator (the proposal) in order to strengthen known deficiencies and ensure the ongoing fitness for purpose of the structure. Key features of the proposal include:

– 700 new embedded anchors
– 500 millimetre reinforced concrete topping slab
– new baffle blocks
– raised chute blocks
– abutment armouring.

Key works associated with the proposal include:

– site establishment (including access tracks) and construction laydown areas
– concrete cutting and pouring
– minor earthworks
– cofferdam installation and water management
– dissipator strengthening works
– site rehabilitation.

The proposal area and construction works area are shown in Figure E.1.

Construction would be phased so that Molonglo River flow would be maintained throughout the works. Construction is expected to commence in early 2024 and take up to 24 months.

Need for the proposal

In 2016 a Dam Safety Review was undertaken for the Scrivener Dam and its associated structures. The dam safety review highlighted several risks regarding the structure of the dam's dissipator. Risks related to the standards adopted at the time of construction as well as observations and latent conditions on site.

Subsequently the NCA completed several studies and investigations to determine how the dissipator functions under a range of different operational scenarios. The investigations found, under certain conditions, there is a risk of failure of the dissipator which could lead to a dam safety emergency.

The strengthening works described in this report are proposed to address the dissipator's deficiencies and improve dam safety.

Statutory requirements

The proposal is located on Designated Land which falls under the authority of the NCA. Approval from the ACT Government is not required under the *Planning and Development Act 2007*.

The proposal would be approved under the ACT *Planning and Land Management Act 1988* under a Minor Works Approval. This Environmental Impact Assessment (EIA) identifies and describes potential environmental benefits and impacts of the proposal to support the Minor Works Approval. The scope and limitations of this EIA is set out in section 1.5.

The proposed works are located within a waterway and as such an Environment Protection Authority (EPA) waterways works licence would be required for the proposal. The proposal area is also located in the Molonglo River Reserve established under the *Nature Conservation Act 2014* (NC Act). The proposal will require a licence to damage land under the NC Act.

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). An EPBC referral is not required.

Government and community consultation

Relevant ACT Government agencies and community stakeholders were contacted and provided with the opportunity to comment on the proposed works.

Community stakeholders associated with the use of Lake Burley Griffin. Key concerns raised were:

– inability to use jetty locations safely
– inability to access pontoons safely
– damage to pontoons or vessel
– loss of access to key service points for vessels (Kingston Harbour / slipway)
– navigational hazards
– safety risks associated with increased traffic
– weed management.

These issues have been discussed in this EIA Report (refer section 5). Government agencies also provided comment on any relevant permits that may be required. This is further discussed in section 4.2.

Consultation will continue to be undertaken throughout the design and the proposed works in order to minimise impacts to key user groups. Formal public consultation will also be undertaken during the PWC Works Approval.

The NCA will work collaboratively with user groups to offer solutions.

This may include:

– regular updates of lake level lowering
– timing of proposed works
– regular updates to navigational hazards
– updates at quarterly meetings regarding any issues with or access to facilities and lake infrastructure.

Potential environmental impacts

The potential environmental impacts of the proposal as well as management measures to address these impacts are discussed in section 5. The following key construction impacts have been identified should the proposal proceed:

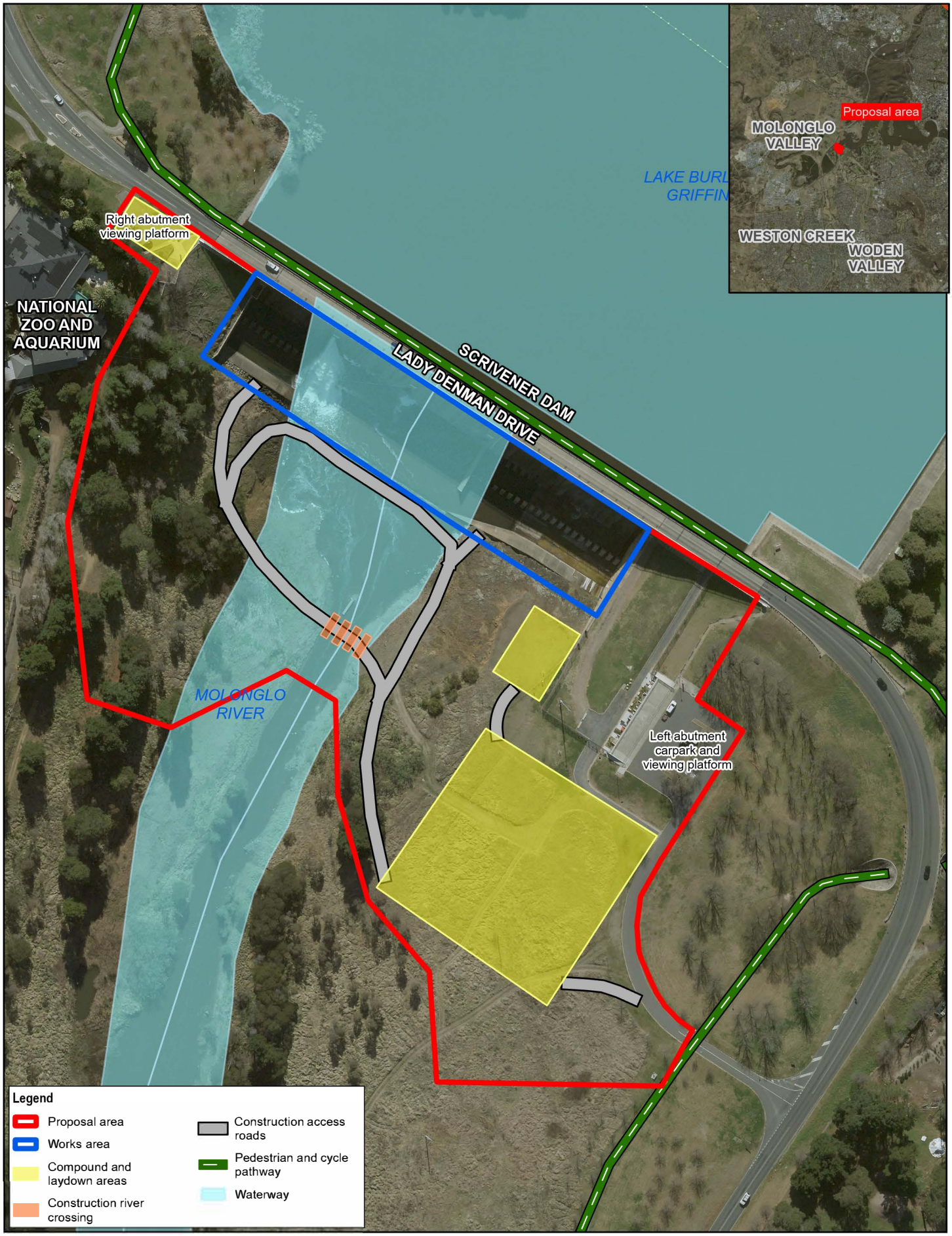
– increased risk of erosion and sedimentation
– vegetation removal
– temporary impacts to lake users resulting from the lake lowering.

However, the proposal would result in a strengthened dissipator and a safer Scrivener Dam.

Conclusion

The proposal is required in order to ensure ongoing safe operation of Scrivener Dam.

Given the nature, scale and extent of the impacts and implementation of the safeguards outlined within this EIA, the proposed works are unlikely to have a significant impact on the environment.



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GHD

National Capital Authority
Scrivener Dam
Dissipator Strengthening Project (DSP)

Project No. **12608465**
Revision No. **-**
Date **10/05/2023**

Key features of the proposal

FIGURE E.1

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1. Introduction

1.1 Background

The National Capital Authority (NCA) propose to undertake strengthening of the Scrivener Dam dissipator, located on the immediately downstream of Scrivener Dam, Weston Creek (the proposal). GHD Pty Ltd (GHD) has been engaged by the NCA to provide an environmental impact assessment (EIA) to better understand potential environmental impacts of the project and mitigation strategies; and, support required approvals for the proposal.

This EIA report provides an assessment of the potential environmental impacts associated with the construction and operational activities, identification of relevant permits required for the construction, and identification of potential mitigation measures required. This EIA report is supported by specialist studies including:

– *Biodiversity Impact Assessment* (refer Appendix B)
– *Traffic Impact Assessment* (refer Appendix C)
– *Noise and Vibration Impact Assessment* (NVIA) (WSP, 2023) (refer Appendix D).

A Heritage Impact Assessment and a Cultural Heritage Assessment were also commissioned to assess the potential impacts of the proposal on non-Aboriginal and Aboriginal heritage. At the time of writing this EIA Report (May 2023) these reports were not finalised. This EIA Report will be amended to includes the results of these heritage assessments at a later date.

1.2 The proposal

In 2016, a Dam Safety Review was undertaken for Scrivener Dam and its associated structures. The dam safety review highlighted several risks regarding the structure of the dissipator of Scrivener Dam. Subsequent investigations found, under certain conditions, there is a risk of failure of the dissipator which could lead to a dam safety emergency.

As such, the dissipator requires strengthening and associated upgrades to:

– improve the safety of the dam
– avoid further damage to the dam structure.

The design for the proposal is documented in the *Scrivener Dam Dissipator Strengthening – 50% Detailed Design* (GHD, 2022b). This EIA assesses the proposal as described in section 2 and the design report which include following works:

– **700 new anchors**: approximately 700 new double corrosion protected anchors to be installed to a depth of between 10.5 m and 12 m in a grid across the dissipator.
– **500 mm reinforced concrete topping slab:** a new 500 mm reinforced concrete topping slab to be installed over the entire top of the existing dissipator topping slab. The new topping slab would tie into the new anchors.
– **New baffle blocks:** the baffle blocks would be rebuilt 500 mm higher than the existing baffle blocks to account for the additional height added by the topping slab.
– **Raised chute blocks:** the chute blocks would be raised 500mm to account for the additional height added by the topping slab.
– **Abutment armouring:** the downstream abutments of the dam would receive additional armouring to reduce scour and erosion.

These works would take place within and around the dissipator and below Scrivener Dam in the Molonglo River waterway (refer to the ‘proposal area’ in Figure 2.1). The works would also include establishing a site compound adjacent to the Scrivener Dam Office, material laydown areas, and temporary access roads.

1.3 The proponent

The NCA was established under the *Australian Capital Territory Planning and Land Management Act 1988*. One of the key roles of the NCA is to serve the interests of the Australian Government, the nation, and its people.

The roles and responsibilities of the NCA can be summarised into three key areas:

– planning and design of nationally significant parts of Canberra
– information and education
– managing the National Capital Estate.

The NCA's statutory roles give it the capacity to ensure national assets are created, maintained, and meet the expectations of users. As part of its responsibilities, the NCA is responsible for the management, maintenance, and operations of Scrivener Dam.

1.4 Purpose of this report

The purpose of this EIA is to better understand the potential environmental impacts of the proposal and provide mitigation measures to help mitigate or minimise potential impacts.

In addition, the report may be used to support a Minor Works Approval for the proposal.

The EIA includes:

– a written description of works (refer section 2)
– a Locality Plan (refer section 2.1)
– supporting reports and assessments for planning and environmental matters (section 3 and section 5)
– a summary of consultation undertaken for the proposal (refer section 4).

1.5 Scope and limitations

This report: has been prepared by GHD for National Capital Authority and may only be used and relied on by National Capital Authority for the purpose agreed between GHD and National Capital Authority as set out in section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than National Capital Authority arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by National Capital Authority and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

2. Description of the proposal

2.1 Proposal area

Scrivener Dam is located at the western end of Lake Burley Griffin, between the National Zoo and Aquarium, Lady Denman Drive, and Government House. Scrivener Dam maintains the water level of Lake Burley Griffin by damming the Molonglo River. Water released from Scrivener Dam continues down the Molonglo River.

The surrounding land uses mostly relate to recreational use of the lake and the foreshore such as boating, swimming and cycling. Associated infrastructure nearby includes boat ramps, access roads, cycle paths, and general open space.

Scrivener Dam and Lake Burley Griffin are classified as Designated Land which falls under the jurisdiction of the NCA while the Molonglo River Corridor is a combination of Designated Land and Territory Land.

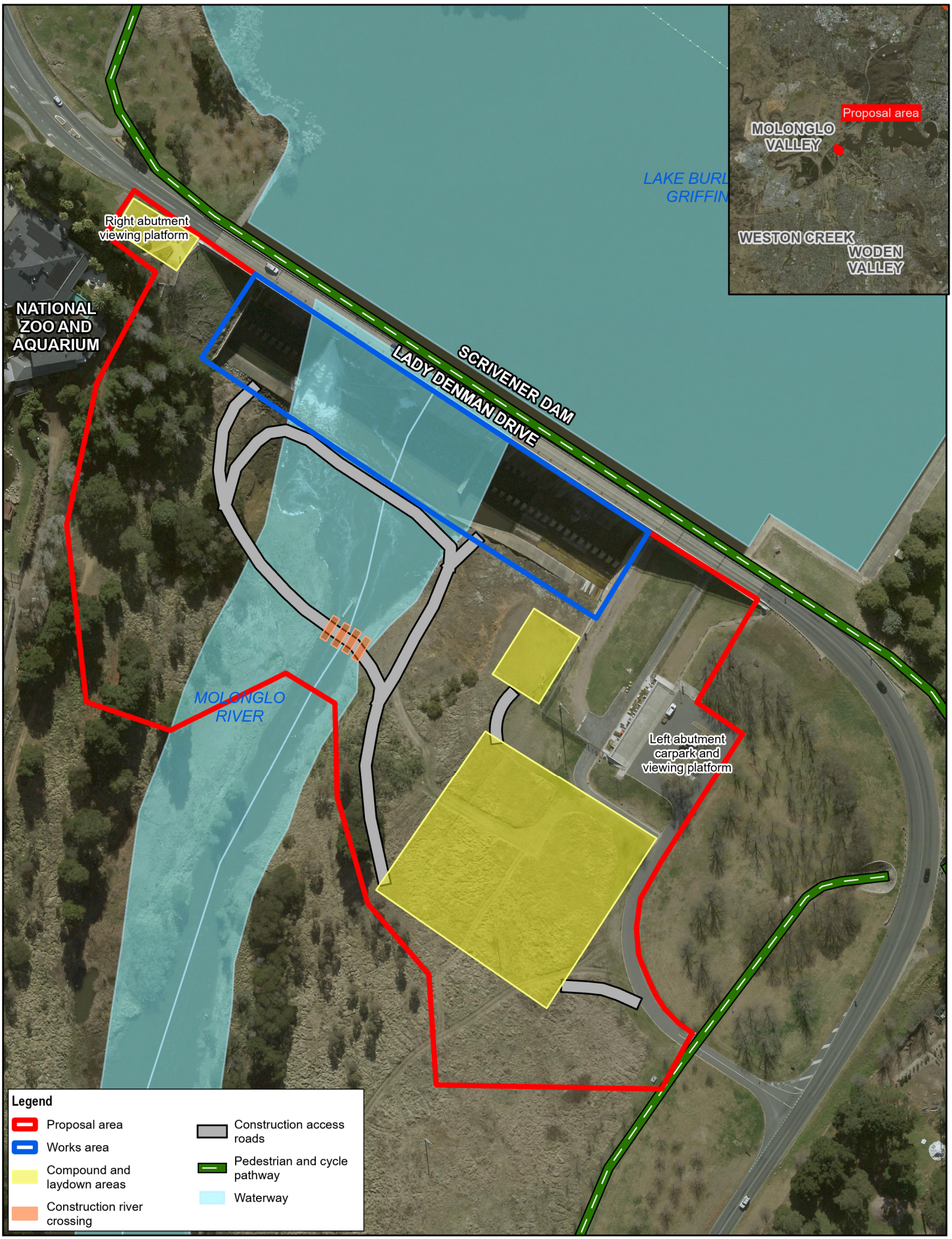
The river corridor downstream of the Scrivener Dam is within the Molonglo River Reserve. Management of this reserve is guided by the *Nature Conservation (Molonglo River Reserve) Reserve Management Plan 2019*.

The proposal area, shown in Figure 2.1, is located on the downstream wall of Scrivener Dam in Canberra, ACT. Scrivener Dam impounds[1] water from the Molonglo River to form Lake Burley Griffin. The proposal area also includes the banks of the Molonglo River downstream of the dam, including a viewing platform and carpark on dam's left[2] abutment[3] and a small carpark on the dam's right abutment.

Construction would mostly involve undertaking remedial and strengthening works to the dissipator structure in the 'works area', shown in Figure 2.1. Ancillary infrastructure, such as compounds and access tracks, would be contained within the proposal area. The proposal area would extend across Canberra Central Section 122 Block 3, Molonglo Valley Blocks 27 and 77 and Weston Creek Blocks 1142, 1202 and 1220.

A regional context with respect to Lake Burley Griffin is presented in Figure 2.2.

[1] Impoundments are artificially created standing waterbodies, produced by dams on streams or rivers.
[2] Left and right refer to the sides of a dam looking downstream.
[3] Abutment refers to the part of the valley side against which the dam is constructed.



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Key features of the proposal

FIGURE 2.1

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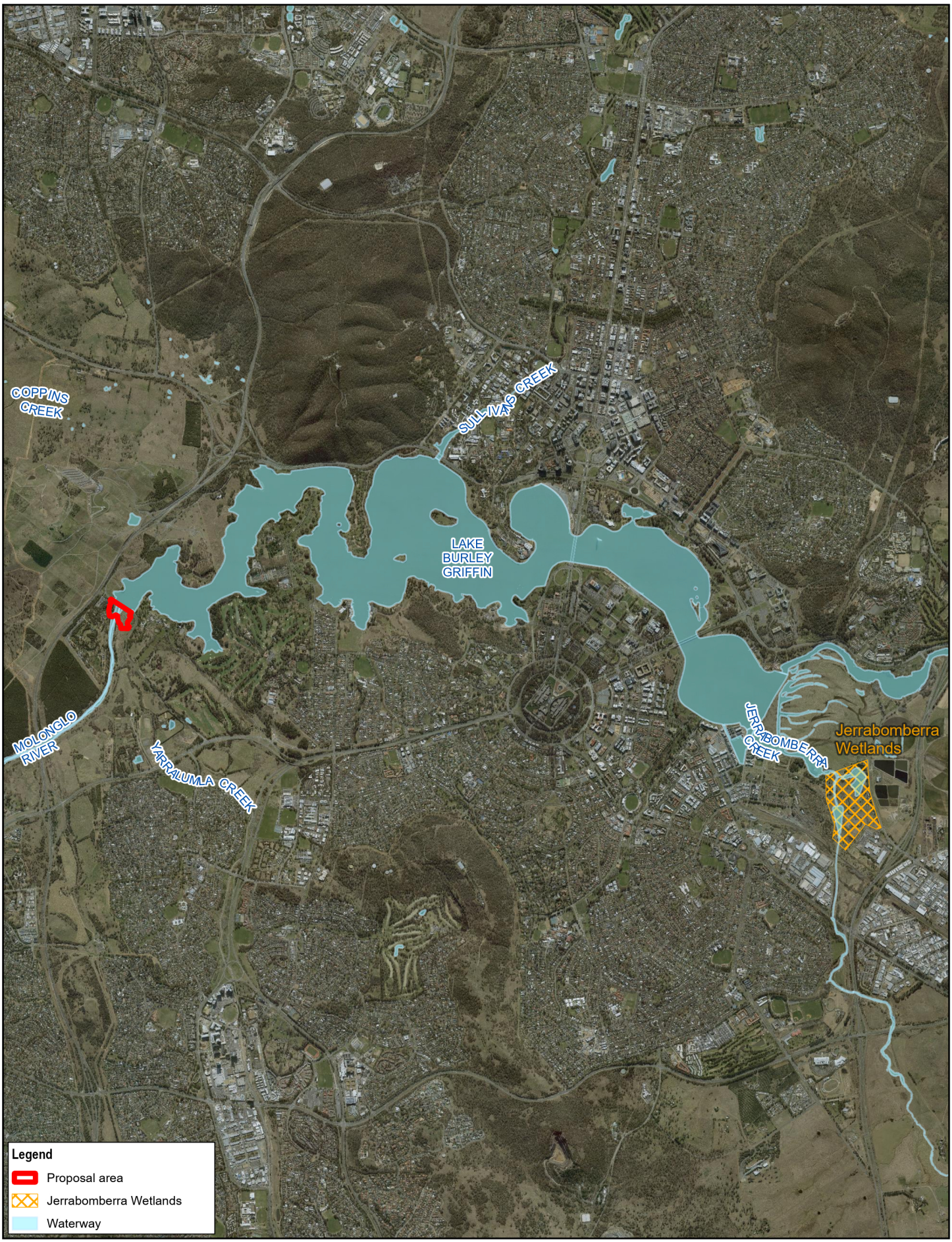

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National Capital Authority
Scrivener Dam
Dissipator Strengthening Project (DSP)

Lake Burley Griffin context

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FIGURE 2.2

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2.2 Existing infrastructure

2.2.1 Scrivener Dam

The general layout of Scrivener Dam is shown in Figure 2.3.

Scrivener Dam consists of a concrete gravity dam with five fish belly spillway gates. The spillway gates enable large and controlled volumes of water to flow over the dam during high flow events. The dam also contains three sluice gates which control smaller volumes of water through the dam.

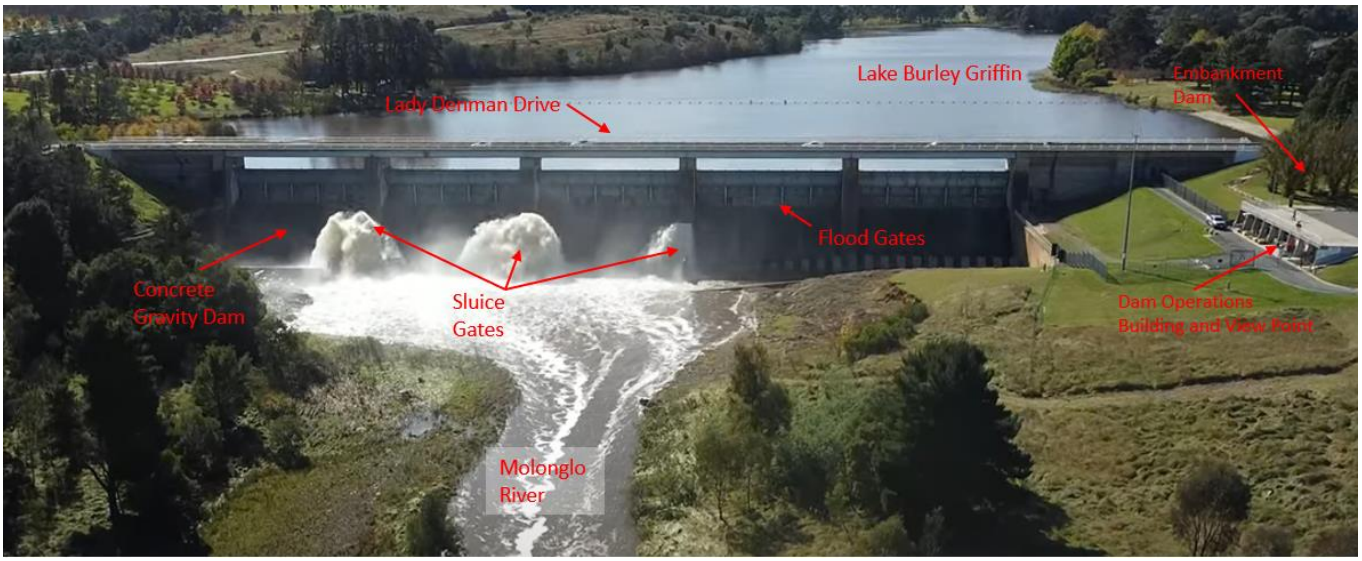


Figure 2.3 General arrangement of Dam

2.2.2 Dissipator

The downstream wall of Scrivener Dam features a concrete dissipator. The dissipator absorbs energy from the water flowing over the gates to protect the dam structure and reduce erosion.

The general layout of the Scrivener Dam dissipator is shown in Figure 2.4 and includes:

– a concrete slab
– stilling basin
– chute blocks
– baffle blocks
– training walls
– vertical anchors embedded within the concrete slab.

Anchors embedded within dissipators provide stability to these structures. However, previous reviews of the dam suggest the existing Scrivener Dam anchors are potentially deficient and corroded although their exact condition is unknown.

Figure 2.4 General layout of Scrivener Dam dissipator

2.2.3 Road infrastructure

Scrivener Dam supports a two-direction single carriage way road bridge which enables pedestrians and other traffic to travel along Lady Denman Drive over the dam. Access to Scrivener Dam is via a paved road on the left abutment of the dam that turns off Lady Denman Drive leading to a car park, look out, and dam operation building.

Figure 2.5 Lady Denman Drive atop Scrivener Dam looking north-west. Sourced from Google Maps, 2023.

2.2.4 Active transport infrastructure

The road bridge also supports pathways and cycle pathways either side of the road carriageway.

A bike and pedestrian path intersects with the paved road off Lady Denman Drive which acts as the main entry point to Scrivener Dam. This is signed as a give-way area as such, cars of other traffic access the Scrivener Dam look out must give way to cyclists or pedestrians.

2.3 Need for the proposal

In 2016 a Dam Safety Review was undertaken for Scrivener Dam and its associated structures. The dam safety review highlighted several risks regarding the structure of the dissipator of Scrivener Dam. Risks related to the standards adopted at the time of construction as well as observations and latent conditions on site.

Subsequently the NCA completed several studies and investigations to determine how the dissipator functions under a range of different operational scenarios. The investigations found, under certain conditions, there is a risk of failure of the dissipator which could lead to a dam safety emergency.

The strengthening works described in this report are proposed to address the dissipator's deficiencies and improve dam safety.

2.4 Design of the proposal

2.4.1 Key features

To address the issues identified in section 2.3, the following upgraded infrastructure is proposed:

– **700 new anchors:** About 700 new double corrosion protected anchors to be installed to a depth of between 10.5 m and 12 m in a grid across the dissipator.

- **500 mm reinforced concrete topping slab:** A new 500 mm reinforced concrete topping slab to be installed over the entire top of the existing dissipator topping slab. The new topping slab would tie into the new anchors.
- **New baffle blocks:** The baffle blocks would be rebuilt 500 mm higher than the existing baffle blocks to account for the additional height added by the topping slab.
- **Raised chute blocks:** The chute blocks would be raised 500mm to account for the additional height added by the topping slab.
- **Abutment armouring:** The downstream abutments of the dam would receive additional armouring to reduce scour and erosion.

2.4.2 Anchors

To add stability to the dam about 700 anchors of up to 12 m in length and greater than 50 mm in diameter would be installed in a grid across the existing dissipator. The anchors would consist of a threaded steel rod encased in grout[4] within a PVC liner to provide two layers of corrosion protection such as in Figure 2.6.

A downhole hammer drill[5] would be used to drill holes through the existing dissipator concrete slab and into the bedrock foundation. The double corrosion protection anchors would then be installed within these holes. The holes would then be filled with grout to permanently embed the anchors within the foundation.

Anchor design of the size, length and spacing would be determine in the 90% design phase.

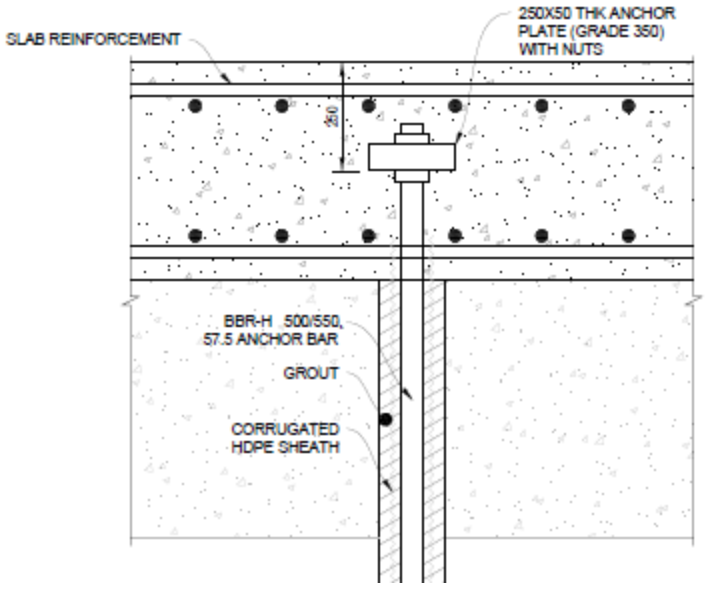


Figure 2.6 Anchor assembly and anchor head detail

2.4.3 Reinforced concrete topping slab

Prior to the pouring of the new reinforced concrete topping slab, the existing slab would be prepared either using mechanic scabble, water blaster or a combination of both. A new *in-situ* concrete topping slab would then be poured over the existing topping slap and newly installed anchors. This would provide an additional 500 mm of concrete depth over the existing dissipator and would tie the new anchors into the existing dissipator topping slab.

2.4.4 Baffle blocks

The baffle blocks would need to be rebuilt with an additional 500 mm height to account of the extension of the topping slab to maintain the existing geometry. To achieve this, the existing baffles would be separated from the

[4] Grout is generally a mixture of water, cement, and sand.
[5] Hammer drill rig works by using a percussive mechanism that creates rapid hammering blows as the drill bit rotates, allowing it to penetrate dense materials with greater ease and speed than a regular drill.

existing dissipator concrete slab using a diamond wire saw. The baffles would then be removed most likely with a crane.

The new *in-situ* concrete baffles would then be cast onto the new topping slab around a newly installed anchor. This would reinforce the connection between the new baffles and the new topping slab.

2.4.5 Chute blocks

The dam's chute blocks would need to be raised 500 mm to account for the raised topping slab. To achieve this the top layer of the existing chute blocks would be demolished using mechanic scabble, water blaster or a combination of both. New concrete would then be poured above the exposed concrete of the chute blocks to raise them by 500 mm from their original height.

2.4.6 Abutment armouring

During large floods the water downstream of the dam overtops the training walls and could potentially erode the existing abutments. Additional protection would be installed on the downstream dam abutments to increase their erosion and scour protection. Erosion protection will likely consist of flexible concrete matts, geotextile fabric, or a combination of both. These measures repaired with large rip rap covered with soil and the area revegetated.

2.5 Construction method

2.5.1 Work methodology

Construction of the proposal would likely occur in the following stages:

- **Preliminary Stage – Site establishment:** This would involve establishing compounds and site facilities, construction of access roads and hardstand areas, and crane set up. This phase would also include construction of a river crossing bridge to better enable access to the works area.
- **Stage 1 – Bays 3, 4, and 5**: A water management system would be installed to dewater the Stage 1 work areas and create a dry place for construction. Works would then begin on Bays 3, 4 and 5 on the left of the dam. Water would continue to flow through the Bay 2 sluice gate and if needed Bay 1 via operating a gate. Abutment armouring would be installed on the existing abutments.
- **Stage 2 – Bay 1 and 2 construction:** The cofferdam in front of Bay 3 would be removed and Bays 1 and 2 would be dewatered to the isolated work area and provide construction access. Flow would then be re-established through Bays 3, 4 and 5.
- **Stage 3 – Demobilisation and rehabilitation**: The site would be demobilised and rehabilitated.

Likely works areas for Stage 1 and 2 and shown in Figure 2.7 and bay numbers are shown in Figure 2.8.

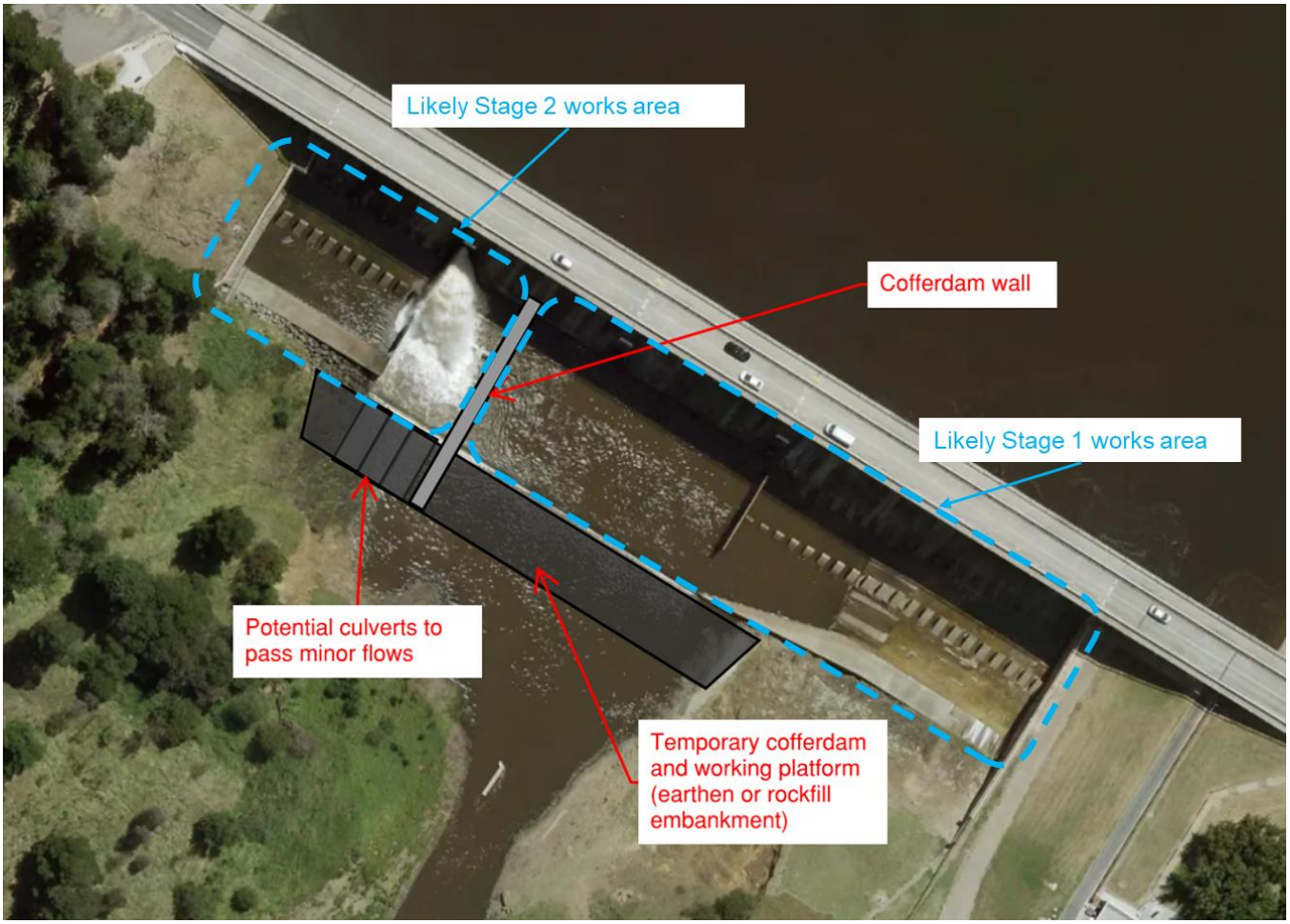


Figure 2.7 *Likely Stage 1 and 2 works areas and cofferdam locations*

Figure 2.8 *Numbering of bays and gates within Scrivener Dam*

The construction method would be refined during detailed design and would be phased to ensure that flows along the Molonglo River can be maintained throughout the works. To achieve this, cofferdams would likely be used to isolate a portion of the works area for construction while allowing water to flow in the area outside of the cofferdam.

A cofferdam is a watertight enclosure from which water is pumped to expose the bed of a body of water in order to enable construction to occur. The cofferdams would likely be made of a large pile of rip rap, or clay covered in rip rap, covered in a waterproof High-Density Polyethylene liner. Water within the enclosed work area would be collected in sumps[6]. Water within sumps would be filtered and discharged to the Molonglo River. Culverts may also be placed within the cofferdam walls to allow minor water flows to migrate underneath the cofferdam wall.

The material for the cofferdams would likely be installed at the beginning of construction using a truck and removed at the end of the works using an excavator and trucks.

The cofferdams would likely be located in the grey areas shown in Figure 2.7. While the configuration of the cofferdams may vary, the environmental impacts of this methodology would likely remain similar. As such, this report assesses one potential cofferdam configuration while noting this may not be the exact layout used by the contractor.

Where other uncertainty remains in the construction methodology a 'worst case scenario' has been used to allow impacts to be assessed conservatively.

2.5.1.1 Site establishment

Appropriate sediment and erosion controls would be installed within the Molonglo River and throughout the proposal area to capture silt and soil that could be mobilised during the works. This would be implemented as part of an erosion and sediment control plan under a Construction Environmental Management Plan (CEMP).

Temporary site facilities such as access roads, site compounds, services, storage and handling areas, and crane areas would be established. A site compound is required to support the construction works comprising site offices, lunch sheds, ablution blocks, change rooms, and worker car parking. Portable toilets would be regularly serviced via a pump-out arrangement and disposed of appropriately off-site by the contractor.

Indicative locations for these facilities are shown in Figure 2.1.

Hardstand areas on each side of the dam would be established to manage materials and for a staged delivery (required to suitably manage floods).

Earthworks would be required to form access tracks to the suitable grade. A temporary river crossing would be constructed to enable construction access to both sides of the Molonglo River. The river crossing would likely consist of a series of large pipes topped with gravel that vehicles may drive over. These would be placed on the riverbed and thus excavation is not anticipated to be required. The pipes and gravel would be removed once the works were completed.

Excess spoil would either be reused within the proposal area or tested and disposed of at an appropriately licenced facility.

Removal of vegetation would be undertaken by a suitable qualified arborist. For the purposes of environmental assessment, it has been assumed that all vegetation within the proposal area shown in Figure 2.1 would be removed. It is unlikely that all of the proposal area would need to be cleared, however it has been assessed as such to provide the contractor flexibility while undertaking the works. The extent of vegetation clearing would be minimised where practicable to minimise impact to the environment.

2.5.1.2 Bays 3, 4 and 5 works

A water management system would be installed to dewater the Stage 1 work areas and create a dry place for construction. The water management system would likely use cofferdams to separate the Stage 1 work area from the rest of the proposal area as shown in Figure 2.7. Once the cofferdams are installed water would be continuously pumped out of work areas to keep them relatively dry.

[6] A temporary pit which is constructed to trap and filter water for pumping to a suitable discharge area.

Construction would then occur on the sections of the dissipator within Bay 3, 4 and 5. Construction would involve installing new anchors, pouring the new topping slab, demolishing the existing baffle blocks and constructing the new baffle blocks, and raising the chute blocks as discussed in Sections 2.4.2, 2.4.3 , 2.4.4 and 2.4.4 respectively.

Work on the abutments would also occur in Stage 1 which would include extending the abutment armouring as discussed in sections 2.4.6.

2.5.1.3 Bays 1 and 2 works

During Stage 2, a cofferdam would be installed around the Bays 1 and 2 work area as shown in Figure 2.7. Once the cofferdams are installed water would be continuously pumped out of work area to keep it relatively dry. Flow would then be re-established through Bays 3, 4 and 5.

As in Stage 1, construction would then occur on the section of the dissipator within the cofferdam including installing new anchors, pouring the new topping slab, demolishing the existing baffle blocks and constructing the new baffle blocks, and raising the chute blocks.

Once complete the water management system would be removed and normal flow re-established.

2.5.1.4 Demobilisation and rehabilitation

Demobilisation of the proposal area, including removal of all temporary site works, the site compound, temporary access roads and hardstands and cranes, would occur progressively throughout construction. This would enable the proposal area to remain as tidy as possible.

Any disturbed vegetation would be rehabilitated at the end of the works. This would be undertaken using a Vegetation Rehabilitation Plan which would include:

– planting of native trees
– stabilisation of Molonglo River banks with shrub or reed plantings
– restoration of rocky areas to provide fauna habitat.

The river crossing would be removed once construction is completed. It is noted that some access tracks may be retained for future maintenance. Any access tracks that remain in place after construction is complete would have vegetation planted along their sides and have appropriate erosion and sediment control plans in place.

2.5.2 Reservoir drawdown

Construction of the proposal would require lowering the height of Lake Burley Griffin by a maximum of 500 mm below the lake's Full Supply Level (FSL) of 555.93 mAHD for up to 24 months during construction.

The reservoir drawdown is required to provide air space that can be filled during high flows which would provide time to evacuate personnel and equipment prior to operations of the sluice and / or flood gates.

Reservoir levels have been very stable since 2000, having remained almost entirely within 150 mm above or below the reservoir FSL of 555.93 mAHD, apart from a small number of occasions where it has dropped below the FSL, as per Figure 2.9. Key points in time where the reservoir level dropped below the typical range occurred between December 2011 and August 2013 where the reservoir level was kept at approximately 555.45 mAHD for a 21-month period while upgrade works occurred on the gate hinges.

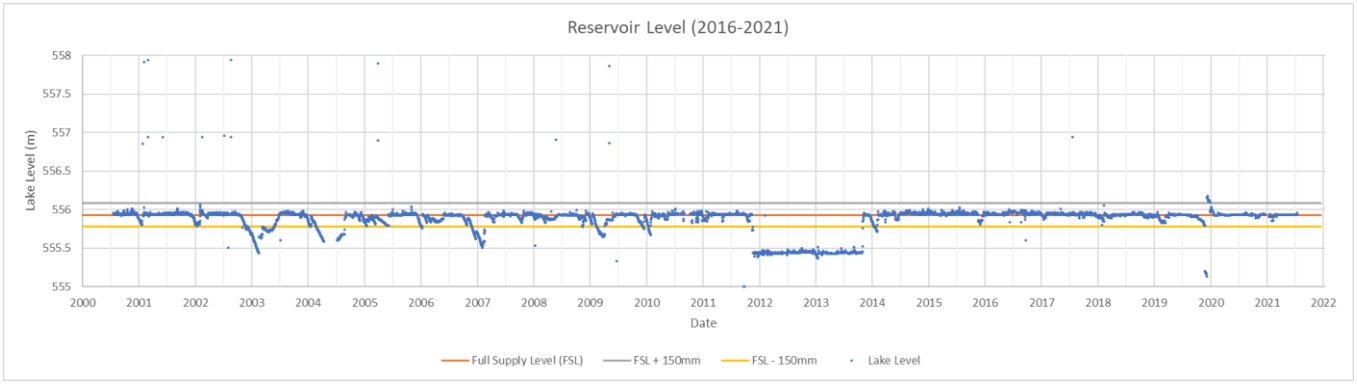


Figure 2.9 Reservoir Level (2016-2021)

Consultation has been undertaken to understand potential impacts of lowering the lake on users (see section 4). Discussion on the impact of this drawdown is discussed in sections 5.1 (biodiversity), 5.2 (hydrology and flooding), 5.10 (commercial and recreational impacts) and 5.8 (visual amenity).

2.5.3 Construction hours and duration

Construction would be undertaken during standard working hours with regular breaks to minimise constant and excessive noise from:

– Monday-Saturday, 7am-6pm
– Sunday and Public Holidays, 9am-5pm.

Construction is expected to commence in early 2024 and take up to 24 months.

Due to the variability in the Molonglo River flow, the contractor may need to work outside of these hours to ensure work can be completed without being impacted by rain fall or flooding. This will be dependent on both long range and short-range weather forecasting.

2.5.4 Workforce

The workforce present during construction would vary however it is expected that at the peak of construction about 60 persons would be on site. Smaller crews would be expected during the initial site establishment and during demobilisation.

2.5.5 Traffic management and access

2.5.5.1 Traffic access

Additional access tracks, as shown in Figure 2.1, would also be constructed to provide access throughout the proposal area. Earthworks would be required to form access tracks to the suitable grade. The access tracks would be constructed to cater for heavy vehicles and would be topped with gravel. A turning circle would also be

constructed within the proposal area and would be constructed to enable manoeuvring of heavy vehicles such as concrete trucks, mobile cranes etc.

It is not expected that any upgrades would be required on the intersection with Lady Denman Drive. The construction work may integrity of the existing pavement. However, at this stage work on Lady Denman Drive is not anticipated and is not included in the scope of this report.

2.5.5.2 Traffic management

Traffic management and safety would be managed through a Traffic Management Plan (refer Section 5.3 and Appendix C).

Traffic management measures such as the installation of signage and temporary traffic lights (which would be sensor activated) are likely to be required at the Lady Denman Drive intersection and along the cycle track (Canberra Centenary Trial). This cycle track is heavily used by cyclists and at times at speed due to the terrain of the cycle route. A pedestrian crossing may be required.

The interface of the newly constructed access tracks and the existing sealed road would be managed by installing a concrete driveway. This would help to help prevent damage to the existing pavement.

2.5.5.3 Traffic volumes

Construction of the proposal would increase vehicle use of Lady Denman Drive in the form of light and heavy vehicles. Estimate traffic movements at peak construction are provided in Table 2.1.

Table 2.1 Indicative construction traffic volumes

Traffic type	Estimated traffic movements at peak construction
Light vehicles	60
Heavy vehicles	20

2.5.6 Services

There are existing services available near the proposal area that could be used for construction including:

– underground and overhead power
– potable water
– NBN and Telstra
– sewer located on the left abutment.

It is not anticipated that any utilities would need to be moved for construction.

3. Statutory context

The proposal will require a 'Minor Works Approval' from the NCA under the *Australian Capital Territory (Planning and Land Management) Act 1988 (Cth)* to carry out certain works in a Designated Area under the National Capital Plan. A Minor Works Approval for the proposal has yet to be sought and obtained and will be supported by information presented in this Environmental Assessment.

This Environmental Impact Assessment is not a statutory requirement for the proposal but has been prepared to provide a complete and consolidated assessment of its potential environmental impacts. It is intended to support the Minor Works Approval, and other statutory approvals if required, for the proposal.

3.1 Commonwealth legislation

3.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Commonwealth Government's primary legislation for the protection of matters of national environmental significance (MNES). It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places. The EPBC Act also regulates actions on or impacting on Commonwealth land, or actions by Commonwealth agencies.

Parts 7, 8 and 9 of the EPBC Act consider and assess the potential impacts of individual actions on MNES. Part 10 of the EPBC Act provides for assessment of impacts of actions over a larger area, such as a landscape scale, or longer timeframe.

Approvals under the EPBC Act are additional to any approvals required under NCA or Territory Legislation.

The *EPBC Act Policy Statement 1.1, Significant Impact Guidelines – Matters of National Environmental Significance* (Commonwealth of Australia, 2013a) and *EPBC Act Policy Statement 1.2, Significant Impact Guidelines – Actions on, or imposing upon, Commonwealth land and Actions by Commonwealth Agencies* (Commonwealth of Australia, 2013b), provide a definition of 'significant impact' and the approach to take where there is scientific uncertainty about the potential impacts.

Appendix A provides the key factors listed under these guidelines that could trigger an EPBC Act referral. The proposal is unlikely to result in a significant impact on any MNES and a referral under the EPBC Act is not required.

3.1.2 Australian Capital Territory (Planning and Land Management) Act 1988

The *Australian Capital Territory (Planning and Land Management) Act 1988* (PaLM Act) (Cth) establishes the NCA and assigns it various functions and responsibilities relating to the Australian Government's interest in the planning and development of the nation's capital. One of the NCA's key roles is the preparation and administration of the National Capital Plan (NCP), which aims to ensure that Canberra and the Australian Capital Territory are planned and developed in accordance with their national significance.

3.1.2.1 National Capital Plan

The NCP is the Australian Government's strategic Plan for Canberra and the Territory and is administered by the NCA. The NCP maintains broad oversight of planning in the Territory and importantly an interest in the planning, design and development of those areas having the special characteristics of the National Capital.

At its broadest level the NCP prescribes land use controls across the whole of the Territory and includes more detailed planning provisions for areas where the Commonwealth has a specific interest. These are identified in the NCP as Designated Areas. It also has jurisdiction over areas of National Land and may set out special requirements for development of any area. The NCP takes precedence over the Territory Plan where any inconsistencies arise.

The General Policy Plan within the NCP sets the broad framework for land use in the Territory and shows the areas which are planned for urban development and those that are not to be developed for urban use. Under the General Policy Plan and the National Capital Open Space System of the NCP the proposal area is identified as urban area. The range and nature of uses permitted in Urban Areas includes those uses compatible with residential, commercial, community, cultural, recreational and industrial activity, other than uses not permitted in the Territory Plan.

The NCP provides that Designated Areas comprise:

– Lake Burley Griffin and its Foreshores
– the Parliamentary zone
– the balance of a Central National Area adjoining the Lake and the Zone, and extending from the foot of Black Mountain to the airport
– the Inner Hills which form the setting of the Central National Area
– the Main Avenues and Approach Routes between the ACT border and the Central National Area.

Given the works are associated with Lake Burley Griffin and its Foreshores, the works fall under NCA jurisdiction.

Under Section 12 of the PaLM Act, where works are proposed in a Designated Area, they are subject to approval by the NCA. Approval may be granted when a proposed work is in accordance with the NCP.

3.2 ACT Government Statutory Requirements

3.2.1 Environmental Protection Act 1997

The *Environment Protection Act 1997* (EP Act) provides the regulatory framework to protect and enhance the environment, to prevent environmental degradation and reduce and eliminate the discharge of pollutants to the air, land and water. The EP Act also provides for the identification and remediation of contaminated land, management of waste and pesticides.

The EP Act establishes the Environment Protection Authority (EPA) as the statutory decision maker for environmental regulation and policy.

Parts 7 and 8 outline requirements for Environmental Protection Agreements and Environmental Authorisations. Certain activities that pose environmental risk require an environmental authorisation issued by the EPA.

An Environmental Authorisation or Environmental Protection Agreement is required under the EP Act for the conduct of Class A activities or Class B activities identified in schedule 1 of the EP Act or certain other situations determined by the EPA.

An Environmental Authorisation is not considered to be required for the proposal.

3.2.2 Environmental Protection Regulation 2005

The Environmental Protection Regulation 2005 supports the EP Act. Part of the regulation identify offences relating to emissions to air, noise and water.

Part 8A details the requirements for Erosion and Sediment control measures for development sites. An approved erosion and sediment control plan will be required to manage and prevent impacts during construction.

Schedule 2 provides noise zones and standards which have been considered in the noise assessment (refer to information in section 5.6).

3.2.3 Heritage Act 2004

The *Heritage Act 2004* (Heritage Act) applies to any heritage objects in the ACT, and to any places located on Territory land. The Heritage Act establishes a system for the recognition, registration and conservation of natural and cultural heritage places and objects, including Aboriginal places and objects, the ACT Heritage Council, provides for Heritage Agreements and establishes enforcement and offence provisions to provide greater

protection for heritage places and objects. It provides a system integrated with land planning and development to consider development applications having regard to the heritage significance of places and to Heritage Guidelines.

Where development may diminish the heritage significance of a registered place or object, or damage an Aboriginal place or object, approval under the Heritage Act from the ACT Heritage Council is required.

In accordance with the *Heritage (Decision about Provisional Registration of Scrivener Dam, Yarralumla) Notice 2013,* Scrivener Dam is not listed on the ACT Heritage Register as it *"is located on National Land within a Designated Area, and as such the* Heritage Act 2004 *does not have direct effect"*.

On 19 May 2023 ACT Heritage Council advised that there are no Heritage Act considerations as long as works are ceased should any Aboriginal objects or places be unexpectedly encountered to allow for heritage assessment and management (in accordance with Section 75 of the Heritage Act). The discovery would then be reported to the Council within five working days in accordance with Section 51 of the Heritage Act. The discovery would then be managed in accordance with any Council advice.

A Heritage Impact Assessment and a Cultural Heritage Assessment were commissioned to further assess the potential impacts of the proposal on non-Aboriginal and Aboriginal heritage. At the time of writing this EIA Report (May, 2023) these reports were not finalised. This EIA Report will be amended to includes the final results of these heritage assessments when available.

3.2.4 Nature Conservation Act 2014

The object of the *Nature Conservation Act 2014* (NC Act) is to protect, conserve and enhance the biodiversity of the ACT. It establishes a formal process for the identification and protection of threatened species and ecological communities and biodiversity in the ACT. The NC Act requires the Conservator of Flora and Fauna to prepare an action plan in response to each declaration of a threatened species, ecological community or threatening process.

The NC Act identifies offences under the Act to protect native species and the requirement for approvals or licences to authorise activities that would otherwise be an offence under this Act, such as to injure or endanger a native animal or plant, or to clear native vegetation or plants in a reserve.

Under the NC Act proponents must assess the likely impact of proposed developments on threatened species and ecological communities listed under the NC Act. A *Biodiversity Impact Assessment* (refer Appendix B) was prepared by GHD to meet this requirement.

The assessment found that the proposal is not likely to have a significant impact on threatened species or ecological communities listed under the NCA Act and as such a referral to the Conservator of Flora and Fauna is not required.

The proposal area is located in the Molonglo River Reserve established under the NC Act. As such, the proposal will require a licence to damage land under the NC Act.

3.2.5 Road Transport (Safety and Traffic Management) Act 1999

The *Road Transport (Safety and Traffic Management) Act 1999* (Road Act) describes the requirements for traffic management and control in Canberra when carrying out works.

Under the Guiding principles for temporary traffic management plans:

– *All developers and contractors intending to use any part of a road or road related area such as a footpath will need to apply to Roads ACT for the authorisation of a temporary traffic management (TTM) plan.*

A TTM would be prepared as part of the proposed works as per the Guiding principles and be approved by Roads ACT. The TTM would include a Traffic Management Plan and Traffic Guidance Scheme.

3.2.6 Tree Protection Act 2005

The *Tree Protection Act 2005* (TP Act) aims to protect trees and the urban forest values within the urban area of the ACT. The TP Act applies to trees on land in built-up urban areas. The built-up urban area is an area declared by the Minister for the Environment and the proposal is not within an area declared to be a built up urban area for

the purpose of this Act. The TP Act identifies protected trees as either registered trees (a tree that is registered under part 7) or regulated trees, which is a tree that is located on leased land and meets certain criteria in size.

As the land is not identified as part of the built-up urban area, and the site is not currently leased land, any trees in the proposal area are not currently regulated by the TP Act.

Best practice would be conducted during the works and it is recommended that any tree that would be defined as a *regulated tree* should be retained for the proposal. This includes:

– is 12 m or more high; or
– has a trunk with a circumference of 1.5 m or more, one metre above natural ground level; or
– has two or more trunks and the total circumference of all the trunks, one metre above natural ground level, is 1.5 m or more; or
– has a canopy 12 m or more wide.

3.2.7 Waste Management and Resource Recovery Act 2016

The *Waste Management and Resource Recovery Act 2016* (WM Act) provides the regulatory framework to manage waste, support innovation and investment in waste management, promote responsibility for waste reduction and promote best-practice waste management.

The objects of the Waste Management and Resource Recovery Act are to manage waste according to the hierarchy of minimisation, recovery and re-use of resources, to support innovation and investment in waste management and to promote responsibility for waste reduction and best practice management.

In the WM Act, *waste* includes the following:

a. any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment;
b. any discarded, rejected, unwanted, surplus or abandoned substance, whether or not intended for sale, recycling, reprocessing, recovery or purification by a separate operation from that which produced it;
c. any other substance declared by regulation to be waste.

Waste may be produced as part of the works which would include spoil from drilling or spoil from levelling areas for construction laydown.

Under the WM Act, waste must be transported by a regulated waste transporter for appropriate disposal where it is not practicable to re-used material on-site.

3.2.8 Water Resources Act 2007

The *Water Resources Act 2007* aims to ensure the use and management of the Territory's water resources are sustainable while protecting the ecosystems that depend on the waterways. It is also designed to protect waterways and aquifers from damage.

If the work is approved by an Environmental Authorisation or Environment Protection Agreement under the EP Act, an additional waterway work licence is not required.

The WR Act requires the following works to be licenced:

– work in a waterway
– construction of a water structure with a capacity of more than 2 megalitres (regardless of whether it is located on or off a waterway).

The WR Act defines *waterway* as:

– a river, creek, stream or other natural channel in which water flows (continuously or intermittently); or
– the stormwater system; or
– a lake, pond, lagoon or marsh in which water collects (continuously or intermittently).
– A waterway includes both the bed and the banks of the waterway.

The works would include construction activities within the bed and banks of waterway (including a small river crossing). The work is not approved under an Environmental Authorisation therefore a waterway work licence will be required to conduct the construction works.

3.3 Other requirements

3.3.1 Territory Plan 2008

The Territory Plan is the key statutory planning document for Territory land in the ACT, providing the policy and statutory framework for the administration of planning in the ACT. The purpose of the Territory Plan is to manage land use change and development in a manner consistent with strategic directions set by the ACT Government, Legislative Assembly and the community. It must not be inconsistent with the National Capital Plan.

The construction footprint would extend to Territory Land however given the works are associated with Designated Land, the NCP takes precedence.

3.3.2 Environment Protection Guidelines for Construction and Land Development in the ACT

The purpose of the guidelines is to provide clear guidance and practical advice to land developers, builders and anyone carrying out or supervising civil construction and building works.

Within the guidelines, the principles of environmental protection are:

– plan environment protection measures in the design phase
– assess risks of erosion and sedimentation
– develop a site-specific Erosion and Sediment Control Plan
– use a suitably qualified person to design control measures
– implement erosion and sediment controls prior to site works commencing
– control the entire site, including risks from outside the site (e.g. overland flow and water entering the site)
– minimise the area of disturbance by staging works
– implement waste and spoil management controls throughout development phases
– conserve and reuse material on site
– rehabilitate the site or stage of development as works are completed
– maintain all controls until the site is fully stabilised
– maximise cost effective environmental improvements using a risk-based management approach.

Appropriate management plans would be developed prior to construction commencing to address the guidelines and principles.

4. Government and community consultation

Relevant ACT Government agencies and community stakeholders were contacted and provided with the opportunity to comment on the proposed works.

Consultation will continue leading up to the start of the proposal and throughout the works.

4.1 Community consultation

Consultation was undertaken by the NCA with key lake user groups on 30 November and 8 December 2022. This included formal public consultation for the NCA Works Approval. Additional consultation was undertaken with Pedal Power on 10 May 2023.

The key points of concern raised were:

– inability to use jetty locations safely
– inability to access pontoons safely
– damage to pontoons or vessel
– loss of access to key service points for vessels (Kingston Harbour / slipway)
– navigational hazards
– safety risks associated with increased traffic
– weed management.

Specific issues raised by lake users and other community groups are summarised in Table 4.2 and categorised in Table 4.2. The consultation was focussed on the proposed temporary lowering of Lake Burley Griffin and increased traffic during to construction.

Lake access and navigational safety are discussed in section 5.10 (commercial and recreational impacts), traffic impacts are discussed in section 5.5 (traffic), and impacts relating to biodiversity are discussed in section 5.1 (biodiversity).

Table 4.1 Community consultation summary

User group	Concerns
Australian National University Sailing Club	Requested a bathymetry[7] survey to be made available.
Botanic Gardens	The Botanic Gardens currently abstract water from the lake, it was noted that lowering the lake levels may inhibit this capability. It was noted that investigations should be undertaken as lake water extraction is monitored by the EPA.
Canberra Cruises and Parties	The part owner noted their vessel currently sits 0.5 m from the bottom of the lake when moored at Kingston Harbour. Kingston Harbour is a point for refuelling, resupplying and sewer discharge. Hence, lowering the lake would mean the business would be inoperable. It was noted that drought after the proposed works may further impact operations if the lake takes a considerable amount of time to return to standard levels. Slipway access was also noted as it is required for survey inspections, repairs and maintenance. If the vessels could not use the slipway, cranage and other facilities would be required. The part owner noted the location of the business was flexible if opportunity arose for temporary relocation.
Canberra Grammar School	The representative asked about previous low lake levels and how these were managed. It was mentioned that marking of hazards was undertaken.
Canberra Yacht Club	The Lotus Bay Launching Jetty is over already shallow water and lowering the lake may render it unusable. It may require an extension to be used.

[7] A bathymetry survey shows the underwater topography of a body of water. This allows for understanding of shallow or deep areas that may cause concern or hazards for boats.

User group	Concerns
	The Lotus Bay Eastern Launch Ramp will likely be able to continue operations however the western ramp may need to be extended. The current Western Ramp has a significant dip that causes issues for boat trailers, and this would be further hindered by additional use. The Lotus Bay Finger Jetty may need to be extended for continued use. The all-access sailing jetty of Lotus Bay would be impacted by lower water levels. Vessels need to be lowered into the water. An extension to the jetty to allow for it to continue to be used for disabled sailing.
Capital Lakes Rowing Club	Pontoon access for the club may become unsafe if the lake level was lowered.
Friends of Grasslands	Friends of Grasslands considered the lowering of the lake would be an opportunity to treat additional weeds and remove carp eggs from the lake. Seasonal lake lowering and fish passageway were requested to be considered but not deemed relevant to this proposal.
Go Boat / Paddle Boats	There was concern regarding the drop off adjacent to Paddle Beach, if the water level were to decrease then the paddle boats may not be able to be dropped off. It was noted that lowering the lake level may cause additional weeds and underwater hazards which make navigation difficult from the launch point.
Pedal Power	Pedal Power noted the construction traffic would be increased and pose a hazard to cyclists. It was noted additional signage for both construction traffic and cyclists could be utilised to ensure caution is taken on both sides of the roadway. Additionally, construction workers would be made aware that they must give way to cyclists during daily meetings.
Rowing ACT	The Canberra Launch Facilities will unlikely be able to be used if the water level was lowered as the club currently do not have a pontoon. Additionally, the water may be too shallow to navigate. The Sullivans Creek pontoon is over existing shallow water and lowering the lake level may cause damage or issues. It was noted the Sullivans Creek already has many navigation hazards and lowering the lake level would expose additional hazards.
Southern Cross	There were concerns that Kingston Harbour may not be able to be used. The importance of the slipway was also noted. If the lake levels were lowered, the slipway may be inoperable as it already has issues accommodating heavier vessels. Damage to engines was noted as a concern due to underwater hazards that may become more prevalent.
YMCA Sailing Club	The club noted their jetty would still be usable if the lake level was lowered but they would lose half their jetty. The club requested an extension with a floating pontoon for continued ease of use. It was noted that in periods were the lake levels have dropped during drought, navigation hazards arose which caused safety concerns.
Other	It was noted that Curley Leaf Pond Weed and Ribbon Weed (Aquatic weeds) could become an issue when the lake level is lowered and management should be considered.

Table 4.2 User groups and key concerns

Key concern / User Group	Inability to use jetty locations safely	Inability to access pontoons safely	Damage to pontoons or vessel	Loss of access to key service points for vessels (Kingston Harbour / slipway)	Navigational hazards	Inability to use lake water	Bathymetry survey	Increased traffic posing safety issues	Weed management.
ANU Sailing Club							O		
Botanic Gardens						O			
Canberra Cruises and Parties			O	O	O		O		

Key concern / User Group	Inability to use jetty locations safely	Inability to access pontoons safely	Damage to pontoons or vessel	Loss of access to key service points for vessels (Kingston Harbour / slipway)	Navigational hazards	Inability to use lake water	Bathymetry survey	Increased traffic posing safety issues	Weed management.
Canberra Grammar School					O				
Canberra Yacht Club	O	O	O		O				
Capital Lakes Club		O			O				
Friends of Grasslands									O
Go Boat / Paddle Boats	O		O		O				O
Pedal Power								O	
Rowing ACT	O	O	O		O				
Southern Cross	O	O	O	O	O				
YMCA Sailing Club	O		O		O				

4.2 Routine consultation

As part of routine stakeholder communication relating to management of Lake Burley-Griffin and Scrivener Dam, the following stakeholders have also been consulted with:

- Environment, Planning and Sustainable Development Directorate (EPSDD)
- Parks and Conservation
- ACT Environment Protection Authority (EPA)
- Jerrabomberra Wetlands
- City Renewal Authority
- Transport Canberra and City Services (TCCS) – Roads: relating to stormwater infrastructure
- TCCS – Dams and Hydrology
- TCCS – City Presentation: relating to ACT managed areas around the lake including Black Mountain Peninsula and Weston Park.
- TCCS – Infrastructure: relating to pumping infrastructure around the Lake
- ACT Property Group
- Pedal Power
- Canberra Ornithologists Group
- Molonglo Conservation Group
- ACT Biosecurity
- Major Projects Canberra (John Gorton Bridge Project).

4.3 ACT Government consultation

Relevant ACT Government agencies were contacted to gain an understanding of additional permits that may be required and understand key concerns. A summary is been provided in Table 4.3.

Table 4.3 Government consultation summary

Agency	Concerns
ACT Heritage Council (Council)	A response to the email dated 1 May was received on 17 May 2023. Council stated that they did not identify any registered heritage places or objects within the proposal area. They noted that review of aerial imagery indicates that the proposal area has been previously disturbed through the installation of infrastructure such as concrete pads, laydown areas, fencing and cleared tracks. Council stated various levels of waterflow, clearance of vegetation, and the installation of the aforementioned infrastructure have all likely contributed to the reduction of archaeological integrity of the site. Therefore, the proposal area is unlikely to contain unrecorded heritage places and objects. Council noted that there may be some areas of Aboriginal archaeological sensitivity along the banks and bed of the Molonglo River further downstream, and any proposed works outside of the current proposal area may require further investigation or archaeological survey. However, at this stage Council has no concerns with the proposed maintenance works and no additional assessment is required for the proposal. Council advised that there are no Heritage Act considerations to the proposal, subject to the following condition being applied: "Should Aboriginal objects or places be unexpectedly encountered during any use of the site, works and/or use of the site at those locations must cease to allow for heritage assessment and management (in accordance with Section 75 of the *Heritage Act 2004*) and the discovery is to be reported to the Council within five working days (in accordance with Section 51 of the *Heritage Act 2004*). The discovery must then be managed in accordance with any Council advice"."
ACT Conservator of Flora and Fauna	A response to the email dated 2 May was received on 17 May 2023. The Conservator confirmed that as the works are located on land in a Designated Area, there are no *Planning and Development Act 2007* requirements for the proposal. The Conservator also noted that the proposal area is within a nature reserve and as such a licence under the *Nature Conservation Act 2014* may be required. The Conservator noted that proposal should have a plan to rescue entrained wildlife (particularly fish) in the works area.
Environment, Planning and Sustainable Developed Directorate (EPD)	A response to the email dated 27 April was received on 3 May 2023. The EPD confirmed that as the works are located on land in a Designated Area, there are no *Planning and Development Act 2007* requirements for the proposal. The EPD also noted that there may be some approvals required under the *Heritage Act 2004* and that ACT Heritage should be consulted.
ACT Parks and Conservation Service – EPD	A response to the email dated 17 May was received on 26 May 2023. The ACT Parks and Conservation Service that the proposal would require a licence to damage land under the *Nature Conservation Act 2014* due to the proposal's location within a nature reserve.
EPA	A response to the email dated 28 April was received on 5 May 2023. The EPA commented that a standard Waterway Works Licence would be required for the construction of the proposal. They also recommended that the Construction Guidelines Environment protection guidelines be referred to for general information regarding land development in the ACT.
TCCS	Meetings were held with the TCCS on 1 April 2023 and 4 April 2023. TCCS commented that there are arrangements in place to manage road closures on Lady Denman Drive if required. TCCS requested that they are kept informed of any potential road closures or delays so that they can notify the public. TCCS recommended consultation with Pedal Power on potential impacts to the cycle path. TCCS confirmed that a Traffic Guidance Scheme would be required for the proposal as well as a public lease for any TCCS land used for the compound.

4.4 Further consultation

Consultation will continue to be undertaken throughout the design and the proposed works in order to minimise impacts to key user groups. The NCA will work collaboratively with user groups to offer solutions.

This may include:

– regular updates of lake level lowering
– timing of proposed works
– regular updates to navigational hazards
– updates at quarterly meetings regarding any issues with or access to Kingston Harbour and the slipway
– monthly proposal updates to the proposal's mailing list.

5. Potential environmental impacts

5.1 Biodiversity

This section summaries the *Biodiversity Assessment Report* prepared by GHD (2023) provided in Appendix B. It discusses potential terrestrial and aquatic biodiversity impacts that may occur as a result of the proposal.

5.1.1 Environmental conditions and value

5.1.1.1 Definitions

This section uses the terms provided in Table 5.1 to describe the proposal area and its surrounding areas. The study area used for the *Biodiversity Assessment Report* is shown in Figure 5.1.

Table 5.1 Definitions of terms used in the Biodiversity Impact Assessment

Subject	Definition
Study area	The area within and adjacent to the proposal area where the field survey was completed.
Locality	The area within a 10 km radius of the proposal area.
Listed threatened species / community	Any species or ecological community that is listed as critically endangered, endangered, or vulnerable under the EPBC Act and / or NC Act.

5.1.1.2 General description

Bioregion

The proposal area occurs within the South-eastern Highlands bioregion and Murrumbateman subregion.

Topography, geology, and water quality

The study area is approximately 540 m above sea level and has been heavily modified and disturbed as a result of the initial construction of Scrivener Dam as well as other infrastructure associated with the urban surrounds.

The Molonglo catchment covers an area of approximately 2,000 km^2. The Molonglo River originates in NSW on the western side of the Great Dividing Range, near Captains Flat, and flows for around 115 km before meeting the Murrumbidgee River west of Canberra. The catchment includes densely developed urban areas, which potentially impact on the ecological condition of the Molonglo River (Jacobs, 2016).

Scrivener Dam influences flow in the lower reaches of the Molonglo River, alters water temperature, and prevents upstream fish migration (GHD, 2013; Jacobs, 2016). Nutrient enrichment, siltation from catchment erosion, heavy metal runoff from historic mining operations, pollution from stormwater runoff, and high flow variability all contribute to the lower Molonglo River having a poorer condition than the nearby section of the Murrumbidgee River (GHD, 2013).

Lake Burley Griffin is 11 km long, up to 1.2 km wide and covers approximately 716 ha at FSL. The shoreline of the lake is 40.5 km in total length and provides important wetland and lake habitat for native fish, birds and wildlife.

The groundwater of Lake Burley Griffin is characterised by its location on a fractured rock with extensive aquifers that have low to moderate productivity. The Groundwater Salinity is 0-1000 mg/l which is suitable for stock, domestic use, and some irrigation purposes. The aquifer recharge is 0.7 GL per year (ACT Government, 1999).

Soils

Scrivener Dam is surrounded by Williamsdale soil landscapes (Jenkins, 2000). The Williamsdale soil landscape includes moderately deep Yellow Chromosols (Yellow Podzolic Soils) on Red and Brown Kandosols (Red and Yellow Earths) on upper rises. Moderately to very deep, poorly to imperfectly drained Sodosols (Sodic Soils) occur on lower rises. This has contributed to a soil landscape which is erodible with localised dispersibility (Jenkins, 2000).

Climate

The locality has an average annual rainfall of 699.2 mm. Summers are typically moderately warm with cold winters. The highest average temperatures are in January at 30.2 °C whilst the coolest average temperatures are in July at 12.7 °C. The wettest month is typically October, averaging 66.8 mm of rainfall. The driest month is typically May with an average of 46.5 mm rainfall.

Surrounding land use and vegetation

The proposal area and surrounds have been highly modified through urban development. The National Zoo and Aquarium are located southwest of the proposal area. The National Arboretum stretches around the site from the north to the southwest. This area was cleared historically but has recently been revegetated.

The proposal area is located on the Molonglo River and is south of Lake Burley Griffin. There are numerous roads surrounding the site, specifically Lady Denman Drive located to the north and east of the proposal area, and Tuggeranong Parkway to the west.

5.1.1.3 Vegetation and flora

Vegetation communities

Terrestrial flora and fauna surveys, and an aquatic habitat assessment, were undertaken by two ecologists on 8 and 9 May 2023 (refer section 5.1.2). The surveys involved vegetation mapping, fauna surveying, and habitat assessment.

The vegetation types identified within the study area are shown in Figure 5.1 and include:

– Candle Bark -Red Box -Red Stringybark Grassy woodland (moderate condition)
– Freshwater wetland (moderate-good condition)
– Acacia regrowth (poor condition)
– Pinus radiata with predominantly native understorey (moderate condition)
– Predominantly exotic grassland (poor condition).

Threatened ecological communities

The nearest mapped areas of threatened ecological communities (TECs) are located approximately 250 m north (Yellow Box-Blakely's Red Gum Grassy Woodland) and 1 km north-east (Natural Temperate Grassland) of the proposal area (ACT Government, 2023a).

Field surveys confirmed that neither of these TECs occur within the study area, nor are any of the vegetation types within the proposal area commensurate with any other TECs listed under the NC or EPBC Acts.

Flora species

A total of 69 flora species from 30 families were recorded within the study area. These comprise 32 native and 37 exotic species. The Poaceae (grasses, 18 species, 11 native) and Fabaceae (shrubs and scramblers, 9 species, 5 native) were the most diverse families recorded.

Vegetation within the study area is in moderate to poor condition with some areas, particularly those adjoining previously cleared or disturbed areas, containing a high cover abundance of exotic species.

Introduced flora species

A total of 37 exotic flora species were recorded within the study area, of these, eight are listed under the ACT *Pest Plants and Animals Act 2005* (PPA Act). Flora species listed under the PPA Act include:

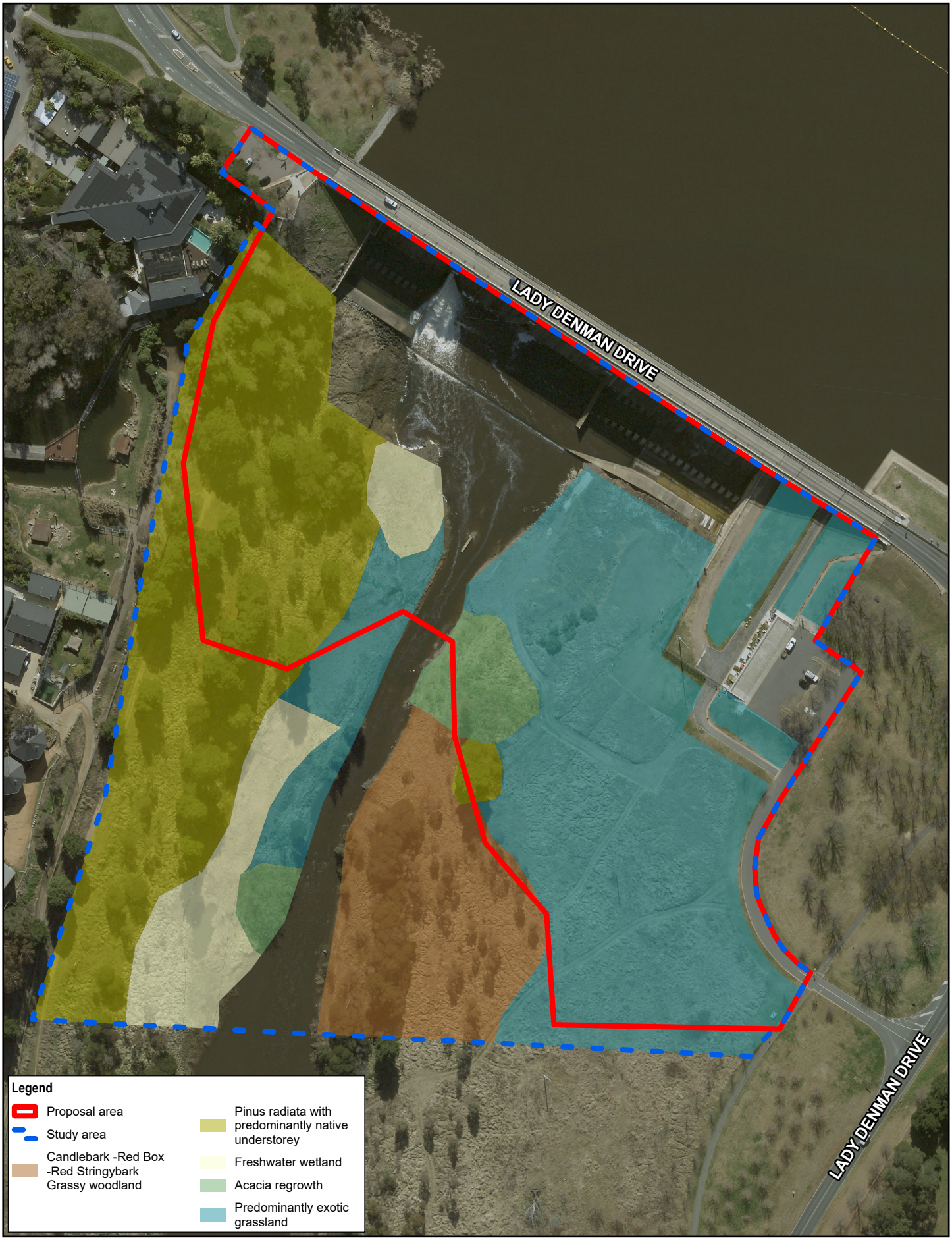
– Hawthorn (*Crataegus monogyna)*
– St John's Wort (*Hypericum perforatum)*
– Radiata Pine (*Pinus radiata)*
– Blackberry (*Rubus fruticosus* spp. agg)
– English Ivy (*Hedera helix)*

– Broad-leaved Privet (*Ligustrum lucidum)*
– Poplar (*Populus alba)*
– Orange Firethorn (*Pyracantha angustifolia)*.

Threatened flora species

No threatened flora species were recorded within the study area.

Due to the highly disturbed nature of the study area, and general lack of suitable habitat for threatened flora species known or predicted to occur within the locality, it is considered unlikely that threatened flora species would occur.



Paper Size ISO A4

0 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

National Capital Authority
Scrivener Dam
Dissipator Strengthening Project (DSP)

Vegetation mapping

Project No. **12608465**
Revision No. **-**
Date **10/05/2023**

FIGURE 5.1

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Print date: 11 May 2023 - 12:34

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5.1.1.4 Fauna species and habitat

Recorded fauna species

A total of 28 fauna species were recorded within the study area across the two survey days. These comprised 25 native and three introduced species. The recorded species included 24 bird species (of which two are introduced species), three mammal species (including one introduced species) and one native frog species. Recorded species included:

– common bird species such as the introduced Rock Dove (*Columba livia*) and the native Sulphur-crested Cockatoo (*Cacatua galerita*) and Australian Magpie (*Cracticus (Gymnorhina) tibicen*)
– Eastern Grey Kangaroo (*Macropus giganteus*)
– Common Wombat (*Vombatus ursinus*)
– introduced European Red Fox (*Vulpes Vulpes*).

The Common Eastern Froglet (*Crinia signifera*) was heard calling during surveys.

No threatened species were recorded.

Introduced fauna species

Fish stocking has been regularly undertaken in the lake since its construction with Rainbow Trout (*Oncorhynchusus mykiss*) and Brown Trout (*Salmo trutta*) forming the majority of stockings up until the 1980s when they were replaced by native Murray Cod (*Maccullochella peelii peelii*) and Golden Perch (*Macquaria ambigua*) (Beitzel et al., 2018).

Recent surveys in 2017 determined that the fish community of Lake Burley Griffin is dominated by the introduced pest species Redfin Perch (*Perca fluviatilis*) and Common Carp (*Cyprinus carpio*), with the latter accounting for 42% of the total number of fish caught (Beitzel et al., 2018).

Six introduced species are reported to be present in the Molonglo River below Lake Burley Griffin. These are Redfin Perch, Common Carp, Mosquitofish, Goldfish, Rainbow Trout, Brown Trout and Orsiental Weatherloach (Lintermans, 2000; 2004).

Fauna habitat values

Terrestrial fauna

The terrestrial habitat within the study area is typical of rural areas, but has some habitat features of relevance for threatened fauna species. A summary of habitat values present is provided in Table 5.2.

Table 5.2 Habitat values present in the biodiversity study area

Habitat attribute/ type	Habitat values	Threatened fauna
Woodland and shrubland	Open woodland provides habitat for a range of fauna species. Various small and medium woodland birds were recorded in these areas. No hollow-bearing trees or stick nests were recorded.	The habitat present could support a diversity of threatened birds such as the Southern Whiteface (*Aphelocephala leucopsis*) and Diamond Firetail (*Staggonopluera guttata*). No nests were identified. There were no hollow bearing trees identified, limiting the habitat value for the majority of threatened species. Most threatened mammals known or predicted to occur within the locality are unlikely to occur, as the study area lacks suitable habitat.
Grassland	Native grassland occurs under Candlebark woodland (outside the proposal area) and exotic pines (within the proposal area). Grassland provides foraging and shelter habitat for various species, including woodland birds, mammals and reptiles.	The Pink-tailed Worm Lizard (*Aprasia parapulchella*) and Striped Legless Lizard (*Delma impar*) are known to occur in native grassland and have various records in the locality. These species can occur in more disturbed areas adjacent to good quality habitat. Potentially suitable habitat in the study area is very limited in area and quality.

Habitat attribute/ type	Habitat values	Threatened fauna
		The Golden Sun Moth (*Synemon plana*) and Key's Matchstick Grasshopper (*Keyacris scurra*) inhabit derived native grasslands and Natural Temperate Grassland communities dominated by native grasses like Kangaroo Grass (*Themeda triandra*). No preferred feed plants occur within the proposal area but there is potentially suitable grassland habitat for these species in the wider study area.
Freshwater wetland	This wetland community occurs in a small depression on the western edge of Molonglo River. It comprises a dense cover of *Machaerina articulata* (Jointed Twig-rush), with *Typha orientalis* (Broadleaf Cumbungi), *Juncus* sp (Rush) and *Persicaria lapathifolia* (Pale Knotweed) also present.	Species like the Australasian Bittern (*Botaurus poiciloptilus*) could potentially inhabit freshwater wetland habitat. Other wetland and migratory birds may also occur on occasion. Wetland vegetation can provide potential habitat for the Green and Golden Bell Frog (*Litoria aurea*). This species prefers marshes with area of open (still) water. Limited preferred habitat is present in the study area. No cobble areas suitable for the Booroolong Frog (*Litoria booroolongensis*) are present.

Aquatic fauna

The desktop review determined four threatened fish species are known from within 10 km of the proposal area: Silver Perch (*Bidyanus bidyanus*), Trout Cod (*Maccullochella macquariensis*), Murray Cod (*Maccullochella peelii*) and Macquarie Perch (*Macquaria australasica*). In addition, the Murray River Crayfish (*Euastacus armatus*) is also known to occur in the locality.

Murray Cod are the only threatened species considered present in Lake Burley Griffin. The Murray Cod population is not self-sustaining, with stocking required to maintain the species in the lake (Beitzel et al., 2018). As such, the population is unlikely to successfully breed in the lake. Beitzel et al. (2018) only recorded three individuals during recent fish surveys, indicating low abundances under existing conditions.

It is unlikely that any other threatened species inhabit the study area as:

– Trout Cod have not been recorded in the Molonglo River or Lake Burley Griffin in recent surveys and there are only seven self-sustaining populations of Trout Cod reported to remain in the wild with the only remaining natural population in the Murray River between Yarrawonga and Barmah State Forest (Cadwallader and Gooley 1984; Ingram et al. 1990; Douglas et al. 1994).
– Silver Perch are considered locally extinct in the ACT (Lucas et al. 2019).
– Macquarie Perch have not been recorded in the Molonglo River since 1980 (DCCEEW 2023a) and have not been recorded within Lake Burley Griffin.
– Murray River Crayfish have been recorded in the Molonglo River but are no longer present (ACT Government 2023b)

As such, it is unlikely that threatened aquatic species are dependent on available habitat in the proposal area or study area (e.g., for breeding or important life cycle periods) and/or preferred habitat is not present.

5.1.1.5 Threatened or migratory species

The PMST search identified 42 threatened fauna species that are known and / or that have the potential to occur within the locality. This comprised 21 birds, five fish, four frogs, three insects, six mammals and three reptiles. Fourteen migratory birds are also predicted to occur in the locality. Species that are likely to occur are summarised in Table 5.3.

Table 5.3 Threatened fauna species

Scientific name	Common name	Status		Records	Records
		EPBC Act	NC Act		
Birds					
Aphelocephala leucopsis	Southern Whiteface	V		Previously been recorded in the proposed site in 2018 (ALA, 2023)	There is suitable foraging and breeding habitat within the proposal area.
Botaurus poiciloptilus	Australasian Bittern	E	E	Previously been recorded in the proposed site in 2017 (ALA, 2023)	Likely to occur in wetland habitat.
Gallinago hardwicki	Latham's Snipe	M		Previously been recorded in the locality.	There is suitable habitat within the proposal area.
Hieraaetus morphnoides	Little Eagle	-	V	20 records within 10km (DPE, 2023)	Likely to forage well above the proposal area on occasion.
Petroica boodang	Scarlet Robin	-	V	72 records within 10km (DPE, 2023)	There is suitable foraging and breeding habitat within the proposal area.
Stagonopleura quttata	Diamond Firetail	V		60 records within 10km (DPE, 2023)	There is suitable foraging and breeding habitat within the proposal area.
Insects					
Keyacris scurra	Key's Matchstick Grasshopper	E		2 records within 10 km (ACT Government, 2023a).	Known populations in the locality. Habitat limited due to the lack of preferred feed plants
Perunga ochracea	Perunga Grasshopper		V	16 records within 10 km (ACT Government, 2023a).	Known populations in the locality. Habitat limited due to the lack of preferred feed plants
Synemon plana	Golden Sun Moth	V	E	45 records within 10 km (ACT Government, 2023a).166 records within 10 km (DPE, 2023)	The closest recorded species is approximately 600 metres south of the proposal area. Habitat limited due to the lack of good quality grassland.
Reptiles					
Aprasia parapulchella	Pink-tailed Worm-lizard	V	V	1000 records within 10 km (ACT Government, 2023a).	Known populations in the locality. Habitat limited due to the lack of good quality grassland and surface rock.
Delma impar	Striped Legless Lizard	V	V	12 records within 10 km (ACT Government, 2023a).	Known populations in the locality. Habitat limited due to the lack of good quality

Scientific name	Common name	Status		Records	Records
		EPBC Act	NC Act		
					grassland and surface rock.
Key to table: CE – critically endangered; E – endangered; V – vulnerable; EX – extinct; NL – not listed.					

5.1.2 Investigations

5.1.2.1 Desktop review

A desktop review was conducted to identify and collate information on the potential ecological values within a 10 km radius of the proposal area. This was undertaken to provide context about the potential presence of mobile species or cryptic species that are known to occur in similar habitat within the region.

The following databases and resources were reviewed:

– Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) for MNES listed under the EPBC Act located within the locality (DCCEEW, 2023a).
– ACTmapi to identify significant plants, animals and registered trees known to occur within the locality (ACT Government, 2023a).
– Vegetation mapping to identify native vegetation types and the potential presence of threatened ecological communities listed under the NC Act and/or the EPBC Act (ACT Government, 2018a).
– ACT Environment and Planning Directorate 'Threatened Species List' (ACT Government, 2022b).
– ACT Environment and Planning Directorate (ACT Government, 2023a) mapping of:
    - Threatened ecological communities
    - Biodiversity records
    - Threatened flora records
    - Rare plant records
    - Tree survey data
    - Vegetation mapping
– NSW BioNet Atlas – threatened NSW species records that overlap into the ACT (DPE, 2023).
– NSW DPI Fisheries Spatial Data Portal (NSW DPI 2022).

5.1.2.2 Field Survey

Terrestrial flora and fauna surveys, and an aquatic habitat assessment, were undertaken by two ecologists on 8 and 9 May 2023. The primary objectives of the field surveys were to:

– map and describe the distribution and condition of vegetation types occurring within the study area
– carry out opportunistic surveying for threatened flora and fauna
– describe the potential impacts on threatened flora and fauna species, populations and ecological communities in the proposal area, and their habitats that could arise from the proposal during construction and operation
– complete a Rapid Bioassessment of aquatic habitat and waterway health as per the ACT AUSRIVAS assessment protocol (Nichols et al., 2000).

5.1.2.3 Likelihood of occurrence

A 'likelihood of occurrence' assessment was undertaken with reference to the habitats contained within the proposal area.

Identification of potential habitat for threatened and migratory species was based on information provided in the species profiles, recovery plans, journal articles, and the field staff's knowledge of species habitat requirements. The likelihood of occurrence assessment was further refined following field surveys.

The likelihood of threatened and migratory species occurring in the proposal area was assessed based on presence of records from the locality since 1999, species distribution and habitat preferences, and the suitability of potential habitat present in the proposal area.

5.1.3 Impacts

5.1.3.1 Direct impacts

Vegetation removal

The proposal would remove up to 2.7 ha of vegetation within the proposal area, including about one hectare of native vegetation and 1.7 ha of exotic grassland. Estimates of the extent of impact to vegetation type is summarised in Table 5.4.

Removal of native vegetation has been calculated based on the assumption that all vegetation would be removed from the proposal area. In reality, the area of native vegetation to be removed, is likely to be much smaller as disturbance would be mostly along the proposed access tracks, site compounds and laydown area. Following the initial site survey, the project design was refined to avoid impacts to native vegetation, where possible.

None of the native vegetation within the study area meets the definition of an NC Act or EPBC Act listed TEC.

The vegetation proposed to be removed:

– comprises of relatively poor condition vegetation that has been previously disturbed
– has a high abundance of exotic species present
– is not likely to contain any substantial habitat for threatened flora or fauna species listed under the NC and / or EPBC Acts.

Table 5.4 Proposed vegetation removal

Vegetation type	Area within proposal area (ha)
Candlebark -Red Box -Red Stringybark Grassy woodland	Nil
Freshwater wetland	0.09
Pinus radiata with predominantly native understorey	0.80
Acacia regrowth	0.11
Predominantly exotic grassland	1.71

Fauna habitat and fragmentation

The proposal area is quite isolated. The riparian vegetation continues south following the Molonglo River on both the east and west banks. None of this habitat is connected to larger extents of better-quality riparian vegetation (woodland or native grass).

The proposed vegetation removal would not fragment habitat for biota nor would it reduce the ability for fauna to disperse through the study area.

Disturbance and mortality of fauna

During construction, death or injury may occur to fauna present during clearing of trees and vegetation. The use of machinery may temporarily deter some fauna species from using potential habitat in the proposal area during construction.

With the implementation of safeguards (refer to section 5.1.4), the proposal would be unlikely to substantially affect fauna in the proposal and surrounding area.

Terrestrial threatened species and migratory species

No threatened terrestrial flora or fauna, including migratory species, were observed in the study area. The proposal layout has been designed to avoid areas of higher quality habitat and disturbance would be confined to areas where there is existing soil and vegetation disturbance.

Given the bulk of works would be located in areas of exotic grassland, and would not isolate any areas of habitat, impacts on these species are likely to be minimal, if at all. It is therefore considered unlikely that the proposal would result in impacts to threatened terrestrial fauna species.

Aquatic habitat

Lake lowering

The lowering of the lake by up to 500 mm could reduce aquatic habitat that has established under current conditions. However, this is not unprecedented, with levels kept at approximately 555.45 mAHD between December 2011 and August 2013 while upgrade works occurred on Scrivener Dam. The lake has also experienced water level decreases in this range on several other occasions since 2000.

Habitat loss

Most of the in-water construction works would occur in the existing footprint of the dissipator although during construction the installation of cofferdams downstream from the dissipator may result in a loss of some aquatic habitat. However, there is limited habitat in this area which is primarily composed of a deep open water pool with limited structural habitat (e.g. snags) or aquatic macrophytes.

As such, the loss of aquatic habitat is considered temporary and minor in extent. On completion of the works the footprint of the dissipator would not be increased so there would be no loss of habitat compared to existing conditions.

Habitat fragmentation

The fragmentation of habitat for aquatic values may occur if a barrier is formed that prevents the free passage of aquatic fauna between areas of suitable habitat. Given the dam wall already acts as a physical barrier this is not expected to be the case. Further there are no migratory fish species occurring naturally in the ACT (Lintermans, 2000; Lintermans and Osborne, 2002).

Aquatic fauna

Hydrological changes

Lowering of Lake Burley Griffin by up to 500 mm during construction could reduce aquatic habitat that has established under current conditions. A short-term drop in water level, although greater than the normal 150 mm range, would not significantly reduce habitat for any species in the lake given that the lake depth ranges from ~18 m near Scrivener Dam wall to two metres (with an average of four metres) (NCA, 2023). Aquatic habitat would remain and no impact to the breeding of native fish would occur.

Release of water during the lake's drawdown has the potential to increase erosion impacts downstream from Scrivener Dam if release rates are significantly greater than the normal release rate. Water would be released from the lake within the normal operating range to minimise this impact.

The construction method would be refined during detailed design and would be phased to ensure that flows along the Molonglo River can be maintained throughout the works.

Given the historical variation in water levels or Lake Burley Griffin and the maintenance of flows in the Molonglo River during construction, the proposal would be unlikely to substantially affect aquatic fauna in the proposal area, the study area or Lake Burley Griffin. Releasing water from the lake into the Molonglo River within the normal operating range would also minimise potential impacts.

Direct impacts to aquatic fauna

During construction, death or injury of aquatic fauna may occur during the clearing of habitat within the Molonglo River. If fish are present during construction, they would generally move away from the site to escape the disturbance. Based on the habitat that is present, it is unlikely to provide significant habitat for aquatic fauna.

Noise and vibration

Construction activities have the potential to affect aquatic fauna through the generation of noise and associated vibration within the Molonglo River. Any disturbance would be short-term and localised, with minor effects on aquatic fauna (i.e. the most plausible impact would be an avoidance response). No adverse noise or vibration impacts are expected during operation as conditions would be comparable to existing conditions.

Light pollution

For aquatic fauna, light pollution may affect the structure and abundance of populations and has the potential to alter predator–prey interactions at multiple trophic levels by creating conditions favourable to predatory species at night (Becker et al. 2013). However, construction would generally be undertaken during standard hours during daylight.

5.1.3.2 Indirect impacts

Runoff, sediment and contamination

Terrestrial values

Vegetation removal and ground disturbance may cause erosion and sedimentation.

Erosion and sedimentation can:

– cause weed problems and stifle plant growth
– alter water quality and fill aquatic habitat with fine sediment reducing habitat value of these areas for fauna such as frogs.

Mitigation measures are described in section 5.3.4 to minimise potential impacts of sedimentation and erosion on water quality.

Aquatic values

The proposal may increase the delivery of sediment during construction of cofferdams, access tracks and the temporary river crossing. In waterways erosion and sedimentation can cause:

– reduced uptake of dissolved oxygen by fauna due to the clogging of gills (Kjelland et al., 2015; McKenzie et al., 2020)
– decreases in photosynthesis and the health of flora (Lovett et al., 2007)
– reduced foraging capacity of native fish while favouring exotic species such as Carp that are not visual feeders (Utne-Palm, 2002; Lovett et al., 2007)
– the blanketing of the substrate and other habitats (Hynes, 1970; Lovett et al., 2007).

Sediment eroded into rivers also has the potential to carry nutrients and other contaminants (DSE 2003).

Appropriate sediment and erosion controls would be installed within the Molonglo River and throughout the proposal area to capture silt and soil that could be mobilised during the works. With mitigation measures in place, no adverse impacts to aquatic values in the Molonglo River are expected due to the proposal due to the localised extent of the proposal area and short-term duration of the potential impacts.

Spills and leaks

There is potential for accidental spills and leaks of various contaminants during construction. These could include spills while refuelling, leaky and unmaintained equipment or plant, failure of storage containers, and runoff from the slurry generated from hydro-cutting of concrete or the pouring of the new reinforced concrete topping slab or baffles.

Contaminants such as fuels and chemicals can have both lethal and sublethal impacts (e.g., changed physiology, reproduction and behaviour) on aquatic biota that can occur as a result of both acute (short-term) and chronic (long-term) exposure (Weis, 2014; Ucan-Marin and Dupuis, 2015). Toxicants can also impact aquatic habitat values and lead to reduced dissolved oxygen (Enujiugha and Nwanna, 2004).

Accidental spills and other sources of contamination would also be managed through a soil and water management plan prepared prior to construction commencement, as part of the CEMP.

Invasion and spread of weeds, pathogens and disease

The proposal may cause the dispersal of weed propagules (seeds, stems and flowers) into adjacent areas of native vegetation via plant and machinery, erosion (wind and water) and via workers shoes and clothing. This could result in a decline in the condition of retained native vegetation and associated native fauna habitats.

Construction activities have the potential to spread aquatic weeds into the Molonglo River should they be attached to machinery or other plant that enters the river, or there is the delivery of seeds or weeds associated with runoff. Severe infestations of weeds in rivers can adversely affect habitat (Madsen, 2005; Cheery and Bosse, 2014) and can:

– block channels
– restrict flows
– increase silt accumulation
– degrade water quality
– form dense infestations reducing the diversity of aquatic flora.

In-water construction activity which uses equipment or vehicles which have come into contact with freshwater systems where diseases are present prior to entering site, has the potential to transfer diseases to native fish and frogs within the Molonglo River.

The potential for significant or new impacts associated with weeds, pathogens and disease is relatively low given the existing development and extent of past and current human visitation across the proposal area and surrounding area.

A weed and pest management plan will be developed before the commencement of construction (as part of the CEMP) to mitigate impacts associated with the spread of weeds and pathogens.

Noise, light and vibration

Noise can cause changes in behaviours such as foraging, requiring additional energy expenditure if fauna need to forage further afield. Impacts during construction would be short term, temporary and are unlikely to deter fauna from using habitat features retained in the proposal area, in the long term.

Edge effects

‘Edge effects’ can include increased noise and light, weed incursion or erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna.

Given most of the remnant vegetation has been cleared and the proposal area and surrounding area has been historically modified, it is unlikely the proposal would cause any new edge effects.

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5.1.4 Mitigation measures

Efforts have been made through the proposal planning and design process to minimise and mitigate impacts to ecological values. Particularly, avoiding and minimising impacts to native vegetation as far as is practicable.

Table 5.5 lists relevant safeguards to further avoid, minimise and manage potential impacts to biodiversity. These management measures will be incorporated into a Construction Environmental Management Plan (CEMP) to be implemented for construction.

Other safeguards and management measures that are relevant to biodiversity are also identified in sections 5.3 (water quality) and 5.6 (noise and vibration).

It is noted that the licence to damage land under the NC Act may require additional mitigation measures.

Table 5.5 Biodiversity mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
B1	Impacts to native vegetation and habitat	A flora and fauna management plan would be developed before the commencement of construction (as part of the CEMP). Measures will be implemented before, during and after construction to avoid and mitigate impacts to flora and fauna within the study area. The CEMP will include the following measures: – Removal of areas of native vegetation will be minimised wherever possible. – No vegetation removal or soil disturbance will occur outside the proposal area. – Establishing exclusion zones by fencing or demarcating areas (with construction barrier fencing or similar) that are outside the disturbance footprint and are not to be disturbed. – All staff will be inducted and informed of the limits of vegetation clearing and the areas of vegetation to be retained. – An ecologist or qualified wildlife handler is to be present during clearing works in areas of native vegetation to rescue and relocate any injured or displaced wildlife. If any threatened flora or fauna are identified in the proposal area during construction, work will cease immediately and the NCA and/or appropriate agencies will be contacted.	Contractor	Pre-construction / Construction
B2	Spread of weeds	A weed and pest management plan will be developed before the commencement of construction (as part of the CEMP). Measures will be implemented before, during and after construction to prevent the establishment and/or spread of weeds within and beyond the proposal area. Weed management measures would include, but not be limited to: – Vehicle and machinery wash/brush downs will be established and implemented so that weed species are not spread to non-infested	Contractor	Pre-construction / Construction

ID	Impact	Mitigation measure	Responsibility	Timing
		areas. No construction vehicles or staff should enter surrounding areas to minimise weed spread. – Sediment control, such as silt fences, will assist in reducing the potential for spreading weeds downstream. Soil disturbance will be avoided as much as possible to minimise the potential for erosion and spread of weeds.		
B3	Soil erosion, sedimentation and water quality	An Erosion and Sediment Control Plan (ESCP) will be developed in accordance with the Environment Protection Guidelines for Construction and Land Development in the ACT (EPA, 2022). The ESCP will be implemented prior to construction commencing on site and updated as needed during the construction phase to address changed conditions. This plan would include measures to avoid sediment running into the Molonglo River including: – installing a silt curtain within the Molonglo River downstream of all ground disturbing work. – installation of sediment fences prior to ground disturbance or river work occurring to capture runoff and prevent erosion – a system to capture, treat and dispose of the slurry from hydro-cutting and core drilling – implementing stockpile management – diverting surface runoff away from disturbed soil and stockpiles – inspecting controls at least weekly and immediately after rainfall. In addition, the ESCP will state the following: – Refuelling or maintenance of plant and machinery will not be undertaken within 50 m of waterways or drainage lines (including Lake Burley Griffin and the Molonglo River). – Storage of fuels and other chemicals area to follow Australian standards. – A rehabilitation and revegetation plan (RRP) will be prepared for areas disturbed during the works. This will identify appropriate methods for stabilising disturbed soils to resist erosion. – Sediment and erosion controls will be inspected regularly, particularly after a high rainfall events (defined as greater than 30 mm in 24 hours), and maintenance works undertaken as needed. These controls would remain in place after construction until sufficient regeneration of vegetation to prevent erosion or sedimentation occurs. – Weather forecasts will be checked daily and high risk soil and erosion activities must not be undertaken immediately before or during high rainfall or wind events. Disturbed surfaces would be compacted and	Contractor	Pre-construction / Construction

ID	Impact	Mitigation measure	Responsibility	Timing
		stabilised in anticipation of rain events to reduce the potential for erosion. – During drawdown of Lake Burley Griffin, water would be released within the normal operating range to minimise the potential for increased erosion in the Molonglo River and maintain habitat in the river.		
B3	Invasion and spread of pathogens	A weed and pest management plan will be developed before the commencement of construction (as part of the CEMP). The plan would include protocols to minimise the risk of introducing or spreading invasive pathogens and would include protocols to prevent introduction or spread of pathogens like Chytrid Fungus and Phytophthora following the Hygiene guidelines for wildlife (DPIE, 2020). All machinery entering the site must be appropriately washed down and disinfected prior to work on site.	Contractor	Pre-construction / Construction
B4	Aquatic fauna management	An aquatic fauna management plan is to be developed (as part of the CEMP) prior to construction works, specifically to develop protocols for any aquatic fauna that are present within the cofferdam prior to dewatering. The plan should consider: – Development and implementation of handling and salvage protocols for aquatic fauna during construction, including legislative permit and authorisation requirements of wildlife handlers. – Clearance of coffer dams during the de-watering process and following flood events which over-top the coffer dam. If clearance is not possible (e.g., for safety reasons), screens/filters to be placed on temporary pumps to be used to dewater coffer dam to avoid entrainment.	Contractor	Pre-construction / Construction

5.2 Hydrology and flooding

5.2.1 Environmental conditions and value

5.2.1.1 Hydrology

Lake Burley Griffin is a shallow, artificial lake with a maximum depth of 17.6 m near Scrivener Dam, a mean depth of 4.0 m, and a shallowest point of 1.9 m in the east of the lake. The lake is formed by impoundment of the Molonglo River by Scrivener Dam.

Lake Burley Griffin has a catchment boundary that encompasses five catchment areas which include Googong, Upper Molonglo, Lower Queanbeyan, Jerrabomberra Headwaters and Central Molonglo Catchments (refer Figure 5.2). The Central Molonglo Catchment includes runoff from Sullivans, Woolshed and Jerrabomberra Creeks around Canberra.

Rainfall from this area flows into Lake Burley Griffin. Scrivener Dam is operated to release enough water so that regardless of the inflows into Lake Burley Griffin the lake generally stays at a stable level. Flow in the Molonglo River upstream and downstream of the dam are shown in Figure 5.3. Molonglo River flows are about 50% higher during the months of July to December compared to January to June.

The closest Bureau of Meteorology (BoM) monitoring station to Scrivener Dam with rainfall data is located at Australian National Botanic Gardens (station number 70247). Data from the BoM (BoM, 2023) reports that the average annual rainfall recorded at Australian National Botanic Gardens is 699.2 millimetres.

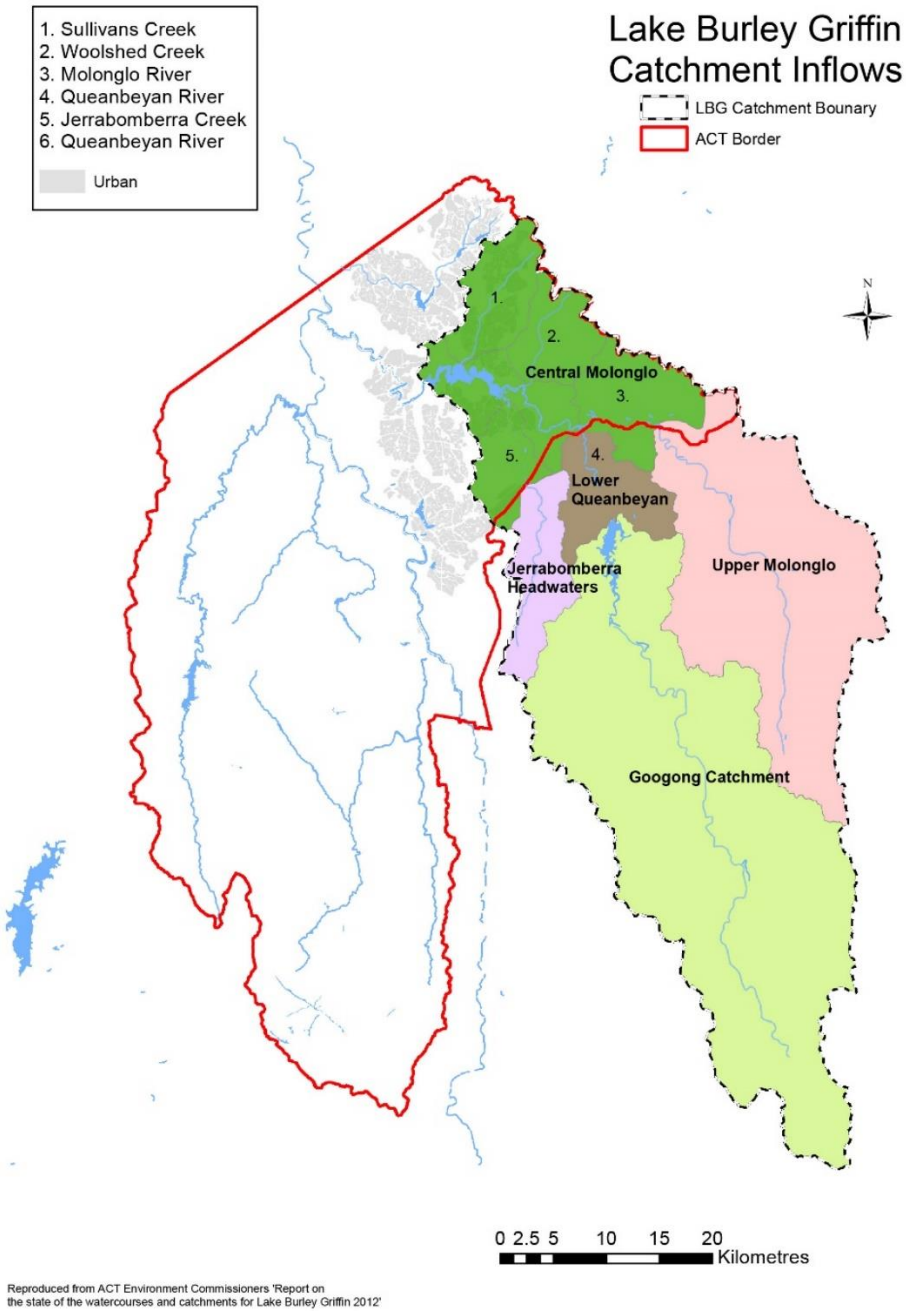

Figure 5.2 Lake Burley Griffin Catchment Inflows (NCA, 2012)

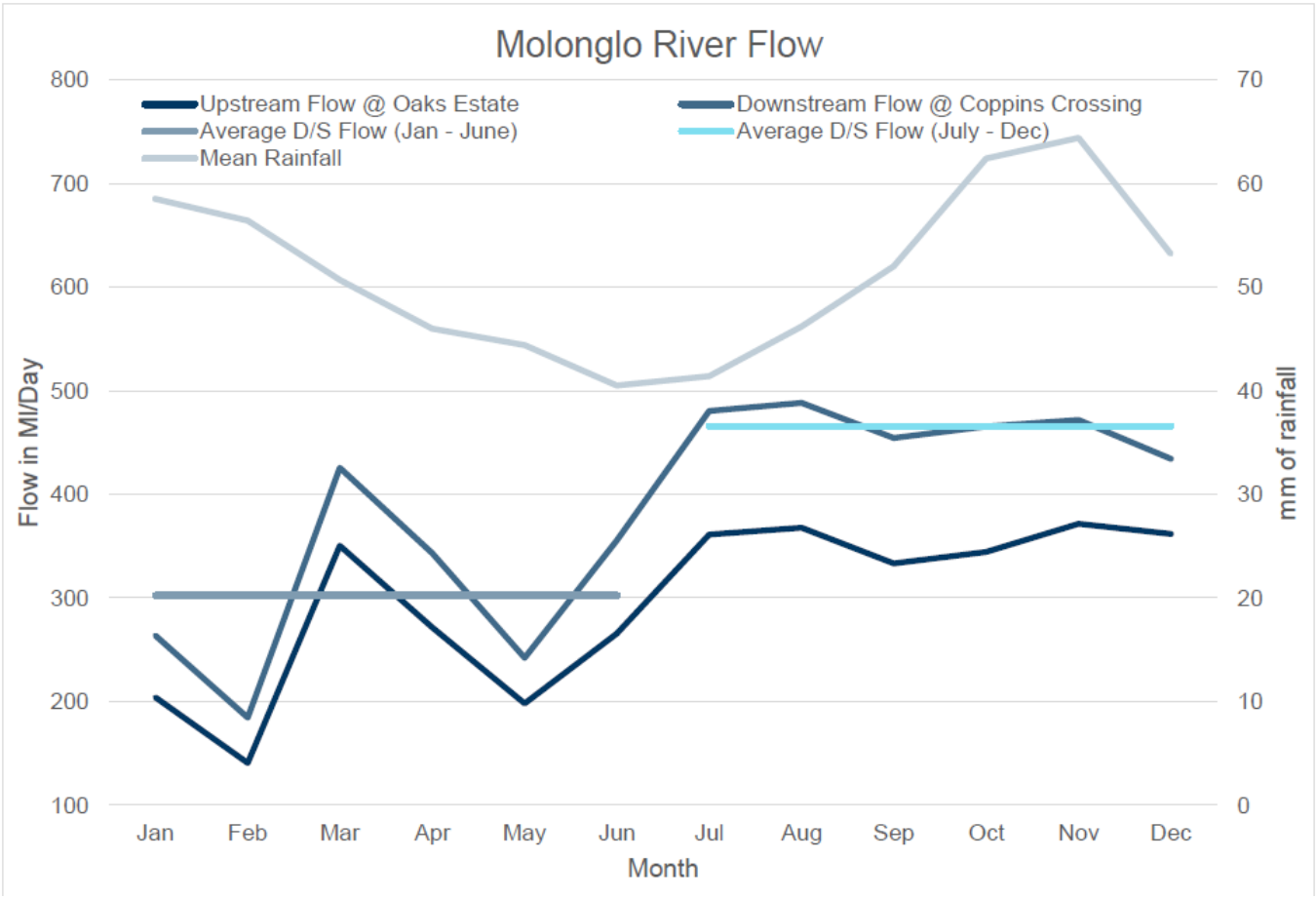

Figure 5.3 Molonglo River flow upstream and downstream of Scrivener Dam. Sourced from GHD (2022b).

5.2.1.2 Flooding

The proposal area is located in the Molonglo River channel immediately downstream of Scrivener Dam and as such is exposed to flooding. The proposal area is mapped as being in a high hazard area for a 1% Annual Exceedance Probably (AEP) flood event[8] (ACTmapi, 2020).

Flow through the Molonglo River is managed by Scrivener Dam. As discussed, Lake Burley Griffin water levels are very tightly controlled and are generally maintained at FSL +/-150 mm.

Flow through Scrivener Dam is guided by a carefully designed flood procedure (Flood Operations Procedure Version 20.0 outlined in the Scrivener Dam Operations and Maintenance Manual). High inflows into Lake Burley Griffin trigger operators of the dam to allow higher volumes of water through the dam to reduce the risk of flooding upstream. The flood operation activation triggers from the Flood Operations Procedure are summarised in Table 5.6.

The NCA utilise comprehensive flood monitoring and forecasting in order to manage Scrivener Dam so that even during a 1% AEP flood event Lake Burley Griffin maintains the same level (ACT Government, 2018b).

[8] A flood with a 1% AEP has a one in a hundred chance of being exceeded in any year.

Table 5.6 Flood operation activation trigger summary

Mode	Triggers
Standby Mode	Inflows at Oaks Estate (and other inflows) rising and expected to exceed 40m3/s, OR Forecast of a possible weather event in the Catchment that could lead to Flood Operations, OR Early manual sluice valve operations underway to maintain lake level
Flood Operations Mode Sluices on Manual and preparing for gate operations	Inflows at Oaks Estate (and other inflows) exceed 40m^3/s, AND Sluice Valve Operations have switched to full open manual, AND An inflow assessment (or modelling) indicates gate operations will be necessary
Flood Operations Mode Gates – Level 1	Flap Gate Operations (Discharge 80 m^3/s up to 900 m^3/s) ACT Flood classification: Minor
Flood Operations Mode Gates – Level 2	Flap Gate Operations (above 900 m^3/s up to 1400 m^3/s) ACT Flood classification: Moderate
Flood Operations Mode Gates – Level 3	Flap Gate Operations (above 1400 m^3/s) ACT Flood classification: Major
Stand Down Mode	Storage level can be maintained at normal operating levels by automatic sluices

5.2.2 Investigations

As part of the GHD (2022b) *Scrivener Dam Dissipator Strengthening – 50% Detailed Design Report* an analysis of potential hydrological and flooding impacts of the proposal was undertaken. The analysis included:

– a review of current dam operations
– a review of inflow to Lake Burley Griffin with respect to seasonal operations and river flow
– a review of current flood procedures
– proposed flood protection measures.

The following sections summarise potential impacts of the proposal on hydrology and flooding.

5.2.3 Impacts

5.2.3.1 Hydrology

As part of construction of the proposal, the lake would be temporarily lowered by 0.5 m. The 0.5 m drawdown was selected by balancing potential flood risk, navigational hazards (refer section 5.9.1), other commercial and recreation impacts (refer section 5.9.1) and visual impacts (refer section 5.8.1).

To lower the lake level water would be released from Lake Burley Griffin via Scrivener Dam. Water would be released in a controlled manner in accordance with Scrivener Dam operating procedures to reduce the risk of downstream bank erosion.

The lake would be lowered by 0.5 m for up to 24 months. This could potentially have impacts for aquatic flora and fauna (as discussed in section 5.1). However, given this drawdown would be temporary and within previous lake level fluctuations, impacts are not anticipated to be significant. User groups have been consulted about the drawdown and this is discussed in section 4.1 .

There is also a possibility that lower lake levels may impact users that extract water from the lake. However, this impact would be limited given that Lake Burley Griffin is mostly an aesthetic and recreational reservoir. Users of

the lake water would be notified prior to lake levels being lowered so that alternative arrangements for water extraction could be arranged if necessary.

There is a risk that lake levels could drop further if drought conditions occurred during the construction period. To manage this risk the NCA would monitor long-term forecasts and take preventative measures to prepare for lower inflows.

Upon completion of construction, flows through Scrivener Dam would need to be restricted to refill the lake. The reduction in water released to the Molonglo River while the lake is refilling could have potential impacts downstream to the fauna, flora, and water quality. This risk would be managed through appropriate mitigation measures such as refilling the lake slowly so that riparian flows in the Molonglo River are maintained

5.2.3.2 Flooding

Due to the proposal's location in a high-risk flood area, during a high flow event water spillages could pose a threat to construction, workers, and visitors to the site. Lowering Lake Burley Griffin by 0.5 m would reduce this risk by providing additional air space in the dam that could be used to capture unexpected, additional flows. As shown in Table 5.7 a lake level reduction of 0.5 m would provide 3,755 megalitres of water storage.

Table 5.7 Water storage with respect to reduction in lake level

Reduction from standard lake level (m)	Water storage capability (megalitres)
0.25	1,899
0.5	3,755
0.75	5,559
1.0	7,305
1.25	8,984
1.5	10,590

It is expected that the majority of the flood operation activation triggers currently in place could be maintained during construction. The final design of the cofferdams is to be determined during detailed design however, it is expected that:

– the cofferdam arrangement would be allow for safe work during the operation of two sluice gates (allowing 60 m^3/s of water through Scrivener Dam)
– the works area within the cofferdams could be protected during flows of up to 80 m^3/s through Scrivener Dams
– where flows are predicted to exceed 80 m^3/s the construction contractor would fully demobilise the proposal area and the works area would be flooded in a controlled manner.

Final flooding operation procedures would be determined with the contractor, dam owners and operators once detailed design is complete. These operation procedures would determine when partial demobilisation or full demonisation of the proposal area would be required.

The cofferdams are expected to be able to withstand a flood level up to *Flood Operation Mode Gates – Level 1* (refer Table 5.6). It is highly unlikely that the cofferdam would be lost during flood larger than this, however, the cofferdam would be designed so that the cofferdam's failure would not impact the permanent Scrivener Dam structure.

Cofferdam failure would unlikely result in significant downstream impacts given the flow velocity and volume of water would be smaller than what is occasionally released in the dam and would not be significantly different from standard operations of release of water.

Upstream flooding risk for the wider Lake Burley-Griffin area would be reduced during the construction period due to the additional airspace provided in the dam during the construction.

5.2.4 Mitigation measures

Table 5.8 lists relevant safeguards to avoid, minimise and manage potential impacts to hydrology and flooding. Other safeguards and management measures that are relevant to hydrology and flooding are listed in sections 5.1 (biodiversity), 5.3 (water quality) and 5.12 (hazards and utilities).

Table 5.8 Flooding and hydrology mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
HF1	Maintaining flow in the Molonglo River	Construction sequencing will always allow for the operation of at least one sluice gate.	Contractor / NCA	Construction
HF2	Reducing potential risks to the Molonglo River	During emptying the lake water will be released in controlled manner in accordance with Scrivener Dam operating procedures to reduce the risk of downstream erosion.	NCA	Construction
HF3	Reducing potential risks to the Molonglo River	Refilling of the lake back to FSL will be undertaken over a long period of time so that flows are continued to be provided to the Molonglo River downstream.	NCA	Construction / Operation
HE4	Impacts to stakeholders	The NCA will notify stakeholder and community members of the timing and duration of lake lowering to enable them to prepare. Stakeholder consultation will be ongoing throughout construction of the proposal.	NCA	Construction
HE5	Managing risk of drought	The NCA will monitor forecasts and manage the lake in appropriately to reduce the risk the lake falling below 0.5 m from FSL during any drought periods.	NCA	Construction
HF6	Managing flood risk to construction	During construction the lake will be lowered by a maximum of 0.5 m while this is required for construction safety.	Contractor / NCA	Construction
HF7	Managing flood risk to construction	The Contractor and the NCA will prepare and implement an appropriate Flood Management Procedure to be included in the CEMP to determine evacuation and site preparation before and during flood events.	Contractor / NCA	Pre-construction / Construction

5.3 Water quality

This section discusses potential water quality impacts that may occur as a result of the proposal.

5.3.1 Environmental conditions and value

5.3.1.1 Lake Burley Griffin

Water quality in the lake is highly dependent upon the quality of its inflows, which are dependent upon the amount and intensity of rainfall in the catchment area for the lake, along with the effects of the management of that catchment (GHD, 2022a).

The NCA manages Lake Burley Griffin which involves a water quality monitoring program. The water quality monitoring program is based on *ACT Guidelines for Recreational Water Quality* (ACT Health, 2010). This program includes:

– routine sampling for eight months of the year for physical, chemical and biological characteristics across the whole lake
– microbiological sampling conducted weekly on recreational beaches during the summer months
– algae monitoring program undertaken weekly via visual inspections and samples taken monthly.

The water quality monitoring program has shown that overall, Lake Burley Griffin is considered to be in moderate health. In general, there have been a few exceedances in pH, turbidity, suspended soils and ammonia while nitrogen, phosphorus and bacteria levels tend to fluctuate (GHD, 2022a). Since 1995 there has been a decrease in turbidity, phosphorus concentrations, nitrogen concentrations and Chlorophyll-a levels in the lake (GHD, 2022a).

Lake Burley Griffin sometimes experiences elevated bacteria (enterococci) levels and toxic blue green algae blooms (GHD, 2022a). Enterococci are a faecal indicator bacteria. Sources of faecal contamination can include sewage overflow and spills, bird and animal sources, and mixed sources such as urban runoff. Faecal contamination is often present after high rainfalls and elevated concentrations of enterococci in recreational waters are of public health concern (GHD, 2022a).

Cyanophyta (blue-green algae) comprise of several species, which can produce biologically active toxins that can harm water users, if exposed. Historically, several toxin-producing species have been known to occur in the lake, posing water quality risks to recreational users (GHD, 2022a). Heath risks poses by blue green algae have previously led to temporary closures of the lake particularly during warm, summer months, when algal growth increases due to elevated temperature (GHD, 2022a).

Lake Burley Griffin also acts as a sink for sediment transported by the Molonglo River (Stinton et al., 2020). Previous water quality studies have observed metal contamination within the Molonglo River and Lake Burley Griffin (Stinton et al., 2020).

The benchmarks for Lake Burley Griffin water quality parameters are provided in Table 5.9 (NCA, 2011) which are based on current guidelines for recreational and ecological water (ACT Health, 2014; ANZECC, 2018).

Table 5.9 Water quality benchmarks for Lake Burley Griffin (NCA, 2011)

Criteria	Benchmark
pH[9]	6.5 – 8.5 pH units
Electrical conductivity	400 µS[10]
Turbidity	20 – 40 NTU[11]
Suspended solids	20 – 40 mg/litre
Ammonia	0.1 mg/litre
Oxidised nitrogen	0.01 mg/litre

[9] pH is the measure of acidity or alkalinity
[10] Micro siemens
[11] National turbidity units, combined East and West Basin limits.

Criteria	Benchmark
Total nitrogen	1.0 – 1.4 mg/L
Total phosphorous	0.06 mg/L
Chlorophyll-a (algae indicator)	20µg/L
Cyanophyta (blue-green algae)	20,000 cells/mL
Enterococci (faecal indicator)	<200 CFU/100mL

5.3.1.2 Molonglo River downstream of Scrivener Dam

The proposal area is located within the Molonglo River immediately downstream of Scrivener Dam (see Figure 5.4). Water quality within this stretch of river is likely to be similar to the water within Lake Burley Griffin.

Figure 5.4 View of Molonglo River downstream of Scrivener Dam

5.3.2 Investigations

A qualitative desktop assessment of potential impacts to water quality during the construction of the proposal was undertaken using available desktop information.

5.3.3 Impacts

5.3.3.1 Lake Burley Griffin

Construction of the proposal would take place entirely downstream of Scrivener Dam. As such the risk of impacting the water quality of Lake Burley Griffin would be low. Lowering the lake level by 0.5 m could potentially lead to an increase of concentration of some contaminates. However, the drawdown would be temporary and within historical fluctuations of lake and as such substantial impacts to water quality from lowering the lake are unlikely.

It is expected that water quality within Lake Burley Griffin would continue to fluctuate within natural ranges. Lowering the lake would also provide an opportunity to improve water quality through programs to clean up the exposed lake banks such as by removing litter.

5.3.3.2 Molonglo River

The proposal includes a number of activities which have the potential to impact the water quality of the Molonglo River. These include:

– operating vehicles and machinery in the river corridor which may lead to hydrocarbon spills or increased sediment transport
– demolition works potentially leading to fine and coarse debris in the waterway
– soil stockpiling, ground disturbance and vegetation removal leading to increased sediment in the waterway.

Increased sedimentation can impact water quality by temporarily increasing water turbidity and suspended sediments loads. This may impact of aquatic ecology by reducing the light that can penetrate water or by smothering aquatic plants (refer section 5.1).

Ground disturbance could also result in the mobilisation of pollutants or potential contaminants that may persist in proposal area. The risk of increased sediment runoff from the proposal areas would be heightened in periods of wet weather.

While mobilisation of finer sediments would occur, this would be short-term and likely cause a minimal impact on water quality with the use of appropriate management measures including:

– sediment control devices
– avoiding work in heavy rain
– progressively stabilising the site.

The materials required for construction of the proposal would be generally inert and harmless except for the small quantities of welding materials, lubricants, solvents, fuels, and oils. There is a potential risk for accidental spills, including:

– accidents during demolition and installation works in the works area
– leaks and drips from poorly maintained machinery and equipment
– mismanaged storage of waste materials, including potential for debris to enter the water.

The primary impact from spills would be a reduction in water quality which would have an impact upon the aquatic environment. The impact would depend on the quantity and type of material spilt. Mitigation measures identified in section 5.3.4 would be implemented so that the risk to the environment is minimised.

5.3.4 Mitigation measures

Table 5.10 lists relevant safeguards to avoid, minimise and manage potential impacts to water quality.

As stated in section 5.3.4, mitigation measure B3 provides that an ESCP will be developed in accordance with the *Environment Protection Guidelines for Construction and Land Development in the ACT* (EPA, 2022) and included as part of the CEMP. The ESCP would include measures to avoid sediment running into the Molonglo River including:

– installing a silt curtain within the Molonglo River downstream of all ground disturbing work.
– installation of sediment fences prior to ground disturbance or river work occurring to capture runoff and prevent erosion
– a system to capture, treat and dispose of the slurry from hydro-cutting and core drilling
– implementing stockpile management
– diverting surface runoff away from disturbed soil and stockpiles
– inspecting controls at least weekly and immediately after rainfall.

Other safeguards and management measures that are relevant to water quality are also identified in sections 5.2 (hydrology and flooding) and 5.4 (soils and erosion).

Table 5.10 Water quality mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
WQ1	Sediment from stockpiles entering waterways	Stockpiles will be managed in accordance with *Guidelines for Stockpile Management* (EPA, 2019) which includes consideration of: – location of stockpiles in relation to water and / or buildings – type of material being stockpiled – the volume of the stockpile/s. Stockpiles will only be temporary measures and spoil should be disposed of or re-used a quickly as practicable.	Contractor	Construction
WQ2	Contaminated runoff entering waterways.	No equipment wash will occur at or around the proposal area.	Contractor	Construction
WQ3	Spills entering the waterway.	The CEMP will include an emergency plan for spills and will outline spill management measures, including: – spill kits will be available at the compound site and proposal area – bunding will be placed around generators and storage of chemicals to capture spills and leaks – deliveries to the lake will be managed appropriately to prevent run off or spills.	Contractor	Pre-construction / Construction

5.4 Soil, erosion and contamination

This section discusses potential soil, erosion and contamination impacts that may occur as a result of the proposal.

5.4.1 Environmental conditions and value

5.4.1.1 Geology

The geological conditions in the vicinity of Scrivener Dam are characterised by the Canberra Rift, a sequence of Silurian Age volcanic and sedimentary rocks bounded by faults (SMEC, 2023). Scrivener Dam is located on Mount Painter Volcanics which are '*dacite, porphyritic, dark grey to green-grey, with phenocrysts of quartz, plagioclase and mafic minerals altered to chlorite and opaques, inhomogeneous cryptocrystalline groundmass, xenoliths of igneous and sedimentary, with accessory garnet*' (SMEC, 2023).

5.4.1.2 Soils

Scrivener Dam is surrounded by Williamsdale soil landscapes (Jenkins, 2000). Williamsdale is associated with soil that is moderately to very deep, poorly to imperfectly drained sodosols on low rise and fans. These soils are hard setting, dispersive, have acidic topsoils, experience seasonal water logging and minor gully erosion.

The banks of the Molonglo River at the proposal are steep and feature erosion along temporary roads within the proposal area (refer Figure 5.5).

5.4.1.3 Land contamination

There is no known contamination in the soils or water within the proposal area and the proposal area is not listed on the *Register of contaminated sites* under the EP Act.

There is no known fill that has been imported in the proposal area.

Acid sulfate soils have a low probability of occurring in the proposal area (CSIRO, 2013).

Figure 5.5 River crossing and temporary track leading up towards main office

5.4.2 Investigations

A qualitative desktop review was undertaken of geology and soils at the site from publicly available information and from a technical memorandum prepared by SMEC in January 2023.

5.4.3 Impacts

5.4.3.1 Soils

Construction of the proposal would involve:

– earthworks required for excavation and access tracks
– ground disturbance during the installation of the river crossing and coffer dams
– importation and stockpiling of fill.

These activities could potentially cause:

– erosion of exposed soil and stockpiled materials
– dust generation during excavation and vehicle movement over exposed soil
– increased sediment loads entering the downstream Molonglo River waterway.

Ground disturbance and stockpiling could result in dust generation during excavation and vehicle movement over exposed soil. Potential impacts to air quality are discussed further in section 5.9.

Due to the proposal area's location within a riverbed, construction of the proposal would pose a high potential risk of increased sedimentation within the downstream Molonglo River. The sediment and erosion controls to manage this impact are listed in section 5.4.4 and include installing sediment curtains, appropriately bunding stockpiles, and minimising ground disturbance.

With the implementation of appropriate mitigation measures, the risk of substantial impacts from sedimentation are expected to be low given that the proposal area is already exposed to eroding soils (as shown in Figure 5.5 and Figure 5.4). Impacts from the proposal would be temporary and active construction areas would be stabilised and rehabilitated progressively.

5.4.3.2 Land contamination

The proposal has the potential to contaminate the land through the presence of portable toilets, generators, vehicle movements and machinery storage. Vehicles would be maintained and refuelled offsite. Portable toilets would be located within the site compound. The toilets would be regularly serviced via a pump-out arrangement and disposed of appropriately off-site by the contractor.

Excavation work is required which may lead to unknown contaminated areas bring discovered. Any potential contaminated areas would be tested on site prior to disposal. Given the spoil would be re-used on-site, it is unlikely that the proposed works would contribute to additional contamination.

Additionally, the works would involve concrete cutting and other modifications of concrete such as drilling. If a temporary storage pond is made to store the cuttings or slurry, it has potential to leak into the soil or rain could wash it into the Molonglo River. The CEMP will include protocols to management concrete slurry to reduce the risk of downstream contamination.

5.4.4 Mitigation measures

As stated in section 5.1.4, mitigation measure B3 provides that an ESCP will be developed in accordance with the *Environment Protection Guidelines for Construction and Land Development in the ACT* (EPA, 2022) and included as part of the CEMP. The ESCP would include measures to avoid sediment running into the Molonglo River including:

- installing a silt curtain within the Molonglo River downstream of all ground disturbing work.
- installation of sediment fences prior to ground disturbance or river work occurring to capture runoff and prevent erosion
- a system to capture, treat and dispose of the slurry from hydro-cutting and core drilling
- implementing stockpile management
- diverting surface runoff away from disturbed soil and stockpiles
- inspecting controls at least weekly and immediately after rainfall.

Other safeguards and management measures that are relevant to soil and erosion are listed in section 5.3 (water quality) and 5.11 (construction waste).

Table 5.11 Soil, erosion and contamination mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
SEC1	Soil and erosion impacts from the proposal	Ground disturbance will be minimised where possible and rehabilitated progressively.	Contractor	Construction
SEC2	Soil and erosion impacts from the proposal	Work will cease in heavy rainfall.	Contractor	Construction
SEC3	Soil and erosion impacts from the proposal	Cleared areas will be revegetated after construction of the proposal is completed.	Contractor	Construction
SEC4	Land contamination from spills or unexpected finds during excavations	The following contamination management measures would be included in the CEMP and implemented on site: – machinery will be checked prior to works commencing to ensure no leaks – vehicles will be maintained and refuelled offsite – no refuelling will occur on-site – oils or fuels (if required) would be stored appropriately on hardstand area on bunds – any spills would be cleaned-up as appropriate and the EPA would be contacted – imported fill (if required) would be sourced appropriately and tested to ensure no contamination	Contractor	Construction

ID	Impact	Mitigation measure	Responsibility	Timing
		– material would be tested and re-used on-site. – an unexpected find protocol will be developed.		
SEC5	Land contamination from concrete slurry	The CEMP will include protocols to manage concrete slurry to reduce the risk of downstream contamination. This would be managed in accordance with *Designated cutting area and wash area* (Access Canberra, n.d.) which includes measures such as: – ensure concrete waste washed from trucks and mixer units is contained and does not leave the site or enter the stormwater system – dispose of any liquid waste (fuel, wet paint, solvents etc) through a hazardous waste contractor.	Contractor	Construction

5.5 Traffic

This section summaries the *Traffic Assessment* undertaken by GHD provided in Appendix C. It discusses potential traffic and transportation impacts that may occur as a result of the proposal.

5.5.1 Environmental conditions and value

5.5.1.1 Road network

Primary access to the proposal area for construction traffic would be provided via Lady Denman Drive. The Cotter Road to the south is expected to be the other major road link used by vehicles travelling to the site.

A map of the road classifications in proximity to Scrivener Dam is shown in Figure 5.6.

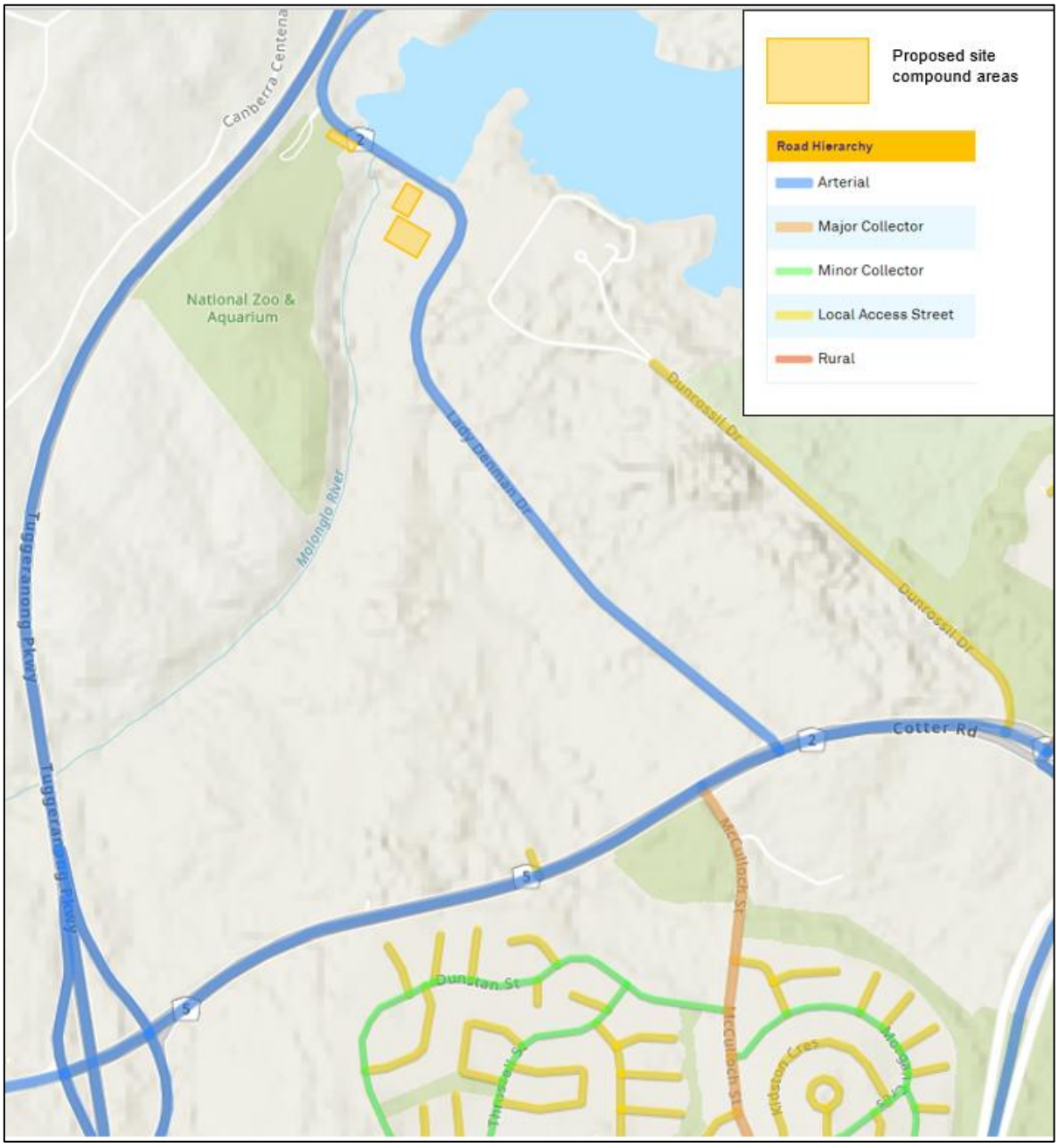

Figure 5.6 ***Road classification of key roads in proximity of the proposal area. Sourced from Active Travel Infrastructure Practitioner's Tool (modified by GHD).***

Lady Denman Drive

Lady Denman Drive, shown in Figure 5.7, is an arterial road[12] that provides a link between other arterial roads in the Canberra area. Lady Denman Drive is approximately 6.3 km in length between Cotter Road near Curtin and Parkes Way in Acton. Lady Denman Drive runs along the Molonglo River and Lake Burley Griffin, providing access to locations along the lakefront. On the western side of the dam, Lady Denman Drive provides access to the National Zoo and Aquarium.

Cotter Road

Cotter Road, shown in Figure 5.8, is an arterial road providing connections from regional areas and suburbs in the greater Canberra region to the central area of Canberra. Cotter Road extends for a distance of approximately 18 km between the Cotter Dam to an off-ramp that merges with Adelaide Avenue, which continues to Capital Hill.

Cotter Road is assumed to be a primary access road for the site, with most vehicles expected to access Lady Denman Drive via Cotter Road.

Figure 5.7 Map of Lady Denman Drive

Figure 5.8 Map of Cotter Road

5.5.1.2 Public and active transport

A desktop review of public transport services found no public transport services were available near the proposal area.

A shared path for pedestrians and cyclists that runs alongside Lady Denman Drive to provides access to the north as well as waterfront areas around Lake Burley Griffin. The shared path runs through the proposed access to the site compound (refer Figure 5.9).

[12] Arterial road refers to a principal route for the movement of people and goods.

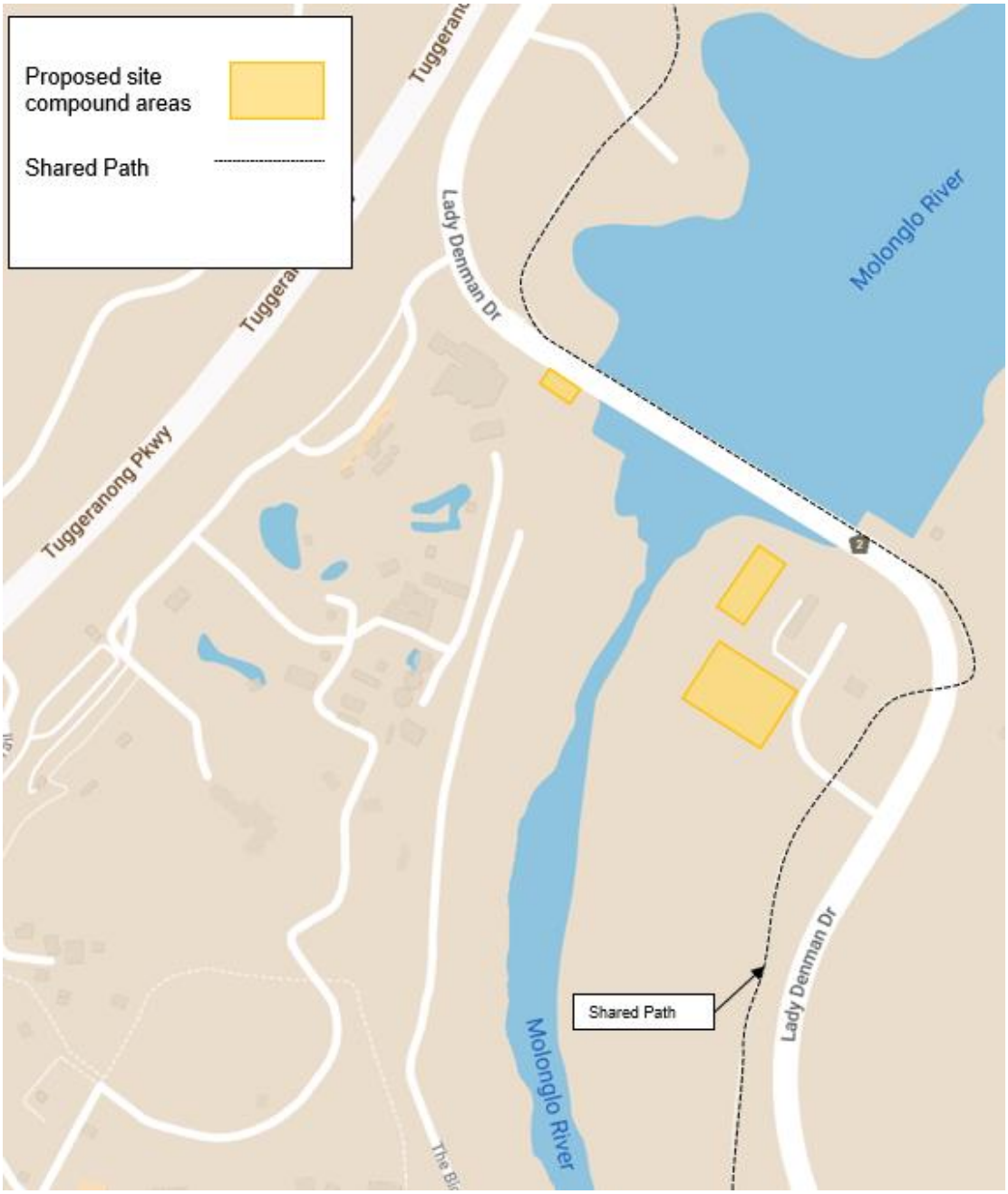

Figure 5.9 Active transport services near the proposal area

5.5.1.3 Freight routes

The ACT Government identifies the Tuggeranong Parkway and Cotter Road as key freight routes.

5.5.1.4 Parking

Street parking is not available on the roads in the vicinity of the proposal.

A car park is located immediately on the left abutment of the dam. This carpark serves the Scrivener Dam Lookout. This car park is expected to remain operational throughout all construction phases.

Additionally, small car park with approximately seven spaces, which is accessed from Lady Denman Drive, is located on the right abutment of the dam. The car park serves a small viewing platform.

5.5.1.5 Crash review

The crash data from the last five-year period is presented in Table 5.12.

The five year-data analysed, starting from January 2016, shows 11 crashes reported within a 500 m radius of the proposal area, with all resulting in property damage only. None of the recorded crashes resulted in injury or fatality.

The locations of each crash in relation to the proposed site compounds are shown in Figure 5.10. There are no significant clusters of incidents in the immediate proximity of the proposal area.

Table 5.12 Reported crashes within a 500 m radius. Data sourced from Australian Federal Police Crash Report.

Year	Total number of crashes reported	of which resulted in **Fatality**	of which resulted in **Injury**	of which resulted in **Property Damage Only**
2016	0	0	0	0
2017	4	0	0	4
2018	1	0	0	1
2019	0	0	0	0
2020	5	0	0	5
2021	1	0	0	1
Total	**11**	**0**	**0**	**11**

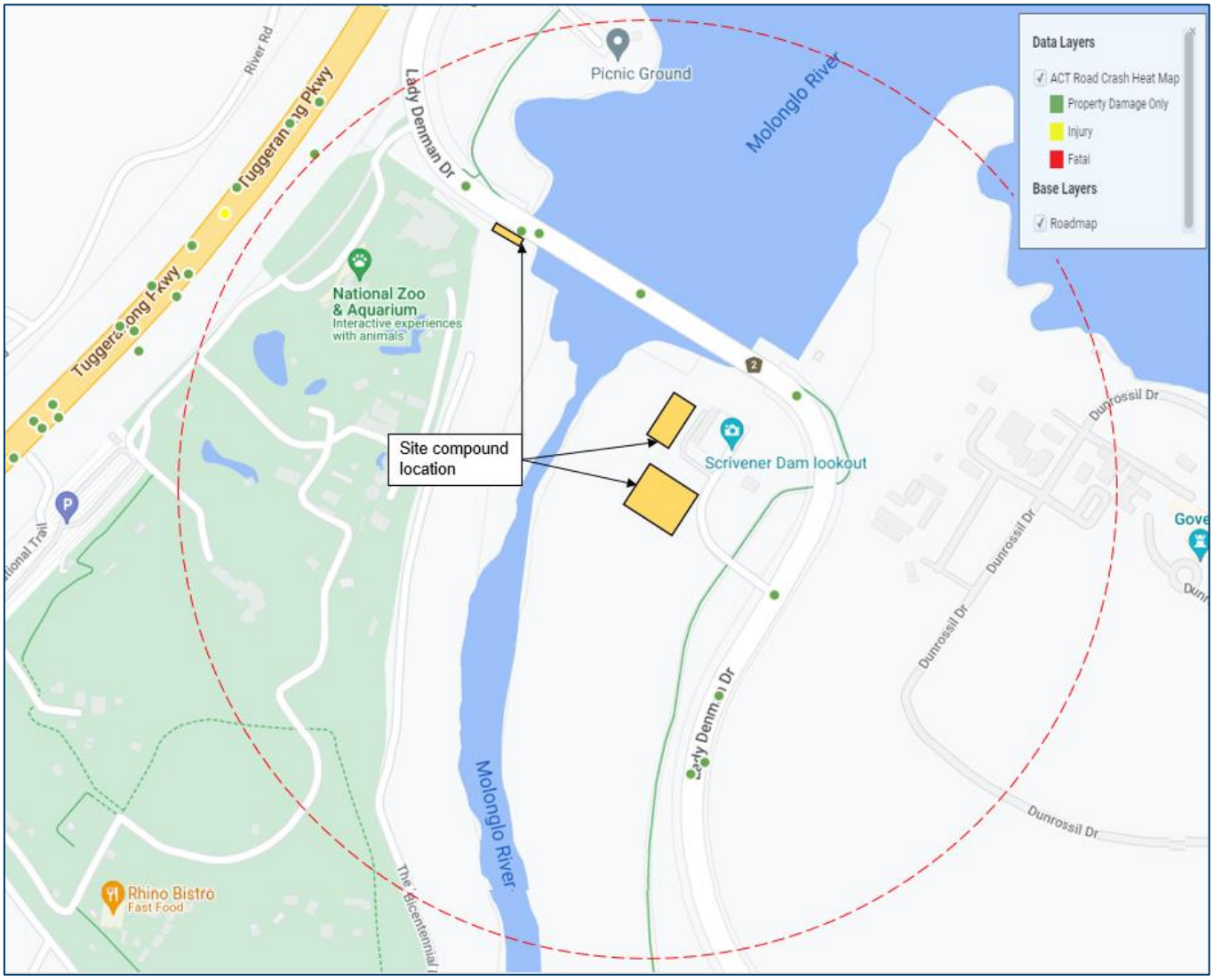

Figure 5.10 Road crashes within 500 m of the proposal area by crash severity. Sourced from ACT Government Open Data Portal (modified by GHD).

5.5.1.6 Traffic volumes

TCCS provided week-long tube count data for Lady Denman Drive, north of Cotter Road, for the week between 20th May 2018 and 26th May 2018. The average weekday outputs from the tube counts are provided in Figure 5.11.

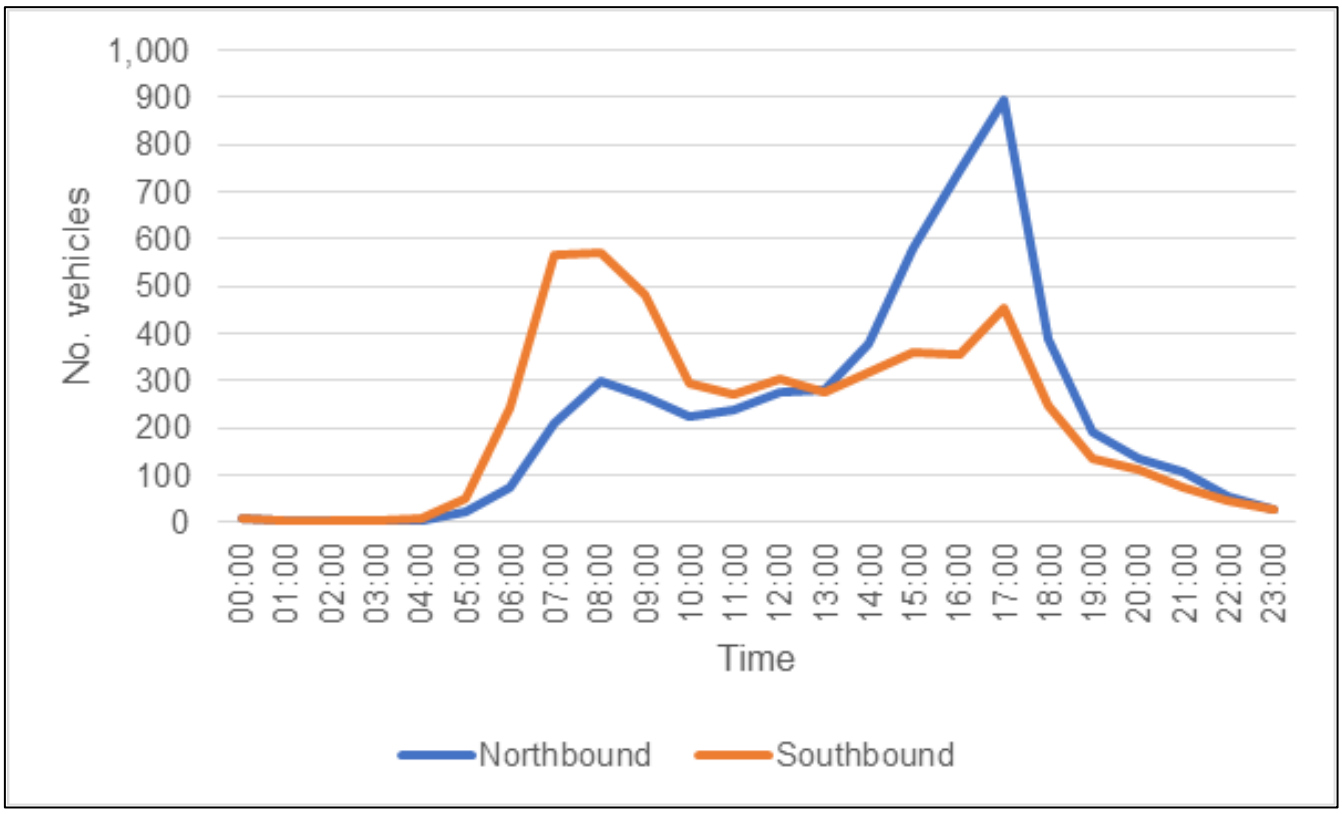

Figure 5.11 Lady Denman Drive traffic data

The data in Figure 5.11 indicates that:

– Vehicle activity on Lady Denman Drive is “tidal”, namely predominantly southbound in AM peak periods and northbound in PM peak periods.
– The AM peak hour occurred between 8:00 am - 9:00 am with approximately 300 northbound and 570 southbound vehicles.
– The PM peak hour occurred between 5:00 pm – 6:00 pm with approximately 890 northbound and 450 southbound vehicles.

5.5.1.7 Traffic performance

The *Guide to Traffic Management Part 3: Transport Study and Analysis Method* (Austroads, 2020) indicates that two lane roads with one travel lane in either direction, operating with uninterrupted flows, have a capacity of 1,800 passenger car units/hour (pc/h). Applying this capacity to Lady Denman Drive, the data in Figure 5.11 indicates that it is operating well within its mid-block capacity, further:

– Outputs from Google Maps indicates that in periods of peak morning activity Lady Denman Drive operates under free flow activity. However, eastbound traffic on Cotter Road experiences localised congestion (refer to Figure 5.12).
– The available data indicates that in peak periods of afternoon activity Lady Denman Drive and Cotter Road operate at an acceptable level.
– The Google Maps outputs are consistent with the available data, which indicates that Lady Denman Drive is operating well within its mid-block capacity during peak periods of activity.

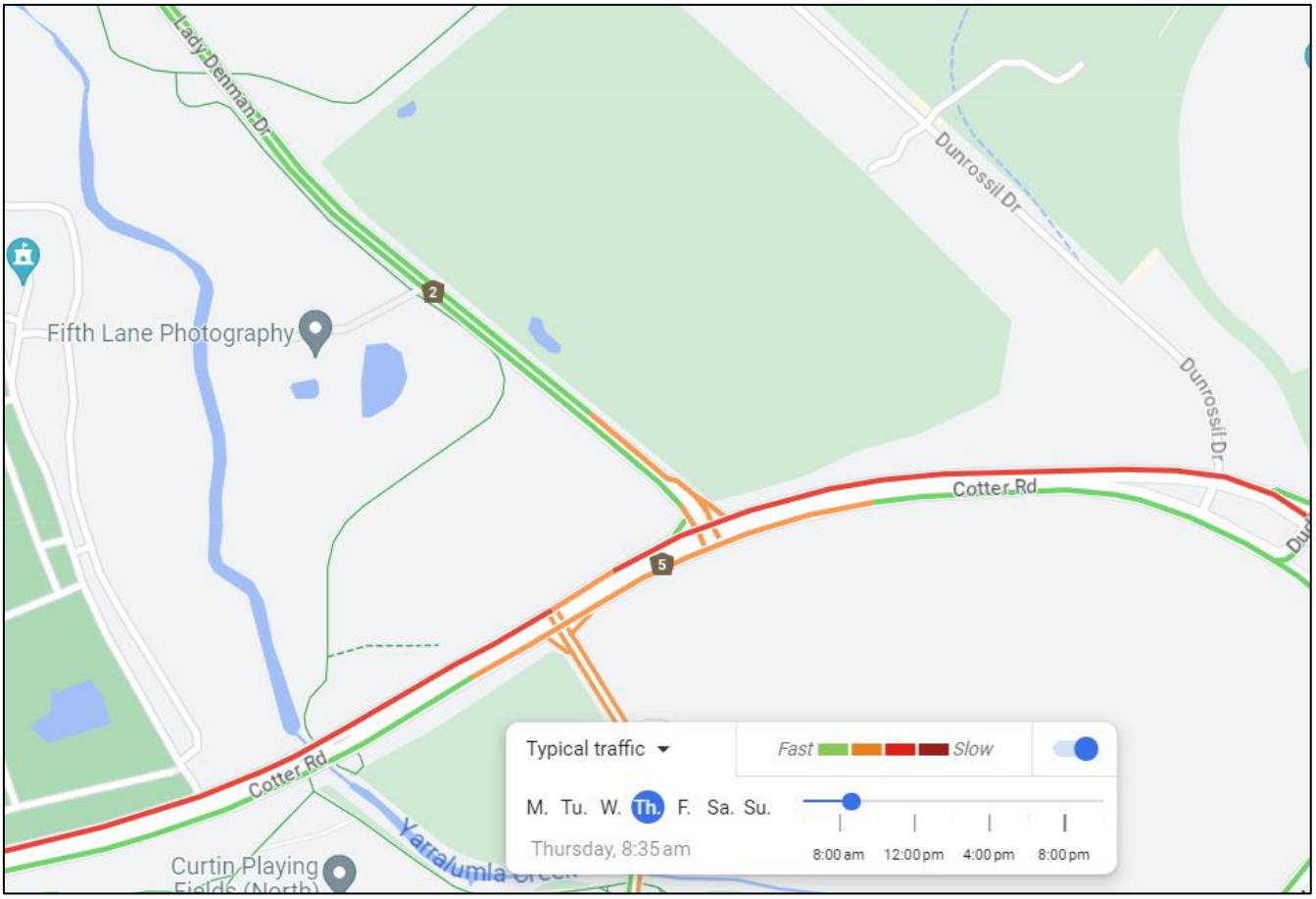

Figure 5.12 Localised traffic conditions (typical Thursday at 8:30 am). Sourced from Google Maps (modified by GHD).

5.5.2 Investigations

The *Traffic Assessment* was undertaken by GHD to assess potential traffic and transportation impacts that may occur as a result of the proposal. This assessment involved:

- reviewing desktop data to understand the existing traffic and transportation conditions in the vicinity of the proposal area (refer section 5.5)
- quantifying the construction impacts of the proposal on the adjoining traffic and transport infrastructure (refer section 5.5.3)
- identifying high level mitigation measures to minimise the impact of the proposal (refer section 5.5.4).

5.5.3 Impacts

5.5.3.1 Traffic

Traffic generation

The estimated peak hour construction vehicle activity assumed the following:

- It is expected that up to 60 full-time equivalent workers would be employed during the construction of the proposal. Most of the construction workforce are likely to be based in Canberra and Queanbeyan.
- It is expected that workers would typically access the proposal area in the morning and depart the proposal area in the afternoon. It has been assumed that peak worker vehicle activity coincides with the adjoining road network peak periods, as a conservative assumption.
- It has been assumed that all construction workers would drive to the site, with a car occupancy of one, i.e., no carpooling.

– It is expected that up to about 20 trucks would access / egress the proposal area per day. Assuming a typical (weekday) workday occurs between 7:00 am and 6:00 pm, on average, this equates to approximately two trucks an hour.
– To be conservative, it has been assumed that five construction trucks would access / egress the construction site in a single hour.

Based on the above, for the purposes of this assessment the highest hourly traffic generation for the proposal under the peak construction scenario is assumed to be up to 70 vehicle trips in total, which would consist of the traffic presented in Table 5.13.

Table 5.13 Hourly construction traffic generation during peak construction scenario

Vehicle movement type	AM peak hour	PM peak hour
Inbound heavy vehicle movements	5	5
Outbound heavy vehicle movements	5	5
Inbound light vehicle trips	60	0
Outbound light vehicle trips	0	60

Trip Distribution

The trips generated by construction of the proposal would be distributed throughout the nearby existing road network.

It is expected that the primary direction of travel to and from the site would be toward Cotter Road to the south of the proposal area, with Cotter Road being the access route to Lady Denman Drive. This is due to Cotter Road being a major arterial road and designated freight route allowing for access for construction-related heavy vehicles.

Some light vehicles trips generated by the construction workers travelling to and from site may use Lady Denman Drive to the north of the site to access Tuggeranong Parkway which provides access to the areas of Northern Canberra.

Impacts to traffic

The vehicle activity associated with the construction of the proposal is expected to be minor (up to 70 vehicles an hour) and would only occur for a period of about 18 months. The construction vehicle trips are typically expected to fall within the daily fluctuations of the adjoining arterial road network.

Accordingly, the impacts of the proposal on the adjoining road network are expected to be negligible and Lady Denman Drive is expected to continue to operate well within its mid-block capacity.

5.5.3.2 Active transport

As discussed, a recreational shared path is located adjacent to the proposal area, which crosses over the expected access / egress point to the construction compounds.

This crossing point, shown in Figure 5.13, would need to be managed through traffic control measures throughout the construction process to ensure the operation of the shared path is maintained.

The traffic control measures implemented would focus on ensuring the safety of pedestrians and cyclists while supporting the movement of vehicles to and from the construction compounds.

Accordingly, the impacts of construction vehicles on active transport facilities are expected to be negligible.

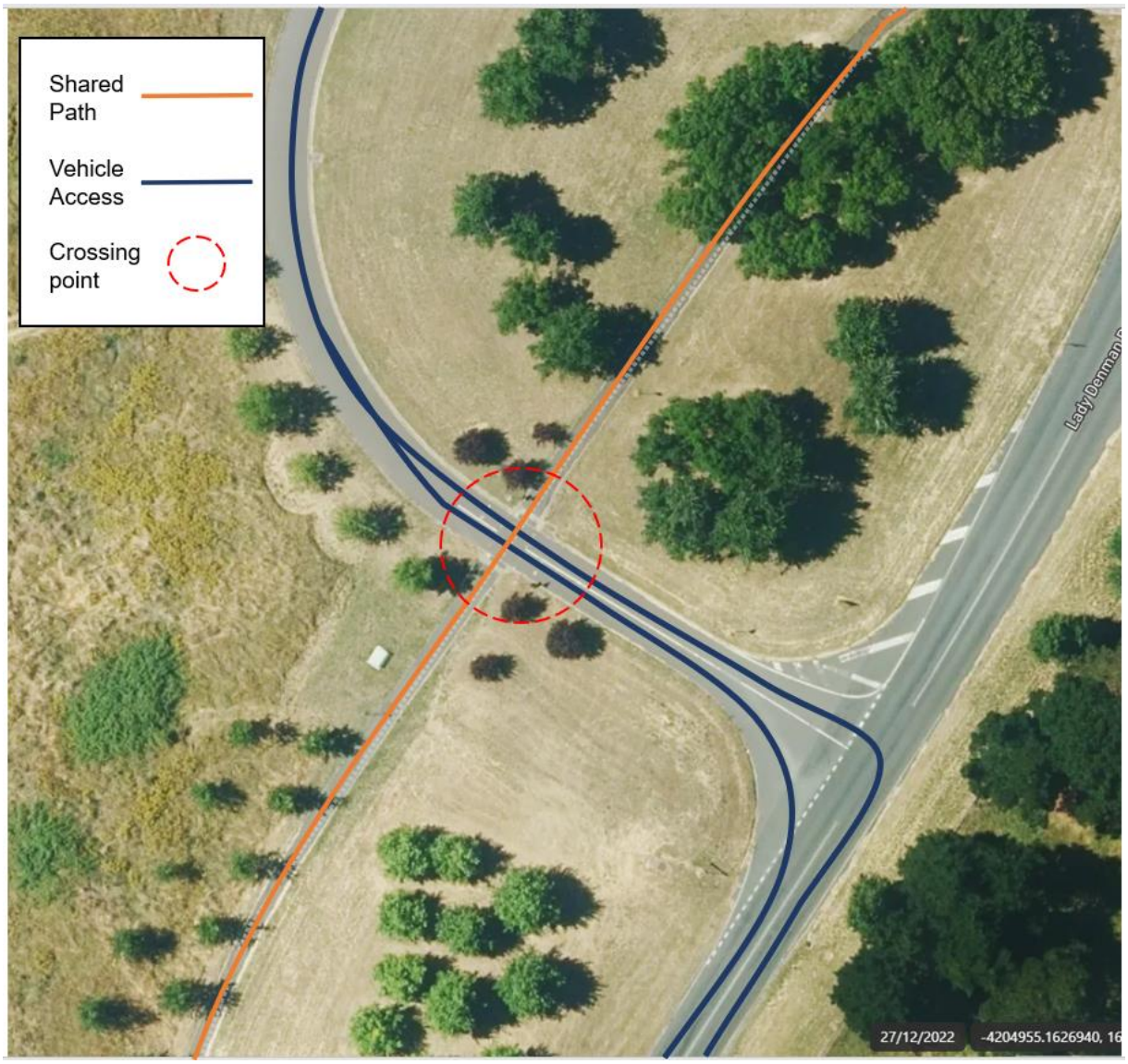

Figure 5.13 Shared path crossing with vehicle access to site. Sourced from MetroMap, modified by GHD.

It is noted that a meeting was held with NCA and Pedal Power ACT to discuss the proposal's construction activity on the adjoining active transport facilities. Pedal Power ACT recommended that:

– additional signage for cyclists should be included in a construction traffic management plan
– the signage should include warnings about Construction Works Ahead and Heavy Vehicles Ahead
– consideration should be given to given to placing a temporary signage stop sign on the shared path (at the crossing point), to support the safety of cyclists crossing the road.

A construction traffic management plan that supports the safety of pedestrians / cyclists would be prepared and implemented prior to and for the duration of construction of the proposal.

5.5.3.3 Road safety

The crash review provided in section 5.5.1 shows that traffic incidents within 500 m of the proposal area were quite low over the five-year period analysed, with no incidents resulting in injury or fatality.

Appropriate traffic control measures in the vicinity of the proposal area would be adopted to ensure that the safety of all road users is not impacted by construction-related vehicles travelling to and from the site.

Accordingly, the impact of construction vehicles on road safety is expected to be negligible.

5.5.3.4 Parking

Parking for workers would be provided within the construction compounds.

On-street parking is not permitted on Lady Denman Drive near the proposal area. As such, no impacts on street parking are anticipated.

As discussed, a car park that serves the Scrivener Dam Lookout is located adjacent to the dam. It is proposed that this car park remain open during construction of the proposal to reduce impacts to the community. Traffic controls such as signage, would be used to ensure the safety of vehicles accessing / egressing the car park during construction, supported by appropriate signage.

The small car park (seven spaces) serving the right abutment viewing platform would be used as a compound during construction.

Accordingly, the impact of construction vehicles on parking is typically expected to be negligible.

5.5.3.5 Other developments

Access / egress to and from the National Zoo and Aquarium would be maintained throughout the construction period. Accordingly, the impacts of construction vehicles on other nearby developments are expected to be negligible.

5.5.4 Mitigation measures

Table 5.14 lists relevant safeguards to avoid, minimise and manage potential traffic and transport impacts of the proposal.

In accordance with ACT Government requirements, a detailed construction traffic management plan would be prepared for the proposal, prior to construction. The plan would require approval from the ACT Government and would be implemented for the entire construction period.

Based on discussions with TCCS officers, they noted that their media team could keep the wider community notified about any construction impacts via social media, radio and media releases.

Table 5.14 Traffic and transport mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
T1	Minimise impacts to traffic and transport networks.	A construction traffic management sub-plan will be developed prior to construction. This will include, at a minimum, the following management measures: – preparation of a Traffic Guidance Scheme, detailing adequate road signage at construction work sites to inform motorists, cyclists and pedestrians of the work site ahead to ensure that the risk of road accidents and disruption to surrounding land uses is minimised – identify the requirement for traffic controllers – maintain accessibility for pedestrians and cyclists – indicate routes to be used by heavy construction-related vehicles to minimise impacts on sensitive land uses and businesses – implement measures to manage traffic flows around the area affected by the construction of the project, including, as required, regulatory and direction signposting, line marking, and variable message signs and all other traffic control devices necessary for the implementation of the construction traffic management sub-plan – implement measures to maintain public access to the lookout car park, including the potential use of signage. – undertake consultation with the relevant road authorities during preparation of the sub-plan – ensure the performance of project traffic arrangements is monitored during construction – undertake consultation with the community groups, i.e. Pedal Power.	NCA / Contractor	Pre-construction
T2	Minimise impacts to the operation of nearby developments	Vehicle access to the National Aquarium and Zoo will not be impacted by construction of the proposal.	Contractor	Construction

ID	Impact	Mitigation measure	Responsibility	Timing
T3	Minimise environmental impacts associated with the movement of vehicles.	The roads leading to and from the proposal area will be monitored. Necessary steps will be taken to rectify any road deposits caused by site vehicles, to maintain the safety of road users. Where possible, construction vehicle activity will be offset from peak periods of road network activity as per standard construction practice.	Contractor	Construction
T4	Minimise environmental impacts associated with the movement of vehicles.	Employees and contractors will be inducted to raise awareness and understanding of traffic and transport mitigation measures to be implemented during construction.	Contractor	Construction

5.6 Noise and vibration impacts

This section summaries the *Noise and Vibration Impact Assessment* (NVIA) (WSP, 2023) provided in Appendix D. It discusses potential noise and vibration impacts that may occur as a result of the proposal.

5.6.1 Environmental conditions and value

5.6.1.1 Sensitive receivers

Sensitive receivers in the vicinity of the proposal area are shown in Figure 5.14 and include:

– the National Zoo and Aquarium including onsite accommodation
– the grounds of Government House
– numerous public recreational areas.

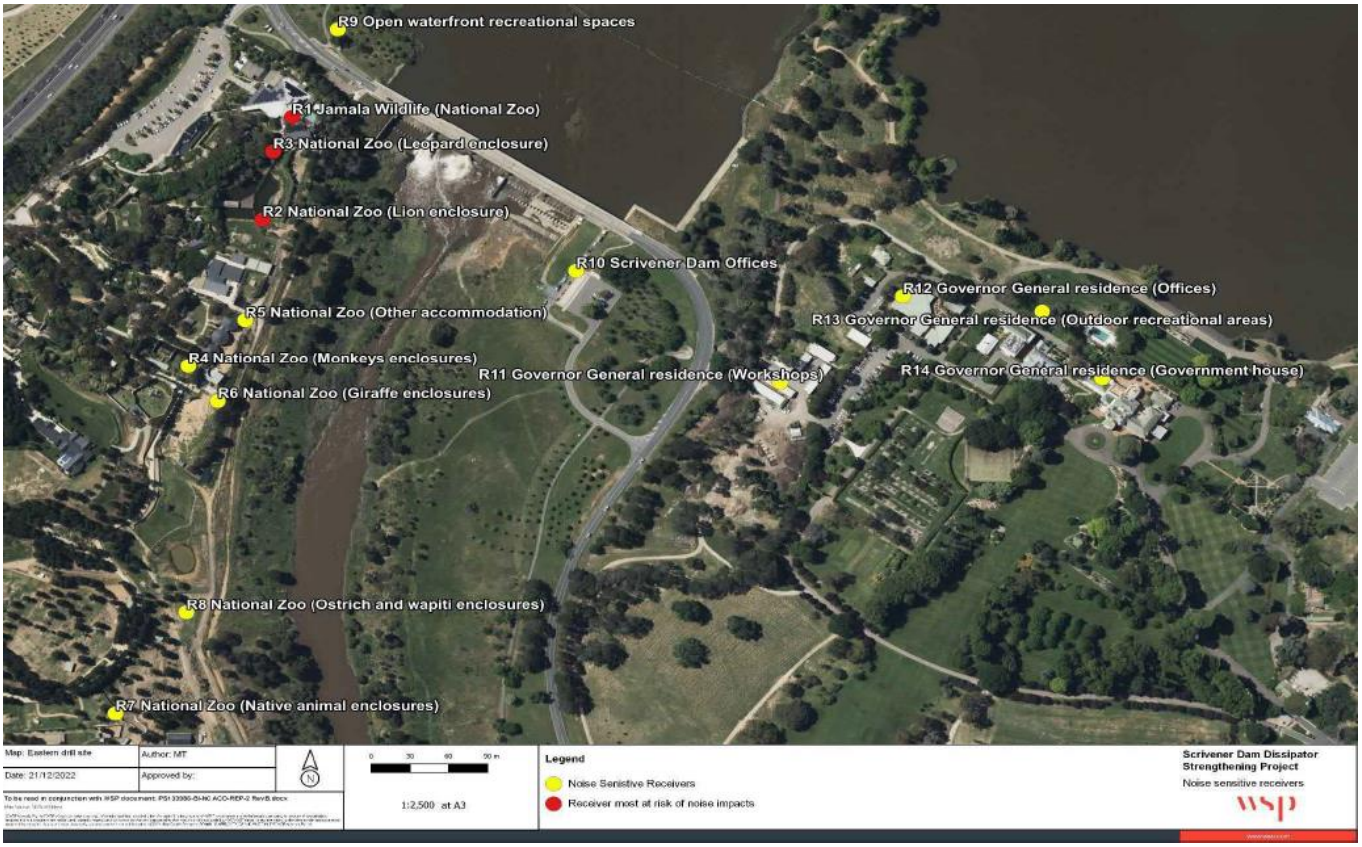

Figure 5.14 Sensitive receivers in the vicinity of the proposal area

5.6.1.2 Existing background noise

Within the zoo areas, noise levels ranged between approximately 55 – 65 dBA, with noise levels influenced by visitors, wild birds, and on-site water features. Road traffic noise from Tuggeranong Parkway was also constantly audible in the background.

5.6.2 Investigations

WSP (2023) undertook investigations to assess potential impacts from noise and vibration generated by the proposal on the sensitive receivers near the proposal area. This assessment included:

– reviewing policy guidance to determine appropriate noise levels (noise goals) for nearby areas
– undertaking noise monitoring to determine existing noise levels and noise generation from the loudest equipment likely to be used during construction of the proposal (rock drilling unit)

– noise modelling and validation to predict noise emissions during construction
– simulated noise impact testing to understand the potential impact of construction noise on fauna at the National Zoo.

5.6.3 Impacts

5.6.3.1 Noise

Predicted construction noise at sensitive receivers were generally found to be within noise goals. Locations where predicted noise levels were found to be close to noise goals included:

– National Zoo (Jamala Wildlife Lodge) (moderate risk)
– National Zoo (Other accommodation) (low risk)
– Open waterfront recreational space (low risk).

However, observations from the simulated noise testing found that construction noise at the Jamala Wildlife Lodge were unlikely to be substantially louder than the existing background noise from the dam release water. Although noise would be audible in external spaces overall there would be a low likelihood of substantial impacts.

The simulated noise testing found that both lions and giraffes resumed normal behavior after displaying curiosity at the simulated noise source after a few minutes. The zebras did not appear to notice the noise. As such, the simulated noise testing found that construction would be unlikely to impact these animals.

The potential impacts from noise have been summarised in Table 5.15. Overall, noise impacts were not found to be substantial and would be manageable with the mitigation measures provided in section 5.6.4.

Table 5.15 Noise impacts

Sensitive receiver	Impacts
Jamala Wildlife Lodge	Simulated noise was not substantially louder than existing background noise from the dam release water. Drilling noise would be clearly audible in external spaces however there is a low likelihood of substantial impacts.
National Zoo and Aquarium (general)	Construction noise is a temporary impact are expected to be manageable with moderate noise mitigation measures.
Lion enclosure	During the simulated noise test the two lions were generally curious about the noise however within two minutes resumed their normal behaviour. There is a low likelihood of substantial impacts during construction.
Giraffe enclosure (and nearby zebra)	During the simulated noise test one of the two giraffes approached the noise source cautiously. During this time, one giraffe was relatively immobile and alert. No response was observed in the other giraffe or either zebra. Within a few minutes, the giraffe appeared to be resuming normal behaviour. There is a low likelihood of substantial impacts during construction.
Government House	Construction would be audible at Government House however notable noise impacts are expected unlikely. Some events at the Government House may require lower levels of background noise (for example to allow speeches during formal functions, etc) and as such appropriate management recommendations have been provided.
Recreational areas	Noise impacts are not expected to occur at waterfront recreational areas north of the Scrivener Dam. Noise levels at recreational waterfront areas south of the dam are expected to extend approximately 200 m south along the Molonglo River. However, noise impacts in this area would not be substantial.
Residential suburban areas	Noise impacts in nearby suburbs (Curtin and Yarralumla) are expected to remain below existing background noise levels.

5.6.3.2 Vibration

The assessment found that vibration would be unlikely to cause impacts to sensitive receivers or damage buildings.

5.6.4 Mitigation measures

Table 5.16 lists relevant safeguards to avoid, minimise and manage potential noise and vibration impacts of the proposal.

Table 5.16 Noise and vibration mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
NV1	Noise impacts to sensitive receivers	The CEMP will include measures to minimise noise impacts during construction, including, but not limited to: – construction work to be undertaken during 7 am and 6 pm on Monday to Saturday, excluding public holidays (per time restrictions to qualify for the exemption) – consideration of respite periods or shutdowns during particularly sensitive time periods – localised noise screens around noisy plant (where acoustic effectiveness can be demonstrated prior) – site inductions for construction staff to include information about noise impacts and management measures – noise monitoring of construction works and at receiver locations at the commencement of operations and in response to noise complaints – the consideration of a later start time for construction works to reduce impacts at Zoo accommodation areas – consider if quieter construction methods are viable, particularly alternatives to hammer drilling. Likewise use the smallest suitable equipment on site. – sound Power Level testing of the proposed drilling equipment should be undertaken to ensure modelling inputs are accurate – precise work areas and a full equipment list should be developed to determine potential total noise impacts – potential noise impacts should be considered when planning worksite layout (in particular noisy areas such as compounds, stockpiles, laydowns, etc) – alternatives to reversing / warning beepers (broadband alarms, cameras, etc) should be installed on all on site equipment.	Contractor	Pre-construction and construction
NV2	Extended noise impacts to the Zoo staff, guests and animals and Government House	Stakeholder consultation will be undertaken to: – determine upcoming events at the Zoo and Government House and their potential sensitivity to noise – track any animal behavioural changes and determine additional and acceptable mitigation measures	NCA	Pre-construction and construction

ID	Impact	Mitigation measure	Responsibility	Timing
		– discuss noise management measures with hotel guests such as closing of doors and windows and not remaining in rooms for extended periods during works.		

5.7 Heritage

A Heritage Impact Assessment and a Cultural Heritage Assessment were commissioned to assess the potential impacts of the proposal on non-Aboriginal and Aboriginal heritage. At the time of writing this EIA Report (May, 2023) these reports were not finalised.

The following section provides a summary of the draft Heritage Impact Statement undertaken by Marshall and Baker (2022) provided in Appendix E.

This EIA Report will be amended to include the results of the final heritage assessments when available.

5.7.1 Environmental conditions and values

Scrivener Dam is part of a recognised heritage place, Lake Burley Griffin and Adjacent Lands, which is on the Commonwealth Heritage List established by the EPBC Act.

5.7.2 Investigations

The Heritage Impact Statement (Marshall and Baker, 2022) undertaken for the proposal was based on:

– a review of the concept design for the proposal
– discussions with an NCA advisor
– a review of the Commonwealth Heritage List place record for Lake Burley Griffin and Adjacent Lands (DCCEEW, 2022), archival records, and the heritage management plan for the dam (GML, 2009)
– a site inspection
– comparison with other Australian dams
– research regarding hydraulic energy dissipators.

5.7.3 Impacts

The Heritage Impact Statement found the proposal would have very minor adverse impacts on the original dissipator. The assessment noted that while the new concrete elements would appear as bright, clean concrete when first installed, it is expected that these would patinate (weather) over time and become less noticeable.

Overall, the proposal would be consistent with conservation policies and would not be considered to be a significant impact within the meaning of the EPBC Act.

5.7.4 Mitigation measures

Table 5.17 lists relevant safeguards to avoid, minimise and manage potential non-Aboriginal heritage impacts of the proposal.

Table 5.17 Non-Aboriginal heritage mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
H1	Records of heritage fabric	The NCA will ensure that a good record (photographs and plans) is made of the dissipator in its original configuration, and that this record is archived for future reference.	NCA	Pre-construction
H2	Remediation of visual changes	The landscape impacted by the temporary construction phase will be remediated upon completion of the project.	Contractor	Construction

5.8 Visual amenity

5.8.1 Environmental conditions and value

5.8.1.1 Scrivener Dam

Scrivener Dam is situated on the incised channel of the Molonglo River and surrounded by undulating terrain. The dam can be viewed from:

– the National Zoo entry
– to a limited extent for traffic travelling on Lady Denman Drive and Scrivener Dam entry (see Figure 5.15)
– recreational areas towards the western end of Lake Burley Griffin.

There is a viewing platform on the eastern side of the Dam which is regularly used by tourists and ACT residents (see Figure 5.16).

The proposal area mostly consists of the dissipator, managed turf and some riparian vegetation.

Figure 5.15 View from main entry to Scrivener Dam

Figure 5.16 View from below Scrivener Dam viewing area

5.8.1.2 Lake Burley Griffin

Lake Burley Griffin is Canberra's centrepiece, and a significant number of national institutions, parks and national public places are located on or near its shores (NCA, n.d.). It provides visual amenity for recreational users of the lake as well as visitors to foreshore parks and businesses.

5.8.2 Investigations

A site inspection was undertaken on 29 April 2023 to understand visual amenity impacts, based on:

- the characterisation of the existing landscape character and views
- a discussion of potential impacts to visual amenity from the project
- proposed safeguards and mitigation measures.

5.8.3 Impacts

5.8.3.1 Potential construction impacts

The construction activities and compound sites would temporarily impact the visual amenity of the proposal area. Vegetation would be removed within the proposal area. Additionally, construction equipment, compounds, laydown areas, security fencing, and signage would be visible from the viewing platform and Lady Denman Drive. However, the visual amenity impacts from construction in the proposal area are expected to be minimal given:

- a relatively small amount of vegetation would be removed
- active construction would be mostly focused in the works area which is located in a steep channel and as such is screened from most viewpoints
- construction would be relatively minor and would be temporary
- construction is often conducted in the works area

– road users on Lady Denman Drive would only have brief views of the proposal area.

Lowering the lake during construction would temporarily expose areas of the banks that may be covered in algae, soils areas or rock. This has the potential to affect the visual amenity for:

– members of the public that are using the lake and recreation areas on the lake's foreshores such as Lotus Bay and Yarralumla Beach
– tourists visiting the national landmarks such as the National Zoo and Aquarium and the National Museum of Australia
– lake side businesses such as the Boat House and the Jetty
– commuters on the Tuggeranong Parkway and Lady Denman Drive.

This impact would likely be more pronounced in the eastern part of Lake Burley Griffin where the lake is shallower.

The visual amenity impacts from lowering of the lake are temporary and lowered to levels previously experienced during drought and previous maintenance works.

5.8.3.2 Potential operation impacts

The proposal would have negligible visual amenity impacts during operation. The proposal area would be remediated once construction was completed. The strengthened dissipator would look very similar the existing dissipator and Lake Burley Griffin would be restored to normal levels.

5.8.4 Mitigation measures

Table 5.18 lists relevant safeguards to avoid, minimise and manage potential visual amenity impacts of the proposal. Other safeguards and management measures that are relevant to visual amenity are listed in sections 5.1 (biodiversity) and 5.10 (commercial and recreational impacts).

Table 5.18 Visual amenity mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
V1	Visual impacts of the proposal	The CEMP will include measures to minimise visual impacts during construction, including, but not limited to: – ensuring the site is kept tidy – rehabilitating all areas disturbed by construction and ancillary works at the conclusion of the construction – removal of rubbish that becomes exposed during lake lowering – utilising plain security fencing and screening to reduce visual amenity impacts to the viewing platform.	Contractor	Construction

5.9 Air quality

5.9.1 Environmental conditions and value

The existing air quality of the local area is likely influenced by emissions from motor vehicles (from Tuggeranong Parkway and Lady Denman Drive). Air quality conditions are also influenced by the prevailing weather and climatic conditions, bushfires, and other natural factors such as pollen. Based on a search of air quality in ACT (ACT Health, 2023) air quality in Civic (the nearest station) has been good to very good between April 2022 and May 2023.

Canberra Airport weather station (station number 070351) is located about 10 kilometres to the east of the proposal area. Afternoon winds are generally stronger than morning winds at Canberra Airport weather station tending towards 14-21 kilometres per hour with morning winds generally 6-11 kilometres per hour (BoM, 2023). Wind is generally north-easterly.

Nearby sensitive receivers include:

– the National Zoo and Aquarium including onsite accommodation
– the grounds of Government House
– Curtain, Yarralumla and Weston, nearest residential suburbs
– numerous public recreational areas.

5.9.2 Investigations

A desktop review was undertaken to establish existing air quality conditions by examining databases recording air quality and weather information near the proposal area.

5.9.3 Impacts

During construction of the proposal temporary impacts on air quality may arise from:

– minor generation of particles and dust from general construction work (e.g. excavations, demolition and cleaning)
– dust generation from temporary roads
– minor emissions (primarily diesel exhaust) from plant and machinery
– minor emissions from construction traffic.

These are expected to have a minimal impact given the works are relatively minor and short-term, and there are limited nearby sensitive receivers. Impacts to air quality would be managed with standard construction controls and mitigation measures.

5.9.4 Mitigation measures

Table 5.19 lists relevant safeguards to avoid, minimise and manage potential air quality impacts of the proposal. Other safeguards and management measures that are relevant to air quality are listed in section 5.4 (soils and erosion).

Table 5.19 Air quality mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
AQ1	Dust creating poor air quality conditions	The CEMP will include measures to minimise air quality impacts during construction, including, but not limited to: – covering all loaded trucks and equipment – speed restrictions and the stabilisation of accesses and parking areas.	Contractor	Construction
AQ2	Vehicle emissions creating poor air quality conditions	Vehicle and equipment emissions will be managed through the maintenance of equipment and vehicles. Machinery will be turned off rather than left to idle when not in use.	Contractor	Construction

5.10 Commercial and recreational impacts

5.10.1 Environmental conditions and value

Lake Burley Griffin is Canberra's centrepiece. It acts a key aesthetic, recreational and cultural landmark for Canberra. There are several national institutions along the shores of Lake Burley Griffin. Lake Burley Griffin also plays an important role in tourism and is used by numerous businesses.

The eastern and central basins of the lake and associated foreshore areas feature more lakeside development and are both commonly used for lakeside recreation purposes like walking and exercise. The western basin of the lake is less-built-up and used more for water-based recreation, such as sailing, rowing and fishing (Stinton et al., 2020).

Lake Burley Griffin is regularly used by many recreational lake users, commercial businesses, and general ACT community (see section 4.1). Lake Burley Griffin is used for water obstacle courses and a range of events including triathlons (when the lake water quality is suitable), fireworks and light shows.

A pedestrian and cycling path is located to the east and north of the proposal area (see Figure 5.17). This route is generally busiest during peak hours when the ACT community travels to and from work but is also generally used throughout the day and into the evening.

Figure 5.17 Pedestrian and cycling crossing off Lady Denman Drive

5.10.2 Investigations

This assessment was informed by desktop information, a site visit undertaken on 19 April 2023 and information obtained from consultation undertaken with the Lake User Group by the NCA in December 2022.

It includes discussion of:

– the existing social environment and land uses including recreational uses in the vicinity of the proposal area
– potential commercial and recreational impacts from construction of the proposal
– proposed mitigation measures to manage the potential impacts.

5.10.3 Impacts

5.10.3.1 Noise, air and traffic impacts

Construction of the proposal may cause minor amenity impacts near the proposal area from noise and vibration, and dust generation. These aspects have been assessed separately in sections 5.6 and 5.9, respectively.

As discussed in section 5.5 the increased traffic associated with construction of the proposed works may pose a hazard to cyclists and pedestrians. These impacts would be minor and managed with the mitigation measures outlined in section 5.5.4.

5.10.3.2 Visual amenity

There would be some temporary visual impacts associated with vegetation removal, establishment of site compounds and worksites and lowering of the lake level. These impacts are assessed in section 5.8. Lowering the lake level may reduce the visual amenity of lake views from lake side businesses and recreational areas. However, the commercial and recreational impacts from reduced visual amenity are not anticipated to be significant as:

– the impact would be short-term
– drawdown would be limited to levels previously experienced during drought and other maintenance works
– visual impacts would be managed through mitigation measures outlined in section 5.8.4.

5.10.3.3 Lake use and navigational hazards

The main commercial and recreational impacts associated with the proposal would be the lake use and potential impacts on watercraft associated with lowering the lake level.

As discussed in section 4 lake levels may impact the usability of fixed height lake infrastructure. Some recreational activities such as sailing and rowing rely on the maintenance of the lake level. Many of the jetty and pontoon locations have been selected based on the depth of water so differing vessels can be catered for.

Information obtained from consultation with the Lake User Group was used to inform the proposed temporary reduction in lake level. Initially, the construction method considered lowering the lake up to 1.5 m. However, to limit potential impacts on lake users a compromise of 0.5 m was selected. It is understood that limiting the lake lowering to 0.5 m would enable Kingston Harbour to continue to be accessed.

To further reduce impacts to the usability of jetties and pontoons the NCA would supply floating pontoons. The floating pontoons would be used to provide temporary access to the lake in locations where shallower water impacted the ability of vessels to berth and launch.

Lowering the lake level may also increase the number of shallow navigation hazards within the lake. Navigational hazards, such as shopping trolleys or other debris, could cause damage to vessels due to collision. To manage this impact, a bathymetric map with known hazards would be made available to recreational and commercial users of the lake. Further, the NCA would host a webpage where navigation hazards could be reported, and the users of the lake notified.

The NCA would continue to work with the Lake User Group to identify reasonable and feasible measure to reduce impacts from construction of the proposal.

5.10.3.4 Benefits

Positive impacts that would be generated by construction of the proposal including:

– increased employment opportunities for skilled and semi-skilled workers (about 60 opportunities)
– increased opportunities for local businesses to supply goods and services to the construction workforce.

Additionally, community groups would be able to access areas of the lake that are usually too deep to remove litter, carp eggs and invasive aquatic weeds. If cleaning programmes were undertaken these would improve the usability of the lake by reducing navigational hazards associated with litter and weeds. It would also reduce invasive species, such as carp, within the lake which compete with native species for resources.

5.10.4 Mitigation measures

Table 5.20 lists relevant safeguards to avoid, minimise and manage potential commercial and recreational impacts of the proposal. Other safeguards and management measures that are relevant to commercial and recreational impacts are listed in sections 5.5 (traffic) and 5.8 (visual amenity).

Table 5.20 Commercial and recreational impact mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
CR1	Limiting impacts to commercial and recreational lake users	The lake will be lowered by no more than 0.5 m below FSL. Lake lowering will be reduced when possible and safe.	NCA	Construction
CR2	Managing impacts to lake users	Measures to reduce impacts to lake users will be considered including: – providing floating pontoons where existing pontoons and jetties cannot be used – providing additional mooring points for larger vessels if Kingston Harbour becomes inaccessible.	NCA	Construction
CR3	Managing navigational hazards in the lake	A bathymetric map will be made available to lake users. The NCA notifying key user groups of exact dates of lake lowering and navigational hazards as they become known.	NCA	Construction

5.11 Construction waste

5.11.1 Environmental conditions and value

Public waste bins are provided:

– at the Scrivener Dam carpark
– within the Scrivener Dam offices
– within the existing site office.

5.11.2 Investigations

A desktop review of existing conditions and the proposed construction method was undertaken to understand the type of waste that may be generated and appropriate measures for managing waste.

5.11.3 Impacts

Construction activities would generate various waste streams that would need to be managed and disposed of. Potential wastes produced by construction would include:

– green waste from the removal of vegetation
– waste fuels, oils, liquids and chemicals
– packaging wastes such as cardboard, timber, paper and plastic
– sewage from the temporary compound
– potentially contaminated sediment (refer section 5.4)
– earthworks spoil associated with site levelling
– drilling mud or slurry
– general waste, including food, litter and other wastes generated by the construction workers.

Any excavated material, including dredged material, would be reused where suitable or classified before being disposed to an appropriately licenced facility in accordance with the *Requirements for the reuse and disposal of contaminated soil in the ACT* (EPA, 2022b) and *Waste Classification Guidelines: Part 1 Classifying Waste* (EPA, 2014).

Ancillary facilities would be contained within the site compound and include a portable toilet. Fuels, oils and other required liquids which would be stored in bunded containers.

Drilling mud or slurry would be disposed of as appropriate and according to *Requirements for the Classification and Reuse of Drilling Mud Waste in the ACT* (Access Canberra, n.d.) or best practice guidelines.

All waste removed from the proposal area would be transferred by a licenced contractor to a licenced receiving facility in accordance with *Material stockpile and waste management* (Access Canberra, n.d.) or other relevant best practice guidelines.

Overall, the proposal would generate relatively limited waste and would have a low construction waste impact.

5.11.4 Mitigation measures

Table 5.21 lists relevant safeguards to avoid, minimise and manage potential impacts from construction waste generated by the proposal. Other safeguards and management measures that are relevant to construction waste are listed in sections 5.3 (water quality) and 5.4 (soil and erosion).

Table 5.21 Construction waste mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
CW1	Reducing construction waste	Options for beneficial reuse of green waste on site will be considered such as mulching using for temporary stabilisation of exposed area. Where green waste from vegetation removal cannot be reused on site, reuse on other sites would be investigated prior to disposal.	Contractor	Construction
CW2	Appropriate waste management	Worksites would be maintained in a tidy state, and all general litter would be appropriately disposed of, and recycled where possible.	Contractor	Construction
CW3	Appropriate waste management	Waste generated from the construction of the proposal would be transported to an appropriately licenced waste disposal or transfer facility. Where required, this would include using a licenced contractor to remove regulated waste, under current ACT EPA Guidelines.	Contractor	Construction

5.12 Hazards

5.12.1 Environmental conditions and value

As discussed in section 5.2 the proposal is located in a flood risk area.

The geological conditions in the proposal area are considered to be highly erodible and precautions would be taken during construction works (GHD, 2022b)

5.12.2 Investigations

A qualitative desktop discussion of hazards, informed by team members working on the detailed designs for the proposal.

5.12.3 Impacts

The main hazards associated with proposal are those associated with navigation on Lake Burley Griffin and downstream flooding. These have been assessed separately in section 5.10 and 5.2 respectively.

Other potential hazards and risks associated with the proposal during construction would include:

– physical injury to public due to various hazards and risks associated with the construction activities
– physical injury to users of the bike path or Scrivener Dam lookout from construction traffic entering the site
– construction materials, waste and / or other objects causing water pollution and risk to human health
– physical injury to construction workers due to various hazards and risks associated with the construction activities (e.g., construction activities in flood area)
– risk to human health or the environment from the dispersion of potentially contaminated sediments
– risk to human health or the environment from air quality related impacts from dust generated during construction activities
– potential impacts to known and unknown utilities.

Construction hazards would be managed through implementation of standard safety controls as well as a CEMP. Further mitigation measures to reduce hazards from the proposal are listed in sections 5.5 (traffic), 5.4 (land, soil and contamination), 5.3 (water quality) and 5.9 (air quality).

5.12.4 Mitigation measures

Table 5.22 lists relevant safeguards to avoid, minimise and manage potential impacts from hazards generated by the proposal. Other safeguards and management measures that are relevant to hazards are listed in section 5.2 (hydrology and flooding) and 5.10 (commercial and recreational impacts).

Table 5.22 Hazards and utilities mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
H1	Flooding of the construction area	The weather will be closely monitored for the duration of the proposed works to ensure equipment can be relocated for periods of heavy rainfall that may cause flooding. Cofferdams to be monitored throughout the proposed works to ensure they are operating in correct manner. Construction staff will remain alert in periods of rainfall and abide by the Flood Management Procedure included in the CEMP.	Contractor	Construction

5.13 Utilities

5.13.1 Environmental conditions and value

Utilities are within proximity to the proposal area. These include:

– an overhead powerline to the south
– an underground gas pipe that crosses the river approximately 20 m downstream of the river crossing
– a sewer on the left abutment.

5.13.2 Investigations

A qualitative desktop discussion of utilities, informed by team members working on the detailed designs for the proposal.

5.13.3 Impacts

Known and unknown utilities may be impacted during construction. As previous construction and maintenance works such as the 2012 anchor bolt program have been conducted in the same works area, the risk of hitting utilities is considered low. However, construction workers may need to be aware of overhead powerlines nearby and gas mains near the proposal area.

5.13.4 Mitigation measures

Table 5.23 lists relevant safeguards to avoid, minimise and manage potential impacts to utilities generated by the proposal.

Table 5.23 Utilities mitigation measures

ID	Impact	Mitigation measure	Responsibility	Timing
U1	Damage to existing utilities nearby	Utilities in the area be marked out via a service locator.	Contractor	Pre-construction

6. Environmental management

Given the proposed works are to upgrade the dissipator and improve safety, impacts for the proposed works are considered to be low to moderate. The operational impacts are negligible given the works would not change the standard function of the Scrivener Dam.

A summary of mitigation measures to implement during the final design and construction of the proposed works has been provided in Table 6.1.

Table 6.1 Mitigation measures summary

ID	Impact	Mitigation measure	Responsibility	Timing
B1	Impacts to native vegetation and habitat	A flora and fauna management plan would be developed before the commencement of construction (as part of the CEMP). Measures will be implemented before, during and after construction to avoid and mitigate impacts to flora and fauna within the study area. The CEMP will include the following measures: – Removal of areas of native vegetation will be minimised wherever possible. – No vegetation removal or soil disturbance will occur outside the proposal area. – Establishing exclusion zones by fencing or demarcating areas (with construction barrier fencing or similar) that are outside the disturbance footprint and are not to be disturbed. – All staff will be inducted and informed of the limits of vegetation clearing and the areas of vegetation to be retained. – An ecologist or qualified wildlife handler is to be present during clearing works in areas of native vegetation to rescue and relocate any injured or displaced wildlife. – If any threatened flora or fauna are identified in the proposal area during construction, work will cease immediately and the NCA and/or appropriate agencies will be contacted.	Contractor	Pre-construction / Construction
B2	Spread of weeds	A weed and pest management plan will be developed before the commencement of construction (as part of the CEMP). Measures will be implemented before, during and after construction to prevent the establishment and/or spread of weeds within and beyond the proposal area. Weed management measures would include, but not be limited to: – Vehicle and machinery wash/brush downs will be established and implemented so that weed species are not spread to non-infested areas. No construction vehicles or staff should enter surrounding areas to minimise weed spread. – Sediment control, such as silt fences, will assist in reducing the potential for spreading weeds downstream. – Soil disturbance will be avoided as much as possible to minimise the potential for erosion and spread of weeds.	Contractor	Pre-construction / Construction
B3	Soil erosion, sedimentation and water quality	An Erosion and Sediment Control Plan (ESCP) will be developed in accordance with the Environment Protection Guidelines for Construction and Land Development in the ACT (EPA, 2022). The ESCP will be implemented prior to construction commencing on site and updated as needed during the construction phase to address changed conditions. This plan would include measures to avoid sediment running into the Molonglo River including: – installing a silt curtain within the Molonglo River downstream of all ground disturbing work. – installation of sediment fences prior to ground disturbance or river work occurring to capture runoff and prevent erosion – a system to capture, treat and dispose of the slurry from hydro-cutting and core drilling – implementing stockpile management – diverting surface runoff away from disturbed soil and stockpiles – inspecting controls at least weekly and immediately after rainfall.	Contractor	Pre-construction / Construction

ID	Impact	Mitigation measure	Responsibility	Timing
		In addition, the ESCP will state the following: – Refuelling or maintenance of plant and machinery will not be undertaken within 50 m of waterways or drainage lines (including Lake Burley Griffin and the Molonglo River). – Storage of fuels and other chemicals area to follow Australian standards. – A rehabilitation and revegetation plan (RRP) will be prepared for areas disturbed during the works. This will identify appropriate methods for stabilising disturbed soils to resist erosion. – Sediment and erosion controls will be inspected regularly, particularly after a high rainfall events (defined as greater than 30 mm in 24 hours), and maintenance works undertaken as needed. These controls would remain in place after construction until sufficient regeneration of vegetation to prevent erosion or sedimentation occurs. – Weather forecasts will be checked daily and high risk soil and erosion activities must not be undertaken immediately before or during high rainfall or wind events. Disturbed surfaces would be compacted and stabilised in anticipation of rain events to reduce the potential for erosion. – During drawdown of Lake Burley Griffin, water would be released within the normal operating range to minimise the potential for increased erosion in the Molonglo River and maintain habitat in the river.		
B3	Invasion and spread of pathogens	A weed and pest management plan will be developed before the commencement of construction (as part of the CEMP). The plan would include protocols to minimise the risk of introducing or spreading invasive pathogens and would include protocols to prevent introduction or spread of pathogens like Chytrid Fungus and Phytophthora following the Hygiene guidelines for wildlife (DPIE, 2020). All machinery entering the site must be appropriately washed down and disinfected prior to work on site.	Contractor	Pre-construction / Construction
B4	Aquatic fauna management	An aquatic fauna management plan is to be developed (as part of the CEMP) prior to construction works, specifically to develop protocols for any aquatic fauna that are present within the cofferdam prior to dewatering. The plan should consider: – Development and implementation of handling and salvage protocols for aquatic fauna during construction, including legislative permit and authorisation requirements of wildlife handlers. – Clearance of coffer dams during the de-watering process and following flood events which over-top the coffer dam. – If clearance is not possible (e.g., for safety reasons), screens/filters to be placed on temporary pumps to be used to dewater coffer dam to avoid entrainment.	Contractor	Pre-construction / Construction
HF1	Maintaining flow in the Molonglo River	Construction sequencing will always allow for the operation of at least one sluice gate.	Contractor / NCA	Construction
HF2	Reducing potential risks to the Molonglo River	During emptying the lake water will be released in controlled manner in accordance with Scrivener Dam operating procedures to reduce the risk of downstream erosion.	NCA	Construction

ID	Impact	Mitigation measure	Responsibility	Timing
HF3	Reducing potential risks to the Molonglo River	Refilling of the lake back to FSL will be undertaken over a long period of time so that flows are continued to be provided to the Molonglo River downstream.	NCA	Construction / Operation
HE4	Impacts to stakeholders	The NCA will notify stakeholder and community members of the timing and duration of lake lowering to enable them to prepare. Stakeholder consultation will be ongoing throughout construction of the proposal.	NCA	Construction
HE5	Managing risk of drought	The NCA will monitor forecasts and manage the lake in appropriately to reduce the risk the lake falling below 0.5 m from FSL during any drought periods.	NCA	Construction
HF6	Managing flood risk to construction	During construction the lake will be lowered by a maximum of 0.5 m while this is required for construction safety.	Contractor / NCA	Construction
HF7	Managing flood risk to construction	The Contractor and the NCA will prepare and implement an appropriate Flood Management Procedure to be included in the CEMP to determine evacuation and site preparation before and during flood events.	Contractor / NCA	Pre-construction / Construction
WQ1	Sediment from stockpiles entering waterways	Stockpiles will be managed in accordance with *Guidelines for Stockpile Management* (EPA, 2019) which includes consideration of: – location of stockpiles in relation to water and / or buildings – type of material being stockpiled – the volume of the stockpile/s. Stockpiles will only be temporary measures and spoil should be disposed of or re-used a quickly as practicable.	Contractor	Construction
WQ2	Contaminated runoff entering waterways.	No equipment wash will occur at or around the proposal area.	Contractor	Construction
WQ3	Spills entering the waterway.	The CEMP will include an emergency plan for spills and will outline spill management measures, including: – spill kits will be available at the compound site and proposal area – bunding will be placed around generators and storage of chemicals to capture spills and leaks – deliveries to the lake will be managed appropriately to prevent run off or spills.	Contractor	Pre-construction / Construction
SEC1	Soil and erosion impacts from the proposal	Ground disturbance will be minimised where possible and rehabilitated progressively.	Contractor	Construction
SEC2	Soil and erosion	Work will cease in heavy rainfall.	Contractor	Construction

ID	Impact	Mitigation measure	Responsibility	Timing
	impacts from the proposal			
SEC3	Soil and erosion impacts from the proposal	Cleared areas will be revegetated after construction of the proposal is completed.	Contractor	Construction
SEC4	Land contamination from spills or unexpected finds during excavations	The following contamination management measures would be included in the CEMP and implemented on site: – machinery will be checked prior to works commencing to ensure no leaks – vehicles will be maintained and refuelled offsite – no refuelling will occur on-site – oils or fuels (if required) would be stored appropriately on hardstand area on bunds – any spills would be cleaned-up as appropriate and the EPA would be contacted – imported fill (if required) would be sourced appropriately and tested to ensure no contamination – material would be tested and re-used on-site – an unexpected find protocol will be developed.	Contractor	Construction
SEC5	Land contamination from concrete slurry	The CEMP will include protocols to manage concrete slurry to reduce the risk of downstream contamination. This would be managed in accordance with *Designated cutting area and wash area* (Access Canberra, n.d.) which includes measures such as: – ensure concrete waste washed from trucks and mixer units is contained and does not leave the site or enter the stormwater system – dispose of any liquid waste (fuel, wet paint, solvents etc) through a hazardous waste contractor.	Contractor	Construction
T1	Minimise impacts to traffic and transport networks.	A construction traffic management sub-plan will be developed prior to construction. This will include, at a minimum, the following management measures: – preparation of a Traffic Guidance Scheme, detailing adequate road signage at construction work sites to inform motorists, cyclists and pedestrians of the work site ahead to ensure that the risk of road accidents and disruption to surrounding land uses is minimised – identify the requirement for traffic controllers – maintain accessibility for pedestrians and cyclists – indicate routes to be used by heavy construction-related vehicles to minimise impacts on sensitive land uses and businesses – implement measures to manage traffic flows around the area affected by the construction of the project, including, as required, regulatory and direction signposting, line marking, and variable	NCA / Contractor	Pre-construction

ID	Impact	Mitigation measure	Responsibility	Timing
		message signs and all other traffic control devices necessary for the implementation of the construction traffic management sub-plan – implement measures to maintain public access to the lookout car park, including the potential use of signage – undertake consultation with the relevant road authorities during preparation of the sub-plan. – ensure the performance of project traffic arrangements is monitored during construction – undertake consultation with the community groups, i.e. Pedal Power.		
T2	Minimise impacts to the operation of nearby developments	Vehicle access to the National Aquarium and Zoo will not be impacted by construction of the proposal.	Contractor	Construction
T3	Minimise environmental impacts associated with the movement of vehicles.	The roads leading to and from the proposal area will be monitored. Necessary steps will be taken to rectify any road deposits caused by site vehicles, to maintain the safety of road users. Where possible, construction vehicle activity will be offset from peak periods of road network activity as per standard construction practice.	Contractor	Construction
T4	Minimise environmental impacts associated with the movement of vehicles.	Employees and contractors will be inducted to raise awareness and understanding of traffic and transport mitigation measures to be implemented during construction.	Contractor	Construction
NV1	Noise impacts to sensitive receivers	The CEMP will include measures to minimise noise impacts during construction, including, but not limited to: – construction work to be undertaken during 7 am and 6 pm on Monday to Saturday, excluding public holidays (per time restrictions to qualify for the exemption) – consideration of respite periods or shutdowns during particularly sensitive time periods – localised noise screens around noisy plant (where acoustic effectiveness can be demonstrated prior) – site inductions for construction staff to include information about noise impacts and management measures – noise monitoring of construction works and at receiver locations at the commencement of operations and in response to noise complaints – the consideration of a later start time for construction works to reduce impacts at Zoo accommodation areas	Contractor	Pre-construction and construction

ID	Impact	Mitigation measure	Responsibility	Timing
		– consider if quieter construction methods are viable, particularly alternatives to hammer drilling. Likewise use the smallest suitable equipment on site. – sound Power Level testing of the proposed drilling equipment should be undertaken to ensure modelling inputs are accurate – precise work areas and a full equipment list should be developed to determine potential total noise impacts – potential noise impacts should be considered when planning worksite layout (in particular noisy areas such as compounds, stockpiles, laydowns, etc) – alternatives to reversing / warning beepers (broadband alarms, cameras, etc) should be installed on all on site equipment.		
NV2	Extended noise impacts to the Zoo staff, guests and animals and Government House	Stakeholder consultation will be undertaken to: – determine upcoming events at the Zoo and Government House and their potential sensitivity to noise – track any animal behavioural changes and determine additional and acceptable mitigation measures – discuss noise management measures with hotel guests such as closing of doors and windows and not remaining in rooms for extended periods during works.	NCA	Pre-construction and construction
H1	Records of heritage fabric	The NCA will ensure that a good record (photographs and plans) is made of the dissipator in its original configuration, and that this record is archived for future reference.	NCA	Pre-construction
H2	Remediation of visual changes	The landscape impacted by the temporary construction phase will be remediated upon completion of the project.	Contractor	Construction
V1	Visual impacts of the proposal	The CEMP will include measures to minimise visual impacts during construction, including, but not limited to: – ensuring the site is kept tidy – rehabilitating all areas disturbed by construction and ancillary works at the conclusion of the construction – removal of rubbish that becomes exposed during lake lowering – utilising plain security fencing and screening to reduce visual amenity impacts to the viewing platform.	Contractor	Construction
AQ1	Dust creating poor air quality conditions	The CEMP will include measures to minimise air quality impacts during construction, including, but not limited to: – covering all loaded trucks and equipment – speed restrictions and the stabilisation of accesses and parking areas.	Contractor	Construction
AQ2	Vehicle emissions creating poor	Vehicle and equipment emissions will be managed through the maintenance of equipment and vehicles. Machinery will be turned off rather than left to idle when not in use.	Contractor	Construction

ID	Impact	Mitigation measure	Responsibility	Timing
	air quality conditions			
CR1	Limiting impacts to commercial and recreational lake users	The lake will be lowered by no more than 0.5 m below FSL. Lake lowering will be reduced when possible and safe.	NCA	Construction
CR2	Managing impacts to lake users	Measures to reduce impacts to lake users will be considered including: – providing floating pontoons where existing pontoons and jetties cannot be used – providing additional mooring points for larger vessels if Kingston Harbour becomes inaccessible.	NCA	Construction
CR3	Managing navigational hazards in the lake	A bathymetric map will be made available to lake users. The NCA notifying key user groups of exact dates of lake lowering and navigational hazards as they become known.	NCA	Construction
CW1	Reducing construction waste	Options for beneficial reuse of green waste on site will be considered such as mulching using for temporary stabilisation of exposed area. Where green waste from vegetation removal cannot be reused on site, reuse on other sites would be investigated prior to disposal.	Contractor	Construction
CW2	Appropriate waste management	Worksites would be maintained in a tidy state, and all general litter would be appropriately disposed of, and recycled where possible.	Contractor	Construction
CW3	Appropriate waste management	Waste generated from the construction of the proposal would be transported to an appropriately licenced waste disposal or transfer facility. Where required, this would include using a licenced contractor to remove regulated waste, under current ACT EPA Guidelines.	Contractor	Construction
H1	Flooding of the construction area	The weather will be closely monitored for the duration of the proposed works to ensure equipment can be relocated for periods of heavy rainfall that may cause flooding. Cofferdams to be monitored throughout the proposed works to ensure they are operating in correct manner. Construction staff will remain alert in periods of rainfall and abide by the Flood Management Procedure included in the CEMP.	Contractor	Construction
U1	Damage to existing utilities nearby	Utilities in the area be marked out via a service locator.	Contractor	Pre-construction

7. Conclusions

GHD has prepared this EIA on behalf of the NCA to assess the potential environmental impacts associated with the proposed Scrivener Dam Dissipator Strengthening Project.

The EIA considered potential impacts from key construction activities including:

– site establishment
– installation of cofferdams
– demolition and construction within the Molonglo riverbed
– drawdown of Lake Burley-Griffin
– construction traffic movement.

Feedback from community and government stakeholders was also considered as part of the EIA.

The EIA found that the main potential environmental impacts associated with construction the proposal would be:

– erosion and sedimentation
– vegetation removal
– commercial and recreational impacts.

Once operational, the impact of the proposal would be negligible given the works will not change the standard operation of the Scrivener Dam and the land would be remediated.

Potential sediment and erosion impacts would be managed with an ESCP which would require the use of erosion and sediment controls such as:

– silt curtains and sediment fences
– stockpile management
– surface flow diversion.

Efforts have been made through the proposal planning and design process to minimise impacts to native vegetation as far as is practicable. Impacts would further be reduced through the implementation of a flora and fauna management plan which would require:

– minimising vegetation removal wherever possible
– demarcation of vegetation that is not to be disturbed
– protocols for unexpected identification of threatened flora or fauna during vegetation removal.

The NCA would continue to work with the Lake User Group and other key stakeholders to identify reasonable and feasible measure to reduce commercial and recreational impacts from construction of the proposal.

Given the nature, scale and extent of the impacts and implementation of the safeguards outlined within this EIA, the proposed works are unlikely to have a significant impact on the environment.

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act. An EPBC referral is not required.

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Appendices

Appendix A

Consideration of EPBC Act guidelines

A Protected Matters Search Tool (PMST) (DCCEEW, 2023b) search of the proposal area was conducted on 8 April 2023 using a 10 km buffer (PMST search area). Table B.1 and Table B.2 summarise the results of the PMST search and identify the key factors that could trigger an EPBC Act referral.

The matter of national significance described as ‘a water source, in relation to coal seam gas development and large coal mining development’ is excluded as the proposal is not that type of development.

The proposal is unlikely to result in a significant impact on any MNES.

Table A.1 Matters of national environmental significance and Commonwealth land

<table>
<tr><th>EPBC Act controlling provision</th><th>Description</th></tr>
<tr><td colspan="2">Matters of National Environmental Significance</td></tr>
<tr><td>World Heritage Properties</td><td>Nil.</td></tr>
<tr><td>National Heritage Places</td><td>Nil. The PMST report indicates four National Heritage Properties are located within the PMST search area. These are outside of the proposal area:
– High Court - National Gallery Precinct
– Old Parliament House
– Australian Academy of Science Building
– Australian War Memorial and the Memorial Parade</td></tr>
<tr><td>Wetlands of International Importance (RAMSAR wetlands)</td><td>Nil. The nearest RAMSAR wetland is Riverland located approximately 500 kilometres downstream from the proposal.</td></tr>
<tr><td>Great Barrier Reef Marine Park</td><td>Nil.</td></tr>
<tr><td>Commonwealth Marine Area</td><td>Nil.</td></tr>
<tr><td>Listed Threatened Ecological Communities (TECs)</td><td>Nil. Based on the PMST report, there are two TECs that are likely to occur within the PMST search area. Two ecologists conducted a site visit and determined the vegetation did not meet the criteria of either TEC.
<table>
<tr><th>Threatened Ecological Community</th><th>EPBC Status</th><th>Location</th></tr>
<tr><td>White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</td><td>Critically Endangered</td><td>Likely to occur in proposal area.</td></tr>
<tr><td>Natural Temperate Grassland of the South Eastern Highlands</td><td>Critically Endangered</td><td>Likely to occur in proposal area.</td></tr>
</table></td></tr>
<tr><td>Listed Threatened Species</td><td>Unlikely. Based on the PMST, 56 listed threatened species may or are likely to occur in the PMST search area. Given works are temporary and the clearing of vegetation is primarily exotic, impacts are not expected to occur.</td></tr>
<tr><td>Listed Migratory Species</td><td>Unlikely. Based on the PMST, 14 listed migratory species may or are likely to occur in the PMST search area. Given works are temporary and the clearing of vegetation is primarily exotic, impacts are not expected to occur.</td></tr>
</table>

EPBC Act controlling provision	Description
Commonwealth marine area or the Great Barrier Reef Marine Park	Nil.
Is the proposal nuclear action?	Nil.
Other Matters Protected by the EPBC Act	
Commonwealth Lands	Nil. Based on the PMST, 38 Commonwealth Lands within the PMST search area. No lands are within the proposal area.
Commonwealth Heritage Places	Unlikely. Based on the PMST, 77 Commonwealth Heritage Places within the PMST search area. Two listed Commonwealth Heritage Areas are in within or adjacent to the proposal area: – Lake Burley Griffin and Adjacent Lands (Place ID: 105230) – Yarralumla and Surrounds (Place ID: 105381). Scrivener Dam is part of a recognised heritage place, Lake Burley Griffin and Adjacent Lands. The proposal would have very minor impacts on some original fabric of Scrivener Dam during construction. However, once construction is complete the dissipator would look visually similar to the original structure.
Listed Marine Species	Nil.
Whales and Other Cetaceans	Nil.
Critical Habitats	Nil. Based on the PMST, one critical habitat is within the PMST search area. This is not within the proposal area.
Commonwealth Reserves Terrestrial	Nil. Based on the PMST, one Commonwealth Reserves Terrestrial is within the PMST search area. This is not within the proposal area.
Australian Marine Parks	Nil.

Table A.2 Actions by Commonwealth agencies or actions on Commonwealth land

Factor	Impact
Are landform changes planned, medium or large-scale excavation or filling required?	The proposal involves excavation however the proposal would not result in any significant landform changes since Scrivener Dam and the embankments would be returned to their original state. Changes to landform would be temporary and considered minimal given the localised nature of the proposal.
Are changes to coastal landscapes or processes possible?	The proposal would not result in an impact to coastal landscapes or processes.
Are impacts to ocean forms, processes, or life possible?	The proposal would not result in an impact ocean forms, processes, or life.

Factor	Impact
Are changes to water resources (e.g., water quality, quantity or availability, water table levels, channel diversion or drainage patterns)?	The proposal would be unlikely to significantly change the water resources in the area. Flow from Scrivener Dam into the Molonglo River would be maintained. Lake Burley-Griffin would be temporarily lowered however this would be limited to previously experienced drawdowns. Mitigations measures would be put in place to manage impacts to water quality.
Is it possible the project will result in a release of pollutants, disturb contaminated or acid sulfate soils, or contribute to greenhouse effect?	The proposal would be unlikely to result in a release of pollutants, disturb contaminant or acid sulfate soils or contribute to greenhouse effect. There is no known presence of contaminated or acid sulfate soils. Mitigation measures would be in place to minimise risk of pollutants and greenhouse effect contribution.
Will the project require medium to large scale vegetation clearance, including clearance of a threatened species, introduce invasive species, involve burning or be likely to stunt the growth of native vegetation?	The proposal would removing a small amount of vegetation that is primarily exotic and unlikely to be substantial habitat for threatened flora or fauna species. Mitigation measures would be in place to minimise the risk of introduced invasive species. The proposal area would be rehabilitated with native vegetation which would result in an overall net increase in native vegetation.
Is it possible the project will threaten or displace a native animal population, reduce available habitat, introduce exotic species, or involve burning?	The proposal would be unlikely to threaten or displace a native animal population given the poor quality of habitat in the proposal area. Mitigation measures would be in place to minimise the risk of introduced species.
Is it possible the project will increase demand or availability of community services, affect community health and amenity, cause physical dislocation, change cultural identity?	The proposal would be unlikely to significantly increase demand or availability of community services, cause physical dislocation, community health or change cultural identity. During construction lowering Lake Burley-Griffin may affect community amenity by reducing the visual amenity of the lake and creating some access and navigation issues for vessels. However, these impacts would not be significant as they would be short term and managed through mitigation measures.
Is it possible the project will impact on the heritage values of a place (e.g., destroy, alter, change sight lines, inhibit existing uses, alter the setting, change the value)?	Scrivener Dam is part of a recognised heritage place, Lake Burley Griffin and Adjacent Lands. The proposal would have very minor impacts on some original fabric of Scrivener Dam during construction. However, once construction is complete the dissipator would look visually similar to the original structure. Lake Burley Griffin would temporarily be lowered as part of the proposal. Existing uses of the lake would be maintained throughout the proposal works and changes to sight lines, settings or value are considered to be minimal and temporary. As such, the proposal would be unlikely to significantly impact on the heritage values of a place.

Appendix B

Biodiversity Assessment Report

Scrivener Dam

Biodiversity Assessment Report

National Capital Authority

6 June 2023

→ **The Power of Commitment**

Project name	Scrivener Dam - Dissipator Strengthening - Environmental Assessment				
Document title	Scrivener Dam | Biodiversity Assessment Report				
Project number	12608465				
File name	12608465-RPT_Scrivener Dam Biodiversity Impact Assessment-Rev0.docx				

Revision	Author	Reviewer		Approved for issue		
		Name	Signature	Name	Signature	Date
A	A Quin R Abbott C George P Lind	S Bidwell K Crosby	On File	Hugh Swinbourne	On File	16 May 2023
B	A Quin	S Bidwell K Crosby	On File	Hugh Swinbourne	On File	29 May 2023
0	A Quin	S Bidwell K Crosby		Hugh Swinbourne	On File	6 June 2023

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1. Introduction

1.1 Purpose of this report

During the Dam Safety Review conducted in 2016 for the Scrivener Dam and its associated structures, it was discovered that the dissipator's design lacked robustness. As such, the dissipator requires strengthening and associated upgrades to ensure no further damage to the structure and to improve the safety of the dam for the workers.

GHD Pty Ltd (GHD) has been engaged by the National Capital Authority (NCA) to provide a Biodiversity Impact Assessment for the proposed upgrades to the Scrivener Dam structures. This report aims to inform the Environmental Impact Assessment (EIA) that will support a Minor Works Approval for the proposal.

The primary objectives of this assessment are to:

– Determine the likelihood of occurrence of species, populations and ecological communities and their habitats listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Australian Capital Territory (ACT) *Nature Conservation Act 2014* (NC Act).
– Identify the significance of potential impacts associated with the proposal, including direct and indirect impacts on species, populations and ecological communities and their habitats listed under EPBC Act and NC Act.
– Advise on development design and specific mitigation/management actions to avoid, minimise or offset potential impacts on threatened species and/or communities and other biodiversity values.
– Identify the likely requirement or otherwise for further approvals under the EPBC Act and/or NC Act.

1.2 Definitions

For the purposes of this report, definitions of key terms are as described in Table 1.

Table 1 Report definitions

Subject	Definition
Proposal site	The area where proposed works will be located and includes the area that would be directly impacted by the proposal (shown on Figure 1).
Study area	The area within and adjacent to the proposal site where the field survey was completed.
Locality	The area within a 10 km radius of the proposal site.
Listed threatened species / community	Any species or ecological community that is listed as critically endangered, endangered or vulnerable under the EPBC Act and/or NC Act.

1.3 Proposal site

Scrivener Dam is located at the western end of Lake Burley Griffin, between the National Zoo and Aquarium, Lady Denman Drive, and Government House. Scrivener Dam maintains the water level of Lake Burley Griffin by damming the Molonglo River. The surrounding land uses mostly relate to recreational use of the lake and the foreshore such as boating, swimming and cycling. Associated infrastructure nearby includes boat ramps, access roads, cycle paths, and general open space.

Scrivener Dam and Lake Burley Griffin are classified as Designated Land which falls under the jurisdiction of the NCA while the Molonglo River Corridor is a combination of Designated Land and Territory Land.

The proposal site, shown in Figure 1, is located on the downstream wall of Scrivener Dam in Canberra, ACT. Scrivener Dam impounds[1] water from the Molonglo River to form Lake Burley Griffin. The broader study area also

[1] Impoundments are artificially created standing waterbodies, produced by dams on streams or rivers.

includes the banks of the Molonglo River downstream of the dam, including a viewing platform and carpark on dam's left[2] abutment[3] and a small carpark on the dam's right abutment.

1.4 Project description

The NCA proposes to upgrade and strengthen the Scrivener Dam dissipator (the proposal) in order to meet the Australian Capital Territory (ACT) Dam Safety Code and maintain operation of Scrivener Dam. Construction would mostly involve undertaking remedial and strengthening works to the dissipator structure in the proposal site. Ancillary infrastructure, such as compounds and access tracks, would also be contained within the proposal site.

Key features of the proposal include:

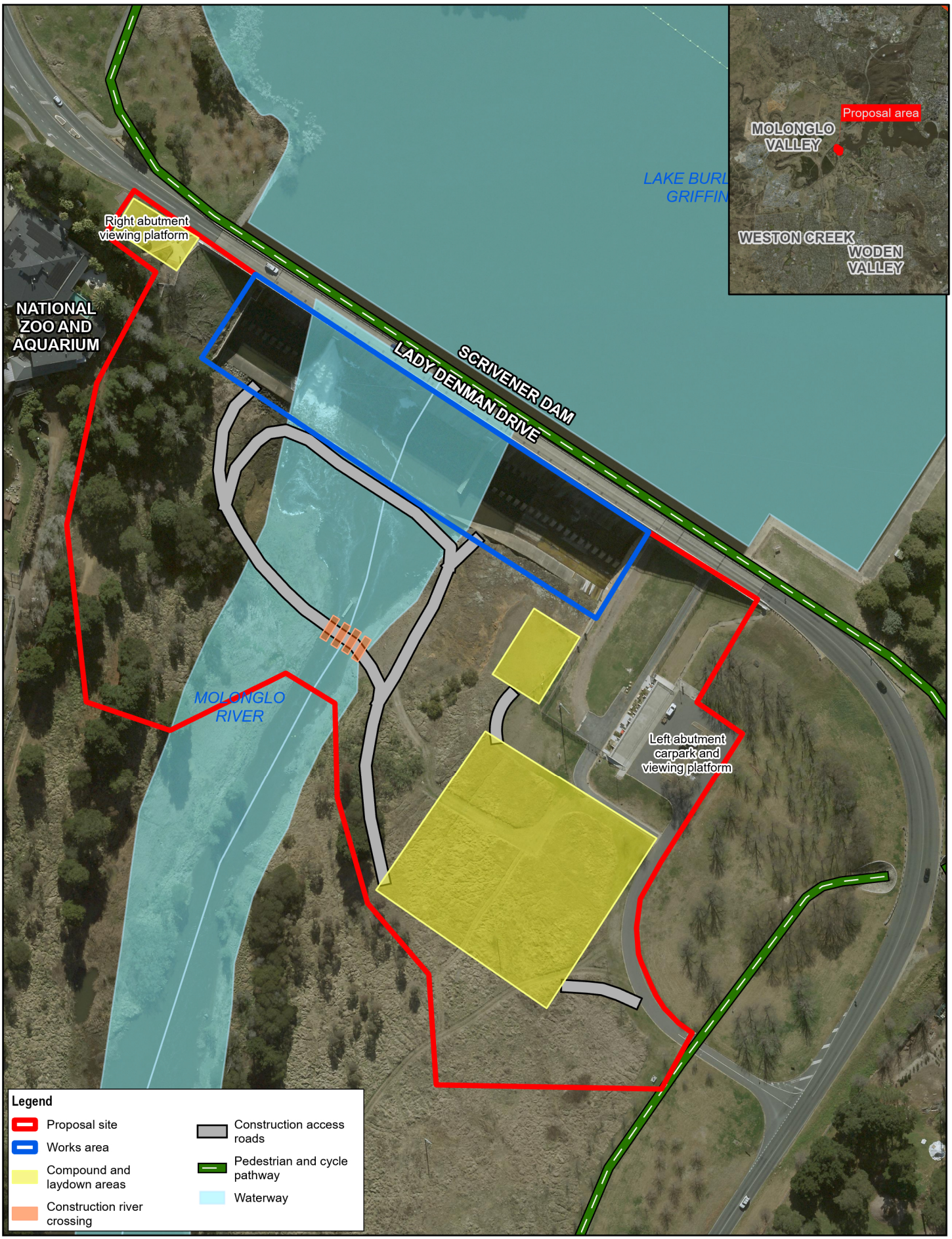
– 700 new embedded anchors
– 500 millimetre reinforced concrete topping slab
– New baffle blocks
– Raised chute blocks
– Abutment armouring.

Key works associated with the proposal include:

– Site establishment (including access tracks) and construction laydown areas
– Concrete cutting and pouring
– Minor earthworks
– Cofferdam installation and water management
– Dissipator strengthening works
– Site rehabilitation.

Construction of the proposal would also require lowering the height of Lake Burley Griffin by a maximum of 500 mm below the lake's Full Supply Level (FSL) of 555.93 mAHD for up to 24 months during construction. The reservoir drawdown is required to provide air space that can be filled during high flows which would provide time to evacuate personnel and equipment prior to operations of the sluice and / or flood gates.

[2] Left and right refer to the sides of a dam looking downstream.
[3] Abutment refers to the part of the valley side against which the dam is constructed.



Paper Size ISO A4

0 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

National Capital Authority
Scrivener Dam
Dissipator Strengthening Project (DSP)

Project No. **12608465**
Revision No. **-**
Date **10/05/2023**

Proposal site

FIGURE 1

\\ghdnet\ghd\AU\Sydney\Projects\21\12608465\GIS\Maps\Deliverables\12608465_EnvironmentalAssessment.aprx
Print date: 26 May 2023 - 14:01

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1.5 Scope and limitations

This assessment has been prepared by GHD for National Capital Authority and may only be used and relied on by National Capital Authority for the purpose agreed between GHD and National Capital Authority as set out in Section 1 of this report.

GHD otherwise disclaims responsibility to any person other than National Capital Authority arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report and on the date of the field survey. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Section 1.6 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

Survey limitations are outlined in section 3.2.4.

1.6 Assumptions

The services undertaken by GHD in connection with preparing this assessment:

– Were limited to those detailed specifically in Section 1.1 of this report.
– Are based on the project footprint (i.e., proposal site) presented in this report (shown on Figure 1).
– Are based on the desktop review and survey methods presented in Section 3 of this report.

2. Statutory framework

2.1 Commonwealth Legislation

2.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's central environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places (Matters of National Environmental Significance; MNES).

The EPBC Act requires approval from the Australian Minister for the Environment for actions likely to have a significant impact on listed MNES. There are nine MNES protected by the EPBC Act and, in addition, the EPBC Act also regulates actions on or impacting on Commonwealth land, or actions by Commonwealth agencies.

Parts 7, 8 and 9 of the EPBC Act considers and assesses the potential impacts of individual actions on MNES. Part 10 of the EPBC Act provides for assessment of the impacts of actions over a larger area, such as a landscape scale, or longer timeframe.

MNES of relevance to this report include:

– Nationally listed threatened species and ecological communities
– Listed migratory species

Consideration of potential impacts upon MNES potentially impacted by the proposal has been undertaken as part of the BAR.

2.2 ACT Government legislation

2.2.1 Nature Conservation Act 2014

This report has been prepared to identify the potential habitats and NC Act listed species and ecological communities that could potentially occur in the proposal site and to inform the environmental assessment and approvals processes.

For addressing the ecological significance of proposed developments in the ACT, proponents must assess the likely impact of the proposed development on threatened species and ecological communities listed under the NC Act.

The NC Act establishes a formal process for the identification and protection of threatened species and ecological communities in the ACT region. The Act requires the Conservator of Flora and Fauna to prepare an action plan in response to each declaration of a threatened species, ecological community or threatening process.

An action plan outlines conservation and protection proposals for the species or ecological community concerned, and proposals to minimise the effect of a threatening process. The primary objective is to maintain long-term, viable wild populations of each species and viable ecological communities, as components of the indigenous biological resources of the ACT.

Any planning proposal that has implications for any identified threatened species or ecological community must consider the objectives of the action plan. Any supporting environmental statements or planning studies should consider the action plan and ensure the project does not compromise the long-term viability of any such species or ecological community.

If it is assessed that a project may have a significant impact on a threatened species or ecological community, the project must be referred to the Conservator of Flora and Fauna.

2.2.2 Fisheries Act 2000

The *Fisheries Act 2000* aims to sustainably manage the fish populations of the ACT. Specific objectives of the *Fisheries Act 2000* are to:

– Conserve native fish species and their habitats
– To manage sustainably the fisheries of the ACT by applying the principles of ecologically sustainable development mentioned in the *Environment Protection Act 1997*
– To provide high quality and viable recreational fishing
– To cooperate with other Australian jurisdictions in sustaining fisheries and protecting native fish species.

Native fish species that occur or with the potential to occur within the study area or proposal site are discussed in Section 5.3.1 and potential impacts are discussed in Section 6.

2.2.3 Pest Plants and Animals Act 2005

The purpose of the *Pest Plants and Animals Act 2005* is to protect the ACT's land and aquatic resources from threats from pest plants and pest animals, to promote a strategic approach to pest management, to identify pest plants and animals, and to manage pest plants and animals.

Section 7 of the Act provides for the Minister of the Environment to declare a plant to be a pest plant. A declaration may also declare that a pest plant is:

– Notifiable – in which case its presence must be notified to the Director General within 2 working days.
– Must be suppressed – all infestations on a premises must be controlled
– Must be contained – infestations must be prevented from spreading to neighbouring premises; or
– Prohibited – supply and propagation is not allowed.

Pest plants that occur within the proposal site are discussed in section 4.1.6.2.

3. Methods

3.1 Desktop review

A desktop review was conducted to identify and collate information on the potential ecological values within a 10 km radius of the proposal site. This was undertaken to provide context about the potential presence of mobile species or cryptic species that are known to occur in similar habitat within the region.

A search of relevant databases was undertaken to determine potential biodiversity values within a 10 km radius (defined as 'the locality') of the proposal site. The following databases and resources were reviewed:

- Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) for MNES listed under the EPBC Act located within the locality (DCCEEW, 2023).
- ACTmapi to identify significant plants, animals and registered trees known to occur within the locality (ACT Government, 2023a).
- Vegetation mapping to identify native vegetation types and the potential presence of threatened ecological communities listed under the NC Act and/or the EPBC Act (ACT Government, 2018).
- ACT Environment and Planning Directorate 'Threatened Species List' (ACT Government, 2022b).
- ACT Environment and Planning Directorate (ACT Government, 2023a) mapping of:
    - Threatened ecological communities
    - Biodiversity records
    - Threatened flora records
    - Rare plant records
    - Tree survey data
    - Vegetation mapping
- NSW BioNet Atlas – threatened NSW species records that overlap into the ACT (DPE, 2023).
- NSW DPI Fisheries Spatial Data Portal (NSW DPI 2022).

3.2 Field survey

Terrestrial flora and fauna surveys, and an aquatic habitat assessment, were undertaken by two ecologists on 8 and 9 May 2023. The primary objectives of the field surveys were to:

- Map and describe the distribution and condition of vegetation types occurring within the study area.
- Carry out opportunistic surveying for threatened flora and fauna.
- Describe the potential impacts on threatened flora and fauna species, populations and ecological communities in the proposal site, and their habitats that could arise from the proposal during construction and operation.
- Complete a Rapid Bioassessment of aquatic habitat and waterway health as per the ACT AUSRIVAS assessment protocol.

3.2.1 Flora assessment

A combination of random meander and targeted searches for threatened species were used to survey the study area and to map vegetation communities. Species lists are included in Appendix A. Detailed descriptions of survey techniques are outlined below.

3.2.1.1 Vegetation mapping-and flora surveys

Vegetation and floristic attributes were assessed in accordance with the random meander method described by Cropper (1993). During this meander, all vascular plant species observed were identified and notes were taken regarding dominant species, structure of vegetation, landscape position and soils within each vegetation type.

As rare plants often exist in discrete populations in specific areas, a random search can increase the probability of finding rare plant populations. A random search effort also encompasses a greater portion of the landscape, as the search is not limited to specific areas and is useful in surveying difficult terrain and irregular shaped search areas. Transect surveys were also conducted randomly throughout the study area, and general floristic data such as opportunistically observed species, vegetation composition and community condition were recorded for the area.

The floristic and structural information recorded within each vegetation type was used to identify and describe the nominated vegetation types and determine the conservation status of vegetation types with reference to the NC Act and EPBC Act.

Plant specimens that could not be identified rapidly in the field were collected and subsequently identified using plant keys and reference text. Plant specimens that were problematic to identify (either insufficient sample collected or no reproductive material available at the time of the survey) were identified to genus level.

Information regarding vegetation structure, disturbance history and presence of priority weed species was also recorded throughout the study area.

3.2.2 Fauna assessment

3.2.2.1 Habitat Assessment

Habitat assessments were conducted for all fauna groups and observations of fauna signs were recorded. Fauna habitat resources were assessed to identify areas of potential habitat within the study area. Specific resources such as shelter, roosting, basking and foraging sites for birds, arboreal mammals, amphibians, ground-dwelling mammals and reptiles were also recorded.

Habitat details recorded included presence or absence of:

– Native grasslands and Natural Temperate Grasslands (NTG)
– Nest or hollows
– Burrows or underground warrens and tunnels
– Rocky ground and outcrops
– Areas of partially embedded rocks
– Waterbodies
– Other features likely to provide potential habitat for threatened fauna.

A Rapid Bioassessment of aquatic habitat and waterway health was completed as per the ACT AUSRIVAS assessment protocol (Nichols et al. 2000). This included documentation of habitat under current conditions, noting important features for aquatic fauna, such as habitat complexity (in-stream vegetation, large woody debris), litter, substrate composition, riparian vegetation, bank slope and other features. Photos were also taken at each site to accompany the site description.

3.2.2.2 Opportunistic fauna observations

All opportunistic fauna observations, including bird calls, were recorded during flora surveys and habitat assessment.

3.2.3 Weather conditions

Weather observations during the field surveys were taken from the Tuggeranong weather station (station 70339) which is located approximately 8.5 km south of the proposal site (BoM, 2023). The conditions at the time of survey are described in Table 2.

Table 2 Weather conditions during the surveys (BoM, 2023)

Survey date	Rainfall past 24 hours (mm)	Temperature (°C)	Weather observations	Wind gusts (max) (km/hr)
8 May 2023	32	1.9 – 12.2	Clear sky with scattered cloud covering. Temperatures warmed slowly during the day from a	56

Survey date	Rainfall past 24 hours (mm)	Temperature (°C)	Weather observations	Wind gusts (max) (km/hr)
			very cool morning to a mild afternoon. No rainfall fell during the day. Wind speeds were considered a moderate gale.	
9 May 2023	15	-3.2 – 15.5	Clear sky with scattered cloud covering. Temperatures warmed slowly during the day from a below zero morning to a mild afternoon. No rainfall fell during the morning of the survey. Gentle breeze.	28

3.2.4 Survey limitations

Given the duration, methodology and timing of the field surveys (two days in May) it is likely that many species that occur in the study area (permanently, seasonally or transiently) were not detected during the survey. The timing of the survey was outside the survey or activity period for some species (for example the Golden Sun Moth (*Synemon plana*)). As the survey was undertaken in late-autumn, temporal conditions may not be suitable for some species. The cooler weather may impact the activity of reptiles and frogs while most migratory species would not be present in this time of year. Additionally, some fauna species are highly mobile and transient. Consequently, it is likely that not all species either resident or transitory to the site would have been recorded during field surveys. Several of the grass species within the study area were not in flower at the time of survey and as such did not have any fertile material that could be used to aid identification. In these instances, plants were identified to genus level only.

The desktop assessment (Appendix B) provides a list of the threatened biota that are known or predicted to occur in the locality. This list was refined based on the field surveys and habitat assessments to compile a list of those threatened biota that could potentially occur in the study area (including seasonal, transient or cryptic species). The habitat assessment conducted for the study area also allows for identification of habitat resources for such species and an assessment of their likelihood of occurrence in the study area on this basis. As such, the survey was not designed to detect all species, rather to provide an overall assessment of the biodiversity values in the study area in order to inform the impact assessment.

3.3 Likelihood of occurrence

Following collation of database records and review of species and community profiles, a ‘likelihood of occurrence’ assessment was undertaken with reference to the habitats contained within the proposal site. Identification of potential habitat for threatened and migratory species was based on information provided in the species profiles (DCCEEW 2022b, EES 2022c), recovery plans, journal articles, and the field staff’s knowledge of species habitat requirements. The likelihood of occurrence assessment was further refined following field surveys. The likelihood of threatened and migratory species occurring in the proposal site was assessed based on presence of records from the locality since 1999, species distribution and habitat preferences, and the suitability of potential habitat present in the proposal site. The results of this assessment are provided in Appendix B.

5. Existing environment

5.1 General description

5.1.1 Bioregion

The proposal site occurs within the South-eastern Highlands bioregion and Murrumbateman subregion. General characteristics of this region are described in Table 3.

Table 3 Properties of the Murrumbateman subregion (NPWS, 2003)

Property	Within subregion Murrumbateman
Geology	Fine-grained Palaeozoic sedimentary and metasedimentary rocks, with minor areas of coarse acid volcanics. Tertiary alluvial terraces along main streams.
Characteristic landforms	Undulating plateau with rounded hills and peaks, entrenched meandering streams with chain of ponds tributaries.
Typical soils	Mottled yellow and brown texture contrast soils with strongly bleached topsoils. Dark organic loams and clay loams on valley floors. Saline patches present.
Vegetation	Blakely's red gum, yellow box, on lower slopes, red stringybark, bundy and white gum on ridges. Areas of apple box, and mottled gum. Limited swampy flats and valley floor grasslands.

5.1.2 Topography, geology and water quality

The heavily urbanised locality crosses three different hydrogeological landscapes, South Canberra, Uriarra Road, and Sullivans Creek. The study area is approximately 540 m above sea level and has been heavily modified and disturbed as a result of the initial construction of Scrivener Dam as well as other infrastructure associated with the urban surrounds. The locality has significant groundwater features, the Molonglo River and Lake Burley Griffin. It is also separated into two ACT water management areas, Lower Molonglo and Central Molonglo.

The Molonglo catchment covers an area of approximately 2,000 km^2. The Molonglo River originates in NSW on the western side of the Great Dividing Range, near Captains Flat, and flows for around 115 km before meeting the Murrumbidgee River west of Canberra. The catchment includes densely developed urban areas, which potentially impact on the ecological condition of the Molonglo River (Jacobs 2016). For example, Scrivener Dam influences flow in the lower reaches, alters water temperature and prevents upstream fish migration (GHD 2013; Jacobs 2016). This includes the Queanbeyan Sewage Treatment Plant, that discharges treated wastewater into the Molonglo River upstream of Lake Burley Griffin (Molonglo Catchment Group 2010). Nutrient enrichment, siltation from catchment erosion, heavy metal runoff from historic mining operations, pollution from stormwater runoff and high flow variability all contribute to the lower Molonglo River having a poorer condition than the nearby section of the Murrumbidgee River (GHD 2013). Reaches upstream of the LMWQCC are now also susceptible to impacts from development including the Molonglo 3 urban development project (Jacobs 2016).

Lake Burley Griffin is 11 km long, up to 1.2 km wide and covers approximately 716 ha at full supply level. The shoreline of the lake is 40.5 km in total length and as well as providing a recreation resource, it provides important wetland and lake habitats for native fish, birds and wildlife. The groundwater of Lake Burley Griffin is characterised by its location on a fractured rock with extensive aquifers that have low to moderate productivity. The Groundwater Salinity is 0-1000 mg/l which is suitable for stock, domestic and some irrigation purposes. The aquifer recharge is 0.7 GL per year (ACT Government 1999).

5.1.3 Soils

Scrivener Dam is surrounded by Williamsdale soil landscapes (Jenkins 2000). The Williamsdale soil landscape includes moderately deep Yellow Chromosols (Yellow Podzolic Soils) on Red and Brown Kandosols (Red and Yellow Earths) on upper rises. Moderately to very deep, poorly to imperfectly drained Sodosols (Sodic Soils) occur on lower rises. This has contributed to a soil landscape which is erodible with localised dispersibility (Jenkins,

2000). This soil is highly susceptible to tunnelling or piping failure and needs to be well compacted throughout to reduce permeability and saturation settlement.

5.1.4 Climate

The locality has an average annual rainfall of 699.2 millimetres (mm). Summers are typically moderately warm with cold winters. The highest average temperatures are in January at 30.2°C whilst the coolest average temperatures are in July at 12.7°C. The wettest month is typically October, averaging 66.8 mm of rainfall. The driest month is typically May with an average of 46.5 mm rainfall.

5.1.5 Surrounding land use and vegetation

The proposal site and surrounding area has been highly modified through urban development. The National Zoo and Aquarium are located southwest of the site. The National Arboretum stretches around the site from the north to the southwest. This area was cleared historically but has recently been revegetated. The proposal site is located on the Molonglo River and is south of Lake Burley Griffin. There are numerous roads surrounding the site, specifically Lady Denman Drive located to the north and east of the proposal site, and Tuggeranong Parkway to the west.

The proposal site is in land zones designated area (DES), and transport (TSZ1), and overlay zones are nature reserve and public land (PUBLAN).

5.2 Vegetation and flora

5.2.1 Vegetation communities

The ACTmapi database vegetation mapping suggests that the study area contains three vegetation types:

– Exotic woodland (EW)
– Urban open space (UOS) and
– Plantation / exotic (PLE)

Field surveys confirmed the presence of three native and two predominantly exotic vegetation types within the study area.

Descriptions of vegetation types recorded within the study area are provided in Table 4 to Table 8. The mapped extent of vegetation types within the study area is shown on Figure 2.

Table 4 Candle Bark -Red Box -Red Stringybark Grassy woodland

Candle Bark -Red Box -Red Stringybark Grassy woodland	
Description	A small patch of Candle Bark -Red Box -Red Stringybark Grassy woodland occurs on the eastern bank of Molonglo River in the south of the study area. The canopy cover is approximately 15 percent and is comprised of young eucalypts to 10 meters tall. The canopy is dominated by *Eucalyptus rubida* subsp. *rubida* (Candle Bark), *Eucalyptus polyanthemos* (Red Box) with occasional *Eucalyptus macrorhyncha* (Red Stringybark). These sparse eucalypts occur over a midstorey of scattered *Acacia dealbata* (Silver Wattle) and a ground layer dominated by dense *Poa labillardierei* subsp *labillardierei* (Common Tussock Grass) tussocks. Other common species within the groundlayer of this community include the exotic grasses *Festuca arundinacea* (Tall Fescue), *Paspalum dilatatum* (Paspalum) and *Phalaris aquatica* (Phalaris) as well as a variety of exotic forbs such as *Verbena bonariensis (*Purpletop), *Rumex crispus* (Curled Dock), *Hypericum perforatum* (St John's Wort), *Cirsium vulgare* (Spear Thistle) and *Rubus fruticosus* sp. agg. (Blackberry).

Candle Bark -Red Box -Red Stringybark Grassy woodland	
Photos	 
Conservation significance	NC Act – Not listed EPBC Act – Not listed
Condition	This community is in moderate condition. There is a high abundance of exotic and high threat weeds present including the highly invasive species *Hypericum perforatum* (St John's Wort) and *Rubus fruticosus* sp. agg. (Blackberry).
Area within study area (ha)	0.64
Area within proposal site (ha)	0.0

Table 5 Freshwater Wetland

Freshwater wetland	
Description	This wetland community occurs in a small depression on the western edge of Molonglo River. It comprises a dense cover of *Machaerina articulata* (Jointed Twig-rush), with *Typha orientalis* (Broadleaf Cumbungi), *Juncus* sp (Rush) and *Persicaria lapathifolia* (Pale Knotweed) also present. Exotic species within the wetland include *Rumex crispus* (Curled Dock), *Cyperus eragrostis* (Umbrella Sedge) and *Conyza bonariensis* (Fleabane).
Photos	
Conservation significance	NC Act – Not listed EPBC Act – Not listed
Condition	This community is in moderate-good condition with a relatively low abundance and diversity of exotic species present.

Freshwater wetland	
Area within study area (ha)	0.39
Area within proposal site (ha)	0.09

Table 6 Acacia regrowth

Acacia regrowth	
Description	Acacia regrowth comprises *Acacia dealbata* (Silver Wattle) to 3 meters tall over an understorey comprised of mixed native and exotic grasses and forbs. Common natives include *Poa labillardierei* subsp *labillardierei* (Common Tussock Grass), and *Bothriochloa macra* (Red Leg Grass). Dominant exotic flora included *Festuca arundinacea* (Tall Festuca), *Paspalum dilatatum* (Paspalum), *Phalaris aquatica* (Phalaris) *Verbena bonariensis (*Purpletop), *Rumex crispus* (Curled Dock), *Hypericum perforatum* (St John's Wort), *Cirsium vulgare* (Spear Thistle) and *Rubus fruticosus* sp. agg. (Blackberry).
Photos	
Conservation significance	NC Act – Not listed EPBC Act – Not listed
Condition	Poor – this vegetation has been significantly disturbed and comprises a high cover of exotic species.
Area within study area (ha)	0.19
Area within proposal site (ha)	0.11

Table 7 Pinus radiata with predominantly native understorey

Pinus radiata with predominantly native understorey	
Description	This community occurs along the western bank of the Monlonglo River. It comprises a stand of exotic *Pinus radiata* (Radiata Pine) to 25 metres tall over an understorey dominated by native tussock grasses including *Poa labillardierei* subsp. *labillardierei* (Common Tussock Grass), *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Panicum effusum* (Hairy Panic) *Austrostipa* sp (Spear Grass), *Rytidosperma* spp. (Wallaby Grass) and *Anthosachne scabra* (Wheat Grass).Other native groundcover species present include *Hydrocotyle laxiflora, Viola hederacea* (Ivy-leaved Violet), *Glycine tabacina, Lomandra multiflora* (Many-headed Matt Rush), and *Dichondra repens* (*Kidney Weed).* There is a high abundance of exotic species through this community including *Ligustrum lucidum (Large leaved Privet), Pyracantha angustifolia* (Orange Firethorn), *Crataegus monogyna* (Hawthorn), *Hypericum perforatum* (St John's Wort), *Rubus fruticosus* spp. agg (Blackberry), *Festuca*

Pinus radiata with predominantly native understorey	
	arundinacea (Tall Festuca), *Paspalum dilatatum* (Paspalum), *Hedera helix* (English Ivy), *Robina pseudoacacia* (False acacia), *Verbascum thapsus* subsp. *thapsus* (Great Mullein) and *Dactylis glomerata* (Cocksfoot).
Photos	
Conservation significance	NC Act – Not listed EPBC Act – Not listed
Condition	This community is in moderate condition. There is a high abundance of exotic and high threat weeds present including areas of dense *Hedera helix* (English Ivy), *Phalaris aquatica* (Phalaris), *Paspalum dilatatum* (Paspalum) and *Rubus fruticosus* sp. agg. (Blackberry).
Area within study area (ha)	1.55
Area within proposal site (ha)	0.8

Table 8 Predominantly exotic grassland

Predominantly exotic grassland	
Description	This vegetation comprises exotic grasses and maintained lawns. Flora species present include introduced *Paspalum dilatatum* (Paspalum), *Festuca arundinacea* (Tall Festuca) and *Cenchrus clandestinus* (Kikuyu Grass). Exotic forbs are scattered throughout the community and include *Plantago lanceolata* (Plantain), *Hypericum perforatum* (St John's Wort), *Hypochaeris radicata* (Flatweed) and *Conyza bonariensis* (Fleabane).
Photos	
Conservation significance	NC Act – Not listed EPBC Act – Not listed
Condition	This vegetation is in poor condition and comprises predominantly exotic species.

Predominantly exotic grassland	
Area within study area (ha)	2.0
Area within proposal site (ha)	1.71

5.2.2 Threatened ecological communities

The PMST search identified two threatened ecological communities (TECs) listed under the EPBC Act that may occur within the study area:

– White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered
– Natural Temperate Grassland of the South Eastern Highlands (critically endangered)

The nearest mapped areas of TECs are located approximately 250 m north (Yellow Box-Blakely's Red Gum Grassy Woodland) and 1 km north-east (Natural Temperate Grassland) of the proposal site (ACT Government 2023a).

Field surveys confirmed that neither of these TECs occur within the study area, nor are any of the vegetation types within the proposal site commensurate with any other TECs listed under the NC or EPBC Acts.

5.2.3 Flora species

A total of 69 flora species from 30 families were recorded within the study area. These comprise 32 native and 37 exotic species. The Poaceae (grasses, 18 species, 11 native) and Fabaceae (shrubs and scramblers, 9 species, 5 native) were the most diverse families recorded. The full list of flora species recorded within the study area is included in Appendix A.

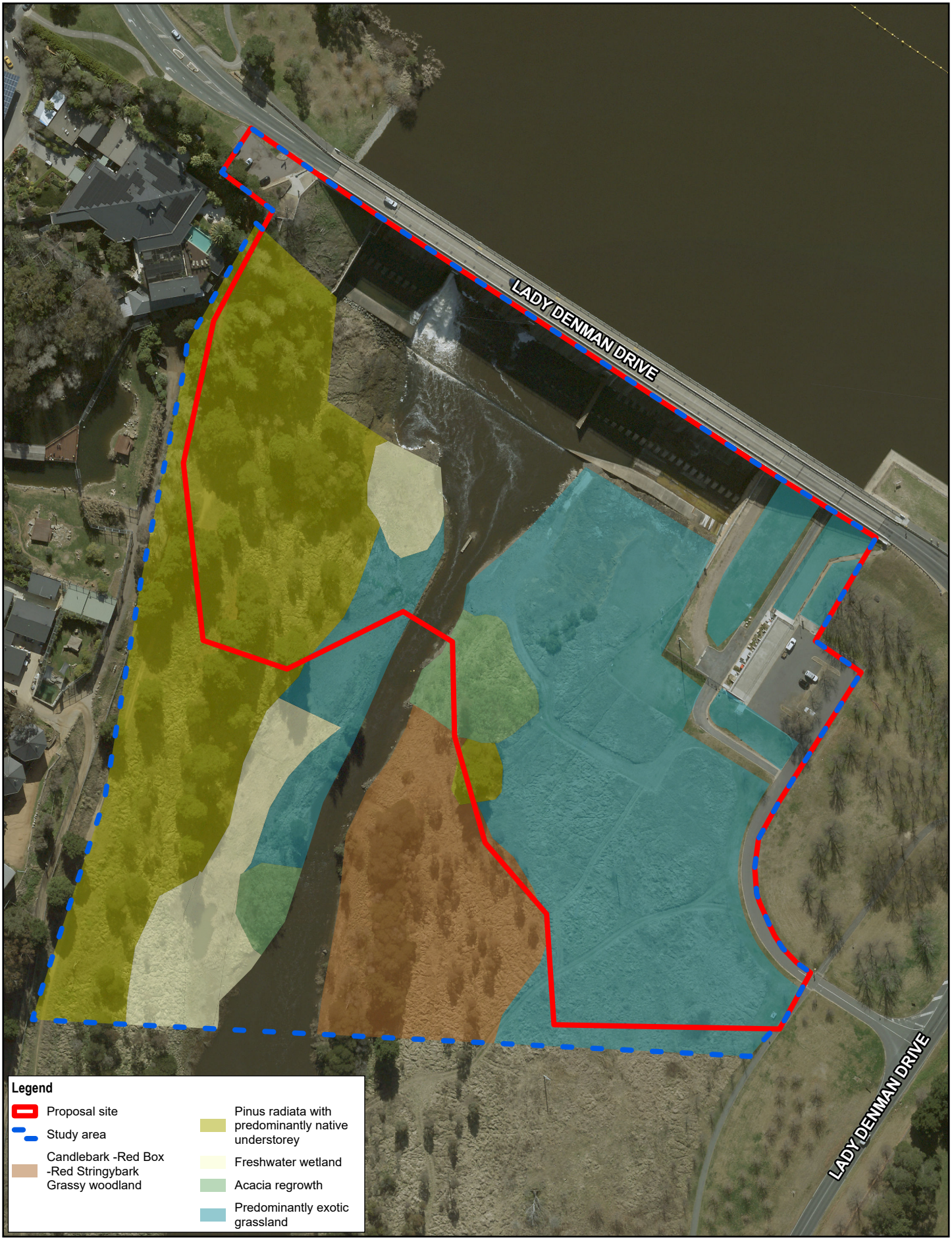
Vegetation within the study area is in moderate to poor condition with some areas, particularly those adjoining previously cleared or disturbed areas, containing a high cover abundance of exotic species.

5.2.4 Introduced flora species

Thirty-seven exotic flora species were recorded within the study area, of these, eight are listed under the ACT *Pest Plants and Animals Act 2005* (PPA Act). Flora species listed under the PPA Act along with their associated declarations are provided in Table 9. A full list of exotic flora recorded within the study area is provided in Appendix A.

Table 9 Pest plants listed under the PPA recorded within the study area

Species name	Common name	Declaration under PPA
Crataegus monogyna	Hawthorn	must be contained
Hypericum perforatum	St John's Wort	must be contained
Pinus radiata	Radiata Pine	must be contained
Rubus fruticosus spp. agg	Blackberry	must be contained
Hedera helix	English Ivy	prohibited
Ligustrum lucidum	Broad-leaved Privet	prohibited
Populus alba	Poplar	prohibited
Pyracantha angustifolia	Orange Firethorn	prohibited



Paper Size ISO A4

0 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

National Capital Authority
Scrivener Dam
Dissipator Strengthening Project (DSP)

Vegetation mapping

Project No. **12608465**
Revision No. **-**
Date **10/05/2023**

FIGURE 2

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Print date: 11 May 2023 - 12:34

Data source: ACT_TRANSPORT/road_labels_grey_for_imagery: , ACT_BASE_MAP/basic_for_imagery: , ACT_IMAGERY\imagery202207gda2020: . Created by: akildea

5.2.5 Threatened flora species

No threatened flora species were recorded within the study area.

Database results indicate that 19 threatened flora species are known or have the potential to occur within the locality. The nearest threatened flora species to the proposal site is Hoary Sunray (*Leucochrysum albicans* subsp. *tricolor)*, which is known to occur approximately 1.6 km west of the site (ACT Government, 2023a).

Due to the highly disturbed nature of the study area and general lack of suitable habitat for threatened flora species known or predicted to occur within the locality it is considered unlikely that threatened flora species would occur (refer to Appendix B for further detail regarding the likelihood of occurrence of threatened flora species within the proposal site)

5.3 Fauna species and habitat

5.3.1 Fauna species

A total of 28 fauna species were recorded within the study area across the two survey days. These comprised 25 native and three introduced species. The recorded species included 24 bird species (of which two are introduced species), three mammal species (including one introduced species) and one native frog species. All bird species were common species, including two introduced species, that are known to utilise disturbed peri-urban and rural habitats, such as feral species like the Rock Dove (*Columba livia*) and natives including the Suphur-crested Cockatoo (*Cacatua galerita*) and Australian Magpie (*Cracticus (Gymnorhina) tibicen*). Three mammal species were identified via scats: the Eastern Grey Kangaroo (*Macropus giganteus*), the Common Wombat (*Vombatus ursinus*) and the introduced European Red Fox (*Vulpes Vulpes*). The Common Eastern Froglet (*Crinia signifera*) was heard calling during surveys. The full list of the species recorded during within the study area is included in Appendix A. No threatened species were recorded, however potential habitat is discussed below.

5.3.2 Introduced fauna species

A range of introduced fauna has been previously recorded in the locality (DPE, 2023). This includes common feral species such as Rock Doves (*Columba livia*) as well as invasive predators like Foxes (*Vulpes vulpes*). These are likely to be prevalent across the disturbed peri-urban matrix throughout the study area and there is evidence that a number of these species may reside, forage or move through the proposal site itself.

Seven introduced fish species have been confirmed as present or historically present in Lake Burley Griffin including Australian Bass (*Percalates novemaculeata*) that are not native to the region and their presence is likely due to illegal stocking or the release of aquarium fish (Beitzel et al. 2018). Recent surveys in 2017 determined that the fish community of Lake Burley Griffin is dominated by the introduced pest species Redfin Perch (*Perca fluviatilis*) and Common Carp (*Cyprinus carpio*), with the latter accounting for 42% of the total number of fish caught (Beitzel et al. 2018). Other exotic species in the lake are Mosquitofish (*Gambusia holbrooki*) and Goldfish (*Carassius auratus*) (Beitzel et al. 2018). The stocking of fish in the lake has been undertaken regularly since its construction with Rainbow Trout (*Oncorhynchusus mykiss*) and Brown Trout (*Salmo trutta*) forming the majority of stockings up until the 1980's when they were replaced by native Murray Cod (*Maccullochella peelii peelii*) and Golden Perch (*Macquaria ambigua*) (Beitzel et al. 2018). Both species of Trout were not recorded in recent fish survey so of the lake in 2017 (Beitzel et al. 2018). Six introduced species are reported to be present in the Molonglo River below Lake Burley Griffin. These are Redfin Perch, Common Carp, Mosquitofish, Goldfish, Rainbow Trout, Brown Trout and Orsiental Weatherloach (Lintermans 2000; 2004).

5.3.3 Fauna habitat values

Terrestrial fauna

The terrestrial habitat within the study area is typical of rural areas, but has some habitat features of relevance for threatened fauna species. A summary of habitat values present is provided in Table 10.

Table 10 Habitat values

Habitat attribute/ type	Habitat values	Threatened fauna
Woodland and shrubland	Open woodland provides habitat for a range of fauna species. Various small and medium woodland birds were recorded in these areas. No hollow-bearing trees or stick nests were recorded.	The habitat present could support a diversity of threatened birds such as the Southern Whiteface (*Aphelocephala leucopsis*) and Diamond Firetail (*Staggonopluera guttata*). No nests were identified and these. There were no hollow bearing trees identified, limiting the habitat value for the majority of threatened species. Most threatened mammals known or predicted to occur within the locality are unlikely to occur, as the study area lacks suitable habitat.
Grassland	Native grassland occurs under Candlebark woodland (outside the proposal site) and exotic pines (within the proposal site) . Grassland provides foraging and shelter habitat for various species, including woodland birds, mammals and reptiles.	The Pink-tailed Worm Lizard (*Aprasia parapulchella*) and Striped Legless Lizard (*Delma impar*) are known to occur in native grassland and have various records in the locality. These species can occur in more disturbed areas adjacent to good quality habitat. Potentially suitable habitat in the study area is very limited in area and quality. The Golden Sun Moth (*Synemon plana*) and Key's Matchstick Grasshopper (*Keyacris scurra*) inhabit derived native grasslands and Natural Temperate Grassland communities dominated by native grasses like Kangaroo Grass (*Themeda triandra*). No preferred feed plants occur within the proposal site but there is potentially suitable grassland habitat for these species in the wider study area.
Freshwater wetland	This wetland community occurs in a small depression on the western edge of Molonglo River. It comprises a dense cover of *Machaerina articulata* (Jointed Twig-rush), with *Typha orientalis* (Broadleaf Cumbungi), *Juncus* sp (Rush) and *Persicaria lapathifolia* (Pale Knotweed) also present.	Species like the Australiasian Bittern (*Botaurus poiciloptilus*) could potentially inhabit freshwater wetland habitat. Other wetland and migratory birds may also occur on occasion. Wetland vegetation can provide potential habitat for the Green and Golden Bell Frog (*Litoria aurea*). This species prefers marshes with area of open (still) water. Limited preferred habitat is present in the study area. No cobble areas suitable for the Booroolong Frog (*Litoria booroolongensis*) are present.

Aquatic fauna

The desktop review determined four threatened fish species are known from within 10 km of the proposal site - Silver Perch (*Bidyanus bidyanus*), Trout Cod (*Maccullochella macquariensis*), Murray Cod (*Maccullochella peelii*) and Macquarie Perch (*Macquaria australasica*). In addition, the Murray River Crayfish (*Euastacus armatus*) is also known to occur in the locality.

Of the threatened fish and crayfish, Silver Perch, Murray Cod, Macquarie Perch and the Murray River Crayfish have all been recorded in surveys of the Molonglo River below Lake Burley Griffin (Lintermans 2000; Lintermans 2004; Beitzel et al. 2018). Above Scrivener Dam Silver Perch, Murray Cod and Macquarie Perch have been recorded in surveys of either Lake Burley Griffin or the Molonglo River (Lintermans 2000; Lintermans 2004; Beitzel et al. 2018).

Murray Cod are the only threatened species considered present in Lake Burley Griffin (see Appendix A) and while they occupy a broad range of flowing and standing waters, it is considered a main river channel specialist with a high affinity for structural woody habitat in deeper water, close to banks in areas of flowing water. The Murray Cod population is not self-sustaining, with stocking required to maintain the species in the lake (Beitzel et al. 2018). As such, the population is unlikely to successfully breed in the lake. Beitzel et al. (2018) only recorded three individuals during recent fish surveys, indicating low abundances under existing conditions.

It is unlikely that any other threatened species inhabit the study area (see Appendix B):

– Trout Cod have not been recorded in the Molonglo River or Lake Burley Griffin in recent surveys (see Appendix A) and there are only seven self-sustaining populations of Trout Cod reported to remain in the wild with the only remaining natural population in the Murray River between Yarrawonga and Barmah State Forest (Cadwallader and Gooley 1984; Ingram et al. 1990; Douglas et al. 1994).
– Silver Perch are considered locally extinct in the ACT (Lucas et al. 2019).
– Macquarie Perch have not been recorded in the Molonglo River since 1980 (DCCEEW 2023a) and have not been recorded within Lake Burley Griffin.
– Murray River Crayfish have been recorded in the Molonglo River but are no longer present (ACT Government 2023b)

As such, it is unlikely that threatened aquatic species are dependent on available habitat in the proposal site or study area (e.g., for breeding or important life cycle periods) and/or preferred habitat is not present.

5.3.4 Threatened and migratory fauna species

The PMST search identified 42 threatened fauna species that are known and/or that have the potential to occur within the locality. This comprised 21 birds, five fish, four frogs, three insects, six mammals and three reptiles. Fourteen migratory birds are also predicted to occur in the locality. Species that are likely to occur are summarised in Table 11.

Table 11 Threatened fauna species

Scientific name	Common name	Status		Records	Records
		EPBC Act	NC Act		
Birds					
Aphelocephala leucopsis	Southern Whiteface	V		Previously been recorded in the proposed site in 2018 (ALA, 2023)	There is suitable foraging and breeding habitat within the proposal site.
Botaurus poiciloptilus	Australasian Bittern	E	E	Previously been recorded in the proposed site in 2017 (ALA, 2023)	Likely to occur in wetland habitat.
Gallinago hardwicki	Latham's Snipe	M		Previously been recorded in the locality.	There is suitable habitat within the proposal site.
Hieraaetus morphnoides	Little Eagle	-	V	20 records within 10km (DPE, 2023)	Likely to forage well above the proposal site on occasion.
Petroica boodang	Scarlet Robin	-	V	72 records within 10km (DPE, 2023)	There is suitable foraging and breeding habitat within the proposal site.
Stagonopleura quttata	Diamond Firetail	V		60 records within 10km (DPE, 2023)	There is suitable foraging and breeding habitat within the proposal site.
Insects					
Keyacris scurra	Key's Matchstick Grasshopper	E		2 records within 10 km (ACT Government, 2023a).	Known populations in the locality. Habitat limited due to the lack of preferred feed plants
Perunga ochracea	Perunga Grasshopper		V	16 records within 10 km (ACT Government, 2023a).	Known populations in the locality. Habitat limited due to the lack

Scientific name	Common name	Status		Records	Records
		EPBC Act	NC Act		
					of preferred feed plants
Synemon plana	Golden Sun Moth	V	E	45 records within 10 km (ACT Government, 2023a).166 records within 10 km (DPE, 2023)	The closest recorded species is approximately 600 metres south of the proposal site. Habitat limited due to the lack of good quality grassland.
Reptiles					
Aprasia parapulchella	Pink-tailed Worm-lizard	V	V	1000 records within 10 km (ACT Government, 2023a).	Known populations in the locality. Habitat limited due to the lack of good quality grassland and surface rock.
Delma impar	Striped Legless Lizard	V	V	12 records within 10 km (ACT Government, 2023a).	Known populations in the locality. Habitat limited due to the lack of good quality grassland and surface rock.
Key to table: CE – critically endangered; E – endangered; V – vulnerable; EX – extinct; NL – not listed.					

7. Impact assessment

7.1 Direct impacts

7.1.1 Vegetation removal

Native vegetation within the proposal site would be impacted as a result of the construction of access tracks, site compounds and laydown areas. Following the initial site survey, the project design was refined to avoid impacts to native vegetation where possible. Removal of native vegetation has been calculated based on the assumption that all vegetation would be removed from the proposal area. In reality, the area of native vegetation to be removed, is likely to be much smaller as disturbance would be localised within this area.

The proposal would remove up to 2.7 ha of vegetation within the proposal site, including approximately 1 ha of native vegetation and 1.7 ha of exotic grassland. Estimates of the extent of each vegetation type that would be impacted by the proposal is summarised in Table 12 and shown in Figure 2.

None of the native vegetation within the study area meets the definition of an NC Act or EPBC Act listed threatened ecological community. Impacts to Candlebark -Red Box -Red Stringybark Grassy Woodland and Freshwater Wetland within the study area have been largely avoided and vegetation to be removed comprised relatively poor condition vegetation that has been previously disturbed, has a high abundance of exotic species present and is not likely to contain any substantial habitat for threatened flora or fauna species listed under the NC and/or EPBC Acts.

Table 12 Vegetation removal

Vegetation type	Area within proposal site (ha)
Candlebark -Red Box -Red Stringybark Grassy woodland	Nil
Freshwater wetland	0.09
Pinus radiata with predominantly native understorey	0.80
Acacia regrowth	0.11
Predominantly exotic grassland	1.71

7.1.2 Fauna habitat and fragmentation

The proposal site is quite isolated in the north, north-west through to south-west portions of the site due to urban development that has included areas of revegetation and introduced exotic grass and tree species. The riparian vegetation continues south following the Molonglo River on both the east and west banks. None of this habitat is connected to larger extents of better-quality riparian vegetation (woodland or native grass). Nonetheless, the native woodland and riparian vegetation would be retained. The loss of acacia regrowth and potentially some exotic grass, shrubs and trees would not fragment habitat for biota nor would it reduce the ability for fauna to disperse through the study area.

7.1.3 Disturbance, injury and mortality of fauna

During construction, death or injury may occur to fauna present during clearing of trees and vegetation. If birds are present but not nesting during construction, they will generally move away from the site to escape disturbance.

The proposal has the potential to temporarily affect the use of the site by fauna as a result of increased disturbance during construction. The use of machinery may temporarily deter some fauna species from using potential habitat in the site during construction.

With the implementation of safeguards (refer to Section 8), the proposal would be unlikely to substantially affect fauna in the site and surrounding area.

7.1.4 Impacts to terrestrial threatened species and migratory species

No threatened terrestrial flora or fauna, including migratory species, were observed in the study area. The project layout has been designed to avoid areas of higher quality habitat and disturbance will be confined to areas where there is existing soil and vegetation disturbance. No hollow-bearing trees would be removed, which limits impacts for many species. Several threatened bird species were identified as likely to occur in the proposal site. Impacts on these species are considered unlikely due to their mobile nature, limited impacts on native vegetation, and lack of evidence of nesting habitat. No wetland habitat will be removed. A number of terrestrial grassland insects and reptiles occur in the locality. These species are more at risk of impacts compared to more mobile species such as birds. These species tend to be restricted in area, and rely on burrows or surface habitats for shelter, and thus more likely to be subject to mortality during construction. The proposal will not remove any areas of good quality grassland habitat. No areas of Natural Temperate Grassland occur in the study area. While these species can occur in more disturbed areas, the lack of good quality habitat in close proximity reduces the likelihood of occurrence. Given the bulk of works would be located in areas of exotic grassland, and would not isolate any areas of habitat, impacts on these species are likely to be minimal, if at all. It is therefore considered unlikely that the proposal would result in impacts to threatened terrestrial fauna species.

7.1.5 Impacts to aquatic habitat

As mentioned in the Project Description, the full supply level (FSL) of Lake Burley Griffin is 555.93 mAHD and since 2000 water levels have remained stable and usually within 150 mm of the FSL. As such, the lowering of the lake by up to 500 mm to manage flood risks during construction could reduce aquatic habitat that has established under current conditions. However, this is not unprecedented, with levels kept at approximately 555.45 mAHD between December 2011 and August 2013 while upgrade works occurred on Scrivener Dam. The lake has also experienced water level decreases in this range on several other occasions since 2000.

Most of the in-water construction works will occur in the existing footprint of the dissipator although during construction the installation of cofferdams downstream from the dissipator may result in a loss of some aquatic habitat. However, there is limited habitat in this area which is primarily composed of a deep open water pool with limited structural habitat (e.g. snags) or aquatic macrophytes. As such, the loss of aquatic habitat is considered temporary and minor in extent. On completion of the works the footprint of the dissipator would not be increased so there would be no loss of habitat compared to existing conditions.

The fragmentation of habitat for aquatic values may occur if a barrier is formed that prevents the free passage of aquatic fauna between areas of suitable habitat. Given the dam wall already acts as a physical barrier this is not expected to be the case. Furthermore, due to its inland and upland location, there are no diadromous (i.e., migratory) fish species occurring naturally in the ACT (Lintermans 2000; Lintermans and Osborne 2002). As such, fragmentation of habitat will not interrupt spawning migrations of fish but may restrict local movements to preferred habitat. However, as mentioned above, the works will occur within the existing footprint of the dissipator, so it is unlikely to significantly reduce or fragment habitat for any common or threatened aquatic species.

The construction method would also be refined during detailed design and would be phased to ensure that flows along the Molonglo River can be maintained throughout the works. To achieve this, cofferdams would likely be used to isolate a portion of the works area for construction while allowing water to flow in the area outside of the cofferdam. This would assist in maintaining habitat within the Molonglo River downstream of Scrivener Dam.

Based on the above, the proposal would be unlikely to substantially affect aquatic fauna in the proposal site, the study area or Lake Burley Griffin.

7.1.6 Impacts to aquatic fauna

Hydrological changes

Lowering of Lake Burley Griffin by up to 500 mm during construction could reduce aquatic habitat that has established under current conditions. It is known that a range of fish inhabit the lake, including native Murray Cod and Golden Perch, three introduced species (Carp, Goldfish and Redfin) and Australian Bass (not native to the Murray Darling Basin). Murray Cod and Golden Perch are regularly stocked in the lake and are therefore unlikely to successfully breed. A short-term drop in water level, although greater than the normal 150 mm range, would not significantly reduce habitat for any species in the lake given that the lake depth ranges from ~18 m near Scrivener

Dam wall to 2 m (with an average of 4m) (NCA 2023). Aquatic habitat would remain and no impact to the breeding of native fish would occur.

Release of water during the lake's drawdown has the potential to increase erosion impacts downstream from Scrivener Dam if release rates are significantly greater than the normal release rate. Water would be released from the lake within the normal operating range to minimise this impact.

There is potential for changes in flow in the Molonglo River to impact aquatic fauna. However, the construction method would be refined during detailed design and would be phased to ensure that flows along the Molonglo River can be maintained throughout the works. To achieve this, cofferdams would likely be used to isolate a portion of the works area for construction while allowing water to flow in the area outside of the cofferdam.

Given the historical variation in water levels or Lake Burley Griffin and the maintenance of flows in the Molonglo River during construction, the proposal would be unlikely to substantially affect aquatic fauna in the proposal site, the study area or Lake Burley Griffin. Releasing water from the lake into the Molonglo River within the normal operating range would also minimise potential impacts.

Direct impact to aquatic fauna

During construction, death or injury of aquatic fauna may occur during the clearing of habitat within the Molonglo River. If fish are present during construction, they will generally move away from the site to escape the disturbance. Furthermore, based on the habitat that is present, it is unlikely to provide significant habitat for aquatic fauna.

Noise and vibration

Construction activities have the potential to affect aquatic fauna through the generation of noise and associated vibration within the Molonglo River. The main impacts may be related to works such as the hammer drilling, the demolition of existing concrete chutes, and construction of cofferdams when water is present. The published literature contains little relevant information about the potential impacts of noise on freshwater fish and other aquatic fauna, as most information is based on marine or laboratory studies. However, the biology of freshwater and marine fish is similar enough to consider the response to noise and vibration impacts would be comparable (Cox et al. 2016). In the marine environment, the use of seismic air guns resulted in an increased alarm response and movement by fish (Fewtrell and McCauley 2012; Skalski et al. 1992), while pile driving had no or little effect on overall behaviour and movement (Wardle 2001). One laboratory study determined that loud, sudden noise can affect individual and group fish swimming behaviour, but continuous loud noise has less effect (Neo et al. 2015). Overall, fish are more likely to elicit an avoidance response before physical damage occurs if they are not constrained (McCauley et al. 2000). Based on this, the greatest risk to aquatic fauna would be changes to behaviour that could impact aquatic fauna during breeding events. The presence of Scrivener Dam means that there would be no migration of fish throughout this reach of the Molonglo River to breed, and the area that is potentially impacted is small compared to other breeding habitats throughout the Molonglo River for non-migratory species. Any disturbance would therefore be short-term and localised, with minor effects on aquatic fauna (i.e. the most plausible impact would be an avoidance response). No adverse noise or vibration impacts are expected during operation as conditions would be comparable to existing conditions.

Light pollution

For aquatic fauna, light pollution may affect the structure and abundance of populations and has the potential to alter predator–prey interactions at multiple trophic levels by creating conditions favourable to predatory species at night (Becker et al. 2013). Construction would be undertaken during standard hours during daylight although due to flow variability of the Molonglo River, the contractor may need to work outside of these hours to ensure work can be completed without being impacted by rain fall or flooding.

7.2 Indirect impacts

7.2.1 Runoff, sedimentation and contamination

7.2.1.1 Terrestrial values

Clearing of vegetation may increase erosion and sedimentation in the proposal site. Uncontrolled erosion of topsoil from excavated areas and exposed soils and corresponding deposition into native vegetation or waterways can

cause weed problems and stifle plant growth. Sedimentation runoff to waterways from exposed soils due to riparian vegetation clearing and/or earthworks can adversely affect aquatic life by altering water quality and filling aquatic habitat with fine sediment. This reduces the habitat value of these areas for fauna such as frogs.

The topography of the site and the nature of the proposal mean that there is potential for impacts resulting from erosion and sedimentation if adequate controls are not in place during vegetation clearing activities and site works. Mitigation measures are described in Section 6 to minimise potential impacts of sedimentation and erosion on water quality.

7.2.1.2 Aquatic values

In rivers there may be many impacts associated with sedimentation including reduced uptake of dissolved oxygen by fauna due to the clogging of gills (Kjelland et al. 2015; McKenzie et al. 2020), a decrease in photosynthesis and the health of flora (Lovett et al. 2007), reduced foraging capacity of native fish while favouring exotic species such as Carp that are not visual feeders (Utne-Palm 2002; Lovett et al. 2007), and the blanketing of the substrate and other habitats (Hynes 1970; Lovett et al. 2007). Sediment eroded into rivers also has the potential to carry nutrients and other contaminants (DSE 2003). The proposal may increase the delivery of sediment during construction of cofferdams, access tracks and the temporary river crossing.

Other contaminants such as fuels and chemicals can have both lethal and sublethal impacts (e.g., changed physiology, reproduction and behaviour) on aquatic biota that can occur as a result of both acute (short-term) and chronic (long-term) exposure (Weis 2014; Ucan-Marin and Dupuis 2015). Toxicants can also impact aquatic habitat values and lead to reduced dissolved oxygen (Enujiugha and Nwanna 2004). There is potential for accidental spills and leaks of various contaminants during construction. These could include spills while refuelling, leaky and unmaintained equipment or plant, failure of storage containers, and runoff from the slurry generated from hydro-cutting of concrete or the pouring of the new reinforced concrete topping slab or baffles.

Appropriate sediment and erosion controls would be installed within the Molonglo River and throughout the proposal area to capture silt and soil that could be mobilised during the works. Accidental spills and other sources of contamination would also be managed through a soil and water management plan prepared prior to construction commencement, as part of the CEMP.

During operation the likelihood of sedimentation and contamination would be similar to existing conditions. However, during large floods the water downstream of the dam overtops the training walls and could potentially erode the existing abutments. Additional protection would be installed on the downstream dam abutments to increase their erosion and scour protection so there may be a net benefit to aquatic values.

As such, with mitigation measures in place, no adverse impacts to aquatic values in the Molonglo River are expected due to the proposal due to the localised extent of the proposal site and short-term duration of the potential impacts. Mitigation measures are described in Section 6.

7.2.2 Invasion and spread of weeds, pathogens and disease

The proposal may cause the dispersal of weed propagules (seeds, stems and flowers) into adjacent areas of native vegetation via plant and machinery, erosion (wind and water) and via workers shoes and clothing. Some sections of the study area already support infestations of declared pest plants as well as various other weed species; however there is a possibility that additional, more invasive or otherwise damaging environmental weeds may be introduced to the retained vegetation, or that existing pest plant infestations may be further spread into areas that are currently free from infestations. Depending upon the weeds introduced to the site, this could result in a decline in the condition of retained native vegetation and associated native fauna habitats.

Construction activities have the potential to spread aquatic weeds into the Molonglo River should they be attached to machinery or other plant that enters the river, or there is the delivery of seeds or weeds associated with runoff. Severe infestations of weeds in rivers can block channels, restrict flows and increase silt accumulation, degrade water quality, exacerbate flooding and adversely affect habitat (Madsen 2005; Cheery and Bosse 2014). In addition, invasive aquatic weed species which form dense infestations can reduce the diversity of aquatic flora, which can lead to secondary impacts on aquatic invertebrates and fish (van Oosterhout 2009).

Pathogens and disease can be defined as a bacterium, virus or other microorganism that may cause illness or death to aquatic fauna and flora. Of main concern for aquatic ecosystems is the Epizootic Haematopoietic Necrosis Virus (EHNV). Although EHNV primarily affects Redfin Perch and Rainbow Trout, it also has the potential

to negatively impact native fish species (DPI NSW 2021). EHNV has previously been documented in the upper Murrumbidgee catchment in NSW (DPI NSW 2021) and waterways of the ACT including Lake Burley Griffin, Lake Ginninderra and Googong Reservoir (DAWA 2020; Icon Water 2018). Pathogens and diseases, such Chytrid fungus (*Batrachochytrium dendrobatidis*), may also be transported into and from the site by machinery and workers, and can impact frog populations. Any in-water construction activity which uses equipment or vehicles which have come into contact with freshwater systems where these diseases are present prior to entering site, has the potential to transfer these diseases to native fish and frogs within the Molonglo River.

The potential for significant or new impacts associated with weeds, pathogens and disease is relatively low given the existing development and extent of past and current human visitation across the proposal site and surrounding area.

A weed and pest management plan (WPMP) will be developed before the commencement of construction (as part of the CEMP) to mitigate impacts associated with the spread of weeds and pathogens. Given ENHV is already present in Lake Burley Griffin and the Molonglo River no new impacts associated with ENHV are expected to occur. This is not to say that risks should not be managed and steps to mitigate further spread will also be included in the WPMP. With these mitigation measures in place, no adverse effects on aquatic values are expected.

7.2.3 Noise, light and vibration

Noise can cause changes in behaviours such as foraging, requiring additional energy expenditure if fauna need to forage further afield. Impacts during construction would be short term, temporary and are unlikely to deter fauna from using habitat features retained in the proposal site, in the long term.

Operation of the proposal is unlikely to cause long term impacts. Noise, light and other disturbance would be short term and temporary, generally from the arrival and departure of trucks and other machinery. This impact would not be likely to greatly exceed disturbance impacts from the existing transport infrastructure located adjacent to the proposal site.

7.2.4 Edge effects

'Edge effects' can include increased noise and light, weed incursion or erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna.

Given most of the remnant vegetation has been cleared and the proposal site and surrounding area has been historically modified, it is unlikely the proposal would cause any new edge effects.

8. Mitigation measures

8.1 Avoidance and mitigation

Efforts have been made through the proposal planning and design process to minimise and mitigate impacts to ecological values. Particularly, avoiding and minimising impacts to native vegetation as far as is practicable.

In addition, site-specific management measures have been created to further reduce the impact of the proposal. These measures are detailed in Table 13 and will be implemented to minimise the impacts of the proposal on ecological values. These management measures will be incorporated into a Construction Environmental Management Plan (CEMP) to be implemented for construction.

8.2 Mitigating impacts

Table 13 Mitigation measures to be implemented for the proposal

Potential impact	Measure to reduce impact
Impacts to native vegetation and habitat	A flora and fauna management plan would be developed before the commencement of construction (as part of the CEMP). Measures will be implemented before, during and after construction to avoid and mitigate impacts to flora and fauna within the study area. The CEMP will include the following measures: – Removal of areas of native vegetation will be minimised wherever possible. – No vegetation removal or soil disturbance will occur outside the proposal site. – Establishing exclusion zones by fencing or demarcating areas (with construction barrier fencing or similar) that are outside the disturbance footprint and are not to be disturbed. – All staff would be inducted and informed of the limits of vegetation clearing and the areas of vegetation to be retained. – An ecologist or qualified wildlife handler is to be present during clearing works in areas of native vegetation to rescue and relocate any injured or displaced wildlife. If any threatened flora or fauna are identified in the proposal site during construction, work will cease immediately and the NCA and / or appropriate agencies will be contacted.
Spread of weeds	– A weed and pest management plan will be developed before the commencement of construction (as part of the CEMP). Measures will be implemented before, during and after construction to prevent the establishment and/or spread of weeds within and beyond the proposal site. Weed management measures would include, but not be limited to: – Vehicle and machinery wash/brush downs will be established and implemented so that weed species are not spread to non-infested areas. No construction vehicles or staff should enter surrounding areas to minimise weed spread. – Sediment control, such as silt fences, will assist in reducing the potential for spreading weeds downstream. – Soil disturbance will be avoided as much as possible to minimise the potential for erosion and spread of weeds.
Soil erosion, sedimentation and water quality	An Erosion and Sediment Control Plan (ESCP) will be developed in accordance with the *Environment Protection Guidelines for Construction and Land Development in the ACT* (EPA, 2022). The ESCP will be implemented prior to construction commencing on site and updated as needed during the construction phase to address changed conditions. This plan would include measures to avoid sediment running into the Molonglo River including: – Installing a silt curtain within the Molonglo River downstream of all ground disturbing work. – Implementing stockpile management. – Diverting surface runoff away from disturbed soil and stockpiles. – Inspecting controls at least weekly and immediately after rainfall. – Refuelling or maintenance of plant and machinery will not be undertaken within 50 m of waterways or drainage lines (including Lake Burley Griffin and the Molonglo River). – Storage of fuels and other chemicals to follow Australian standards. – A rehabilitation and revegetation plan (RRP) will be prepared for areas disturbed during the works. This will identify appropriate methods for stabilising disturbed soils to resist erosion. – Sediment and erosion controls will be inspected regularly, particularly after a high rainfall events (defined as greater than 30 mm in 24 hours), and maintenance works undertaken as needed. These controls would remain in place after construction until sufficient regeneration of vegetation to prevent erosion or sedimentation occurs. – Weather forecasts will be checked daily and high risk soil and erosion activities must not be undertaken immediately before or during high rainfall or wind events. Disturbed surfaces would be compacted and stabilised in anticipation of rain events to reduce the potential for erosion. – During drawdown of Lake Burley Griffin, water would be released within the normal operating range to minimise the potential for increased erosion in the Molonglo River, and maintain habitat in the river.
Invasion and spread of pathogens	A weed and pest management plan will be developed before the commencement of construction (as part of the CEMP). The plan would include protocols to minimise the risk of introducing or spreading invasive pathogens and would include protocols to prevent introduction or spread of pathogens like Chytrid Fungus and Phytophthora following the Hygiene guidelines for wildlife (DPIE, 2020).

Potential impact	Measure to reduce impact
	All machinery entering the site must be appropriately washed down and disinfected prior to work on site.
Aquatic fauna management	An aquatic fauna management plan is to be developed (as part of the CEMP) prior to construction works, specifically to develop protocols for any aquatic fauna that are present within the cofferdam prior to dewatering. The plan should consider: – Development and implementation of handling and salvage protocols for aquatic fauna during construction, including legislative permit and authorisation requirements of wildlife handlers. – Clearance of coffer dams during the de-watering process and following flood events which over-top the coffer dam. – If clearance is not possible (e.g., for safety reasons), screens/filters to be placed on temporary pumps to be used to dewater coffer dam to avoid entrainment.

9. Conclusion

The NCA proposes to upgrade and strengthen the Scrivener Dam dissipator (the proposal) in order to meet the Australian Capital Territory (ACT) Dam Safety Code and maintain operation of Scrivener Dam. Construction would mostly involve undertaking remedial and strengthening works to the dissipator structure in the proposal site. Ancillary infrastructure, such as compounds and access tracks, would also be contained within the proposal site.

The proposal site has been highly disturbed and the majority of the vegetation is considered degraded with small portions of the proposal supporting moderate condition native vegetation. The proposal site downstream from Scrivener Dam includes a deep open-water pool with minimal aquatic habitat.

The proposal would result in the removal of up to 1.7 ha of exotic vegetation and 1 ha of native grassland and acacia regrowth. No threatened biota was recorded within the proposal site or surrounding study area nor is the vegetation proposed for removal likely to provide any substantial habitat for any threatened species listed under the NC Act or EPBC Act.

Temporary construction of cofferdams within the open-water pool would be required to complete the proposed works, which would restrict access for aquatic fauna to a minor area of aquatic habitat during construction. Noise and vibration impacts may occur during installation of cofferdams and during construction. However, these impacts are unlikely to lead to significant impacts to any aquatic fauna present in the Molonglo River. The Scrivener Dam already blocks fish movement/migration so the most plausible impact would be that fish and other aquatic fauna would avoid the area and move to habitat which would remain available downstream.

It is unlikely that aquatic fauna in downstream reaches would be significantly impacted by these works if mitigation measures to avoid or minimise increased sedimentation, or to salvage any aquatic fauna within cofferdams are implemented.

The study area has limited records for threatened species under either the NC Act or EPBC Act but could potentially contain suitable habitat for some species. Murray Cod are present within Lake Burley Griffin, but the proposed works are unlikely to impact the species.

A number of mitigation measures are recommended in this report to minimise the impacts on biodiversity values within the proposal site and study area. Provided that the mitigation measures are followed, the assessments conclude that the proposal is unlikely to have an impact on any biota or communities listed under the NC Act. The proposal is also unlikely to have an impact on species or communities listed under the EPBC Act.

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Appendix A

Flora and fauna records

Table A 1 Fauna species recorded during survey

Scientific name	Common name	NC Act	EPBC Act	Date recorded		Notes
				8 / 5 / 2023	9 / 5 / 2023	
Birds (native)						
Anas superciliosa	Pacific Black Duck	-	-	✓	✓	Observed
Anthochaera carunculata	Red Wattlebird	-	-		✓	Observed
Cacatua galerita	Sulphur-crested Cockatoo	-	-	✓	✓	Heard / observed
Chenonetta jubata	Australian Wood (Maned) Duck	-	-	✓	✓	Observed
Chroicocephalus (Larus) novaehollandiae	Silver Gull	-	-	✓	✓	Heard / observed
Corvus orru	Torresian Crow	-	-	✓	✓	Heard / observed
Cracticus (Gymnorhina) tibicen	Australian Magpie	-	-	✓		Heard/observed
Egretta (Ardea) garzetta	Little Egret	-	-	✓		Observed
Egretta (Ardea) novaehollandiae	White-faced Heron	-	-	✓	✓	Observed
Elophus roseicapillus	Galah	-	-	✓	✓	Observed
Fulica atra	Eurasian Coot	-	-	✓	✓	Observed
Grallina cyanoleuca	Magpie-lark	-	-	✓	✓	Observed
Lichenostomus virescens	Singing Honeyeater	-	-	✓		Heard
Lichenostomus versicolor	Varied Honeyeater	-	-	✓		Observed
Ocyphaps lophotes	Crested Pigeon	-	-	✓		Heard / observed
Malurus cyaneus	Superb Fairy-wren	-	-	✓	✓	Observed
Malurus lamberti	Variegated Fairy-wren	-	-	✓		Observed
Neochmia temporalis	Red-browed Finch (Firetail)	-	-		✓	Observed
Pachycephala pectoralis	Golden Whistler	-	-	✓		Observed
Pachycephala rufiventris	Rufous Whistler	-	-	✓		Heard
Phalacrocorax sulcirostris	Little Black Cormorant	-	-	✓		Observed
Platycercus elegans	Crimson Rosella	-	-		✓	Heard / observed
Birds (introduced)						
Columba livia	Rock Dove (Feral Pigeon)	-	-	✓	✓	Observed
Turdus merula	Common (Eurasian) Blackbird	-	-		✓	Observed
Mammals (native)						
Macropus giganteus	Eastern Grey Kangaroo	-	-	✓		Scat
Vombatus ursinus	Common Wombat, Coarse-haired Wombat or Bare-nosed Wombat	-	-	✓		Scat / warren
Mammals (introduced)						
Vulpes Vulpes	European Red Fox	-	-	✓		Scat
Frogs						
Crinia signifera	Common Eastern Froglet	-	-	✓		Heard

Table A 2 Flora species recorded within proposal site

Family	Exotic	Scientific Name	Common Name
Apiaceae		*Hydrocotyle laxiflora*	Stinking Pennywort
Araliaceae	*	*Hedera helix*	English Ivy
Asteraceae	*	*Cirsium vulgare*	Spear Thistle
Asteraceae	*	*Conyza bonariensis*	Flaxleaf Fleabane
Asteraceae	*	*Gamochaeta* sp.	
Asteraceae	*	*Hypochaeris radicata*	Catsear
Brassicaceae	*	*Rapistrum rugosum*	Turnip Weed
Campanulaceae		*Wahlenbergia* sp.	Bluebell
Caryophyllaceae	*	*Petrorhagia nanteuilii*	Proliferous Pink
Casuarinaceae		*Casuarina sp.*	
Clusiaceae	*	*Hypericum perforatum*	St. Johns Wort
Cyperaceae		*Baumea articulata*	Jointed Twig-rush
Cyperaceae		*Carex inversa*	Knob Sedge
Cyperaceae		*Cyperus difformis*	Dirty Dora
Cyperaceae	*	*Cyperus eragrostis*	Umbrella Sedge
Fabaceae (Faboideae)		*Glycine tabacina*	Variable Glycine
Fabaceae (Faboideae)	*	*Robinia pseudoacacia*	Black Locust
Fabaceae (Faboideae)	*	*Trifolium arvense*	Haresfoot Clover
Fabaceae (Faboideae)	*	*Trifolium repens*	White Clover
Fabaceae (Faboideae)	*	*Vicia sativa*	Common vetch
Fabaceae (Mimosoideae)		*Acacia dealbata*	Silver Wattle
Fabaceae (Mimosoideae)		*Acacia fimbriata*	Fringed Wattle
Fabaceae (Mimosoideae)		*Acacia mearnsii*	Black Wattle
Geraniaceae		*Geranium solanderi*	Native Geranium
Juncaceae		*Juncus sp.*	A Rush
Lamiaceae	*	*Salvia verbenaca*	Vervain
Lomandraceae		*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush
Malaceae	*	*Crataegus monogyna* subsp. *monogyna*	
Myrtaceae		*Eucalyptus macrorhyncha*	Red Stringybark
Myrtaceae		*Eucalyptus polyanthemos*	Red Box
Myrtaceae		*Eucalyptus rubida*	Candlebark
Oleaceae	*	*Ligustrum lucidum*	Large-leaved Privet
Onagraceae		*Epilobium billardiereanum*	
Onagraceae	*	*Oenothera stricta* subsp. *stricta*	
Pinaceae	*	*Pinus radiata*	Radiata Pine
Plantaginaceae	*	*Plantago lanceolata*	Lamb's Tongues
Poaceae		*Austrostipa sp.*	A Speargrass
Poaceae		*Bothriochloa macra*	Red Grass
Poaceae	*	*Bromus catharticus*	Praire Grass

Family	Exotic	Scientific Name	Common Name
Poaceae	*	*Bromus diandrus*	Great Brome
Poaceae		*Chloris truncata*	Windmill Grass
Poaceae		*Cynodon dactylon*	Common Couch
Poaceae	*	*Dactylis glomerata*	Cocksfoot
Poaceae		*Elymus scaber*	Common Wheatgrass
Poaceae		*Enneapogon nigricans*	Nineawn Grass
Poaceae	*	*Festuca arundinacea*	Tall Festcue
Poaceae		*Lachnagrostis filiformis*	
Poaceae		*Microlaena stipoides*	Weeping Grass
Poaceae		*Panicum effusum*	Hairy Panic
Poaceae	*	*Paspalum dilatatum*	Paspalum
Poaceae	*	*Phalaris aquatica*	Phalaris
Poaceae		*Poa labillardierei* var. *labillardierei*	Tussock
Poaceae		*Rytidosperma* sp.	
Poaceae	*	*Setaria pumila*	Pale Pigeon Grass
Polygonaceae		*Persicaria lapathifolia*	Pale Knotweed
Polygonaceae	*	*Rumex crispus*	Curled Dock
Primulaceae	*	*Lysimachia arvensis*	Scarlet Pimpernel
Rosaceae	*	*Rosa rubiginosa*	Sweet Briar
Rosaceae	*	*Rubus fruticosus* sp. agg.	Blackberry complex
Rosaceae	*	*Sanguisorba minor* subsp. *muricata*	Sheep's Burnet
Rubiaceae	*	*Galium aparine*	Goosegrass
Salicaceae	*	*Populus alba*	White Poplar
Salicaceae	*	*Salix babylonica*	Weeping Willow
Scrophulariaceae	*	*Verbascum thapsus* subsp. *thapsus*	Great Mullein
Solanaceae	*	*Solanum nigrum*	Black-berry Nightshade
Typhaceae		*Typha orientalis*	Broad-leaved Cumbungi
Verbenaceae	*	*Verbena bonariensis*	Purpletop

Table A 3 Aquatic fauna species recorded in the vicinity of the proposal site

Scientific name	Common name	Molonglo River below Lake Burley Griffin	Lake Burley Griffin	Molonglo River above Lake Burley Griffin
Native Fish				
Murray Cod	*Maccullochella peelii*	✓	✓	✓
Macquarie Perch	*Macquaria australasica*	✓		✓
Golden Perch	*Macquaria ambigua*	✓	✓	✓
Silver Perch	*Bidyanus bidyanus*	✓		✓
Freshwater Catfish	*Tandanus tandanus*			✓
Trout Cod	*Maccullochella macquariensis*			
Western Carp Gudgeon	*Hypseleotris klunzingeri*	✓	✓	✓
Mountain Galaxias	*Galaxias olidus*	✓		✓

Scientific name	Common name	Molonglo River below Lake Burley Griffin	Lake Burley Griffin	Molonglo River above Lake Burley Griffin
Australian Smelt	*Retropinna semoni*	✓	✓	
Australian Bass	*Percalates novemaculeata*		✓	
Introduced Fish				
Common Carp	*Cyprinus carpio*	✓	✓	✓
Redfin Perch	*Perca fluviatilis*	✓	✓	✓
Goldfish	*Carassius auratus*	✓	✓	✓
Mosquitofish	*Gambusia holbrooki*	✓	✓	✓
Rainbow Trout	*Oncorhynchusus mykiss*	✓	✓	✓
Brown Trout	*Salmo trutta*	✓	✓	✓
Brook Trout	*Salvelinus fontinalis*			✓
Oriental Weatherloach	*Misgurnus anguillicaudatus*	✓		✓
Crustacea				
Murray River Crayfish	*Euastacus armatus*	✓		
Mammals				
Platypus	*Ornithorhynchus anatinus*	✓		
Amphibians				
Long-necked Turtle	*Chelodina longicollis*	✓		

Presence of fish species based on:

Beitzel, M., Evans, L. and Jekabsons, M. (2018). *Lake Burley Griffin Fisheries Survey 2017*. Report prepared for National Capital Authority by Conservation Research, Environment, Planning and Sustainable Development Directorate, ACT Government.

GHD (2016). Lower Molonglo Water Quality Control Centre Fish Survey 2016. Report by GHD to Icon Water, Canberra, ACT.

Lintermans, M. (2000). *The Status of Fish in the Australian Capital Territory: Review of Current Knowledge and Management Requirements*. A report to the ACT Government by Wildlife Research & Monitoring, Technical Report No. 15, ACT.

Lintermans, M. (2004). 2003 Monitoring Program to Assess the Impacts of the Lower Molonglo Water Quality Control Centre on Fish Populations in the Murrumbidgee and Molonglo Rivers. A report to ActewAGL by Wildlife Research & Monitoring.

Appendix B

Assessment of likelihood of occurrence of threatened biota within proposal site

Table B 1 Key to conservation status for listed threatened species

Code	Conservation status	Legislation
CE	Critically Endangered	NC Act (ACT) and EPBC Act (Federal)
E	Endangered	NC Act (ACT) and EPBC Act (Federal)
V	Vulnerable	NC Act (ACT) and EPBC Act (Federal)
-	Not Listed	NC Act (ACT) and EPBC Act (Federal)

Table B 2 Likelihood of occurrence criteria

Likelihood	Criteria
Confirmed Present	Species recorded during the field survey within the site
Likely to occur	Species has been historically recorded in the proposed site and suitable habitat is present in the proposed site.
May occur	Suitable habitat is present within the proposed site, but the species has not been recorded in the proposed site. The species may have been recorded within the locality.
Unlikely to occur	Species has not been previously recorded in the study area and suitable habitat is generally lacking from the study area; and/or current known distribution does not encompass study area

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
Fauna						
Birds						
Anthochaera phrygia Regent Honeyeater	1 record within 10km (DPE, 2023)	CE	CE	Mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Found in drier coastal woodlands and forests in some years. Only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. Very patchy distribution in NSW, mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests. Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany. Flowering of associated species such as Thin-leaved Stringybark *Eucalyptus eugenioides* and other Stringybark species, and Broad-leaved Ironbark *E. fibrosa* can also contribute important nectar flows at times. Nectar and fruit from the mistletoes *Amyema miquelii*, A. pendula and *A. cambagei* are also utilised (DCCEEW, 2023a; DPE, 2023)	**Unlikely to occur** There is no suitable habitat within the proposed site.	**None**
Aphelocephala leucopsis Southern Whiteface	Previously recorded in the proposal site in 2018 (ALA, 2023)	V	-	Occur across most of mainland Australia south of the tropics, from the north-eastern edge of the Western Australian wheatbelt, east to the Great Dividing Range. There is a broad hybrid zone between the two subspecies extending north from the western edge of the Nullarbor Plain. The northern boundary extends to about Carnarvon in the west, to the southern Northern Territory in central Australia, but is slightly further south in Queensland where the species is largely confined to the south-west of the Mitchell Grass Downs and along the	**Likely to occur** The species has previously been recorded in the proposed site in 2018 (ALA, 2023). There is some suitable habitat within the proposed	**Unlikely impact** There were no nests identified and the areas where the species are more likely to forage are not proposed to be disturbed or removed.

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				southern state border. They live in a wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both. These areas are usually in habitats dominated by acacias or eucalypts on ranges, foothills and lowlands, and plains. Southern whiteface forage almost exclusively on the ground, favouring habitat with low tree densities and an herbaceous understorey litter cover. Birds mainly feed on insects, spiders, and seeds, largely gleaned from the bare ground or leaf litter. Habitat loss and fragmentation is likely the cause of the species decline, especially in the parts of the species' range where there has been complete removal of habitat for intensive agriculture. Droughts may have local impacts (DCCEEW, 2023a; DPE, 2023).	site. No nests were identified. Better quality habitat present in adjacent areas.	
Botaurus poiciloptilus Australasian Bittern	Species previously recorded in the proposal site in 2017 (ALA, 2023)	E	E	Widespread but uncommon over south-eastern Australia. Found over most of NSW except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. May construct feeding platforms over deeper water from reeds trampled by the bird; platforms are often littered with prey remains (DCCEEW, 2023a; DPE, 2023).	**Likely to occur** The species has previously been recorded in the proposed site in 2017 (ALA, 2023). There is suitable habitat within the proposed site.	**Unlikely impact** Areas of wetland habitat are not proposed to be disturbed or removed.
Calidris ferruginea Curlew Sandpiper	Four records 8 km east of the proposed site in Jerrabomberra Wetlands, the most recent 2018 (ALA, 2023)			This species occurs along the coasts of all states of Australia and are scattered inland. There are records across all states during breeding and non-breeding season. In NSW, there are records along the coast, east of the Great Divide as well as scattered records across the Tablelands, Riverina and south-west NSW (DCCEEW, 2023). The species inhabits littoral and estuarine habitats, particularly in intertidal mudflats of sheltered coasts within NSW. There are records within non-tidal swamps, lakes and lagoons both coastal and inland. Forages for worms, molluscs, crustaceans, insects and some seeds in or at the edge of shallow water, or algae mats (DPE, 2023).	**Unlikely to occur** The species has not been previously recorded in the proposed site and suitable habitat is generally lacking.	**None**
Callocephalon fimbriatum Gang-gang Cockatoo	164 records within 10km (DPE, 2023)	E	-	In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-	**May occur** There is limited suitable foraging	**Unlikely impact** Areas of suitable habitat are not

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. In spring and summer the species is generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas (DCCEEW, 2023a; DPE, 2023).	habitat within the proposed site.	proposed to be disturbed or removed.
Calyptorhynchus lathami lathami South-eastern Glossy Cockatoo	2 records within 10km (DPE, 2023)	V	V	The species is uncommon although widespread throughout suitable forest and woodland habitats. Occurs from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species) (DCCEEW, 2023a; DPE, 2023).	**May occur** There is limited suitable foraging habitat within the proposed site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.
Climacteris picumnus victoriae Brown Treecreeper	2 records within 10km (DPE, 2023)	V	V	The western boundary of the species range runs approximately through Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell. Often found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. Also found in mallee and River Red Gum (Eucalyptus camaldulensis) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses. Usually not found in woodlands with a dense shrub layer. Fallen timber is an important habitat component for foraging. Also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains (DCCEEW, 2023a; DPE, 2023).	**May occur** There is limited suitable foraging habitat within the proposed site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.
Daphoenositta chrysoptera Varied Sitella	4 records within 10km (DPE, 2023)	-	V	Sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast	**May occur** There is limited suitable habitat	**Unlikely impact** Areas of suitable habitat are not

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
	Multiple (>20) records of the species in the locality within the previous five years (ALA, 2023).			to the far west. The species inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland (DCCEEW, 2023a; DPE, 2023).	within the proposed site.	proposed to be disturbed or removed.
Falco hypoleucos Grey Falcon	One record from an unknown year 11 km east of the proposed site (ALA, 2023)	V	V	Sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey (DCCEEW, 2023a; DPE, 2023).	**May occur** There is limited suitable habitat within the proposed site.	**Unlikely impact** Highly mobile species, no nest trees present.
Grantiella picta Painted Honeyeater	Six records within the locality, as recent as 2019 (ALA, 2023).	V	V	Nomadic species occurring at low densities throughout its range. Most commonly found on the inland slopes of the Great Dividing Range in NSW, where almost all breeding occurs. More likely to be found in the north of its distribution in winter. Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. Specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema (DCCEEW, 2023a; DPE, 2023).	**May occur** There is limited suitable habitat within the proposed site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.
Hieraaetus morphnoides Little Eagle	20 records within 10km (DPE, 2023)	-	V	Found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. Occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Also found in Sheoak or Acacia woodlands and riparian woodlands of inland NSW. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter (DCCEEW, 2023a; DPE, 2023).	**Likely to occur** Likely to forage.over the proposal site on occasion.	**Unlikely impact** Highly mobile species, no nest trees present.
Hirundapus caudacutus White-throated Needletail	There is one record within the proposed site from 2017 and >30 records within the locality (ALA, 2023).	V	V	Migrates to eastern Australia from October to April. Almost exclusively aerial and most often seen before storms, low pressure troughs and approaching cold fronts and occasionally bushfire. Occurs over most types of habitat, but mostly recorded above wooded areas, including open forest and rainforest. May also fly between trees or in clearings, below the canopy. Recorded roosting in trees in forests and woodlands,	**Likely to occur** Likely to forage well above the proposal site on occasion.	**None** Highly mobile aerial species that is likely to forage above the site only

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				both among dense foliage in the canopy or in hollows (DCCEEW, 2023a; DPE, 2023).		
Lathamus discolor Swift Parrot	2 records within 10km (DPE, 2023)	CE	CE	Migrates from Tasmania to south-eastern Australia in the autumn and winter months. Mostly occurs on the coast and south west slopes in NSW. Occurs on the mainland in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted *Gum Corymbia maculata*, Red Bloodwood *C. gummifera*, Forest Red Gum *E. tereticornis*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens* (DCCEEW, 2023a; DPE, 2023).	**May occur** There is limited suitable habitat within the proposed site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	Species or species habitat known/may occur (DCCEEW, 2023)	V	-	This migratory shorebird has been recorded along the coast of all Australian states. Occurs in Torres Strait and along the south-east and east coast of QLD, NSW, Victoria and Tasmania. There are records along the majority of the SA coast and in WA from Eyre to Derby. This species is found in coastal habitats including intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. There are records in coastal sewage farms and saltwork, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats Forages on the edge of water or in shallow water with exposed sandy or soft mud substrates. Roosting habitat includes sandy beaches, sandbars or spits near saltmarsh (DCCEEW, 2023a).	**Unlikely to occur** No suitable habitat.	**None**
Melanodryas cucullata cucullata South-eastern Hooded Robin	Species or species habitat known/may occur (DCCEEW, 2023)	E	V	Found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west, where it is replaced by subspecies picata. Prefers lightly wooded country, usually open eucalypt woodland, Acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses (DCCEEW, 2023a; DPE, 2023).	**May occur** There is limited suitable habitat within the proposed site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.
Neophema chrysostoma Blue-winged Parrot	Species or species habitat known/may occur	V	-	Breed on mainland Australia south of the Great Dividing Range in southern Victoria from Port Albert in Gippsland west to Nelson, occasionally in the far south-east of South Australia, and the north-western, central and	**Unlikely to occur** There are no records within the last 25 years within the	**None**

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
	(DCCEEW, 2023)			eastern parts of Tasmania. A partial migrant, variable numbers of birds migrate across Bass Strait in winter. During the non-breeding period, from autumn to early spring, birds are recorded from northern Victoria, eastern South Australia, south-western Queensland and western New South Wales, with some reaching south-eastern New South Wales and eastern Victoria, particularly on the southern migration. They inhabit a range of habitats from coastal, sub-coastal and inland areas, through to semi-arid zones. They tend to favour grasslands and grassy woodlands, often found near wetlands both near the coast and in semi-arid zones. The species can also be seen in altered environments such as airfields, golf-courses and paddocks. Pairs or small parties forage mainly near or on the ground for seeds of a wide range of native and introduced grasses, herbs and shrubs. Habitat critical to the survival include: Foraging and staging habitats found from coastal, sub-coastal and inland areas, right through to semi-arid zones including: grasslands, grassy woodlands and semi-arid chenopod shrubland with native and introduced grasses, herbs and shrubs. Wetlands both near the coast and in semi-arid zones used for foraging and staging. Eucalypt forests and woodlands within the breeding range in Tasmania, coastal south-eastern South Australia and southern Victoria. Live and dead trees and stumps with suitable hollows within the breeding range. Though there is no clear explanation for the population decline, declines have likely been caused by habitat loss and deterioration in habitat quality (DCCEEW, 2023a; DPE, 2023).	locality (DPE, 2023; ALA, 2023). no suitable habitat within the proposed site.	
Numenius madagascariensis Eastern Curlew	Species or species habitat known/may occur (DCCEEW, 2023)	CE	CE	This species is primarily distributed along the coast of all the states in Australia and are rarely recorded inland. There are recorded along the entire coast of, NT, QLD and NSW with patchy distribution elsewhere. Do not breed in Australia and are mainly associated with sheltered coasts, harbours, laggoons, mudflats and ssandflats with beds of seagrass. There are records in saltmarsh and mangroves (DCCEEW, 2023a).	**Unlikely to occur** No suitable habitat.	**None**
Petroica boodang Scarlet Robin	72 records within 10km (DPE, 2023)	-	V	Occurs from the coast to the inland slopes in NSW. Disperses to the lower valleys and plains of the tablelands and slopes after breeding. Some birds may appear as far west as the eastern edges of the inland	**Likely to occur** There is suitable habitat within the proposed site.	**Unlikely impact** Areas of suitable habitat are not proposed to be

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				plains in autumn and winter. Found in dry eucalypt forests and woodlands with usually open and grassy understorey with few scattered shrubs. Lives in both mature and regrowth vegetation and occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Abundant logs and fallen timber are important components of its habitat (DCCEEW, 2023a; DPE, 2023).		disturbed or removed.
Polytelis swainsonii Superb Parrot	19 records within 10km (DPE, 2023)	V	V	Found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round. Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest (DCCEEW, 2023a; DPE, 2023).	**May occur** There is limited suitable habitat within the proposal site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.
Pycnoptilus floccosus Pilotbird	Species or species habitat known/may occur (DCCEEW, 2023)	V	-	Endemic to south-east Australia. Upland Pilotbirds occur above 600 m in the Brindabella Ranges in the ACT, and in the Snowy Mountains in NSW and north-east Victoria. Lowland Pilotbirds occur in forests from the Blue Mountains west of Newcastle, around the wetter forests of eastern Australia, to Dandenong near Melbourne. Habitat critical to the survival of the Pilotbird includes: wet sclerophyll forests in temperate zones in moist gullies with dense undergrowth, and dry sclerophyll forests and woodlands occupying dry slopes and ridges (DCCEEW, 2023a; DPE, 2023).	**Unlikely to occur** No suitable habitat.	**None**
Rostratula australis Australian Painted Snipe	Species or species habitat known/may occur (DCCEEW, 2023)	E	E	In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River, the Clarence and lower Hunter Valleys. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Forages nocturnally on mud-flats and in shallow water (DCCEEW, 2023a; DPE, 2023).	**May occur** The most recent record within the locality is from 2020 and is 7 km south-east of the proposed site. There is suitable habitat in the proposed site.	**Unlikely impact** Areas of wetland habitat are not proposed to be disturbed or removed.

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
Stagonopleura guttata Diamond Firetail	60 records within 10km (DPE, 2023)	V	-	The Diamond Firetail occurs on the south-east mainland of Australia from south-east Queensland to the Eyre Peninsula, South Australia, and about 300 km inland from the sea. The species occurs in eucalypt, acacia, or casuarina woodlands (*Casuarina spp.*), open forests and other lightly timbered habitats, including farmland and grassland with scattered trees. They prefer areas with relatively low tree density, few large logs, and little litter cover but high grass cover. The drooping she-oak (*Allocasuarina verticillate*) is considered to be an important source of habitat especially within the Mount Lofty Ranges of South Australia (DCCEEW, 2023a; DPE, 2023).	**Likely to occur** There is suitable habitat within the proposal site.	**Unlikely impact** Limited impact on preferred habitat.
Fish						
Bidyanus bidyanus Silver Perch	Species or species habitat known/may occur (DCCEEW, 2023)	CE	E	A medium to large-bodied river channel specialist. Once widespread across the lowland rivers of the Murray Darling Basin but has suffered significant declines in range and abundance. Reported to be locally extinct in the ACT. Found across a variety of habitats in perennial, flowing rivers from large fast flowing reaches to slower flowing, turbid lowland reaches. Can also be found in impoundments and floodplain lakes, but breeding is low in these environments as they require perennial flowing water to complete its life cycle. Often found where there are rapids and races. Some evidence the species is associated with submergent or emergent vegetation, but juveniles prefer open water. Considered highly mobile throughout all life stages.	**Unlikely to occur** No records upstream, within or downstream of lake Burley Griffin. Considered to be locally extinct in ACT (Lucas et al. 2019).	**None** Unlikely to be present within or downstream from proposal.
Maccullochella macquariensis Trout Cod	Species or species habitat known/may occur (DCCEEW, 2023)	E	E	A medium to large-bodied river channel specialist. Once widespread in middle and upper reaches of the Murray, Murrumbidgee and Macquarie River systems, but the species range and abundance has declined significantly since the 1950s. The only remaining natural population is in the Murray River between Yarrawonga Wier and Barmah State Forest. Inhabits a variety of flowing habitats with cover including woody debris or boulders. Usually located further from the bank (i.e., mid-channel) in deeper, faster-flowing water than other large-bodied fish species. Young of year and larvae only appear to use main channel and flowing	**Unlikely to occur** No records upstream, within or downstream of lake Burley Griffin.	**None** Unlikely to be present within or downstream from proposal site.

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				anabranch channel habitats. Movement is limited, with most individuals exhibiting high site fidelity.		
Maccullochella peelii Murray Cod	Species or species habitat known to occur within 10km Species population or habitat mapped within 10km	V		Australia's largest freshwater fish, reaching a maximum length of 1.8 m and 113 kg. This iconic species has high conservation, biodiversity, cultural and recreational values. Apex predators that occupy a broad range of habitats from large, turbid, slow flowing rivers to clear rocky streams and billabongs. While they occupy a broad range of flowing and standing waters it is considered a main river channel specialist. They show a high affinity for structural woody habitat in deeper water, close to banks in areas of flowing water. While the species generally exhibits high site fidelity and homing behaviours, they opportunistically make large scale movements.	**May occur** Stocked population in Lake Burley Griffin. Has been recorded in Molonglo River downstream from proposal site but site itself not likely to support population.	**Unlikely impact** With standard mitigation measures in place, there is a low likelihood of downstream impacts. Stocked population unlikely to be impacted by temporary lowering of Lake Burley Griffin water levels as sufficient aquatic habitat would remain and population is not self-sustaining, so no impact to breeding. Any direct impacts to aquatic habitat downstream from Lake Burley Griffin would be temporary and in a location that is unlikely to support the species.
Macquaria australasica Macquarie Perch	Species or species habitat known/may occur (DCCEEW, 2023)	E	E	A moderate sized fish that predominantly inhabits rivers. Once widespread and abundant in the southern Murray Darling Basin, this species has undergone considerable declines in range and is now fragmented into small discrete, reproductively isolated populations. It is now mostly restricted to the upper reaches of catchments generally inhabiting reaches where natural flow and water temperature regimes remain and riparian zones are intact. A riverine species that can survive well in impoundments where there is access to suitable riverine habitats for spawning. The species lives in cool, clear waters at well-	**May occur** Has been recorded in Molonglo River downstream from proposal site but site itself not likely to support population.	**Unlikely impact** With standard mitigation measures in place, there is a low likelihood of downstream impacts. Any direct impacts to aquatic habitat would be temporary and in a location

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				defined home sites, generally in deep, slow flowing pools with suitable cover (e.g., undercut banks, woody debris, boulders). Adults are relatively sedentary and have small core home ranges (<4 km).		that is unlikely to support the species.
Murray River Crayfish *Euastacus armatus*	Species or species habitat known/may occur (DCCEEW, 2023)	V	V	The largest species in the *Euastacus* genus and the second largest freshwater crayfish in the world. Historically, they were present within the main channel and tributaries of the Murray, Murrumbidgee, Mitta Mitta, Kiewa, Ovens and Goulburn rivers, existing from the upper reaches (from over 700 m), downstream to at least Murray Bridge in South Australia. Given its widespread distribution, its existence in both large and small streams (ranging from pasture-lands to sclerophyll forests), and particularly its broad altitudinal range, it appears they are tolerant of a variety of instream habitats. Tend to occur predominately near clay banks and in deep water in areas with some flow. They build and use burrows within riverbanks for shelter, often beneath rocks or logs.	**May occur** Has been recorded in Molonglo River downstream from proposal site but site itself not likely to support population.	**Unlikely impact** With standard mitigation measures in place, there is a low likelihood of downstream impacts. Any direct impacts to aquatic habitat would be temporary and in a location that is unlikely to support the species.
Frogs						
Litoria aurea Green and Golden Bell Frog	Species or species habitat known/may occur (DCCEEW, 2023)	V	V	The Green and Golden Bell Frog occurs mainly along coastal lowland areas of eastern NSW and Victoria. The most northern extent of the species distribution is Yuraygir National Park near Grafton, while the most southern is in the vicinity of Lake Wellington, in south-eastern Victoria. The species habitat appears to differ between NSW and Victoria. In NSW, the species commonly occupies disturbed habitats, and breeds largely in ephemeral ponds. However, in Victoria, populations preference habitats with little human disturbance and commonly breed in both ephemeral and permanent ponds. Both populations avoid fast-flowing water and are associated with a large diversity of aquatic and bankside vegetation especially Salt Marsh Rush (*Juncus kraussii*), Club-rush (*Schoenoplectus litoralis*) and Saltwater Rush (*Sporobolus virginicus*) (DCCEEW, 2023a; DPE, 2023).	**May occur** There is potentially suitable wetland habitat present, however fast-flowing water reduces habitat suitability. Only known population is from the Captains Flat area.	**Unlikely impact** Areas of wetland habitat are not proposed to be disturbed or removed.
Litoria booroolongensis Booroolong Frog	Species or species habitat known/may occur	E	-	The Booroolong Frog is restricted to tablelands and slopes in NSW and north-east Victoria at 200–1300 m above sea level. Its range extends from Tamworth in northern NSW to the Southern Highlands in Victoria The	**May occur** No suitable cobble habitat present.	**None**

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
	(DCCEEW, 2023)			species occurs along permanent streams with pools or other rock structures and fringing vegetation cover such as ferns, sedges or grasses. Streams range from small slow-flowing creeks to large rivers. Booroolong Frogs are most commonly associated with wet and dry sclerophyll forests, grassy woodland, heathland, forested wetland, freshwater wetland, rainforest and cleared grazing land or pasture (DCCEEW, 2023a; DPE, 2023).		
Litoria castanea Yellow-spotted Bell Frog	Species or species habitat known/may occur (DCCEEW, 2023)	CE	CE	The Yellow-spotted Bell Frog occurs is two disjunct populations; one centred around the town of Guyra on the New England Tableland, NSW and the other between Canberra, ACT, and Bombala, NSW. Require large permanent ponds or slow flowing 'chain-of-ponds' streams with abundant emergent vegetation such as bulrushes and aquatic vegetation. Habitat may include rotting logs and the roots of uprooted trees (DCCEEW, 2023a; DPE, 2023). The Yellow-spotted Bell Frog was thought to have been rediscovered in 2009 in the southern tablelands near Yass (OEH 2015). Individuals recorded were identified as *L. castanea* however, a genetic assessment of this newly discovered population found that these individuals clustered within the *L. raniformis* inland group at a low level of sequence divergence (DCCEEW, 2023a.	**Unlikely to occur** Limited suitable habitat present, no known extant populations in the region.	**Unlikely impact** Areas of wetland habitat are not proposed to be disturbed or removed.
Litoria raniformis Southern Bell Frog	Species or species habitat known/may occur (DCCEEW, 2023)	V	V	The Southern Bell Frog is widespread in isolated populations throughout the Murray River Valley, greater Melbourne and various major river systems across south-east Australia. This species is found mostly amongst emergent vegetation, including bullrush (*Typha* spp.), reeds (*Phragmites* spp.) and sedges (*Eleocharis* spp.), at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams. The Southern Bell Frog has a preference for warmer lowland water (DCCEEW, 2023a; DPE, 2023).	**May occur** There is potentially suitable wetland habitat present, however fast-flowing water reduces habitat suitability.	**Unlikely impact** Areas of wetland habitat are not proposed to be disturbed or removed.
Insects						
Keyacris scurra Key's Matchstick Grasshopper	2 records within 10 km (ACT Government, 2023a).	E	-	The Key's Matchstick Grasshopper has a range restricted primarily to the ACT and surrounds, with the possibility for formerly detected populations to still be present in Murrumbateman. The species is usually found in native grasslands but has also been recorded in other vegetation associations containing a native grass	**Likely to occur** Known populations in the locality. Habitat limited due to	**Unlikely impact** Limited impact on good quality grassland habitat

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				understory (especially kangaroo grass, *Themeda triandra*) and known food plants (particularly of the family Asteraceae) (DCCEEW, 2023a).	the lack of preferred feed plants	
Perunga ochracea Perunga Grasshopper	16 records within 10 km (ACT Government, 2023a).	-	V	The Perunga Grasshopper has an observed range that stretches 180 km east–west and 150 km north–south over Murrumbateman, Gundaroo, the ACT and Bungendore. The species is found in areas of native grassland, particularly Natural Temperate Grasslands featuring Capeweed *(Arctotheca calendula*), Wild Geranium (*Erodium* spp.) and Common Everlasting (*Chrysocephalum apiculatum*). Some records suggest that the species may also occur in open woodland areas with a grassy understorey, including the Yellow Box–Blakley's Red Gum Grassy Woodland community (DCCEEW, 2023a; DPE, 2023).	**May occur** Known populations in the locality. Habitat limited due to the lack of preferred feed plants	**Unlikely impact** Limited impact on good quality grassland habitat
Synemon plana Golden Sun Moth	45 records within 10 km (ACT Government, 2023a).166 records within 10 km (DPE, 2023)	V	E	The Golden Sun Moth occurs in fragmented populations spanning south-west Victoria, parts of central Victoria, and the ACT and surrounds. The species is strongly association with the presence of native temperate grasslands dominated by Wallaby Grasses (*Rytidosperma* spp.). Populations have been observed in other native grassland, open grassy woodlands and secondary grassland, notably thriving in those invaded by exotic Chilean Needlegrass (*Nassella neesiana*) (DCCEEW, 2023a; DPE, 2023).	**May occur** Known populations in the locality. Habitat limited due to the lack of good quality grassland.	**Unlikely impact** Limited impact on good quality grassland habitat
Mammals						
Chalinolobus dwyeri Large-eared Pied Bat	Species or species habitat known/may occur (DCCEEW, 2023)	V	-	The Large-eared Pied Bat is irregularly distributed in central-eastern NSW and south-eastern and central Queensland, from an area bounded by Shoalwater Bay in Queensland, south to Ulladulla in NSW. The species has a close association with sandstone escarpments and fertile valleys, particularly those supporting box gum woodland. The presence of suitable caves or overhangs may be more important than the precise geology, as Large-eared Pied Bats roost in rhyolite cliffs and mineshafts in south-east Queensland (DCCEEW, 2023a; DPE, 2023).	**Unlikely to occur** There are no records of the species within the locality. There is no suitable habitat within the proposed site.	**None**
Dasyurus maculatus maculatus Spotted-tail Quoll	5 records within 10 km (ACT Government,	E	V	The Spotted-tail Quoll's mainland population occurs in highly fragmented populations across eastern Australia from south-eastern Queensland to western Victoria. The	**Unlikely to occur** Known to use riparian areas for	**None**

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
	2023a). 1 record within 10 km (DPE, 2023)			species is solitary and maintains large home ranges in closed forests (including temperate and sub-tropical rainforest), tall eucalypt forests, open woodlands, open forests, dry woodlands, and coastal heathlands. Desirable habitats provide an abundance of fallen logs, boulder piles, burrows, and tree hollows for daytime sheltering (DCCEEW, 2023a; DPE, 2023).	movement. Limited suitable habitat present, and dam is likely to limit connectivity in the areas	
Petauroides volans Greater Glider (Southern and Central)	Species or species habitat known/may occur (DCCEEW, 2023)	E	V	The Greater Glider (Southern and Central) occurs in eastern Australia, where it has a broad distribution from around Proserpine in Queensland, south through NSW and the ACT, to Wombat State Forest in central Victoria. The distribution is restricted in the ACT, only occurring in the Lower Cotter Catchment and Namadgi National Park. The species is arboreal and largely restricted to eucalypt forests and woodlands. It is typically found in highest abundance in taller, montane, moist eucalypt forests on fertile soils, with relatively old trees and abundant hollows. Some populations occur in drier habitats such as those in south-eastern Queensland (DCCEEW, 2023a; DPE, 2023).	**Unlikely to occur** There are no records within the locality and no suitable habitat within the proposed site.	**None**
Petaurus australis australis Yellow-bellied Glider (South-eastern)	Species or species habitat known/may occur (DCCEEW, 2023)	V	-	The Yellow-bellied Glider (South-eastern) is found at altitudes ranging from sea level to 1400 m and has a widespread but patchy distribution from south-eastern Queensland, through NSW and Victoria to south-eastern South Australia, near the Victorian border. The species occurs in eucalypt-dominated woodlands and forests, including both wet and dry sclerophyll forests, with a preference for large patches of mature old growth forest. They occur most frequently in smooth bark eucalypt woodlands with high floristic diversity providing year-round food supply (DCCEEW, 2023a; DPE, 2023).	**Unlikely to occur** There are no records within the locality and no suitable habitat within the proposed site.	**None**
Phascolarctos cinereus Koala	Species or species habitat known/may occur (DCCEEW, 2023)	E	V	The Koala is widespread though patchily distributed across Australia's east coast, from below Queensland's wet tropics down into South Australia. Their distribution also stretches inland to the Western Plains and South-Eastern Highlands in NSW, and historically the ACT. The species primarily occurs in subhumid Eucalyptus forests and woodlands with a preference for those associated with creek-lines, areas of higher tree species richness, and high leaf-moisture content (DCCEEW, 2023a; DPE, 2023).	**Unlikely to occur** There are no records within the locality and no suitable habitat within the proposed site.	**None**

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
Pteropus poliocephalus Grey-headed Flying-fox	Two records within 3 km of the proposed site (ALA, 2023).	V	V	The Grey-headed Flying-fox occurs in the coastal belt from Rockhampton in central Queensland to Melbourne in Victoria, sometimes ranging into South Australia. Patterns of relative abundance vary widely by season and year, however permanent populations exist in Brisbane, Newcastle, Sydney and Melbourne. The species utilises vegetation communities including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps, *Banksia* woodlands and altered urban landscapes. Eucalyptus and related genera provide the primary part of their diet. Roost sites are typically located near water, such as lakes, rivers or the coast with roost vegetation including rainforest patches, stands of *Melaleuca*, mangroves, and riparian vegetation (DCCEEW, 2023a; DPE, 2023).	**May occur** There are two records within the locality. There is some potential foraging habitat within the site.	**Unlikely impact** The species preferred habitat is not proposed to be disturbed or removed during construction.
Reptiles						
Aprasia parapulchella Pink-tailed Worm-lizard	1000 records within 10 km (ACT Government, 2023a). Two records within 2 km west of the proposed site from 2017 (ALA, 2023).	V	V	The Pink-tailed Worm-lizard occurs in NSW, Victoria and the ACT where it is widely but patchily distributed along the foothills of the western slopes of the Great Dividing Range between Bendigo in Victoria and Gunnedah in NSW, and along the Murrumbidgee and Molonglo River corridors. The species frequents primary and secondary grasslands, grassy woodlands, and other woodland communities, characterised by sloping, rocky outcrops or scattered, partially buried rocks. These rocky habitats tend to be well-drained mid-slope or ridge-top sites with loosely embedded rocks on soil substrate with ant galleries present. A cover of predominantly native grasses, particularly kangaroo grass (*Themeda australis*), characterises the majority of known sites (DCCEEW, 2023a; DPE, 2023).	**Likely to occur** Known populations in the locality. Habitat limited due to the lack of good quality grassland and surface rock.	**Unlikely impact** Limited impact on good quality grassland habitat
Delma impar Striped Legless Lizard	12 records within 10 km (ACT Government, 2023a).	V	V	The Striped Legless Lizard is patchily distributed throughout south-eastern NSW, the ACT, north-eastern, central and south-western Victoria, and south-eastern South Australia**.** The species is a grassland specialist, found only in areas of native grassland and nearby grassy woodland or exotic pasture. Ideal sites have high floristic diversity with plentiful surface rocks, arthropod burrows or suitable cracks in the soil (DCCEEW, 2023a; DPE, 2023).	**Likely to occur** Known populations in the locality. Habitat limited due to the lack of good quality grassland and surface rock.	**Unlikely impact** Limited impact on good quality grassland habitat

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
Tympanocryptis pinguicolla Grassland Earless Dragon	4 records within 10 km (ACT Government, 2023a).	E	E	The Grassland Earless Dragon exists in three distinct subpopulations. One north of Canberra International Airport in the ACT, one stretching south from this same site down to Queanbeyan in NSW, and a third in the Monaro region of NSW. The species exists in native temperate grasslands, especially those with populations of wolf spider (*Lycosa* spp.) and wood cricket (*Cooraboorama canberrae*). Grasslands with high connectivity value, embedded surface rocks and numerous tussocks are desirable (DCCEEW, 2023a; DPE, 2023).	**May occur** Few records in the locality. Habitat limited due to the lack of good quality grassland and surface rock.	**Unlikely impact** Limited impact on good quality grassland habitat
Flora						
Ammobium craspedioides Yass Daisy	Species or species habitat known/may occur (DCCEEW, 2023)	V	-	Occurs between Crookwell and Wagga Wagga, with most populations near Yass. Occurs in moist or dry forest communities, Box-Gum Woodland and secondary grasslands derived from clearing of these communities. Grows in association with a range of eucalypts (Blakely's Red Gum, Apple Box, Broad-leaved Peppermint, Long-leaved Box, Red Stringybark, Brittle Gum, Yellow Box, Red Box, Candlebark).	**Unlikely to occur** No suitable habitat present within proposal site	**None**
Amphibromus fluitans River Swamp Wallaby-grass	Species or species habitat known/may occur (DCCEEW, 2023)	V	-	Historic records in the City of Greater Albury. It has been recorded recently in lagoons beside the Murray River near Cooks Lagoon (Shire of Greater Hume), Mungabarina Reserve, East Albury, at Ettamogah, Thurgoona (Charles Sturt University Campus), near Narranderra, and also further west along the Murray River (near Mathoura) and in Victoria. Amphibromus fluitans grows mostly in permanent swamps.	**Unlikely to occur** Marginal habitat present within proposal site. No works proposed within the marginal habitat i.e. wetland areas.	**None**
Caladenia actensis Canberra Spider Orchid	Species or species habitat known/may occur (DCCEEW, 2023)	CE	CE	The species occurs within a number of vegetation communities across its range; specifically Blakely's Red Gum – Yellow Box ± White Box tall grassy woodlands of the Upper South Western Slopes and western South Eastern Highlands Bioregions, Yellow Box ± Apple Box tall grassy woodland of the South Eastern Highlands and Red Stringybark – Scribbly Gum – Red-Anthered Wallaby Grass tall grass-shrub dry sclerophyll open forest on loamy ridges of the central South Eastern Highlands Bioregion (Armstrong and Turner et al. 2013). Small populations on Mt Ainslie and Mt Majura Nature Reserve occur in Drooping She-oak low woodland to	**Unlikely to occur** No suitable habitat present within proposal site	**None**

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				open forest on shallow infertile hillslopes in the Australian Capital Territory and surrounds (Baines et al. 2013). The majority of populations across the species distribution occur within the endangered Yellow Box-Blakely's Red Gum Grassy Woodland. Canberra Spider Orchid plants occur amid a groundcover of grasses, forbs and low shrubs, often among rocks.		
Dodonaea procumbens Trailing Hop-bush	Species or species habitat known/may occur (DCCEEW, 2023)	V	-	Creeping Hop-bush is found in the dry areas of the Monaro, between Michelago and Dalgety. Here it occurs mostly in Natural Temperate Grassland or Snow Gum Eucalyptus pauciflora Woodland. Grows in open bare patches where there is little competition from other species. Found on sandy-clay soils, usually on or near vertically-tilted shale outcrops.	**Unlikely to occur** No suitable habitat present within proposal site. Conspicuous species that was not observed at the site during field survey	**None**
Eucalyptus aggregata Black Gum	1 record within 10 km (DPE, 2023)	V	V	Known only from scattered localities in the cool upper reaches of the Murray-Darling system of NSW, including the Hawkesbury-Nepean and Shoalhaven catchments, Victoria and the Australian Capital Territory. Also found in man-made lakes on the NSW coast and in lakes and reservoirs, where adults aggregate in small shoals during the spawning season. Inhabits cool, clear freshwaters of rivers with deep holes and shallow riffles.	**Unlikely to occur** Conspicuous species that was not observed at the site during field survey	**None**
Lepidium aschersonii Spiny Peppercress	Species or species habitat known/may occur (DCCEEW, 2023)	V	-	Occurring in the marginal central-western slopes and north-western plains regions of NSW. Found on ridges of gilgai clays dominated by *Acacia harpophyll, Casuarina cristata, Allocasuarina luehmannii* and *Eucalyptus microcarpa*, with the understorey often dominated by introduced plants. Grows as a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense, with sparse grassy understorey with introduced plants and occasional heavy litter.	**Unlikely to occur** No suitable habitat present within proposal site	**None**
Lepidium ginninderrense Ginninderra Peppercress	2 records within 10 km (ACT Government, 2023a)	V	E	There are two known extant populations *of L. ginninderrense*, both in the ACT. The larger population occurs in grassland in the north-west corner of Lawson Grasslands (former Belconnen Naval Transmission Station) in the suburb of Lawson. A second population was discovered in 2012 about 6 km north-north-east of Lawson in the Gungahlin suburb of Franklin (altitude 610	**Unlikely to occur** Marginal grassland habitat present however site has high abundance of tall native and exotic	**None**

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				metres) in an 18 hectare paddock containing disturbed grassland and remnant Box-Gum Woodland. At Lawson, *L. ginninderrense* grows on the floodplain of the Ginninderra Creek, in and around slight depressions which are subject to winter inundation. Native grassland species associated with *L. ginninderrense* at Lawson include Wallaby Grasses (*Rytidosperma* spp.), Windmill Grass (*Chloris truncata*), Lemon Beauty-heads (*Calocephalus citreus*) and Fuzzweed (*Vittadinia muelleri*). *Lepidium ginninderrense* is also often associated with low-growing annual exotic forbs and grasses which colonise the same habitat. It is generally not found among taller native and exotic grasses in the same area, which may out compete *L. ginninderrense* for light and other resources.	tussocks forming a dense covering, which would likely to preclude this species from the site.	
Lepidium hyssopifolium Basalt Pepper-cress	Species or species habitat known/may occur (DCCEEW, 2023)	E	-	Currently known near Bathurst, Bungendore and Crookwell, with historic records near Armidale. Known to have occurred in both woodland with a grassy understorey and in grassland. The species may be a disturbance opportunist, as it was discovered at the most recently discovered site (near Bungendore) following soil disturbance. The cryptic and non-descript nature (appearing like several weed species) of the species makes it hard to detect.	**Unlikely to occur** Areas of potentially suitable grassland habitat within study area have been avoided. No suitable habitat within proposal site.	**None**
Lepidium pseudopapillosum Erect Peppercress	1 record within 10 km (DPE, 2023)	V	-	Victorian collections, where the species is considered to be rare, have been made in Buloke/Black Box woodland and open forest of Grey Box.	**Unlikely to occur** No suitable habitat present within proposal site	**None**
Leucochrysum albicans subsp. *tricolor* Hoary Sunray	2 records within 10 km (DPE, 2023). 40 records within 10 km (ACT Government, 2023a)	E	-	Currently occurs on the Southern Tablelands adjacent areas in an area roughly bounded by Albury, Bega and Goulburn, with a few scattered localities know from beyond this region. Found in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils. The species is highly dependent on the presence of bare ground for germination and can occur in modified habitats such as semi-urban areas and roadsides.	**Unlikely to occur** No suitable areas of bare ground present within proposal site	N**one**
Muehlenbeckia Tuggeranong Tuggeranong Lignum	1 record within 10 km (ACT Government, 2023a)	E	E	The species' known habitat is restricted to flood terraces, altitude about 550 metres, on the eastern bank of the Murrumbidgee River near Tuggeranong in the ACT, in areas of rocky outcrops with pockets of silty sandy soil	**Unlikely to occur** No suitable shrubby woodland habitat present within	**None**

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				(Makinson and Mallinson 1997). M. tuggeranong is found in a highly disturbed riparian shrubby woodland association, heavily invaded by weeds. The species is found on nearly bare rock, or tangled amongst other vegetation (ACT Government, 1999).	proposal site. Species is also conspicuous and would have been observed during field surveys if present.	
Neoastelia spectabilis	Species or species habitat known/may occur (DCCEEW, 2023)	V	-	Grows in rock crevices near waterfalls and in seepage lines on rocky slopes in Antarctic Beech rainforest, between 900 - 1150 m altitude.	**Unlikely to occur** No suitable habitat present.	**None**
Pomaderris cotoneaster Cotoneaster Pomaderris	Species or species habitat known/may occur (DCCEEW, 2023)	E	-	Disjunct distribution including the Nungatta area, Tumut, the Tantawangalo area, near Tallong, the Yerranderie area, the Canyonleigh area and Ettrema Gorge. Found in wide range of habitats, including forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs.	**Unlikely to occur** Conspicuous species that would have been observed during field surveys if present.	**None**
Pomaderris pallida Pale Pomaderris	5 records within 10 km (ACT Government, 2023a)	V	V	Currently only recorded from near Kydra Trig, Tinderry Nature Reserve, the Queanbeyan River, the Shoalhaven River (between Bungonia and Warri), the Murrumbidgee River west of the ACT and the Byadbo area in Kosciuszko NP. Usually grows in shrub communities surrounded by Brittle Gum and Red Stringybark or Callitris spp. woodland, or in open forest.	**Unlikely to occur** No suitable habitat present within proposal site. Species is also conspicuous and would have been observed during field surveys if present.	**None**
Prasophyllum petilum Tarengo Leek Orchid	Species or species habitat known/may occur (DCCEEW, 2023)	E	E	Known from five sites near Boorowa, Queanbeyan area, Ilford, Delegate and west of Muswellbrook. Grows in open sites within Natural Temperate Grassland at the Boorowa and Delegate sites. Grows in grassy woodland in association with River Tussock, Black Gum and tea-trees near Queanbeyan and within grassy groundlayer dominated by Kangaroo Grass under Box-Gum Woodland at Ilford. Flowers in October at Boorowa and Ilford, and December at sites near Queanbeyan and Delegate.	**Unlikely to occur** Marginal habitat present however has not been recorded in locality.	**None**
Rutidosis leptorhynchoides Button Wrinklewort	16 records within 10 km (ACT	E	E	Local populations in Goulburn, the Canberra - Queanbeyan area and Michelago. Occurs in Box-Gum Woodland, secondary grassland derived from Box-Gum	**Unlikely to occur**	**None**

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
	Government, 2023a). 1 record within 10km (DPE, 2023)			Woodland or in Natural Temperate Grassland; and often in the ecotone between the two communities. Grows on soils that are usually shallow, stony red-brown clay loams; tends to occupy areas where there is relatively less competition from herbaceous species. Exhibits an ability to colonise disturbed areas (eg. vehicle tracks, bulldozer scrapings and areas of soil erosion).	No suitable habitat present. Soils within proposal site do not match soils characteristic of this species.	
Senecio macrocarpus Large-fruit Fireweed	Species or species habitat known/may occur (DCCEEW, 2023)	V	-	Occurs in Tablelands east and north of the ACT. Found in woodland, grassland, and sedgeland generally on sparsely vegetated sites on sandy loam to heavy clay soils, often in depressions that are waterlogged in winter. The species is generally characterised by relatively heavy soils that may be susceptible to waterlogging and/or summer drought. In addition to this, observations and specific studies of *S. macrocarpus* in native grasslands suggest that competition from other plant species is important in determining the distribution and persistence of S. macrocarpus. In almost all areas where the species currently occurs, competition from other understorey plants is relatively light, either as a result of the physical and floristic characteristics of the site, or due to regular burning. This relative lack of competition may be an important component of habitat critical to the survival of S. macrocarpus	**Unlikely to occur** Possible suitable habitat in waterlogged areas along the western creek bank. These areas however are densely vegetated and are not likely to provide adequate habitat for this species.	**None**
Swainsona recta Small Purple-pea	3 records within 10 km (DPE, 2023). 5 records within 10 km (ACT Government, 2023a).	E	E	Current populations exist in the Queanbeyan and Wellington-Mudgee areas, previous populations thought extinct include Carcoar, Culcairn and Wagga Wagga. Inhabits grassy woodlands and open-forests dominated by Blakely's Red Gum, Yellow Bloodwood, Candlebark and Long-leaved Box and in association with understorey dominants that include Themeda australis, Poa spp. and Austrostipa spp. Flowers throughout spring, with a peak in October.	**Unlikely to occur** Areas of potentially suitable grassland habitat within study area have been avoided. No suitable habitat within proposal site.	**None**
Thesium austral Austral Toadflax	Species or species habitat known/may occur (DCCEEW, 2023)	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Occurs in grassland or grassy woodland and is often found in association with Kangaroo Grass.	**Unlikely to occur** Site significantly degraded and no Kangaroo grass present.	**None**
Migratory Species						

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
Actitis hypoleucos Common Sandpiper	Species or species habitat known to occur (DCCEEW, 2023)	Mig		Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels (DCCEEW, 2023a, DPE, 2023).	**Unlikely to occur** No suitable habitat within the proposed site.	**None**
Apus pacificus Fork-tailed Swift	Species or species habitat known to occur (DCCEEW, 2023)	Mig	-	Almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide. Mostly occur over inland plains but sometimes above foothills or in coastal areas. Mostly found over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. Also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. Sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines. Also found over settled areas, including towns, urban areas and cities (DCCEEW, 2023a, DPE, 2023).	**May occur** There is suitable habitat within the proposed site.	**Unlikely impact** Aerial species that is not likely to be impacted by the proposal
Calidris acuminata Sharp-tailed Sandpiper	Species or species habitat known to occur (DCCEEW, 2023)	Mig	-	Spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. In Australasia, prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. Breeds in northern Siberia (DCCEEW, 2023a; DPE, 2023).	**Unlikely to occur** No suitable habitat within the proposed site.	**None**
Calidris ferruginea Curlew Sandpiper	Species or species habitat known to occur (DCCEEW, 2023)	CE, Mig	CE	Distributed around most of the Australian coastline. Occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Inland records are probably mainly of birds pausing for a few days during migration. Breeds in Siberia and migrates to Australia for the non-breeding period, arriving in Australia between August and November, and departing between March and mid-April. Generally occupies littoral and estuarine habitats, and is mainly found in intertidal mudflats of sheltered coasts in NSW. Also occurs in non-tidal swamps, lakes and	**Unlikely to occur** No suitable habitat within the proposed site.	**None**

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
				lagoons on the coast and sometimes inland. Forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed (DCCEEW, 2023a; DPE, 2023).		
Calidris melanotos Pectoral Sandpiper	Species or species habitat known to occur (DCCEEW, 2023)	Mig	-	Widespread but scattered records across NSW, east of the divide and in the Riverina and Lower Western regions. Breeds in the northern hemisphere. In Australasia, prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Usually in coastal or near-coastal habitats, and prefers wetlands with open mudflats and low emergent or fringing vegetation such as grass or samphire (DCCEEW, 2023a; DPE, 2023).	**Unlikely to occur** No suitable habitat within the proposed site.	**None**
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Species or species habitat known to occur (DCCEEW, 2023)	Mig	-	Non-breeding migrant to the south east of Australia. Breeds in Japan and on the east Asian mainland. Seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. Found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. Also uses crops and pasture (DCCEEW, 2023a, DPE, 2023).	**Likely to occur** There is suitable habitat within the proposal site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.
Hirundapus caudacutus White-throated Needletail	Species or species habitat known to occur (DCCEEW, 2023)	V, Mig	V	Migrates to eastern Australia from October to April. Almost exclusively aerial and most often seen before storms, low pressure troughs and approaching cold fronts and occasionally bushfire. Occurs over most types of habitat, but mostly recorded above wooded areas, including open forest and rainforest. May also fly between trees or in clearings, below the canopy. Recorded roosting in trees in forests and woodlands, both among dense foliage in the canopy or in hollows (DCCEEW, 2023a, DPE, 2023).	**May occur** Species may forage high above the site.	**None**
Limosa lapponica Bar-tailed Godwit	Species or species habitat known to occur (DCCEEW, 2023)	Mig		Recorded in the coastal areas of all Australian states. Widespread along the east and south-east coasts of NSW, including the offshore islands. Few inland records from NSW. Inhabit estuarine mudflats, beaches and mangroves. Common in coastal areas around Australia. Social birds, often seen in large flocks and in the company of other waders (DCCEEW, 2023a, DPE, 2023).	**Unlikely to occur** No suitable habitat within the proposed site.	**None**

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
Monarcha melanopsis Black-faced Monarch	Species or species habitat known to occur (DCCEEW, 2023)	Mig		Found along the coast of eastern Australia, becoming less common further south. Occurs around the eastern slopes and tablelands of the Great Divide, inland to Coutts Crossing, Armidale, Widden Valley, Wollemi National Park, Wombeyan Caves and CanberraIt. Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating (DCCEEW, 2023a, DPE, 2023).Known	**May occur** There is limited suitable habitat within the proposal site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.
Motacilla flava Yellow Wagtail	Species or species habitat known to occur (DCCEEW, 2023)	Mig		Occurs within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns. Breeds in temperate Europe and Asia (DCCEEW, 2023a, DPE, 2023).	**May occur** There is limited suitable habitat within the proposal site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.
Myiagra cyanoleuca Satin Flycatcher	Species or species habitat known to occur (DCCEEW, 2023)	Mig		Found along the east coast of Australia from far northern Queensland to Tasmania. Uncommonly seen species, especially in the far south of its range, where it is a summer breeding migrant. Inhabits heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests (DCCEEW, 2023a, DPE, 2023).	**May occur** There is limited suitable habitat within the proposal site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew	Species or species habitat may occur (DCCEEW, 2023)	CE, Mig		Occurs across the entire coast but is mainly found in estuaries such as the Hunter River, Port Stephens, Clarence River, Richmond River and ICOLLs of the south coast. Generally occupies coastal lakes, inlets, bays and estuarine habitats, and is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts in NSW. Rarely seen inland (DCCEEW, 2023a, DPE, 2023).	**Unlikely** No suitable habitat within the proposed site.	**None**
Pandion haliaetus Osprey	Species or species habitat known to occur (DCCEEW, 2023)	Mig		Found right around the Australian coast line, except for Victoria and Tasmania. Common around the northern coast, especially on rocky shorelines, islands and reefs. Uncommon to rare or absent from closely settled parts of south-eastern Australia. Rare records from inland areas. Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. Breeds in NSW from July to September. Nests are made high up in dead trees or in dead crowns of live trees, usually within 1 km of the sea.	**May occur** There is limited suitable habitat within the proposal site.	**Unlikely impact** Wide-ranging species, no nest trees present.

Species name	Presence	EPBC Act	NC Act	Habitat description	Likelihood of occurrence	Likelihood of impact
Rhipidura rufifrons Rufous Fantail	Species or species habitat known to occur (DCCEEW, 2023)	Mig		Found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas	**May occur** There is limited suitable habitat within the proposal site.	**Unlikely impact** Areas of suitable habitat are not proposed to be disturbed or removed.

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The Power of Commitment

Appendix C

Traffic Impact Assessment

Scrivener Dam Dissipator Strengthening Project (DSP)

Traffic Assessment

National Capital Authority

30 May 2023

→ **The Power of Commitment**

Project name		Scrivener Dam - Dissipator Strengthening - Environmental Assessment					
Document title		Scrivener Dam Dissipator Strengthening Project (DSP) | Traffic Assessment					
Project number		12608465					
File name		12608465-RPT-Scrivener Dam Dissipator Strengthening-Traffic Assessment-Rev0.docx					
Status Code	**Revision**	**Author**	**Reviewer**		**Approved for issue**		
			Name	**Signature**	**Name**	**Signature**	**Date**
S3	A	T Davis/ M Lucas	C Steinbach	On File	H Swinbourne	On File	15/05/22
S4	B	M Lucas	C Steinbach	On File	H Swinbourne	On File	30/05/23
S4	0	M Lucas	C Steinbach	On File	H Swinbourne	On File	30/05/23

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1. Introduction

1.1 Background

GHD Pty Ltd (GHD) has been engaged by the National Capital Authority (NCA) to provide an Environmental Impact assessment (EIA) to support a Minor Works Approval for the Scrivener Dam Dissipator Strengthening Project (DSP).

During the Dam Safety Review conducted in 2016 for the Scrivener Dam and its associated structures, it was discovered that the dissipator's design lacked robustness. As such, the dissipator requires strengthening and associated upgrades to ensure no further damage to the structure and to improve the safety of the dam for the workers.

This EIA has been prepared to document the outcomes of a desktop review of available existing information relating to Scrivener Dam and the surrounding environment. This Traffic Assessment provides a preliminary assessment of the potential traffic/transport impacts associated with the construction activities and identification of potential mitigation measures required.

1.2 The DSP proposal

GHD has been engaged as the Detailed Designer for the Scrivener Dam Dissipator Strengthening Project. GHD completed the Concept Design in 2021, the 50 percent Detailed Design in 2023 and are now in the process of undertaking the 90 percent Detail Design for the DSP.

A majority of the project will involve working in and around the dissipator and below Scrivener Dam in the waterway. There will also be the requirement for a site compound adjacent to the Scrivener Dam Office and temporary access roads.

1.3 The proponent

The NCA was established under the *Australian Capital Territory Planning and Land Management Act 1988*. The NCA performs a special role as the trustee of the National Capital and serves the interests of the Australian Government, the nation and its people.

The roles and responsibilities of the NCA can be summarised into three key areas:

– Planning and design of nationally significant parts of Canberra.
– Information and education.
– Managing the National Capital Estate.

The NCA's statutory roles give it the capacity to ensure national assets continue to be created and maintained, are of an appropriate standard, meet the expectations of users, support appreciation and understanding of the role of the Capital and our democracy, and enrich the experience of the Capital. As part of its responsibilities, the NCA is responsible for the management, maintenance and operations of Scrivener Dam.

1.4 Purpose of this report

The purpose of this Traffic Assessment (TA) is to:

– Quantify the construction impacts of the DSP on the adjoining traffic and transport infrastructure.
– Identify high level mitigation measures to minimise the impacts of the DSP.

1.5 Assumptions and limitations

The preparation of this TA relied on the following data sources or was limited by the following:

– The conditions of the surrounding network are based on information supplied by Google Maps/ Streetview.

- Traffic volumes for Lady Denman Drive were provided by the Transport Canberra and City Services Directorate (TCCS).
- No traffic/parking surveys were undertaken as part of this study.
- The scope of works excludes traffic modelling.
- All construction workers will drive to the site with a car occupancy of one person, i.e., no carpooling.
- Peak worker vehicle activity coincides with the adjoining road network peak periods as a conservative assumption.

2. Existing Conditions

2.1 Existing road network

2.1.1 Road Hierarchy

Roads in the ACT, based on the Trunk Road Infrastructure Standard, are classified based on their predominant function and to the extent they serve the following two basic purposes of the road network:

– Movement of traffic
– Access to property

The road classifications used in the ACT are as follows:

– **Arterial Roads** – predominantly serve longer distance travel within a district and through traffic from one district to another and form the principal avenues of communication for metropolitan scale traffic movements. Design traffic volumes are typically greater than 6,000 vehicles per day.
– **Major Collector Roads** – collect and distribute traffic within residential, industrial, and commercial areas and form the link between the primary network and the roads within local areas and should carry only traffic originating or terminating in the area. Design traffic volumes are typically between 3,001 and 6,000 vehicles per day.
– **Minor Collector Roads** – collect and distribute traffic from access streets, linking to the major collector roads within the neighbourhood, and provide secondary connections direct to the external arterial road network. Design traffic volumes are typically between 1,001 and 3,000 vehicles per day.
– **Local Access Streets** – provide access but do not accommodate traffic generated by sites in other streets, excluding rear lanes. Design traffic volumes are typically less than 1,000 vehicles per day.

A map of the road classifications in proximity to Scrivener Dam is shown in Figure 2-1. Primary access for construction traffic will be provided via Lady Denman Drive, which has been identified as an arterial road with Cotter Road to the south expected to be the other major road link used by vehicles travelling to the site. Cotter Road is also identified as an arterial road.

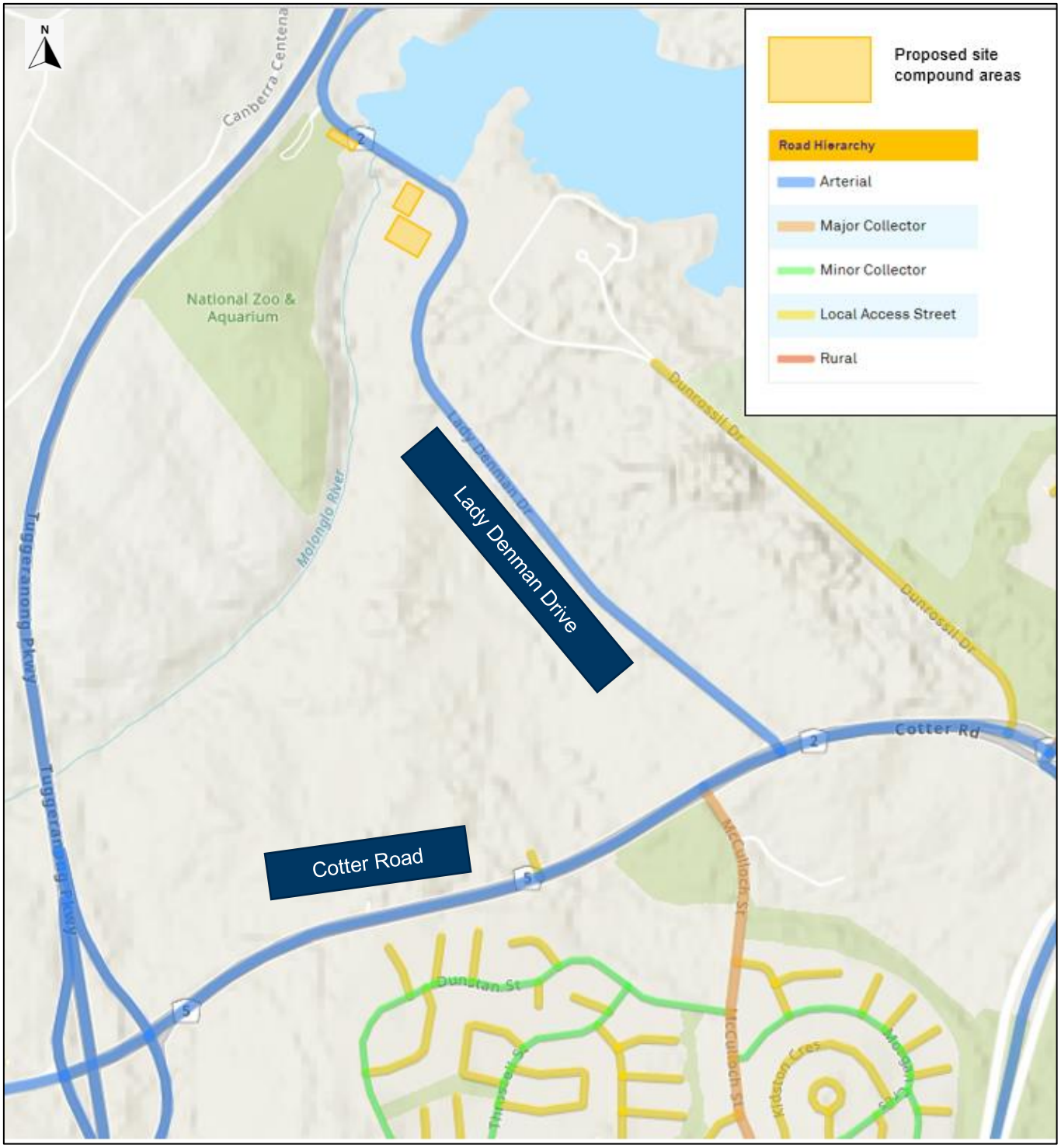


Figure 2-1 Road classification of key roads in proximity to the site

Source: Active Travel Infrastructure Practitioner's Tool (modified by GHD)

2.1.2 Key road characteristics

2.1.2.1 Lady Denman Drive

Lady Denman Drive (Figure 2-2) is an arterial road that provides a link between other arterial roads in the Canberra area. Lady Denman Drive is approximately 6.3 kilometres in length between Cotter Road near Curtin and Parkes Way in Acton. Lady Denman Drive runs along the Molonglo River and Lake Burley Griffin, providing access to locations along the lakefront.

On the western side of the dam, Lady Denman Drive provides access to the National Zoo and Aquarium.

Lady Denman Drive will provide the primary access for vehicles generated from the construction involved in the project to the proposed site compound location. The key features of Lady Denman Drive near the site compound locations are summarised in Table 2-1.

Table 2-1 Lady Denman Drive key features

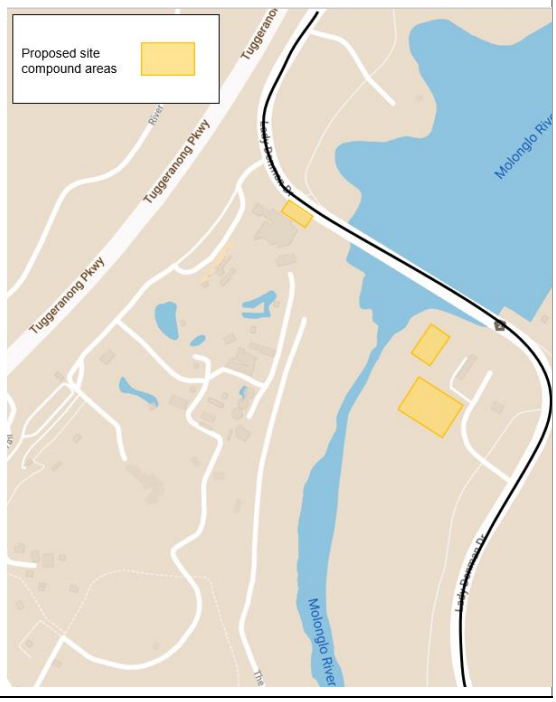
Feature	Description	Key Map
Carriageway	Sealed carriageway with one lane in each direction. The carriageway width is approximately 6.6 metres (3.3 metres per lane in each direction). Travel lanes are delineated by road markings.	
Parking	On-street parking is not permitted.	
Speed limit	70 km/h	
Pedestrian Facilities	No pedestrian facilities such as sidewalks or crossings on the road however, a shared path is present running alongside the Lady Denman Drive near the site compound location.	
Bicycle Facilities	No cycling facilities on Lady Denman Drive however, a shared path is present running alongside the road near the site.	
Public Transport	No access to public transport provided.	

Figure 2-2 (L) Lady Denman Drive looking south from proposed site compound (R) looking north from proposed site compound

Image source: Google Streetview

2.1.2.2 Cotter Road

Cotter Road (Figure 2-3) is an arterial road providing connections from regional areas and suburbs in the greater Canberra region to the central area of Canberra. Cotter Road extends for a distance of approximately 18 kilometres between the Cotter Dam to an off-ramp that merges with Adelaide Avenue, which continues to Capital Hill.

Cotter Road is assumed to be a primary access road for the site, with most vehicles expected to access Lady Denman Drive via Cotter Road. The key characteristics of Cotter Road near the intersection with Lady Denman Drive are outlined in Table 2-2.

Table 2-2 Cotter Road key features

Feature	Description	Key Map
Carriageway	Sealed carriageway with two lanes in each direction. The carriageway width is approximately ten metres in each direction of travel (three metres for the cycling path and 3.5 metres for each vehicle travel lane). There is a 2.6 metre median strip separating the two directions of travel, with travel lanes are delineated by road markings.	
	Extra carriageway width is present at the intersection with Lady Denman Drive, as short lanes and slip lanes are provided for the right-hand and left-hand turns. A short stretch of bus lane is also provided from the Lady Denman Drive intersection on the northern side of the road in both directions with a width of 3.5 metres where present	
Parking	On-street parking is not permitted.	
Speed limit	80 km/h	
Pedestrian Facilities	No pedestrian facilities (footpaths or crossings) present on the road near the Lady Denman Drive intersection.	
Bicycle Facilities	A dedicated bicycle lane is present in both directions of travel.	
Public Transport	No bus stops were found on the road near the site however a dedicated bus lane is present near the intersection with Lady Denman Drive.	

Figure 2-3 (L) Cotter Road looking east and (R) looking west from Lady Denman Drive intersection

Image source: Google Streetview

2.2 Public and active transport

A desktop review of public transport services in the area was conducted and found that no public transport services were available in the proximity of the site.

A review of active transport infrastructure near the site was also conducted and found a shared path for pedestrians and cyclists that runs alongside Lady Denman Drive to provide access to the north as well as waterfront areas around Lake Burley Griffin. The shared path identified within proximity of the proposed site location is shown in Figure 2-4. It is noted that the identified shared path runs through the proposed access to the site compound.

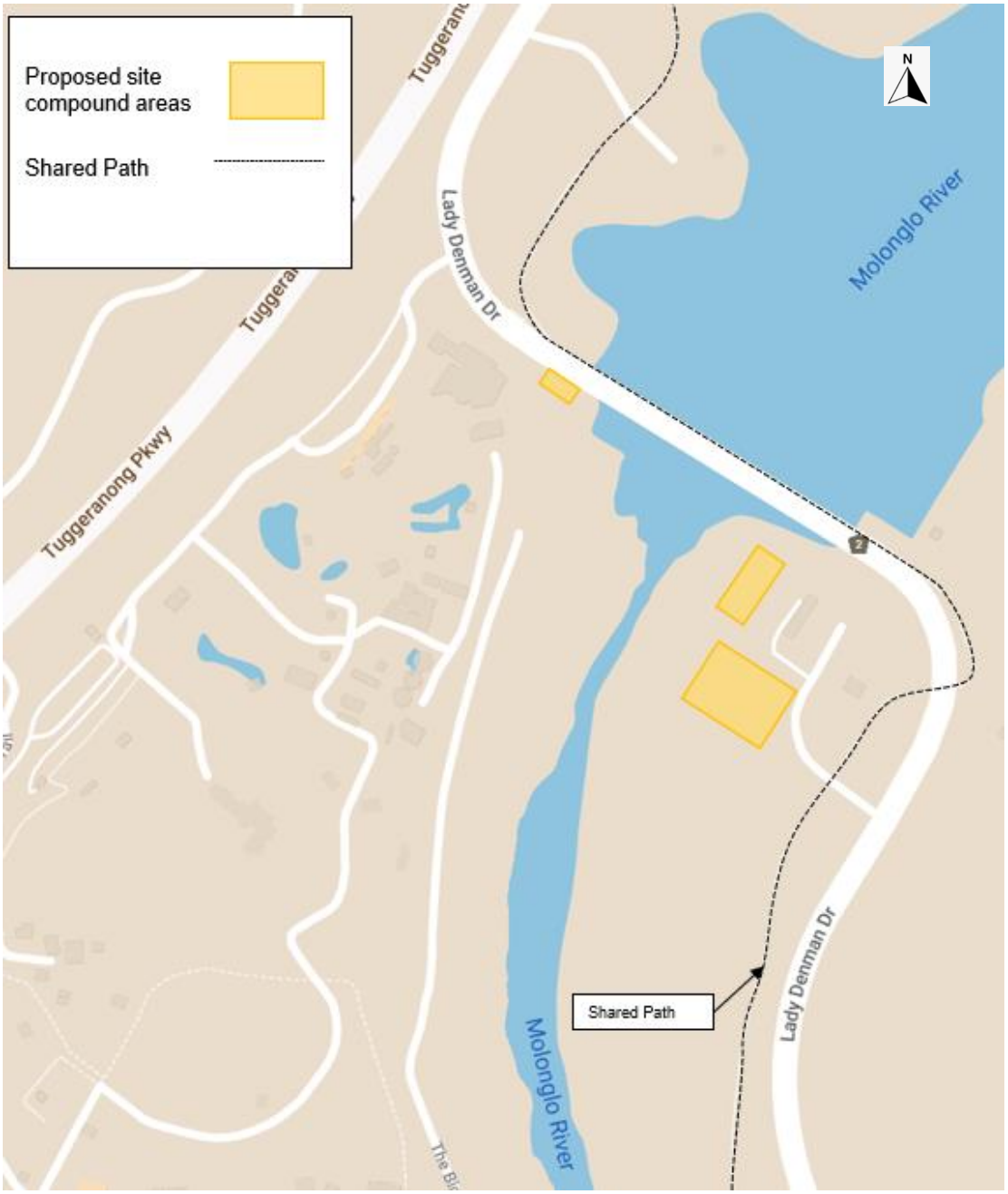


Figure 2-4 Active transport services in the vicinity of the site

Image source: Google Maps (modified by GHD)

2.3 Parking

As detailed in Section 2.1.1, on street parking is not available on the roads in the vicinity of the subject site.

However, a car park is located immediately to the east of the site which serves the Scrivener Dam Lookout (Figure 2-5). This car park is expected to remain operational throughout all construction phases, and as a result measures to ensure safety and access for all vehicles planning to use the car park and lookout areas during construction hours will be adopted throughout construction.

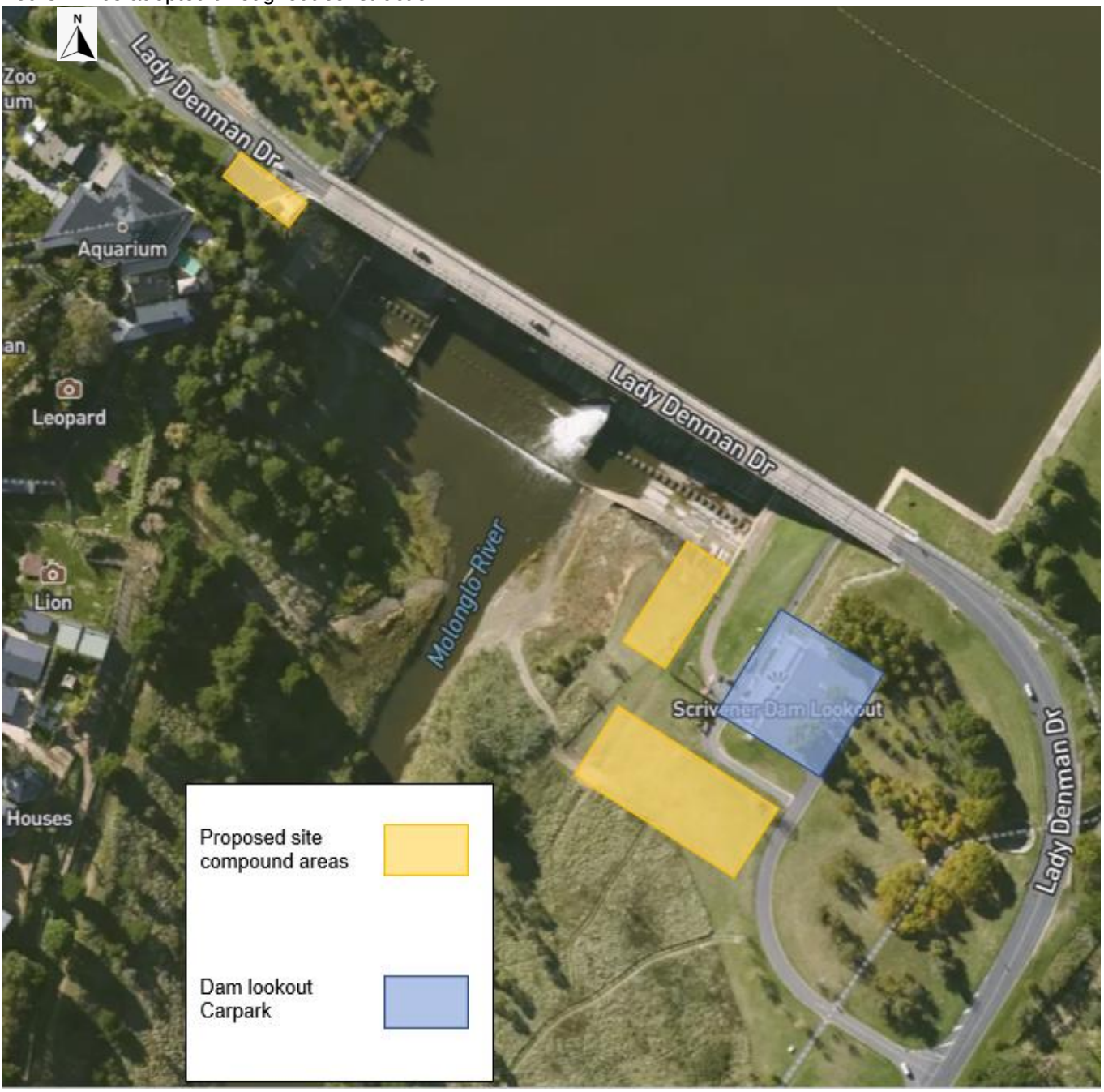


Figure 2-5 Scrivener Dam Lookout car park location with proposed site compound locations

Image source: Google Maps (modified by GHD)

Additionally, small car park with approximately seven spaces, which is accessed from Lady Denman Drive, is located on the western side of the dam. The car park serves a small viewing platform.

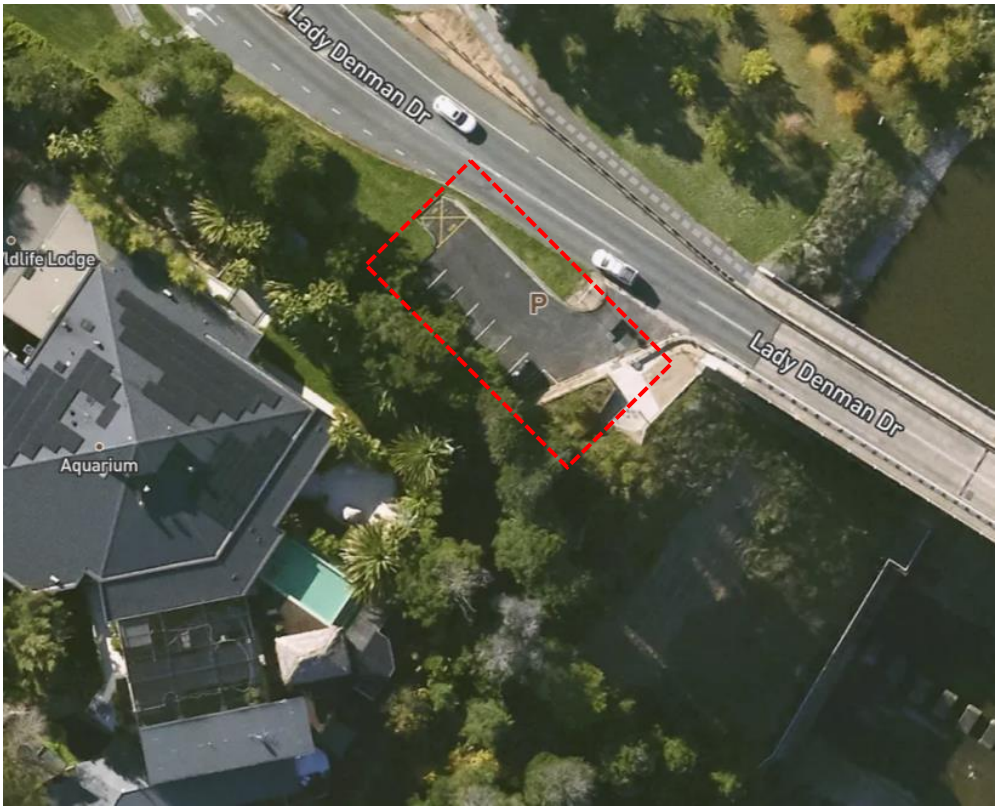


Figure 2-6 Lookout car parking area

Image source: Google Maps

During the construction period, a compound will be located on the lookout car park and the parking spaces will not be available to the general public during this time.

2.4 Freight routes

The ACT Government identifies the Tuggeranong Parkway and Cotter Road as key freight routes (PBS Level 1), as displayed in Figure 2-7.

A PBS L1 heavy vehicle is designated as a truck and dog trailer combination that is not longer than 20 metres and is not a B-double or road train.

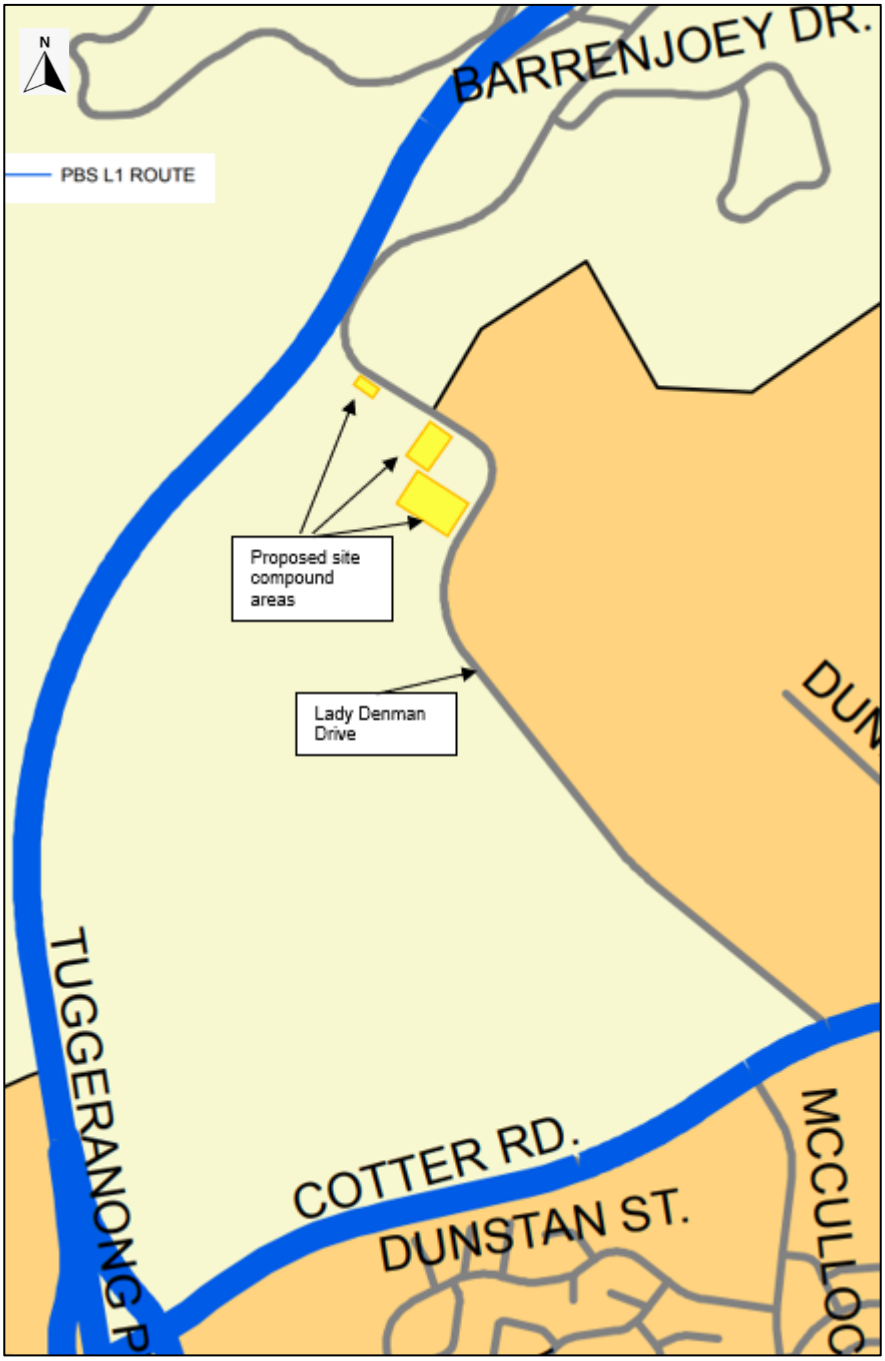


Figure 2-7 Freight routes

Source: Approved ACT Routes for Performance Based Standards (PBS) Level 1 Vehicles, ACT Territory and Municipal Services (modified by GHD)

2.5 Crash review

Road crashes and their locations within ACT are recorded based on the reports of the police and the public through the Australian Federal Police (AFP) Crash Report Form. The crash data from the last five-year period was analysed and is presented in Table 2-3

The five year-data analysed, starting from January 2016, shows 11 crashes reported within a 500-metre radius of the subject site, with all resulting in property damage only. None of the recorded crashes within the site vicinity resulted in injury or fatality. The locations of each crash in relation to the proposed site compounds in Table 2-3 are displayed in Figure 2-8.

Table 2-3 Reported crashes within a 500-metre radius

Year [a]	Total number of crashes reported	of which resulted in **Fatality**	of which resulted in **Injury**	of which resulted in **Property Damage Only**
2016	0	0	0	0
2017	4	0	0	4
2018	1	0	0	1
2019	0	0	0	0
2020	5	0	0	5
2021 [b]	1	0	0	1
Total	**11**	**0**	**0**	**11**

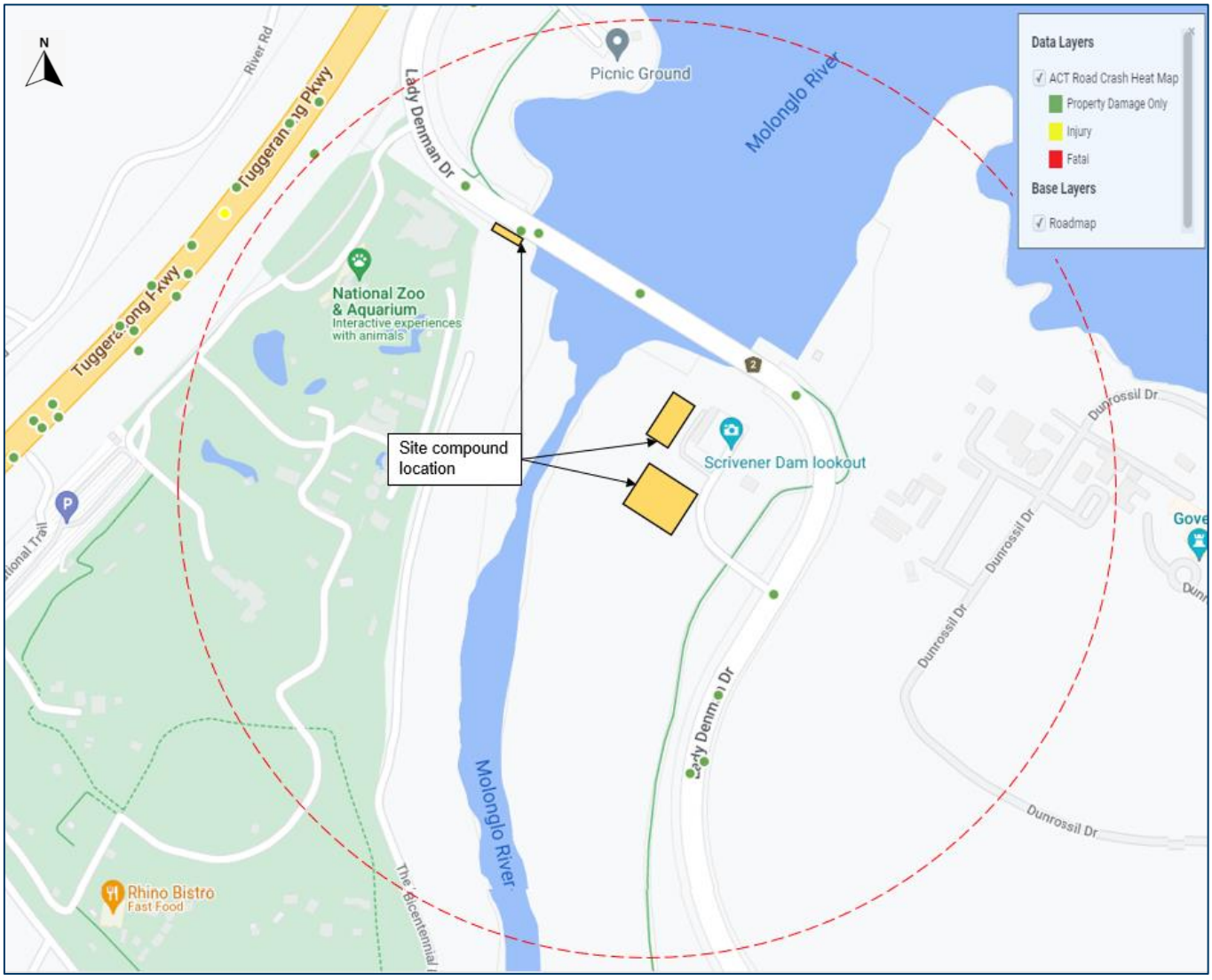


Figure 2-8 Road crashes within 500 metres of the site by crash severity

Source: ACT Government Open Data Portal (modified by GHD)

A heatmap of the reported crashes (Figure 2-9) indicates no significant clusters of incidents in the immediate proximity of the site location.

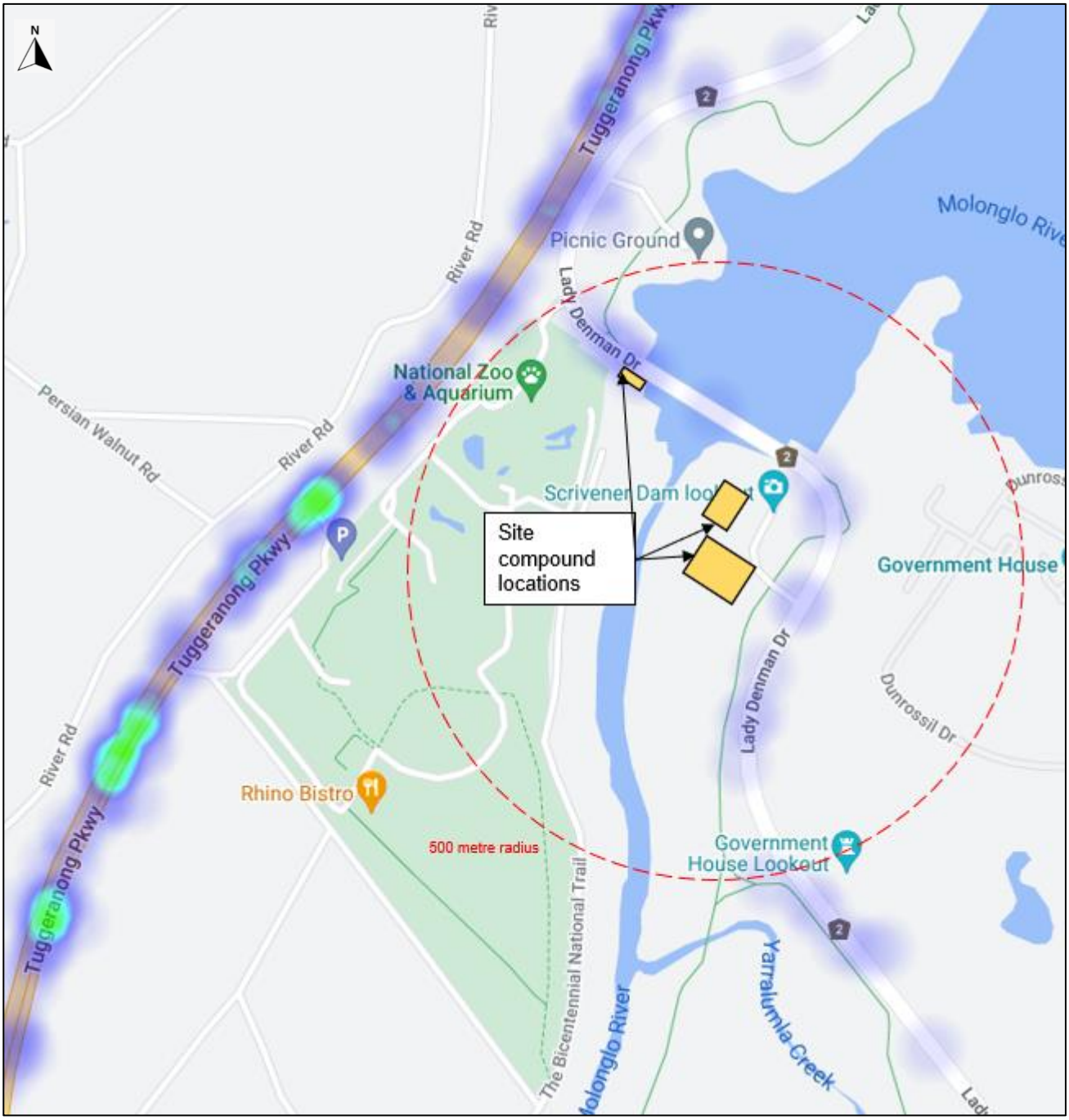


Figure 2-9 Road crash incidents within 500-metres of the proposed station site

Source: ACT Government Open Data Portal; modified by GHD

2.6 Traffic volumes

The Transport Canberra and City Services Directorate (TCCS) have provided week-long tube count data for Lady Denman Drive, north of Cotter Road, for the week between 20th May 2018 and 26th May 2018. The average weekday outputs from the tube counts are provided in Figure 2-10.

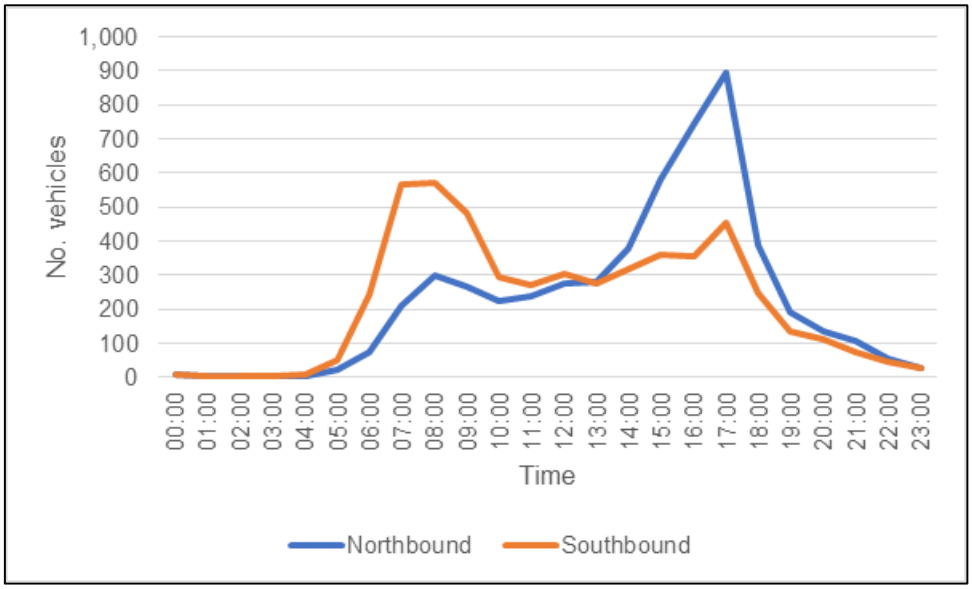


Figure 2-10 Lady Denman Drive traffic data

The data in Figure 2-10 indicates that:

– Vehicle activity on Lady Denman Drive is “tidal”, namely predominantly southbound in AM peak periods and northbound in PM peak periods.
– The AM peak hour occurred between 8:00 am - 9:00 am with approximately 300 northbound and 570 southbound vehicles.
– The PM peak hour occurred between 5:00 pm – 6:00 pm with approximately 890 northbound and 450 southbound vehicles.

2.7 Traffic performance

The Austroads Guide to Traffic Management Part 3: Transport Study and Analysis Method indicates that two lane roads with one travel lane in either direction, operating with uninterrupted flows, have a capacity of 1,800 passenger car units/hour (pc/h). Applying this capacity to Lady Denman Drive, the data in Figure 2-10 indicates that it is operating well within its mid-block capacity, further:

– Outputs from Google Maps indicates that in periods of peak morning activity Lady Denman Drive operates under free flow activity. However, eastbound traffic on Cotter Road experiences localised congestion (refer to Figure 2-11).
– The available data indicates that in peak periods of afternoon activity Lady Denman Drive and Cotter Road operate at an acceptable level.
– The Google Maps outputs are consistent with the available data, which indicates that Lady Denman Drive is operating well within its mid-block capacity during peak periods of activity.

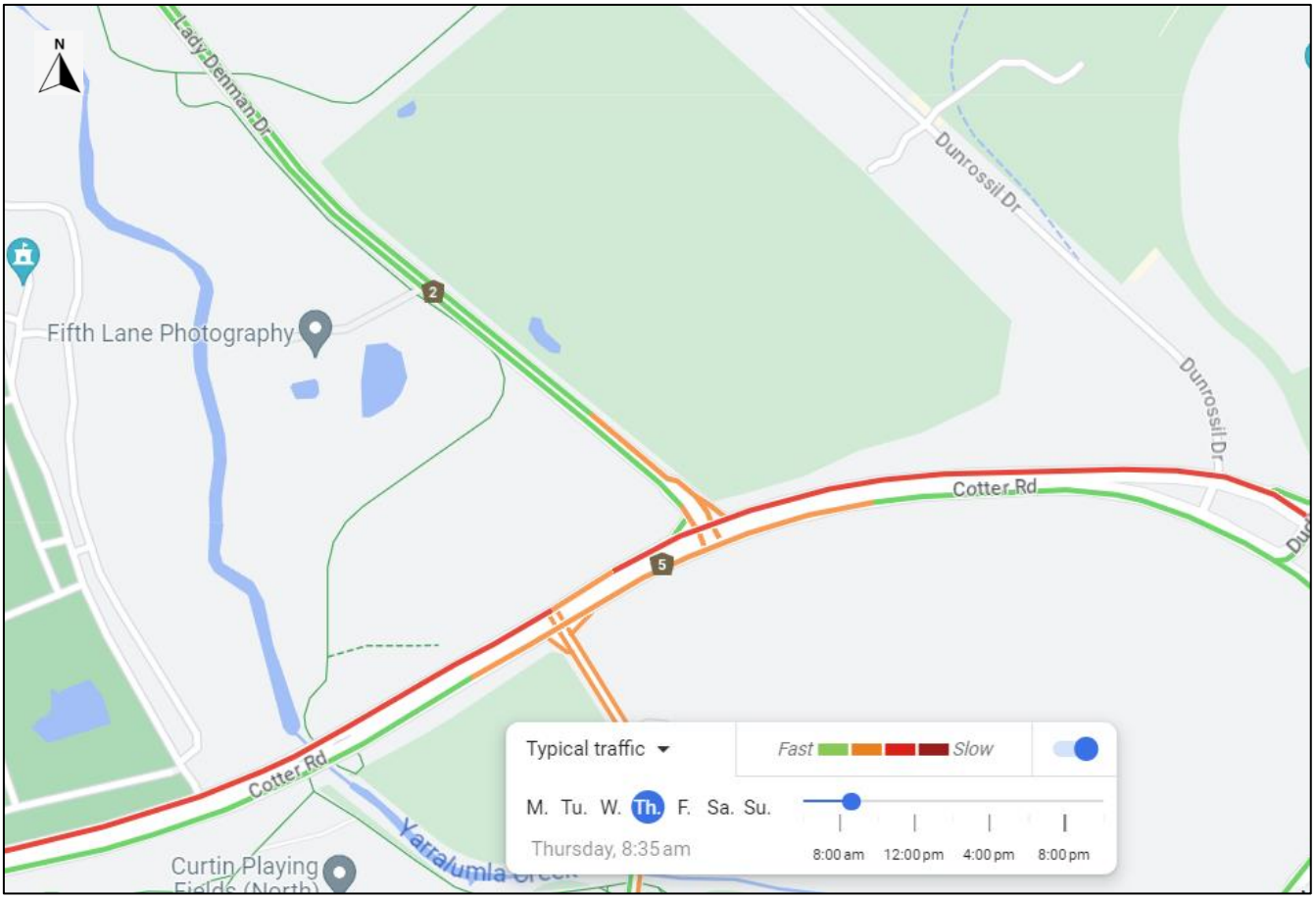


Figure 2-11 Localised traffic conditions (typical Thursday at 8:30 am)

Source: Google Maps (modified by GHD)

3. Project description

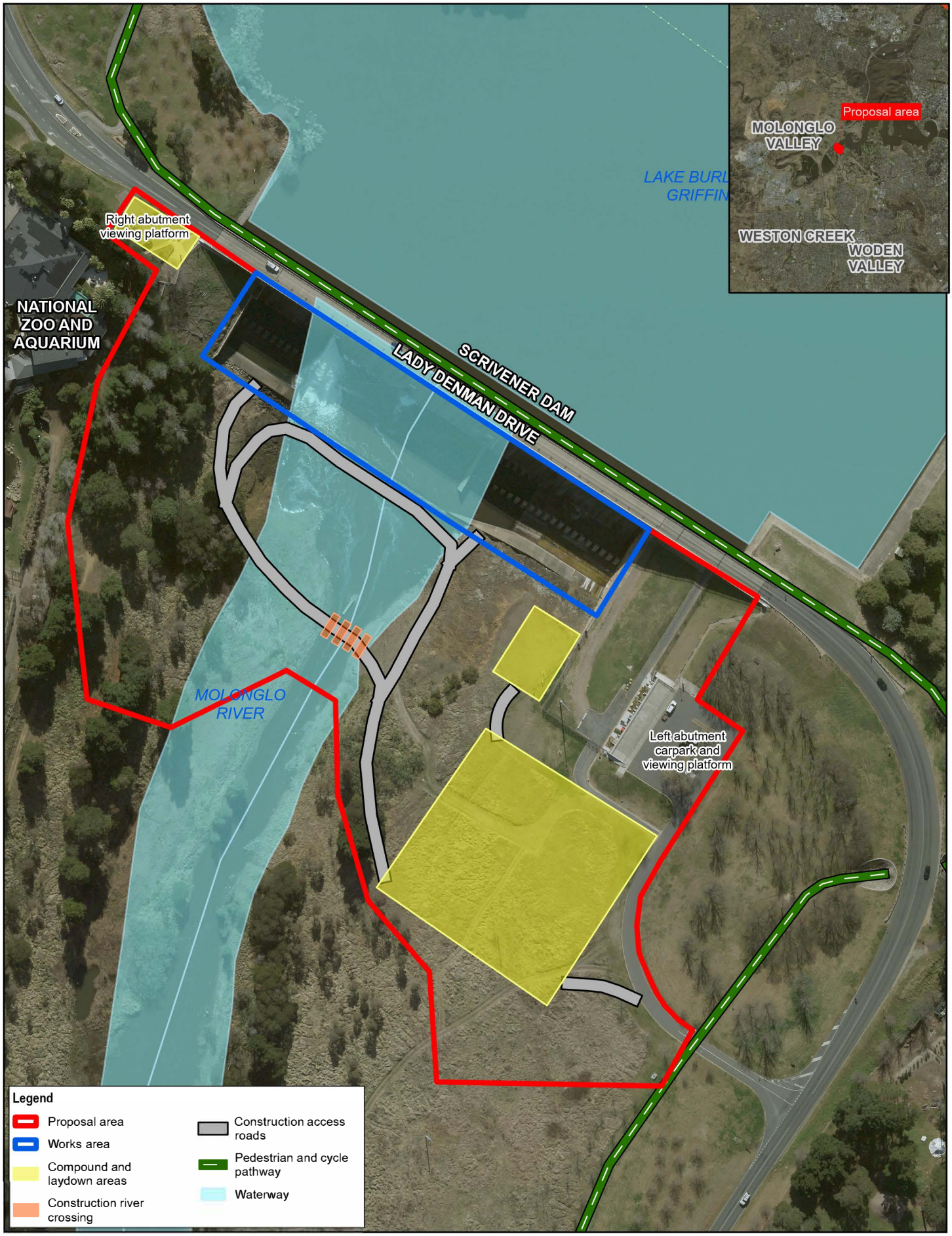
3.1 Introduction

The proposal area, shown in Figure 3-1, is located on the downstream wall of Scrivener Dam in Canberra, ACT. The Scrivener Dam impounds[1] water from the Molonglo River to form Lake Burley Griffin. The proposal area also includes the banks of the Molonglo River downstream of the dam, a viewing platform and car park on dam's left[2] abutment[3] and a small car park on the dam's right abutment.

Scrivener Dam is located at the western end of Lake Burley Griffin, between the National Zoo and Aquarium, Lady Denman Drive, and Government House. The surrounding land uses mostly relate to recreational use of the lake and the foreshore, such as boating, swimming and cycling. Associated infrastructure nearby includes boat ramps, access roads, cycle paths, and general open space.

Construction would mostly involve undertaking remedial and strengthening works to the dissipator structure in the works area, shown in Figure 3-1. Ancillary infrastructure, such as compounds and access tracks, would be contained within the proposal area. The proposal area would extend across Canberra Central Section 122 Block 3, Molonglo Valley Blocks 27 and 77 and Weston Creek Blocks 1142, 1202 and 1220.

[1] Impoundments are artificially created standing waterbodies, produced by dams on streams or rivers.
[2] Left and right refer to the sides of a dam looking downstream.
[3] Abutment refers to the part of the valley side against which the dam is constructed.



Paper Size ISO A4

0 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

N

GHD

National Capital Authority
Scrivener Dam
Dissipator Strengthening Project (DSP)

Project No. **12608465**
Revision No. **-**
Date **10/05/2023**

Key features of the proposal

FIGURE 3.1

\\ghdnetghd\AU\Sydney\Projects\21\12608465\GIS\Maps\Deliverables\12608465_EnvironmentalAssessment.aprx
Print date: 26 May 2023 - 14:03

Data source: ACT_TRANSPORT\road_labels_grey_lor_imagery
ACT_BASE_MAP\basic_lor_imagery
ACT_IMAGERY\imagery20220?gda2020: Created by: sperera2

Additional construction access roads (as shown in Figure 3-1) will be constructed to provide access throughout the proposal area, to support heavy vehicle access to and from the proposed construction compounds.

The access tracks would be constructed to cater for heavy vehicles at a grade that is consistent with Austroads specifications and would be topped with gravel. A turning circle would also be constructed within the proposal area and would be constructed to enable the manoeuvring of heavy vehicles such as concrete trucks, mobile cranes etc. All vehicles will be able to enter the construction compounds, manoeuvre internally and exit the site in a forward direction.

3.2 Access

Primary site access is expected to be via the road to the Scrivener Dam Lookout car park from Lady Denman Drive, as shown in Figure 3-1, as follows:

– The majority of light and heavy vehicles are expected to access/egress the DPS site via the intersection of Lady Denman Drive and Cotter Road.
– All vehicles will access/egress the construction compounds via the current road to/from the lookout car park.
– A temporary bridge structure is proposed on one of the internal access roads to allow access for vehicles to the western side of the dam structure.

It is noted that the active transport paths and lookout car parks are expected to remain operational for the majority of the construction period. Suitable signage (as detailed in Section 5) will be used over the construction period to support the safe operation of the active transport/public car parking facilities in proximity to the construction compounds.

3.3 Construction

3.3.1 Staging

Construction of the DSP would likely occur in the following stages:

– **Preliminary Stage – Site establishment:** This would involve establishing compounds and site facilities, construction of access roads and hardstand areas, and crane set up. This phase would also include the construction of a river crossing bridge to better enable access to the works area.
– **Stage 1 – Bays 3, 4, and 5**: A water management system would be installed to dewater the Stage 1 work areas and create a dry place for construction. Works would then begin on Bays 3, 4 and 5 on the left of the dam. Water would continue to flow through the Bay 2 sluice gate and, if needed Bay 1 via operating a gate. Abutment armouring would be installed on the existing abutments.
– **Stage 2 – Bay 1 and 2 construction:** The cofferdam in front of Bay 3 would be removed, and Bays 1 and 2 would be dewatered to the isolated work area and provide construction access. The flow would then be re-established through Bays 3, 4 and 5.
– **Stage 3 – Demobilisation and rehabilitation**: The site would be demobilised and rehabilitated.

The works areas for Stage 1 and Stage 2 of construction are shown in Figure 3-2.

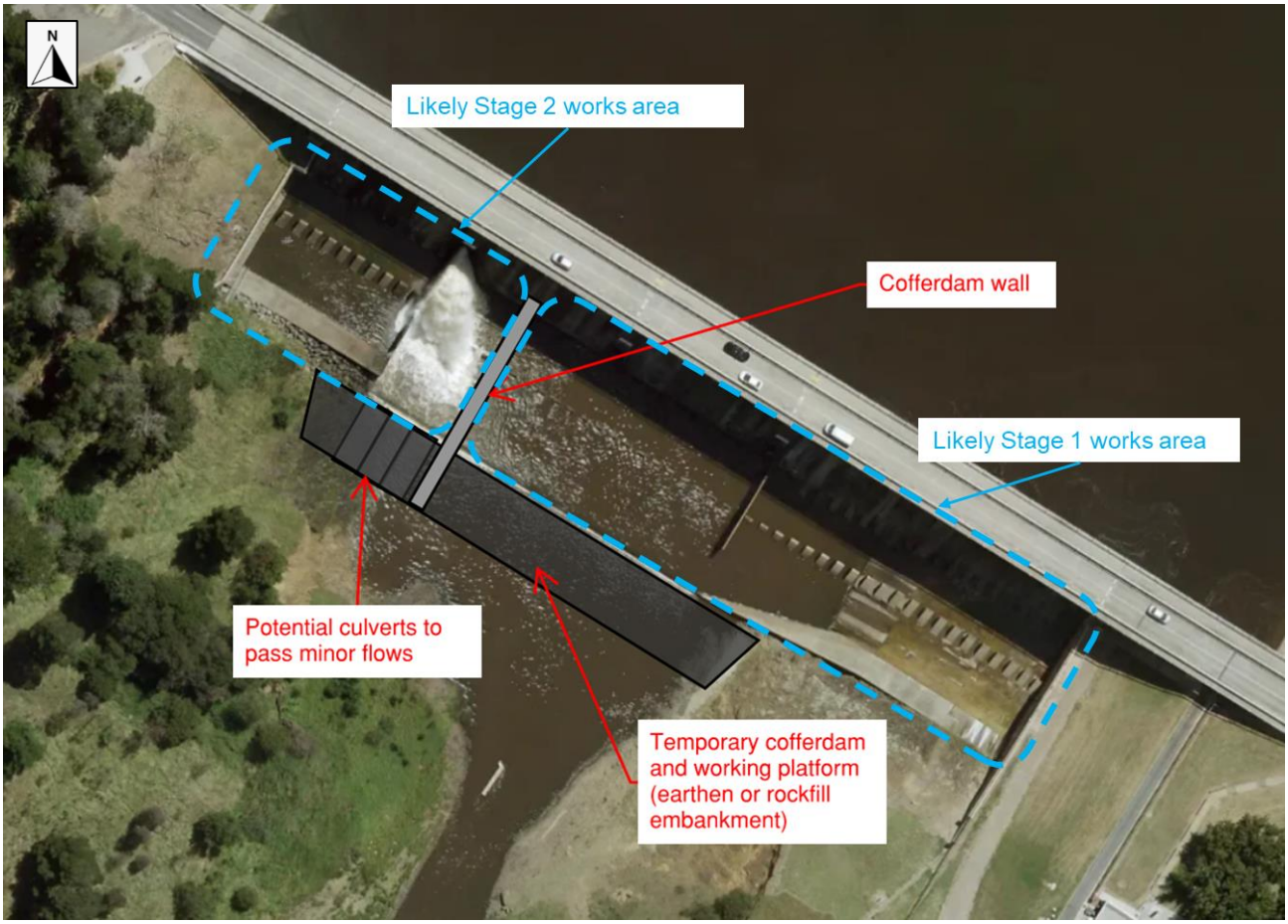


Figure 3-2 Likely Stage 1 and 2 work areas and cofferdam locations

3.3.2 Vehicle activity

The anticipated daily light and heavy vehicle activity associated with each stage of construction is displayed in Table 3-1.

Table 3-1 Expected construction activity

Phase	Construction workers (per day)	Light vehicles (per day)	Heavy vehicles (per day)
Preliminary Stage – Site establishment	40	40	15
Stage 1 – Bays 3, 4, and 5	60	60	20
Stage 2 – Bay 1 and 2 construction	60	60	20
Stage 3 – Demobilisation and rehabilitation:	40	40	15

The data in Table 3-1 indicates that peak vehicle activity is expected to occur in Stage 1 and Stage 2 of construction when up to 60 light vehicles and 20 heavy vehicles are expected to access/egress the site per day.

3.3.3 Program and hours

Construction working hours will be undertaken during the periods specified in the *Environment Protection Regulation 2005* and abide by noise zones outlined in the *Territory Plan*. This may include hours up to:

– 7:00 am to 6:00 pm Monday to Friday
– 8:00 am to 6:00 pm Saturdays
– 8:00 am to 6:00 pm on Sundays or Public Holidays

Construction is expected to commence in early 2024 and take up to 18 months.

4. Impact assessment

4.1 Traffic generation

The peak hour construction vehicle activity has been undertaken on first principles basis in accordance with the expected volumes of workers and heavy vehicles, as follows:

– It is expected that up to 60 full-time equivalent workers will be employed during the strengthening of the dam. Most of the construction workforce is likely to be based in Canberra and Queanbeyan.
– It is expected that workers will typically access the site in the morning and depart the site in the afternoon. It has been assumed that peak worker vehicle activity coincides with the adjoining road network peak periods, as a conservative assumption.
– Additionally, it has been assumed that all construction workers will drive to the site, with a car occupancy of one, i.e., no carpooling.
– It is expected that up to approximately 20 trucks will access/egress the subject site per day. Assuming a typical (weekday) workday occurs between 7:00 am and 6:00 pm, on average, this equates to approximately two trucks an hour.
– To be conservative, it has been assumed that five construction trucks will access/egress the construction site in a single hour.

For the purposes of this assessment, the highest hourly traffic generation for the DSP under the peak construction scenario is assumed to be up to 70 vehicle trips in total, which will consist of the following:

– AM peak hour:
  - Five inbound heavy vehicle movements
  - Five outbound heavy vehicle movements
  - Sixty inbound light vehicle trips.
– PM peak hour:
  - Five inbound heavy vehicle movements
  - Five outbound heavy vehicle movements
  - Sixty outbound light vehicle trips.

4.2 Trip distribution

The trips generated through construction activities as a part of the DSP will be distributed throughout the existing road network in proximity to the site.

It is expected that the primary direction of travel to and from the site will be toward Cotter Road to the south of the site, with Cotter Road being the access route to Lady Denman Drive. This is due to Cotter Road being a major arterial road and designated freight route allowing for access for construction-related heavy vehicles that are expected to be travelling to and from the site.

It is noted, however, that some of the light vehicles generated by the construction workers travelling to and from site may use Lady Denman Drive to the north of the site to access Tuggeranong Parkway which provides access to the areas of Northern Canberra.

4.3 Construction impacts

4.3.1 Impacts to traffic

With respect to the traffic impacts of the DSP, the following is noted:

– The vehicle activity associated with the construction of the DSP is minor (up to 70 vehicles an hour) and will only occur for a period of approximately 18 months.

– The construction vehicle trips are typically expected to fall within the daily fluctuations of the adjoining arterial road network.

Accordingly, the impacts of the project on the adjoining road network are expected to be negligible and Lady Denman Drive is expected to continue to operate well within its mid-block capacity.

4.3.2 Impacts to active transport

With respect to impacts to active transport facilities:

– As detailed in Section 2.2, a recreational shared path is located in proximity to the DSP site, which crosses over the expected access/egress point to the DSP construction compounds.
– This crossing point, shown in Figure 4-1, will need to be managed through traffic control measures (potentially including signage and temporary stop protocols) throughout the construction process to ensure the operation of the shared path is maintained.
– The traffic control measures implemented will focus on ensuring the safety of pedestrians and cyclists while supporting the movement of vehicles to and from the construction compounds.

Accordingly, the impacts of construction vehicles on active transport facilities is expected to be negligible.

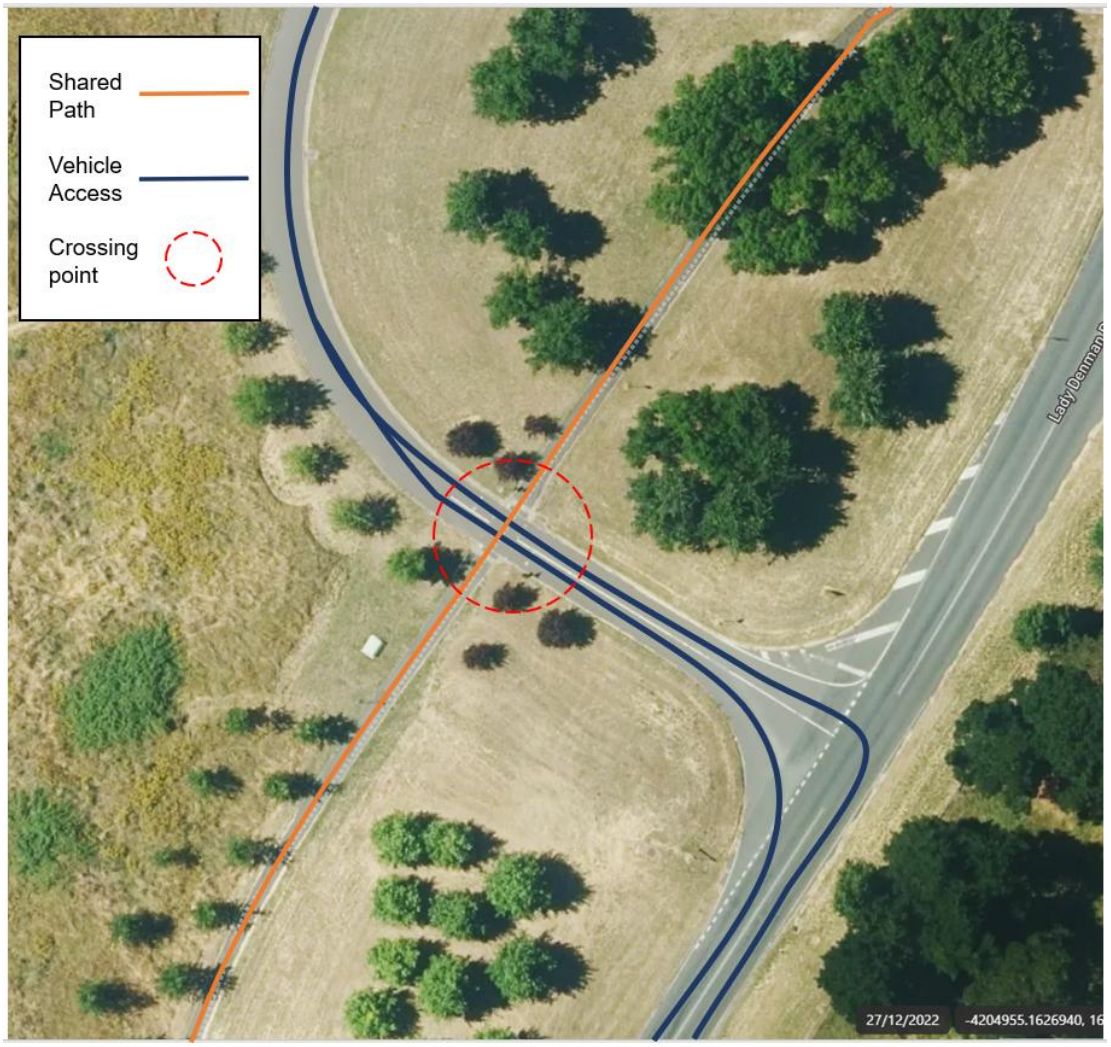


Figure 4-1 Shared path crossing with vehicle access to site

Source: MetroMap (modified by GHD)

It is noted that a meeting was held with NCA and Pedal Power ACT[4] to discuss the DSP construction activity on the adjoining active transport facilities. Pedal Power ACT recommended that:

– Additional signage for cyclists should be included in a construction traffic management plan
– The signage should include warnings about Construction Works Ahead and Heavy Vehicles Ahead
– Consideration should be given to given to placing a temporary signage stop sign on the shared path (at the crossing point), to support the safety of cyclists crossing the road.

As detailed in Section 5, a construction traffic management plan that supports the safety of pedestrians/cyclists will be prepared and implemented prior to and for the duration of DSP construction activities.

4.3.3 Impacts to road safety

With respect to impacts to road safety:

– The impacts to the safety of the surrounding road network should be minimised where possible, especially with the addition of the extra traffic volumes generated during the construction stages.
– The crash review outlined in Section 2.5 shows that traffic incidents within 500 metres of the site were quite low over the five-year period analysed, with no incidents resulting in injury or fatality.
– Appropriate traffic control measures in the vicinity of the site should be adopted to ensure that the safety of all road users is not impacted by construction-related vehicles travelling to and from the site.

Accordingly the impacts of construction vehicles on road safety is expected to be negligible.

4.3.4 Impacts to parking

With respect to impacts to parking the following is noted:

– Due to on-street parking not being permitted on Lady Denman Drive in proximity to the DSP site there is not expected to be any impact to on street parking.
– As discussed in section 2.3, a car park that serves the Scrivener Dam Lookout is located adjacent to the dam.
– It is proposed that this car park will typically be operational throughout the DSP construction works.
– Traffic controls (including signage) will be used to ensure the safety of vehicles accessing/egressing the car park during construction, supported by appropriate signage.
– Parking for workers will be provided within the construction compounds.
– The small car park (seven spaces) serving the viewing platform will be used as a compound during construction works.

The impacts of construction vehicles on parking are typically expected to be negligible.

4.3.5 Impacts to other developments

With respect to impacts to other developments the following is noted:

– Other than the National Zoo and Aquarium, there are no other developments in proximity to the DSP construction site.
– Access/egress to and from the National Zoo and Aquarium would not be impacted by the DSP construction.

Accordingly, the impacts of construction vehicles on other nearby developments are expected to be negligible.

[4] https://www.pedalpower.org.au/about/

5. Mitigation measures

In accordance with a review of the existing traffic facilities and the assessment of the impacts associated with the construction traffic, no road upgrades are required to support the construction of the DSP.

Based on discussions with TCCS officers, they noted that their media team could keep the wider community notified about any construction impacts via social media, radio and media releases.

In accordance with ACT Government requirements, a detailed construction traffic management plan will be prepared for the DSP works, prior to construction. The plan will require approval from the ACT Government and will be implemented for the entire construction period.

Mitigation measures proposed to avoid or minimise traffic and transport impacts during construction, operation, and decommissioning and rehabilitation of the project are listed in Table 5-1.

Table 5-1 Mitigation measures – traffic and transport

No.	Outcome	Mitigation measure	Timing
T1	Minimise impacts to traffic and transport networks.	Develop a construction traffic management sub-plan, prior to construction. Include, at a minimum, the following management measures: – Preparation of a Traffic Guidance Scheme, detailing adequate road signage at construction work sites to inform motorists, cyclists and pedestrians of the work site ahead to ensure that the risk of road accidents and disruption to surrounding land uses is minimised. – Identify the requirement (if needed) for traffic controllers. – Maintain accessibility for pedestrians and cyclists. – Indicate routes to be used by heavy construction-related vehicles to minimise impacts on sensitive land uses and businesses. – Implement measures to manage traffic flows around the area affected by the construction of the project, including, as required, regulatory and direction signposting, line marking, and variable message signs and all other traffic control devices necessary for the implementation of the construction traffic management sub-plan. – Implement measures to maintain public access to the lookout car park, including the potential use of signage. – Undertake consultation with the relevant road authorities during preparation of the sub-plan. Ensure the performance of project traffic arrangements is monitored during construction. – Undertake consultation with the community groups, i.e. Pedal Power	Pre-construction
T2	Minimise impacts to the operation of nearby developments	Ensure vehicle access to the National Aquarium and Zoo is not impacted by construction of the proposal.	Construction
T3	Minimise environmental impacts associated with the movement of vehicles.	Monitor the roads leading to and from the project site and take necessary steps to rectify any road deposits caused by site vehicles, to maintain the safety of road users. Where possible, offset the construction vehicle activity from peak periods of road network activity.	Construction
T4	Minimise environmental impacts associated with the movement of vehicles.	Induct employees and contractors to raise awareness and understanding of traffic and transport mitigation measures to be implemented during construction.	Construction

6. Summary and conclusion

6.1 Summary

In summary:

– GHD was engaged by the NCA to provide an EIA to support a Minor Works Approval for the Scrivener Dam Dissipator Strengthening Project (DSP).
– This EIA has been prepared to document the outcomes of a desktop review of available existing information and site visit relating to Scrivener Dam and the surrounding environment. This Traffic Assessment provides a preliminary assessment of the potential traffic/transport impacts associated with the construction activities and identification of potential mitigation measures required.
– The Austroads Guide to Traffic Management Part 3: Transport Study and Analysis Method indicates that two lane roads with one travel lane in either direction, operating with uninterrupted flows have a capacity of 1,800 pc/h. The available data indicates Lady Denman Drive is operating will within its mid-block capacity.
– A review of the reported crashes indicates no significant clusters of crashes in the proximity of the DSP construction site.
– The vehicle activity associated with the operation of the DSP is negligible and will typically consist of the occasional maintenance vehicle.

The highest hourly traffic generation for the DSP under the peak construction scenario is assumed to be up to 70 vehicle trips in total, which will consist of the following:

– AM peak hour:
  - Five inbound heavy vehicle movements
  - Five outbound heavy vehicle movements
  - Sixty inbound light vehicle trips.
– PM peak hour:
  - Five inbound heavy vehicle movements
  - Five outbound heavy vehicle movements
  - Sixty outbound light vehicle trips.
– The construction vehicle trips are typically expected to fall within daily fluctuations of the adjoining arterial road network.
– As detailed in Section 2.2, a recreational shared path is located in proximity to the DSP site, which crosses over the expected access/egress point to the DSP construction compounds. Signage will be used as required to ensure the safety of pedestrians/cyclists and support the movement of vehicles to and from the construction compounds.
– The lookout car park will at the Scrivener Dam is typically expected to operational throughout the DSP construction period. Traffic controls will be used to ensure the safety of vehicles accessing/egressing the car park during construction.
– Other than the National Zoo and Aquarium, there are no other developments in proximity to the DSP construction site. Access/egress to and from the National Zoo and Aquarium will be maintained throughout the DSP construction period.
– In accordance with ACT Government requirements, a detailed construction traffic management plan will be prepared for the DSP works, prior to construction. The plan will require approval from the ACT Government and will be implemented for the entire construction period.

6.2 Conclusion

Ina accordance with the provision of a suitable construction traffic management plan, the impacts of the DSP on the adjoining traffic and transport networks are expected to be negligible.

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The Power of Commitment

Appendix D

Noise and vibration impact assessment

National Capital Authority

Scrivener Dam Dissipator Strengthening Project

Noise and Vibration Impact Assessment

January 2023

Confidential

Question today
Imagine tomorrow
Create for the future

Scrivener Dam Dissipator Strengthening Project
Noise and Vibration Impact Assessment

National Capital Authority

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Rev	Date	Details
Rev 0	21/12/2022	Draft Assessment for NCA review
Rev 1	10/01/2023	Final report for issue

	Name	date	signature
Prepared by:	M Tonner	21/12/2022	
Reviewed by:	B Ison	21/12/2022	
Approved by:	B Ison	10/01/2023	

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

Table of contents

Glossary

Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Audible range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 hz to 20 khz, although it is possible for some people to detect frequencies outside these limits.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the a-weighted noise level exceeded for ninety percent of a sample period. This is represented as the l90 noise level (see below).
Continuous vibration	Vibration continues uninterrupted for a defined period.
dBA: A-weighted decibels	The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the 'A' filter. A sound level measured with this filter switched in is denoted as dB(A). Most environmental noise is measured using the 'A' filter.
dBC: C-weighted decibels	'C' weighted adjustments are relatively flat across lower frequencies, and as such are better suited for the assessment of low frequency noise.
Diffraction	The distortion around solid obstacles of waves travelling past.
Frequency	The time rate for each wave peak (of a sound wave) to pass a given point. Frequency is measured in hertz (Hz).
L_{90}	The level of noise exceeded for 90% of the time for which a given sound is measured. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	Equivalent sound pressure level – the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring. The sound weighting of the noise measurement is commonly added, for example L_{Aeq} or L_{Ceq}.
L_{Max}	The maximum noise level during a specified period
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level (SPL)	The level of sound pressure at a specific location, expressed in decibels.
Sound Power Level (SWL)	A measure of the acoustic energy emitted from a source of noise, expressed in decibels.

1 Project background

1.1 Introduction

The National Capital Authority (NCA) has commissioned WSP to investigate potential noise impacts associated with the Scrivener Dam Dissipator Strengthening Project (the project). The project will primarily involve rock drilling and concreting works associated with the installation of upgraded anchors and the placement of a topping slab over the existing dissipator.

The work area is located adjacent to the National Zoo and Aquarium, the grounds of Government House and numerous public recreational areas. The Zoo also houses accommodation facilities which may be considered particularly sensitive to noise.

The proposed construction works are expected to be inherently noisy and may impact these surrounding noise sensitive receivers. This report has been prepared to consider potential noise and vibration impacts that may be associated with the rock drilling works, which is expected to be the loudest operation involved with this work.

1.2 Purpose of this report

This report has been prepared to provide information and assessment of potential noise and vibration impacts arising from the use of the rock drill during the proposed works. It is intended to provide NCA and other relevant stakeholders with information to incorporate into more detailed environmental planning as the project progresses. It contains the following sections:

1) Introduction to the project and this report (Section 1)
2) The identification of noise sensitive receivers located in the vicinity of the work and a description of existing noise levels in the vicinity of the project (Section 2)
3) A preliminary discussion of potential noise goals for the identified noise sensitive receivers (Section 3)
4) The results of a noise monitoring undertaken for similar equipment (Section 4)
5) Assessment of potential noise impacts (Section 5)
6) Assessment of potential vibration impacts (Section 6)
7) The results and observations made during simulated drilling works at the National Zoo (Section 7)
8) Recommendations for noise management and future studies (Section 8).

2 Existing noise environment

2.1 Sensitive receivers

The work area is located adjacent to the National Zoo and Aquarium, the grounds of Government House and numerous public recreational areas. The Zoo also houses accommodation facilities which may be considered particularly sensitive to noise. Potential noise concerns were discussed with stakeholders at the National Zoo and Government house and a summary of the matters raised is provided in Table 2.1.

Table 2.1 Summary of stakeholder noise discussions

Stakeholder	Issues raised
National Zoo	— Accommodation facilities (generally single night stay, occupied sporadically between approximately 2pm to 10am) — Guest drinks are held on the Jamala verandas at 6pm each evening — Internal options existing for restaurant operations — Big cat enclosures closest fauna — Native marsupials can be skittish — Likely faunal reactions unknown, however major responses were noted during previous loud events (fighter jet flyovers, fireworks, etc) — Aquarium likely to be insensitive to noise
Government House	— Events held frequently, usually in the northern and eastern areas of site — Offices located in west and northern areas — Workshops located in western areas — Traffic noise currently dominant in western areas
Residential areas	— Potential noise impacts to suburban residential areas. — The most impacted receivers are located at Yarralumla and Curtin, approximately 2km to the east and south respectively.

The location of the primary noise and vibration sensitive receivers are presented in Figure 2.1. A breakdown of these receivers is provided in Table 2.2.

Figure 2.1 Noise sensitive receivers

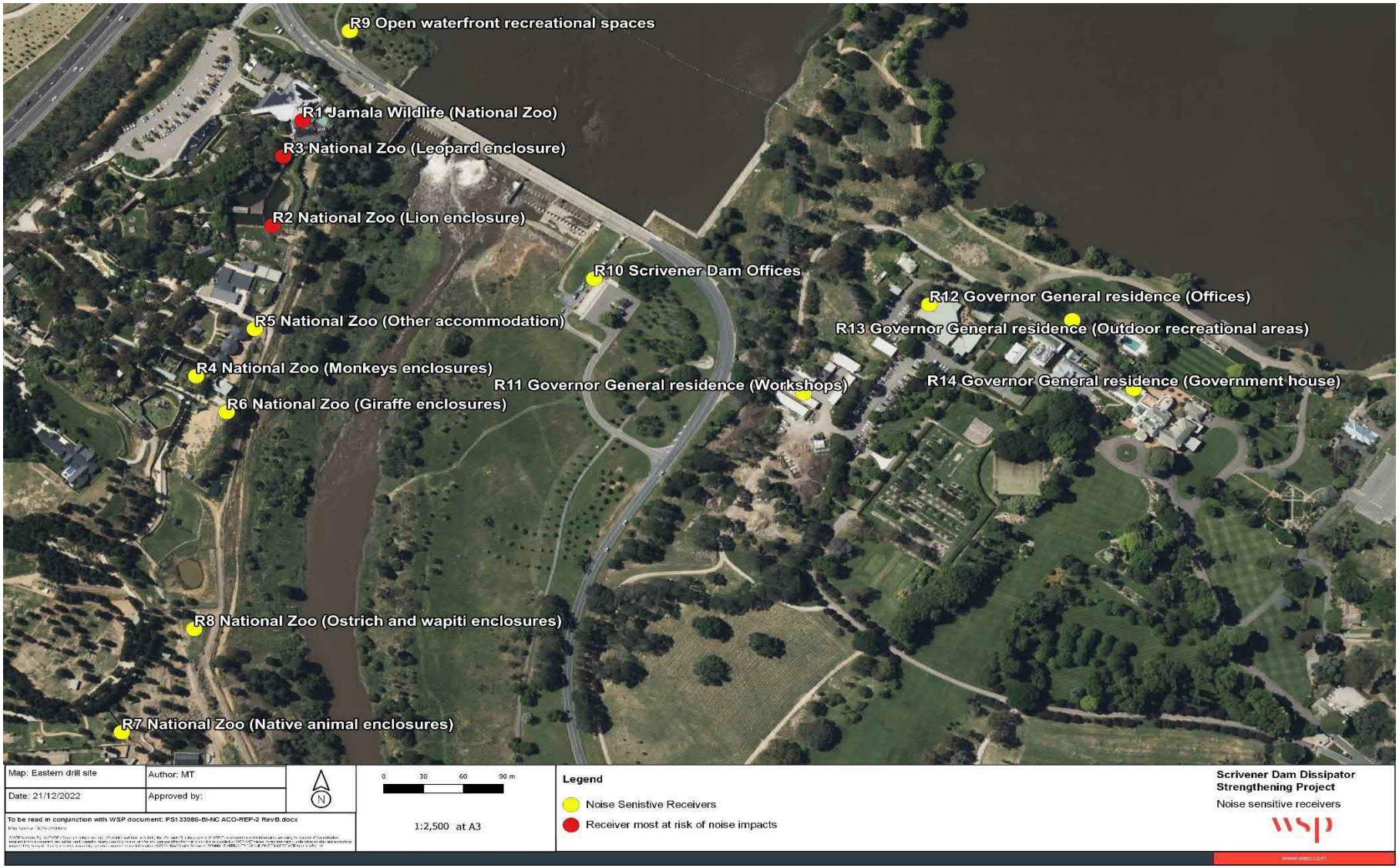

Table 2.2 Summary of noise sensitive receivers by receiver type

Receiver ID	Address	Suburb / Locality	Land use	Approximate distance from dam dissipater (m)
R1	Jamala Wildlife Lodge	Weston	Accommodation	50m
R2	National Zoo (Lion)	Weston	Animal enclosure	90m
R3	National Zoo (Snow Leopard enclosure)	Weston	Animal enclosure	100m
R4	National Zoo (Monkeys enclosures)	Weston	Animal enclosure	200m
R5	National Zoo (Other accommodation)	Weston	Accommodation	200m
R6	National Zoo (Giraffe enclosures)	Weston	Animal enclosure	275m
R7	National Zoo (Native animal enclosures)	Weston	Animal enclosure	300m
R8	National Zoo (Ostrich and Wapiti enclosures)	Weston	Animal enclosure	300m
R9	Open waterfront recreational spaces (north of dam)	Molonglo River (south west)	Active recreation	120m
R10	Scrivener Dam Offices	Scrivener Dam (east)	Office use	40m
R11	Governor General residence (Workshops)	Yarralumla	Workshops	200m
R12	Governor General residence (Offices)	Yarralumla	Office use	250m
R13	Governor General residence (Outdoor recreational areas)	Yarralumla	Passive recreation	350m
R14	Governor General residence (Government house)	Yarralumla	Accommodation	430m

2.2 Attended noise monitoring

Short term attended noise monitoring was carried out at some of these locations on 27 October 2022, to determine existing background noise levels and assist with the validation of the noise model to determine its accuracy (refer Section 5.2).

The monitoring of background noise levels was conducted during the daytime period and carried out at each location until a steady L_{Aeq} level was obtained. Within the zoo areas, noise levels ranged between approximately 55 – 65 dBA, with noise levels influenced by visitors, wild birds and on site water features. Road traffic noise from Tuggeranong Parkway was constantly audible in the background.

Details of all equipment used to conduct the noise survey are presented in Table 2.3. All equipment used in the survey were calibrated by a NATA-approved laboratory and have current calibration certificates as required in AS1055:2018.

The monitoring equipment was fitted with a windshield and was field calibrated before and after the monitoring. No significant drifts in calibration (± 0.5 dB) were noted.

Table 2.3 Noise monitoring equipment

Monitoring	Equipment	Manufacturer	Model	Serial No.	Calibration due
Attended	Sound Level Meter	NTi	XL2	A2A-17705-E0	15/03/2024
Attended	Sound Level Meter	NTi	XL2	A2A-05718-E0	10/11/2023

The results of this monitoring are presented in Table 2.4.

Table 2.4 Summary of background noise monitoring results

Monitoring ID	Duration of measurement (Minutes)	Location	Monitored noise level dBA			Comment
			L_{Amax}	L_{Aeq}	L_{A90}	
L1	3.7	Lion enclosure	86	67	59	Visitors, water feature, some wind
L2	3.6	Giraffe enclosure (1)	70	56	49	Wind, birds, visitors, dam water release, traffic on Tuggeranong Parkway
L3	4.1	Vicinity of ostrich, zebra, wolf enclosures	60	54	50	Visitors, some wind in tress, occasional birds, traffic on Tuggeranong Parkway
L4	1.8	Giraffe enclosure (2)	66	55	52	Staff working, traffic on Tuggeranong Parkway
L5	5.8	Vicinity of dingo, deer enclosures	66	59	56	Cars in parking lot, visitor noise, birds, traffic on Tuggeranong Parkway
L6	1.9	Tiger enclosure	70	62	56	Water feature (including pump), traffic on Tuggeranong Parkway
L9	1.2	Dam water release (Western foreshore)	73	72	71	Water noise dominant
L13	0.9	Dam water release (Eastern foreshore)	71	69	68	Water noise dominant
L14	1.4	Dam Water release (South dam offices)	69	67	66	Water noise dominant
L15	0.3	Dam water release (Public viewing platform)	69	67	66	Water noise dominant
M2	3.1	Molongo River (South of Dam 1)	68	65	64	Water noise dominant
M3	2.4	Molongo River (South of Dam 2)	65	62	62	Water noise dominant
M9	1.9	Jamala Lodge (Outside closest room)	66	65	65	Water noise dominant
M11	1.4	Jamala Lodge (Inside closest room)	50	41	40	A/C, exhaust fam and water noise (dam)

3 Project noise and vibration goals

3.1 The Consolidated National Capital Plan

These are areas of the ACT that have been identified as having special characteristics necessary for the National Capital. National functions include a range of uses and include the arounds surrounding Lake Burley Griffin, including Scrivener Dam and nearby potential affected areas. This is defined as the Lake Burley Griffin and Foreshores Precinct.

Within these Designated Areas the NCA has responsibility for determining detailed planning policy, and for providing approval for works. Governance of these areas is provided in The Consolidated National Capital Plan. This document states that NCA is required to assess any environmental impacts arising from the construction and maintenance activities, including any impacts concerning noise.

The stated nature of the environment of the Molonglo River area of the Lake Burley Griffin precinct is described to provide a quiet backwater for boating, fishing and birdwatching.

No other conditions relevant to noise appear to be contained within The Consolidated National Capital Plan.

3.2 ACT noise guidelines

Although not strictly applicable to this project, the ACT does provide provision for construction noise management in the following documents.

3.2.1 ACT noise zone standards

The *Environment Protection Regulation* (ACT) 2005 (EPR) prescribes requirements designed to control or govern conduct regarding how the environment is impacted from activities and developments:

- Table 2.1 and Table 2.2 from Schedule 2 of the Regulation define noise zones and their associated noise standards. These noise standards apply to noise generated during **construction** and operation of a proposed development. Areas within Central National Area (Parliamentary Zone and Other Areas) are described as Zone C2.
- Once a noise zone has been identified according to the ACT Territory Plan and National Capital Plan, the Noise Standard for that zone is applicable as an upper limit.
- Zone C2 noise limits provide the following noise levels as their recommended upper limit:
  - Monday-Saturday 7 am–10 pm Sunday and public holiday 8 am–10 pm 55 dB $L_{A10\,T}$
  - Other times 45 dB $L_{A10\,T}$
- The following noise limits apply to residential areas (Zone G) :
  - Monday-Saturday 7 am–10 pm Sunday and public holiday 8 am–10 pm 45 dB $L_{A10\,T}$
  - Other times 35 dB $L_{A10\,T}$
- Section 8.2 of the *Noise Environment Protection Policy*, ACT states that these limits are to be measured as $L_{A10\,T}$, where 'T' is not less than 5 minutes or greater than 15 minutes.
- In assessing the noise impact at sensitive receivers, the EPR describes the compliance point as any point as near as practicable to the property boundary.

3.2.2 Exemptions

The Regulation incorporates certain clauses that provide relaxation or exemption from the standards for noise emitted during certain construction activities. The relevant clause for this development is summarised in Table 3.1.

Table 3.1 Noise exemptions – extract from Table 2.3, EPR

Item	Noise	Conditions
21	Noise emitted in the course of development (1).	— The noise is emitted from a place other than a place in noise zone A or B; and — The development will not be finished within 2 weeks after the day it started; and — All relevant noise reduction measures mentioned in AS2436, as in force from time to time, are implemented; and — The noise is emitted between 7 am and 6 pm on Monday to Saturday, excluding public holidays.

If the listed conditions are met when carrying out the relevant activities, the associated noise is exempt from meeting the noise standards determined by the EPR.

3.2.3 Attention-drawing noise characteristics

Certain noise characteristics have a higher potential to cause annoyance, generally requiring additional considerations. Tonality, low frequency emphasis and intermittency are generally considered to be attention-drawing and can cause greater disturbance. On the other hand, short-term single noise events are likely to be less disturbing and may warrant relaxation of the noise criteria. To address these scenarios, the ACT *Noise Measurement Manual* prescribes specific modifying factors for the assessment of relevant noise events, as summarised in Table 3.2.

The potential application of these penalties are discussed in Section 4.4.1.

Table 3.2 ACT Noise Measurement Manual – modifying factor corrections

Factor	Assessment / measurement	When to apply	Correction (Applied to the measured / predicted level)[1]
Tonal Noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: — 5dB or more if the centre frequency of the band containing the tone is above 400Hz. — 8dB or more if the centre frequency of the band containing the tone is 160 to 400Hz inclusive. — 15dB or more if the centre frequency of the band containing the tone is below 160Hz.	+5dB[2]
Low-frequency noise	Measurement of C-weighted and A-weighted level	Measure to assess C- and A-weighted levels over same time period. Correction to be applied if the difference between the two levels is 15dB or more.	+5dB[2]
Impulsive noise	A-weighted fast and impulsive response	If a difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2dB.	Apply difference in measured levels as the correction, up to a maximum of +5dB.
Intermittent noise	Subjectively assessed	Level varies by more than 5dB.	+5dB

Factor	Assessment / measurement	When to apply	Correction (Applied to the measured / predicted level)[1]	
Duration	Single-event noise duration	One event in any 24-hour period, with duration as below.	**Night (10pm to 7am)**	**Day (7am to 10pm)**
		1 to 2.5 hours	0	-2
		15 min to 1 hour	0	-5
		6 min to 15 min	-2	-7
		1.5 min to 6 min	-5	-15
		Less than 1.5min	-10	-20

(1) Where two or more modifying factors are present, the maximum correction is limited to 10dB.

(2) Where a source emits noise which has both tonal and low-frequency components, only one 5dB correction should be applied.

3.3 NSW Interim Construction Noise Guidelines (ICNG)

Beyond the exemptions summarised in Table 3.1 there is no available ACT guidance or policy for assessment of construction noise, and noise assessments are not normally prepared for construction works. Guidance for this assessment has therefore reference NSW Interim Construction Noise Guidelines (ICNG).

A quantitative assessment requires the development of noise management levels (NMLs). For residential receivers, there are based on existing rating background noise levels (RBLs), however for non-residential receivers, additional guidance is provided.

Table 3.3 Noise management levels for non-residential sensitive receivers

Noise Management Levels	
Land use	**Management Noise Level (external) (When in use)** $L_{eq,15min}$ **dBA**
Passive recreation areas	60
Active recreation areas	65
Commercial and industrial premises	70

Feasible and reasonable safeguards and management measures should be implemented where NMLs are exceeded either during or outside of recommended standard hours for construction work.

The ICNG also states the following:

> *The proponent should assess construction noise levels for the project and consult with occupants of commercial and industrial premises prior to lodging an application where required.*
> *During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work.*

3.4 Potential noise impacts on fauna

Substantial variation has been shown in scientific studies in the responses of wildlife to human-generated noise, ranging from serious to non-existent in different species and situations. The risk of hearing damage to wildlife is considered to be

unlikely from this project and any potential impacts are likely to be limited to behavioural effects. Research has shown potential behavioural impacts are probably greater from exposure to very loud noises at close proximity than from long-term exposure to lower noise levels and that many impacts associated with noise are more pronounced when associated with the nearby presence of human activity.

High noise levels have been shown, particularly in some species of birds and frogs, to interfere with communication essential for reproduction. Noise may affect also behaviour by causing animals to retreat from favourable feeding habitat near noise sources, however these impacts are likely to be less relevant to animals within a zoo environment. Decreased responsiveness of wildlife after repeated noise events is frequently observed and usually attributed to habituation.

In fish, studies have shown that behavioural responses depend not only on the noise characteristics, but also on the context of the noise event (e.g. type of noise, location, school size, etc). For example, no response has been noted in fish exposed to high levels of sonar noise, however a stress response is produced in those same fish when predatory sounds (such as a killer whale song) are played.

It is understood that the National Zoo also houses nocturnal animals such as Sugar Gliders and owls. Sugar Gliders are housed within a dark house and as such are active during daytime hours. However Tawny Frogmouth Owls are naturally nocturnal and may be impacted by excessive levels of daytime noise, although it is likely that these animals have been habituated to human induced noise during daytime hours.

It is likely that most animal species within the project area and surrounds are already well habituated to periodic noise disturbance from human activity. It is also likely that noise from the construction activities will be moderate and steady in nature, rather than impulsive and at high levels – as such impacts from the Project are expected to be manageable with the implementation of effective mitigation measures.

3.5 Proposed project noise goals

In consideration of the guidance outlined above, and the existing noise levels within the zoo, the following preliminary noise goals are proposed for this work:

Table 3.4 Summary of noise sensitive receivers by receiver type

ID	Address	Suburb / Locality	Land use	Preliminary external noise goal dB $L_{Aeq(15\ minute)}$	Comments on derivation of goal
R1	National Zoo (Jamala Wildlife Lodge)	Weston	Accommodation	55	Zone C2 noise limits (due to its proximity to active recreational areas, taken as L_{Aeq} instead of L_{A10})
R2	National Zoo (Lion)	Weston	Animal enclosure	65	ICNG (Active recreation) and in consideration of existing noise levels
R3	National Zoo (Leopard enclosure)	Weston	Animal enclosure	65	
R4	National Zoo (Monkeys enclosures)	Weston	Animal enclosure	65	
R5	National Zoo (Other accommodation)	Weston	Accommodation	55	Zone C2 noise limits (due to its proximity to active recreational areas, taken as L_{Aeq} instead of L_{A10})

ID	Address	Suburb / Locality	Land use	Preliminary external noise goal dB $L_{Aeq(15\ minute)}$	Comments on derivation of goal
R6	National Zoo (Giraffe enclosures)	Weston	Animal enclosure	65	ICNG (Active recreation) and in consideration of existing noise levels
R7	National Zoo (Native animal enclosures)	Weston	Animal enclosure	65	
R8	National Zoo (Ostrich and wapiti enclosures)	Weston	Animal enclosure	65	
R9	Open waterfront recreational spaces	Molonglo River (south west)	Passive recreation	60	ICNG (Passive recreation in consideration of NCA Plan for Molongolgo River)
R10	Scrivener Dam Offices	Scrivener Dam (east)	Office use	70	ICNG (Offices, commercial and industrial land use)
R11	Governor General residence (Workshops)	Yarralumla	Workshops	70	
R12	Governor General residence (Offices)	Yarralumla	Office use	70	
R13	Governor General residence (Outdoor recreational areas)	Yarralumla	Passive recreation	60	ICNG (Passive recreation in consideration of NCA Plan for Molongolgo River)
R14	Governor General residence (Government house)	Yarralumla	Accommodation	50	Zone C2 noise limits (- 5dB due to its potentially sensitive landuse)
R15	Nearest residential areas of Curtin	Curtin	Residential	45	Zone G noise limits (standard hours)
R16	Nearest residential areas of Yarralumla	Deakin	Residential	45	

It should be noted that further consultation with National Zoo and Aquarium may refine these noise goals following the commencement of the project.

3.6 Vibration criteria

Criteria for the management of vibration from the rock drilling unit have been derived from guidelines set out in NSW Department of Environment and Conservation *Assessing Vibration: A technical guide, 2006* (AVTG). These guidelines establish the acceptable vibration values for human discomfort and have been reproduced in Table 3.5, which specifies ground vibration limits in terms of Peak Velocity measured in millimetres per second (mm/s). It should be noted that construction work is generally considered as an intermittent source of vibration, however continuous vibration presents a conservative assessment.

Table 3.5 Preferred and maximum vibration levels for continuous vibration

Location	Assessment period	Peak Velocity (mm/s)	
		Preferred	Maximum
Critical working areas (e.g. hospital operating theatres, precision laboratories)	Day or night-time	0.14	0.28
Residences	Daytime	0.28	0.56
	Night-time	0.2	0.4
Offices	Day or night-time	0.56	1.1
Workshops	Day or night-time	1.1	2.2

Building damage vibration criteria are magnitudes larger than the human comfort guidelines and where these are met, there is no risk of building damage.

4 Noise and vibration measurements of rock drilling units

In order to investigate the potential noise and vibration impacts associated with the Project, the Client arranged for WSP to carry out noise and vibration measurements of drilling works that would be considered representative of the rock drilling units that will be used Scrivener Dam Dissipator Strengthening Project.

4.1 Measurement arrangement

A site visit to the Rutledge Drilling company site, was undertaken by WSP on the 15 November 2022 to measure the noise and vibration emissions from a rock drilling unit.

The rock drilling unit that was measured at the site was a compressed air driven mobile drilling rig, drilling 10 m deep holes into rock and soil conditions similar to Scrivener Dam, as illustrated in Figure 4.1.

Figure 4.1 Measured rock drilling unit

It should be noted that the drilling unit that was measured is not fully representative of the unit proposed for the Scrivener Dam Dissipator Strengthening Project. The proposed drilling rig for the Project is a hydraulic driven unit which is expected to produce noise emissions 5 to 10 dB lower than the compressed air driven drilling unit. Sound Power Level (SWL) emissions from the compressed air drilling unit will therefore present a conservative noise impact assessment for the Project.

4.2 Measurement methodology

4.2.1 Noise measurements

The total sound energy radiated by a noise source in all directions, is known as the sound power level (SWL), where the methodology to determine the SWL of a noise source from sound pressure level (SPL) measurements is specified in *International Standard ISO 3744:10 Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure— Engineering methods for an essentially free field over a reflecting plane* (ISO 3744).

4.2.2 Vibration measurements

The Peak Velocity vibration at each measurement location was determined from the vibration levels measured in the vertical z-direction during the operation of the rock drilling unit.

4.3 Measurement setup

Noise and vibration measurements were undertaken at 10 m, 20 m and 30 m distances from the drill rig unit for a range of drilling depths from 0.25 m to 10 m.

The measurements were carried out at the Rutledge Drilling company site in Croftby, Queensland on Tuesday 15 November 2002 between 9:00 am and 02:30pm, where the meteorological conditions of the site included dry conditions, with minimal wind speeds.

All measurements during the generator noise and vibration tests were conducted with the equipment presented

Table 4.1 Noise and vibration measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration due
Sound Level Meter	Nti	XL2	A2A-05707-E0	30/04/2023
Sound and vibration analyser	SVAN	958A	36693	28/06/2024

All equipment used in the survey were calibrated by a NATA-approved laboratory and have current calibration certificates as required in AS1055:2018.

The monitoring equipment was fitted with a windshield and was field calibrated before and after the monitoring. No significant drifts in calibration (± 0.5 dB) were noted.

4.4 Noise emissions

Details of the SWL noise emissions of the rock drilling unit, derived from the SPL measurements, is summarised in Table 4.2.

Table 4.2 Noise emission data of rock drilling unit

Measurement type	Noise emissions
Typical noise emissions of rock drilling unit	110 dBA SWL
Maximum noise emissions of rock drilling unit	115 dBA SWL

4.4.1 Modifying factors

Correction factors that may be applied to the measured noise levels to account for attention-drawing noise characteristics (refer Section 3.2.3) are discussed in the subsequent sections.

4.4.1.1 Tonal noise

The SWL spectrum of the drilling unit, measured over the third-octave bands from 50 Hz to 5 kHz for typical noise emissions shown in Figure 4.2. The spectral noise of the drilling unit shows that the noise measurements do not contain a tonal characteristic. Therefore, the correction for tonality does not need to be applied to the measured drill unit noise levels.

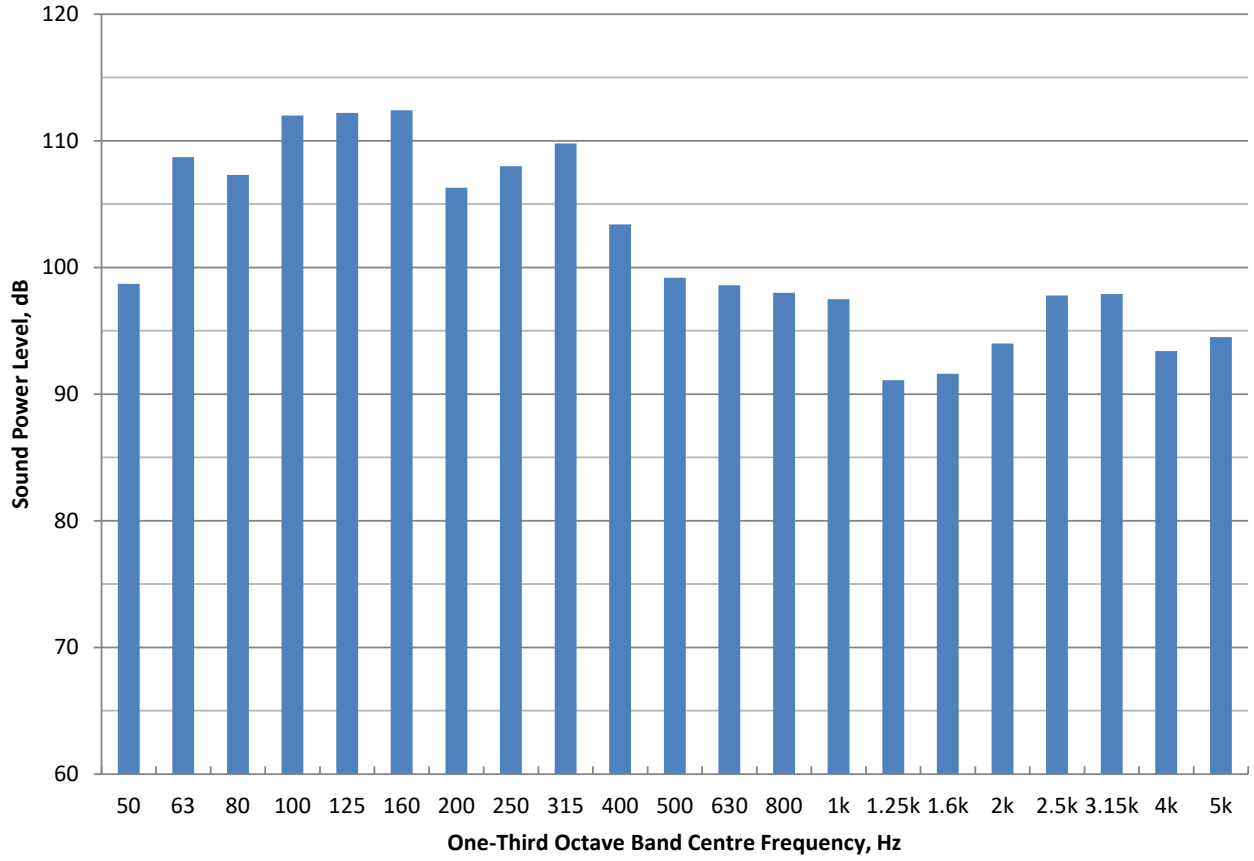

Figure 4.2 1/3 octave band sound power levels of rock drilling unit

4.4.1.2 Low-frequency noise

Table 4.3 presents the measured C and A-weighted rock drilling unit noise levels, which shows that difference between the weighted noise levels is less than 15 dB. Therefore, no low-frequency noise correction is required to be applied to the drill unit noise levels.

Table 4.3 C and A-weighted measured drilling unit noise levels

Noise emissions	Measured $L_{Ceq,1min}$	Measured $L_{Aeq,1min}$	Difference
Typical	91 dB	82 dB	9 dB
Maximum	88 dB	87 dB	1 dB

4.4.1.3 Impulsive noise

Table 4.4 presents the measured A-weighted maximum noise levels of the rock drilling unit, which shows that the difference between the fast response and impulse response is 2.5dB during normal operations. However this remains below the assessed 'maximum' SWL used in this assessment and as such no impulsive noise correction has been applied to the results of this assessment.

Table 4.4 A-weighted maximum noise levels

Noise emissions	Measured $L_{AF,max}$ (fast response)	Measured $L_{AI,max}$ (impulse response)	Difference	Corrected level L_{Aeq} SWL
Typical	88 dB	90 dB	+ 2.5 dB	112.5 dB
Maximum	90 dB	92 dB	+ 1.3 dB	115 dB

4.5 Vibration measurements

4.5.1 Measurement results

The highest vibration levels determined from the operation of the rock drilling unit, measured in the vertical z-direction are shown in Table 4.5, which presents the maximum Pack Velocity vibration levels measured at the monitored distances from the drill rig unit.

Table 4.5 Z-axis Peak Velocity vibration levels from operation of the rock drilling unit

Measurement location	Measured maximum Peak Velocity level
~5 m from the drill rig unit	3.8 mm/s
~10 m from the drill rig unit	0.71 mm/s
~20 m from the drill rig unit	0.16 mm/s
~30 m from the drill rig unit	0.07 mm/s

5 Noise assessment

5.1 Modelling inputs

Noise modelling was conducted to determine the predicted level of operational noise at the identified noise sensitive receivers surrounding the proposal. Modelling was undertaken within SoundPLAN modelling software and utilised the following inputs.

Table 5.1 Noise modelling assumptions

Modelling element	Input/assumption/source reference
Noise Model	SoundPLAN (Version 8.2)
Ground elevation geometry	ACTmapi (September 2022, https://www.actmapi.act.gov.au/imagery.html)
Ground absorption	40% soft ground for grass, wooded areas, and park land 0% for areas of water
Assessment standard	ISO9613-2:1996 noise prediction algorithm
Weather Conditions	Neutral meteorological conditions
Building footprints and heights	Derived from satellite and aerial imagery (ACTmapi, October 2022)
Receiver locations	Determined from aerial photography and on ground truthing
Drill Sound Power Level	115dBA

5.2 Model validation

The noise model used for the assessment was subjected to a validation process to ensure the accuracy of its noise predictions. The model validation process allows for the identification of any errors in the modelling setup and to demonstrate that the noise model accurately represents the existing, real-world conditions.

The validation process involved setting up a noise model using the determined sound power levels of water releases from the dam sluice pipes that were underway at the time of attended noise monitoring (outlined in Section 2.2). This monitoring provided a monitored noise level of 72 dBA at a distance of 46m, which corresponds to a Sound Power Level of approximately 109 dBA.

Noise predictions for the water release were modelled for monitoring sites locations where an accurate indication of the water release noise level could be determined. If the results from the model are within approximately 2dB then it is assumed that the model is accurate to real world operation of the site and can be used for predicting noise levels from future scenarios.

Table 5.2 Results of noise model validation

ID	Location	$L_{Aeq\ (period)}$ dBA		
		Predicted noise level	Measured noise level	Difference
L9	Dam water release (western foreshore)	64.0	65.0	-1.0
L13	Dam water release (eastern foreshore)	70.1	72.0	-1.9
L14	Dam Water release (South Dam Offices)	70.4	69.0	1.4

ID	Location	$L_{Aeq\ (period)}$ dBA		
		Predicted noise level	Measured noise level	Difference
L15	Dam water release (public viewing platform)	65.9	67.0	-1.1
M2	Molongo River (South of Dam 1)	65.6	67.0	-1.4
M3	Molongo River (South of Dam 2)	63.9	64.7	-0.8
M9	Jamala Lodge (Outside closest room)	63.3	62.3	1.0
Median difference				-1.1
Standard deviation				1.2

The validation results show that the modelled noise levels are within +/- 2dB at each location assessed and as such the model is considered validated. The noise model is considered representative of actual operational noise levels.

5.3 Predicted operational noise levels

This section presents the predicted noise levels and potential noise impacts during the operation of the drill rig, which is expected to be the loudest equipment proposed for use on the site. The unit was modelled at the eastern and western ends of the dissipator to provide an indication of the likely range of maximum noise levels at each receiver.

Potential operational noise impacts were determined against the preliminary noise goals outlined in Section 3.5.

The results of this assessment are presented below in Table 5.3 and graphically in Appendix A.

Table 5.3 Predicted drilling noise levels

Receiver ID	Receiver	Suburb / locality	Project noise goal $L_{Aeq,15\ min}$ dBA	Predicted maximum operational noise levels dBA $L_{Aeq,15\ min}$ [1]		Potential Risk of noise impacts
				Eastern drill site	Western drill site	
R1	National Zoo (Jamala Wildlife Lodge)	Weston	55	63	62	Moderate
R2	National Zoo (Lion)	Weston	65	59	58	Nil[2]
R3	National Zoo (Leopard enclosure)	Weston	65	62	61	Nil[2]
R4	National Zoo (Monkeys enclosures)	Weston	65	51	46	Nil[2]
R5	National Zoo (Other accommodation)	Weston	55	57	55	Low
R6	National Zoo (Giraffe enclosures)	Weston	65	57	56	Nil[2]
R7	National Zoo (Native animal enclosures)	Weston	65	50	50	Nil
R8	National Zoo (Ostrich and wapiti enclosures)	Weston	65	52	52	Nil
R9	Open waterfront recreational spaces	Molonglo River (south west)	41	45	38	Low
R10	Scrivener Dam Offices	Scrivener Dam (east)	70	67	62	Nil
R11	Governor General residence (Workshops)	Yarralumla	70	41	45	Nil
R12	Governor General residence (Offices)	Yarralumla	70	38	37	Nil
R13	Governor General residence (Outdoor recreational areas)	Yarralumla	60	31	31	Nil
R14	Governor General residence (Government house)	Yarralumla	50	26	25	Nil
R15	Nearest residential areas of Curtin	Curtin	45	< 35	< 35	Nil
R16	Nearest residential areas of Yarralumla	Yarralumla	45	< 35	< 35	Nil

(1) Based on the maximum noise emissions of rock drilling unit

(2) Ongoing consultation with National Zoo and Aquarium is recommended.

5.4 Discussion

This assessment presents a conservative consideration of potential drilling noise during the proposed works. The actual drill unit is likely to be 5-10 dB quieter than the assessed unit (refer Section 4.1). In addition, the maximum monitored noise levels have been modelled, typical drilling noise was 5dB below these levels. As such, it would be reasonable to assume to actual drilling noise may be in the order of 10dB below these predicted levels.

The results of this maximum noise modelling shows that noise impacts may occur during these works. However it is important to note that as described in Section 3.2.2, where the noise is generated under the following conditions, no noise criteria apply to the work:

Noise emitted in the course of maintaining or repairing something; and

a *the noise is emitted:*

i *between 7 am and 8 pm on Monday to Saturday; or*

ii *between 8 am and 8 pm on Sunday or a public holiday; and*

b *any noise exceeding a zone noise standard is emitted for periods totalling not more than 40 hours in any 8-week period; and*

c *the equipment used is maintained and operated in accordance with the*

The following observations are made in reference to the results outlined in Table 5.3.

5.4.1 National Zoo

The primary noise risks during the work have been identified as likely to occur at accommodation locations within the Zoo. This area is the closest receiver to the dam and several rooms directly overlook the dam itself. Construction of the rooms is generally sound and a reduction of approximately 15 to 20dB is predicted to occur from inside to outside. This may lead to internal noise levels from the dam works of approximately 40 to 50dB.

AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors is commonly used to consider the suitability of interior noise levels for a range of building uses. The document does not contain recommended levels for hotel rooms during daytime hours, however outlines a design sound level range for living areas of residential buildings that are located near major roads, to be between 35 – 45dB L_{Aeq}. The predicted noise levels may be marginally higher than this, however as construction noise is a temporary impact, these levels are expected to be manageable with moderate noise mitigation measures. However impacts may be noted at the start and end of work shifts, during which times accommodation guests are likely to be residing in their rooms.

The impact of noise on animals within the Zoo is largely unknown at this stage. Predicted noise levels are likely to be within the normal range of noise levels currently experienced by the animals. However existing noise sources are highly variable, and the consistent nature of the drilling noise may impact animals in different ways.

The highest noise levels for animal enclosures have been predicted for enclosures in the northern areas of the Zoo, in particular around the Lions and Snow Leopards. It is recommended that the behaviour of these animals is carefully observed during preliminary testing and early phases of the work to identify any behavioural changes.

5.4.2 Government House (Yarralumla)

Construction will be audible at Government House but notable noise impacts are expected unlikely based on the nominated project goals. However some events at the Government House may require low levels of background noise (for example to allow speeches during formal functions, etc) and management recommendations have been provided in Section 6.

Noise impacts at other working areas of Government House are considered unlikely.

5.4.3 Recreational areas

Noise impacts are not expected to occur at waterfront recreational areas north of the Scrivener Dam, where predicted noise levels are well below the proposed project noise goals.

However noise levels at recreational waterfront areas south of the dam are expected to extend approximately 200m south of the dam wall along the Molonglo River.

5.4.4 Residential suburban areas

The suburbs of Curtin and Yarralumla are the most affected residential areas. Noise impacts in these suburbs are expected to remain below existing background noise levels and are likely to be inaudible at most times.

No exceedances of noise goals have been predicted to occur at any other locations.

6 Vibration assessment

6.1.1 Vibration assessment

The vibration levels recorded during the operation of the rock drilling unit and presented in Section 4.5 have been assessed against the recommended vibration criteria for residential areas during daytime hours (refer Section 3.6), which is considered the most onerous vibration target for the Project.

Table 6.1 Z-axis Peak Velocity vibration levels from operation of the rock drilling unit

Measurement location	Measured maximum Peak Velocity level	Peak Velocity target	Vibration target met?
~5 m from the drill rig unit	3.8 mm/s	0.28 mm/s	No
~10 m from the drill rig unit	0.71 mm/s	0.28 mm/s	No
~20 m from the drill rig unit	0.16 mm/s	0.28 mm/s	Yes
~30 m from the drill rig unit	0.07 mm/s	0.28 mm/s	Yes

6.1.2 Discussion

The results of the vibration measurements show that the target for the maximum permissible Peak Velocity vibration level for residential areas are greater than these targets within 10 m from the drill rig unit. The measurements show that the emitted vibration levels from the unit diminish rapidly as the distance from the unit increases.

As the closest sensitive receiver is approximately 40 m from the dam dissipater (Scrivener Dam Offices), the risk of vibration generated from rock drilling unit to cause a disturbance to adjacent sensitive receivers is considered low. There is considered to be no risk of building damage.

7 Simulated noise impact testing

7.1 Introduction

Due to the highly variable nature of faunal responses to noise and the lack of robust information available on the potential impact of construction noise on captive wildlife, NCA commissioned WSP to undertake simulated testing of the proposed works at areas of the National Zoo.

The aims of this monitoring were to observe animal behavior to the predicted noise levels under controlled conditions and to provide zoo staff with an understanding of actual predicted noise levels and how they may be perceived within the site.

7.2 Methodology

The simulated work was undertaken at relevant noise sensitive areas of the National Zoo and in the presence of qualified Zoo staff. The following methodology was employed for the testing.

1 Potentially noise sensitive monitoring locations were identified by zoo representatives

2 A recording of the drill unit was played at each noise sensitive location through speakers at the operational noise level predicted in Table 5.3. The predicted level of animal exposure was correlated with a calculated speaker volume and confirmed using a NTi XL2 Sound Level Meter (S/N A2A-05718-EO), independently calibrated by a NATA accredited laboratory on 10 November 2021 and next due for calibration before 10 November 2023

3 Observations of animal behaviour were noted and agreed by both project and zoo representatives

4 Monitoring was conducted until the zoo representative was satisfied that impacts were unlikely to increase.

An example of the monitoring configuration is provided in Figure 7.1.

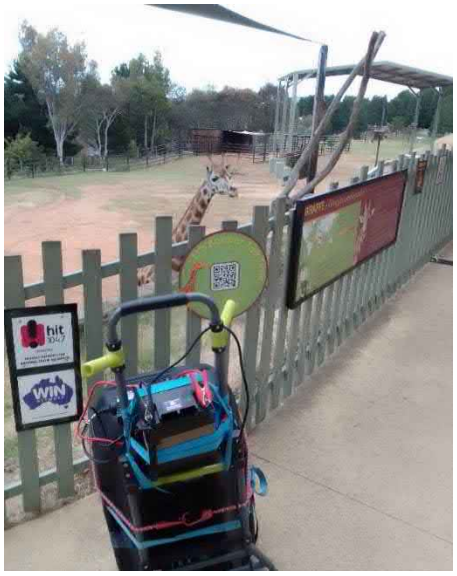

Figure 7.1 Simulated noise exposure configuration

7.3 Observations

Testing parameters and observation notes have been presented below in Table 7.1.

Table 7.1 Simulated drilling observations

Receiver ID	Receiver	Simulated noise level dBA[1]	Notes / observations	Potential Risk of noise impacts
R1	Jamala Wildlife Lodge Pool / front apartment	63	Simulated noise during this test was not substantially louder than existing background noise from the dam release water. Although drilling noise would be clearly audible at external spaces, it was agreed that there was a low likelihood of substantial impacts.	Low
R1	Jamala Wildlife Lodge Dining room / adjacent external spaces	63	External spaces: Simulated noise during this test was not substantially louder than existing background noise from the dam release water. Although drilling noise would be clearly audible at external spaces, it was agreed that there was a low likelihood of substantial impacts. Internal spaces: A reduction of approximately 16dB was monitored at internal spaces. Although the drilling noise was audible in the lack of other noise sources, it was well below the existing levels of background noise and it was agreed that there was a low likelihood of substantial impacts.	Unlikely
R2	Lion enclosure (eastern)	59	At the commencement of testing, the 2 lions in this enclosure were generally sleeping or relaxing in a reclined position. When the simulation began, both lions stood up and appeared curious, watching the testing group intently. During this time, they were relatively immobile and alert. Within 2 minutes, both lions appeared relaxed and had resumed their previous behaviour. It was agreed that there was a low likelihood of substantial impacts.	Unlikely
R2	Lion enclosure (southern)	59	At the commencement of testing, the 4 lions in this enclosure were generally sleeping or relaxing in a reclined position. When the simulation began, both lions stood up and appeared curious, watching the testing group intently. During this time, they were relatively immobile and alert. Within 2 minutes, both lions appeared relaxed and had resumed their previous behaviour. It was agreed that there was a low likelihood of substantial impacts.	Unlikely

Receiver ID	Receiver	Simulated noise level dBA[1]	Notes / observations	Potential Risk of noise impacts
R5	Alternative accommodation	57	Simulated noise during this test was not substantially louder than existing background noise from the dam release water. Drilling noise may be audible at external spaces during periods of low background noise, however, it was agreed that there was a low likelihood of substantial impacts.	Nil
R6	Giraffe enclosure	57	At the commencement of testing, one of the 2 giraffes (and 2 zebras) in this enclosure appeared curious, approaching the noise source cautiously and watching the testing group intently. During this time, one giraffe was relatively immobile and alert. No response was observed in the other giraffe or either zebra. Within approximately 3 minutes, the giraffe appeared to be resuming normal behaviour. It was agreed that there was a low likelihood of substantial impacts.	Unlikely
R8	Zebra enclosure	52	At this location, the simulated noise was not substantially louder than existing background noise levels. Although the zebras in this enclosure did notice the noise and look up as it reached maximum volume, no other reaction was observed and they resumed their normal behaviour almost immediately.	Nil

1 Refer Table 5.3

8 Recommendations

8.1 Background

Preliminary noise predictions outlined in Section 5 indicate that noise impacts may occur at accommodation areas throughout the Zoo and at animal enclosures located in the northern areas of the Zoo. Although no notable impacts have been identified as likely to occur at Government House based on the ICNG noise goals, given the particularly sensitive nature of some activities, management measures should be considered.

Simulated noise testing of drilling activities showed that the predicted noise levels are unlikely to generate significant behavioural impacts for fauna at the zoo, however ongoing observations should be maintained to confirm long term impacts do not arise.

This assessment has considered potential noise and vibration impacts associated with the rock drill, which is expected to be the loudest equipment on site, however additional plant will be involved with works and should be considered.

8.2 Noise management and mitigation

Noise management measures are likely to be required and these will be finalised in future stages of the study, prior to the commencement of construction activities. However effective measures to be considered may include the following:

- Work during 7 am and 6 pm on Monday to Saturday, excluding public holidays (per time restrictions to qualify for the exemption).
- Stakeholder consultation:
  - To determine upcoming events at the Zoo and Government House and their potential sensitivity to noise
  - To track any animal behavioural changes and determine additional and acceptable mitigation measures
- Consideration of respite periods or shutdowns during particularly sensitive time periods
- Discussion of noise management measures with hotel guests. This may include closing of doors and windows and not remaining in rooms for extended periods during works.
- Localised noise screens around noisy plant (where acoustic effectiveness can be demonstrated prior)
- Site inductions for construction staff to include information about noise impacts and management measures
- Noise monitoring of construction works and at receiver locations at the commencement of operations and in response to noise complaints.

Prior to the finalisation of this assessment, the following actions are recommended to assist with accurate determination of potential noise impacts and he identification of reasonable and feasible noise management measures and controls.

- The preparation of a Construction Noise and Vibration Management Plan to consider likely noise and vibration impacts and required management measures following the development of detailed construction methodology
- The consideration of a later start time for construction works to reduce impacts at Zoo accommodation areas
- Consider if quieter construction methods are viable, particularly alternatives to hammer drilling. Likewise use the smallest suitable equipment on site.
- Sound Power Level testing of the proposed drilling equipment should be undertaken to ensure modelling inputs are accurate
- Precise work areas and a full equipment list should be developed to determine potential total noise impacts

- Noise monitoring and simultaneous animal observations should be undertaken within the Zoo in response to any reasonable concerns raised by authorised Zoo representatives
- Potential noise impacts should be considered when planning worksite layout (in particular noisy areas such as compounds, stockpiles, laydowns, etc)
- Alternatives to reversing / warning beepers (broadband alarms, cameras, etc) should be installed on all on site equipment.

9 Limitations

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Appendix A

Rock drilling noise contour maps

R9 Open waterfront recreational spaces

R1 Jamala Wildlife lodge (National Zoo)

R3 National Zoo (Leopard enclosure)

R2 National Zoo (Lion enclosure)

R10 Scrivener Dam Offices

R12 Governor General residence (Offices)

R13 Governor General residence (Outdoor recreational areas)

R5 National Zoo (Other accommodation)

R4 National Zoo (Monkeys enclosures)

R11 Governor General residence (Workshops)

R14 Governor General residence (Government house)

R6 National Zoo (Giraffe enclosures)

R8 National Zoo (Ostrich and wapiti enclosures)

R7 National Zoo (Native animal enclosures)

Map: Western drill site	Author: MT
Date: 21/12/2022	Approved by:

To be read in conjunction with WSP document: PS133986-BI-NC ACO-REP-3

Map Source: NSW SIX Maps

0 30 60 90 m

1:2,500 at A3

Predicted operational noise level dBA Leq,15 min

>80	65-70	50-55
75-80	60-65	45-50
70-75	55-60	40-45

Legend

- Noise Senistive Receivers
- Receiver most at risk of noise impacts
- Building

Scrivener Dam Dissipator Strengthening Project

Western drill side

www.wsp.com

Map: Eastern drill site	Author: MT
Date: 21/12/2022	Approved by:

To be read in conjunction with WSP document: PS133986-BI-NC ACO-REP-3

Map Source: NSW SIX Maps

0 30 60 90 m

1:2,500 at A3

Predicted operational noise level dBA Leq,15 min

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Legend

- Noise Senistive Receivers
- Receiver most at risk of noise impacts
- Building

Scrivener Dam Dissipator Strengthening Project

Eastern drill side

ACTON ACTON ACTON ACTON

ACTON

YARRALUMLA

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YARRALUMLA

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DEAKIN

DEAKIN

DEAKIN

MOLONGLO

COOMBS

WESTON

Map: Impact om suburbs Western drill	Author: MT
Date: 21/12/2022	Approved by:

0 200 400 600 m

1:15,000 at A3

Predicted operational noise level dBA Leq,15 min

>80	65-70	50-55
75-80	60-65	45-50
70-75	55-60	40-45

Scrivener Dam Dissipator Strengthening Project

Impact on suburbs Western drill side

To be read in conjunction with WSP document: PS133986-BI-NC ACO-REP-3

Map Source: NSW SIX Maps

ACTON ACTON ACTON ACTON

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Predicted operational noise level dBA Leq,15 min

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75-80	60-65	45-50
70-75	55-60	40-45

Scrivener Dam Dissipator Strengthening Project

Impact on suburbs Eastern drill side

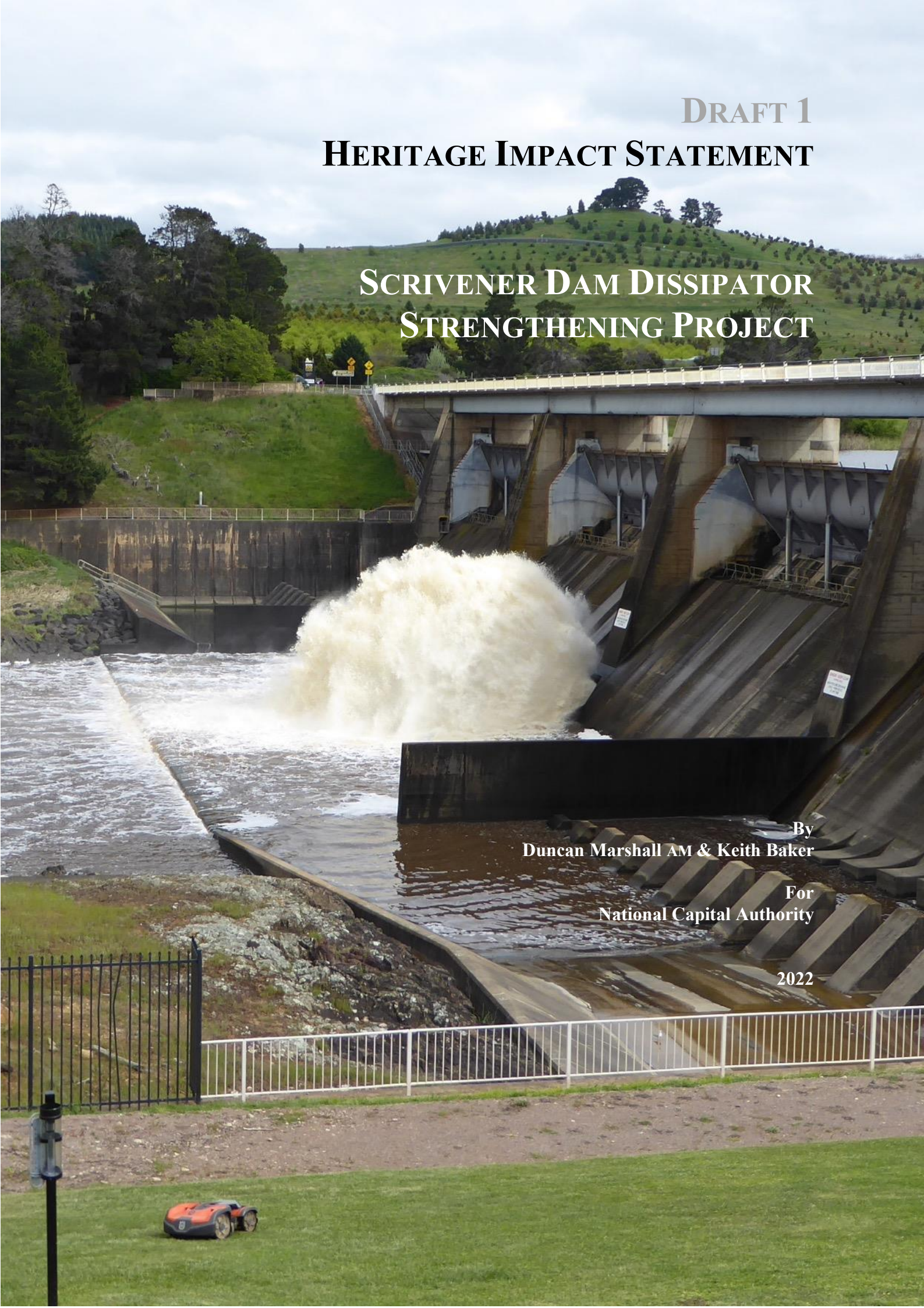
Appendix E

Draft Heritage Impact Statement

DRAFT 1

HERITAGE IMPACT STATEMENT

SCRIVENER DAM DISSIPATOR STRENGTHENING PROJECT



By
Duncan Marshall AM & Keith Baker

For
National Capital Authority

2022

EXECUTIVE SUMMARY

The National Capital Authority is proposing to undertake a project to strengthen the dissipator component of the Scrivener Dam which is immediately downstream of the dam wall. The works are to rectify deterioration and weakening of the dissipator.

Scrivener Dam is part of a recognised heritage place, Lake Burley Griffin and Adjacent Lands, which is on the Commonwealth Heritage List established by the *Environment Protection and Biodiversity Conservation Act 1999*. Accordingly, this assessment has been commissioned to consider the impact of the proposed work on the heritage place.

Having considered the proposed works, it is concluded they will:

- have **very minor impacts** on several values, given proposed changes to the original dissipator as a component of the dam. However, the original form of the dissipator will be sympathetically reflected in the modifications;
- have **no impacts** on a range of other values; and
- be **consistent** with several conservation policies or strategies.

While the new concrete elements will appear as bright, clean concrete when first installed, it is expected that these will patinate over time, and become less noticeable. In addition, the project will also involve temporary construction phase impacts.

However, based on the apparent threshold being applied by the Department of Climate Change, Energy, the Environment and Water, in no case or overall are these impacts considered to be a significant impact within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. Therefore an EPBC Act referral under Part 7 of the Act would not seem warranted unless certainty is required.

In addition, these very minor impacts also could be regarded as *adverse impacts* within the meaning of the Act and there are additional obligations which arise.

In addition to these conclusions, it is recommended:

- the NCA ensure that a good record (photographs and plans) is made of the dissipator in its original configuration, and that this record is archived for future reference; and
- the landscape affected by the temporary construction phase impacts should be remediated upon completion of the project.

❖

CONTENTS

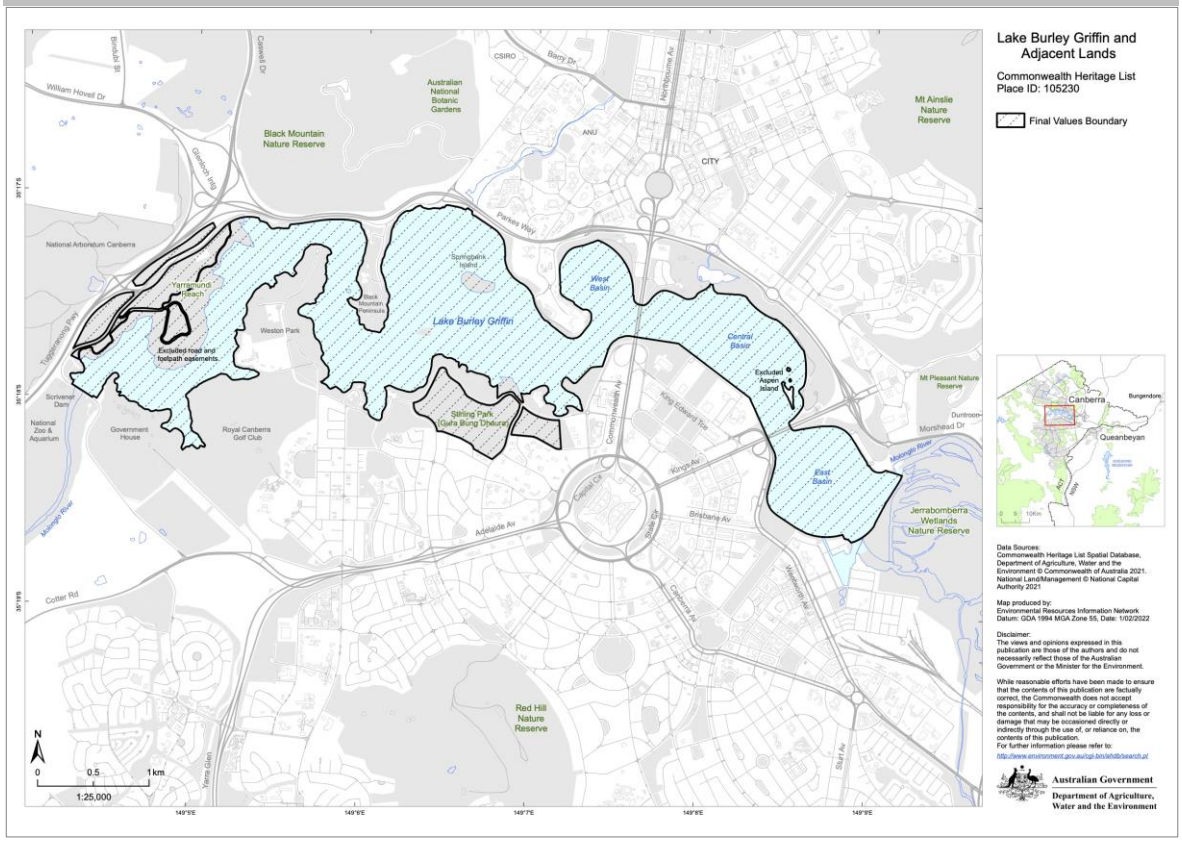
1. INTRODUCTION

The National Capital Authority (NCA) is proposing to undertake a project to strengthen the dissipator component of the Scrivener Dam which is immediately downstream of the dam wall. The works are to rectify deterioration and weakening of the dissipator.

Scrivener Dam is part of a recognised heritage place, Lake Burley Griffin and Adjacent Lands, which is on the Commonwealth Heritage List established by the *Environment Protection and Biodiversity Conservation Act 1999*. Accordingly, this assessment has been commissioned to consider the impact of the proposed work on the heritage place.

However, it is noted the dissipator structure would formally appear to lie outside the boundary of the Commonwealth Heritage place, as indicated in Figure 1 below. None the less, as an integral part of the dam which is included in the listing, this assessment assumes the dissipator shares the same Commonwealth Heritage values.

Figure 1. Plan of Lake Burley Griffin and Adjacent Lands Commonwealth Heritage Listed Place
Source: DCCEEW



This assessment is based on:

- a concept design report (GHD 2021);
- discussions with the key NCA adviser;
- the Commonwealth Heritage List place record for Lake Burley Griffin and Adjacent Lands (DCCEEW 2022);
- the heritage management plan for the dam (GML 2009);
- archival records relating to the design and construction of the dam;
- comparison with other Australian dams;
- research regarding the state of the art with hydraulic energy dissipators; and
- a site inspection.

This report has been prepared by Duncan Marshall AM B.Arch(Hons) BA MICOMOS and Keith Baker FIEAust CPEng(Ret) MICOMOS.

2. SUMMARY OF PROPOSAL

The proposed works involve:

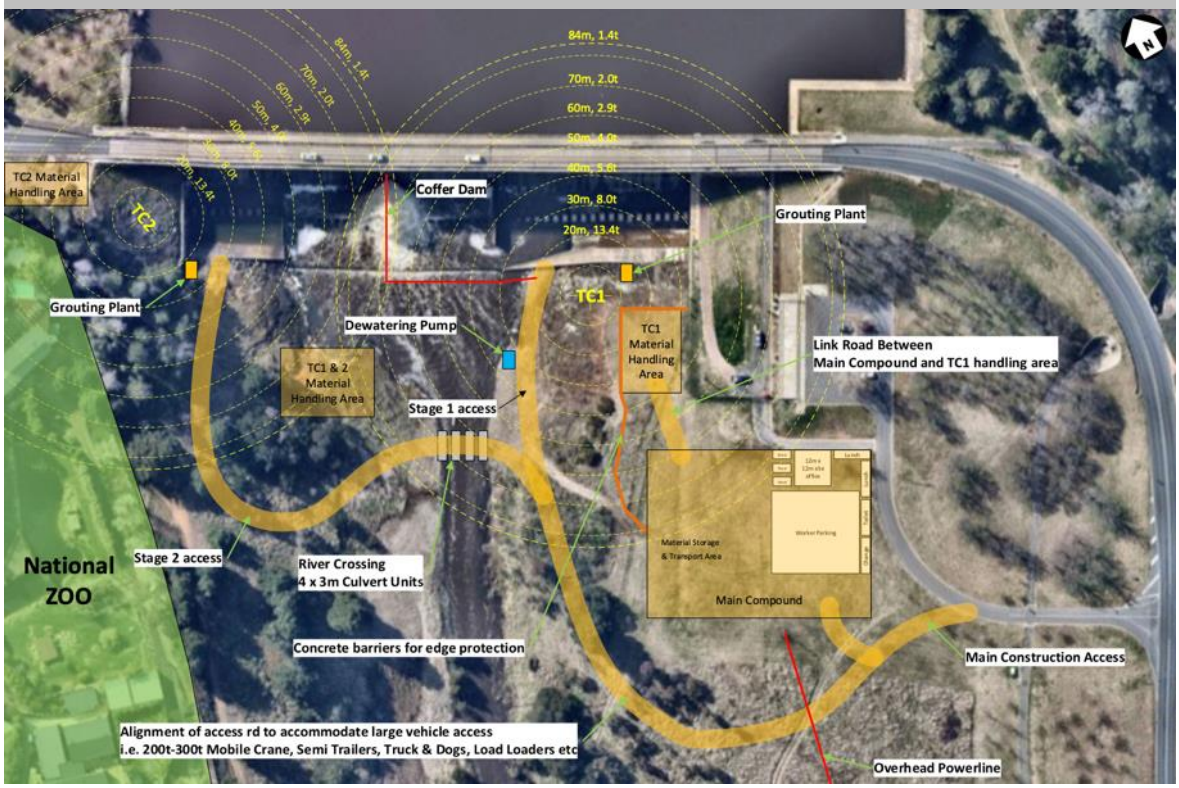
- Preliminary works and demolition – Removal of the existing baffle blocks and surface preparation of the existing slab for placement of the new overlay concrete;
- Anchoring works – Installation of approximately 670 No. 57.5 mm diameter double-corrosion protected passive anchors, on a grid of 2.4 x 12.5 m deep upstream of the central baffles, and a grid of 2.9 x 10 m deep downstream of the baffles;
- Slab works – Placement of a 500 mm thick overlay slab on the top of the existing slab, including construction of contraction joints with double waterstops and tie-ins to the existing structure. As part of these works, the existing chute blocks, baffle blocks and end sill will be raised by 500 mm. The raising will be achieved by complete demolition and reconstruction of the baffle blocks, however the chute blocks and end sill will be raised via a concrete overlay;
- Training Wall extension – Extension of a short (triangular) section of the left and right side walls of the stilling basin to stop water impacting and eroding the abutments; and
- Erosion armouring – Erosion protection of the left and right abutment slopes adjacent to the stilling basin, to minimise erosion of the abutments under unusual and extreme floods. (GHD 2021, pp. ii-iii)

The location of the works is indicated in Figure 2.

Figure 2. Location of the Dissipator below Scrivener Dam
Source: NCA

In addition, temporary works for the construction will include access roads, a site compound, storage and handling areas, and cranes, all located downstream of the dam. A preliminary plan of the construction site layout is provided below.

Figure 3. Preliminary Construction Site Layout
Source: GHD 2022, p. 27



3. CONSIDERATION OF ALTERNATIVES AND MITIGATION MEASURES

In the course of the project, options were considered to address the structural problems with the dissipator. These considerations are summarised in the concept design report as follows.

> GHD was engaged in August 2021 to progress the work undertaken by SMEC and WRL by undertaking an options assessment and developing a concept design to upgrade the stability of the Scrivener Dam stilling basin. During the Options phase, a broad range of upgrade options were identified and were reduced through an options workshop process to determine three preferred options for further development. The three preferred options comprised:
>
> - Option 3 – Installation of a new anchored overlay slab, resulting in the new stilling basin invert being slightly higher than the existing arrangement.
> - Option 4 – Retrofitting anchors into the existing slab to provide sufficient additional resistance.
> - Option 9 – Partial demolition of the existing slab and reconstructing a new anchored slab to the original geometry.
>
> Basic designs and preliminary cost estimates were prepared for these three options, and a multi-criteria assessment was undertaken to determine the preferred option to be taken through to concept stage. Through this process, Option 3 was selected as the preferred option. (GHD 2021, p. ii)

Option 3 is the option considered in this assessment.

4. HERITAGE VALUES

This section discusses the existing Commonwealth Heritage values relevant to the dam, as well as new research on values undertaken for this heritage impact statement.

Commonwealth Heritage Values

Prior to this assessment, the best definition of heritage values for Scrivener Dam was that found in the Commonwealth Heritage List place record (DCCEEW 2022). The full official values from the place record is reproduced at Appendix A. Based on this, key heritage values relevant to this assessment are as follows. In some cases, the values relate to the lake overall including the dam, and in other cases just to the dam or specific aspects of it.

Scrivener Dam is of heritage value because:

- it is part of the creation of Lake Burley Griffin as an important feature of the national capital, its original design and creation;
- of the influence of International Modernism in the fish belly flap gates, which are also a rare technological feature in Australia and have research potential;
- the lake design demonstrates the principal characteristics of, is rare, and demonstrates creative and technical accomplishment for its design reflecting the two most important town planning movements of the twentieth century, City Beautiful Movement and the Garden City Movement, as well as the influence of International Modernism;
- of its technical engineering achievement;
- the lake has social value for the Canberra community as a significant construction achievement; and
- the lake has strong associations with the professions involved in its planning, design and construction.

As noted in the introduction, the dissipator structure would formally appear to lie outside the boundary of the Commonwealth Heritage place. None the less, this assessment assumes the dissipator shares the same Commonwealth Heritage values as the dam.

Additional Research into Heritage Values

Because of the limited existing information on heritage values for the dam, additional research was undertaken to develop a better understanding. This research is summarised below, structured to reflect the Commonwealth Heritage criteria.

Processes (history)

The idea of a lake as a central feature of Canberra emerged as a part of the 1909 proposals for the site for the national capital. The surveyor, Charles Robert Scrivener, who was instrumental in the selection of the site for Canberra, gave one of the reasons for recommending the site as the opportunity afforded for "storing water for ornamental purposes at reasonable cost".

In 1911 the Commonwealth advertised an international design competition for the new city of Canberra. Scrivener's 1909 Canberra Contour Survey of the selected site was used as the basis for entries in the design competition and his 1,825 foot contour line suggested a lake and dam location much like that ultimately built. The dam was subsequently built to hold the lake at the 1,825 foot level, very near the part of the river bed at 1,778 foot

suggested by Scrivener as his dam site E-F, one of four such alternatives suggested.

The dam, known initially as the Woden Dam and then the Canberra Lake Dam, was designed in 1959 for the National Capital Development Commission (NCDC) by engineers of the Commonwealth Department of Works (CDW), who also supervised the construction. The Snowy Mountains Hydroelectric Authority (SMHA) was a sub-consultant for design of the sluices through the dam. Tenders for the construction were called in 1960. The dam was constructed under contract by Citra Australia Ltd and the spillway gates were detailed, supplied and installed by A E Goodwin Ltd in association with the West German firm Rheinstahl Union Bruckenbau.

The energy dissipator of the dam was one of the earliest, if not the earliest in Australia to adopt the US Bureau of Reclamation Basin Type III design, within a year of the basin type being published. The dam adapted the standardised Type III design to the variable flow conditions of the Molonglo River using hydraulic scale models for the river flow, and for the spillway and dissipator performance.

The name of the dam in honour of Charles Scrivener was settled by September 1963 when that name appeared on the brochure for its official opening.

See also Appendix B: History of the Scrivener Dam Energy Dissipator.

Accordingly, the dam is an important part of the early design for the national capital, ultimately realised in the 1960s. It allowed the creation of Lake Burley Griffin as a major feature of the city.

Rarity

With five bays of 30 metre long by 5.5 metre high flap gated spillways, Scrivener Dam is one of the largest 'flap' gated dams in Australia. Meadowbank Dam in Tasmania is the only Australian dam known to have larger flap gates (Smith and Coltheart 1988).

The fish belly flap gates were designed in Germany with a smooth contour to accurately control floodwater. The gates are rare by being operated from below by hydraulic jacks so that there is no projection of the operating mechanism above the water level.

In summary, the dam is uncommon for the size of its flap gates, and the operating mechanism for the gates is also rare.

Characteristic values

Although by no means unique, Scrivener Dam is a fine example of a concrete gravity dam with a large gated spillway. The gates are sized to release flood waters thereby keeping the lake level reasonably constant up to a pre-determined rate of inflow. The dam was constructed with a gated spillway in order to control the lake level and to provide a degree of flood control (Smith and Coltheart 1988).

Technical achievement

Scrivener Dam was at the leading edge in Australian dam design for both the form and control of the flap gates, and the form of the energy dissipater. In an assessment of large dams in Australia, Scrivener Dam was rated 5th of the 26 dams recommended for inclusion in the former Register of the National Estate.

The road bridge over the dam was structurally more conventional than the Kings Avenue

and Commonwealth Avenue Bridges which were built as part of the lake project during the same period. However, the bridge was a technical achievement in its clean slender lines with no unsightly projection above the spillway and below the deck of the bridge, which was a design requirement of the NCDC.

Social value
As an integral part of Lake Burley Griffin, Scrivener Dam shares the social value of the lake.

Significant people and groups
Groups associated with the dam include the NCDC which is associated with the lake overall, the Commonwealth Department of Works for the design and construction of the dam, Snowy Mountains Hydroelectric Authority for the design of the sluice valves, Rheinstahl Union Bruckenbau for the design and manufacture of the fish belly gates, and Citra Australia Ltd for the construction of the dam.

People associated with the dam include Charles Scrivener, who was involved in the selection the site of Canberra with such a dam in mind, Clive Price from the NCDC who managed the lake project overall, Ken Harding, CDW Supervising Engineer Major Development who was the principal designer, B V Kearsley, CDW engineer who conducted the hydrological testing, Arne Fokkema, Supervising Engineer Construction who was the CDW site engineer for construction of the dam, and one or several individuals (not yet identified) from Citra Australia Ltd.

To meet this Commonwealth Heritage criterion, the people or groups need to be important in Australia's history, and for there to be a special association. The NCDC, Department of Works and Snowy Mountains Hydroelectric Authority are all prominent in Australian history. In the case of the NCDC, it is arguable the lake, including the dam, has a special association, as a prominent, early and enduring achievement. However, it is less clear that there is a special association with the Department of Works given its involvement in a large number of projects over a long period of time, and it seems likely there is no special association with the Snowy Mountains Hydroelectric Authority – the Snowy Mountains Scheme being the obvious special association in the latter case.

The other companies noted above do not appear to be important in Australia's history, or for the dam to hold special associations with them.

With regard to people, only Charles Scrivener would appear to be an important figure in Australian history. The dam may have a special association with him as a realised feature for the national capital which Scrivener provided indicative planning for. The other place with a known special association is the Surveyors' plan room (now called a hut) and associated park on the western slopes of Capital Hill.

5. ASSESSMENT OF POTENTIAL IMPACTS

The central task of this assessment is to address the question: do the proposed works have, will they have or are they likely to have a significant or an adverse impact on heritage values? This question can be addressed by considering the impact on the identified heritage values.

The following discussion of impact considers the impact of the proposed works on the relevant heritage values of the dam.

Impact on Heritage Values

Heritage Values	Potential Impact/Comments
Commonwealth Heritage Values	
Processes [history] From the early days of Canberra's establishment as the national capital, the gradual formation of Lake Burley Griffin marked major milestones in the capital city's creation. As a substantial national project, the construction and completion of Lake Burley Griffin demonstrates the push for national development during the years immediately after Federation and before the First World War, and again after the Second World War, under the Menzies government. Lake Burley Griffin is associated with the original city competition brief for the design of Canberra… The Lake's design reflects the influence of three major urban design movements including the City Beautiful movement, the Garden City movement and International Modernism… Modernism can be seen in the engineering works within the place including the fish belly flap gates of Scrivener Dam	**Very minor impact** – given proposed changes to the original dissipator as a component of the dam which is part of the lake. The influence of the design movements are reflected in the slenderness of the road bridge and its support columns as part of the dam, and the clean unobstructed lines of the fish belly flap gates. Neither will be changed. In addition, the engineering design of the dissipator was to be functional rather than aesthetic. The only proposed change in form is to the training walls, which is considered a very minor impact.
Rarity Lake Burley Griffin is an important exemplar design site which can demonstrate design and planning devices characteristic of the two most important town planning movements of the twentieth century; the City Beautiful and Garden City movements… The 'fish-belly' flap gates of Scrivener Dam enable the lake's water levels to be controlled to a precise degree. The technology identified and built at Scrivener Dam (fish-belly-flap gates) is rare in Australia and represents the development of standards in hydrology and dam engineering in its time.	**No impact** – the works will not affect the flap gates. As an additional comment, while there are aspects of rarity in the design of the dissipator in relation to the state of dam design in Australia at the time, they are unrelated to the City Beautiful and Garden City movements. The design of the dissipator equally reflects the development of standards in hydrology, but the proposed concrete overlay work maintains that evidence of the pioneering adoption of design standards coupled with model-based verification of hydrological design.
Research The fish belly flap gates of Scrivener Dam… also provide the opportunity for further research and teaching potential associated with engineering practice and design technologies.	**No impact** – the works will not affect the flap gates. As an additional comment, the teaching potential of the dissipator is unchanged by the proposed overlay works which will sympathetically reflect the original design. It may also be enhanced considering the further hydrological testing and remedial design after 60 years of operation.

Heritage Values	Potential Impact/Comments
Characteristic values The design and final form of Lake Burley Griffin demonstrate key aspects of important design philosophies and styles from the early twentieth century, including the City Beautiful Movement and the Garden City Movement. The influence of International Modernism from the mid-twentieth century is also evident.	**No impact** – the works will not affect the features of the dam reflecting International Modernism.
Technical achievement The design of Lake Burley Griffin strongly reflects two key periods of creative and technical accomplishment. In the early period of the lake's development the lake's design is associated with the City Beautiful and Garden City town planning movements. Work undertaken from the 1950s is associated with International Modernism… Lake Burley Griffin also demonstrates a high degree of technical achievement in engineering. The construction of… Scrivener Dam were projects which demonstrated high levels of achievement in their time.	**Very minor impact** – given proposed changes to the original dissipator as a component of the dam. While the proposed concrete overlay and anchorage are to correct a structural weakness that has developed, the original form of the dissipator will be sympathetically reflected in the modifications. The dissipator has functioned for 60 years to its original design and the proposed works are to strengthen and carefully and sympathetically adapt it to continue to function well into the future.
Social value The lake also connects Canberrans to Canberra's function and purpose as the nation's capital as the lake is a central design element in the construction of the national capital. Canberrans are proud of the lake as a significant construction achievement. The unification of two parts of the city at completion of the lake is remembered.	**No impact.**
Significant people and groups Many professions have been involved in planning, design and construction of Lake Burley Griffin including town planners, architects, landscape architects, engineers and surveyors. In the case of landscape architects and town planners in Australia, the growth of these professions in Australia has a strong association with Lake Burley Griffin and some of the adjacent lands within the place.	**No impact.**
Heritage Values arising from Additional Research	
Processes [history] The dam is an important part of the early design for the national capital, ultimately realised in the 1960s. It allowed the creation of Lake Burley Griffin as a major feature of the city.	**Very minor impact** – given proposed changes to the original dissipator as a component of the dam.
Rarity The dam is uncommon for the size of its flap gates, and the operating mechanism for the gates is also rare.	**No impact.**
Characteristic values Scrivener Dam is a fine example of a concrete gravity dam with a large gated spillway.	**Very minor impact** – given changes to the original dissipator as a component of the dam.
Technical achievement Scrivener Dam was at the leading edge in Australian dam design for both the form and control of the flap gates, and the form of the energy dissipater. The bridge was a technical achievement in its clean slender lines with no unsightly projection above the spillway and below the deck of the bridge.	**Very minor impact** – given changes to the original dissipator as a component of the dam. However, the original form of the dissipator will be sympathetically reflected in the modifications.

Heritage Values	Potential Impact/Comments
Social value As an integral part of Lake Burley Griffin, Scrivener Dam shares the social value of the lake.	**No impact.**
Significant people and groups The NCDC is an important organisation is Australia's history for its key role in the development of Canberra. It is arguable the lake, including the dam, has a special association with the NCDC as a prominent, early and enduring achievement. Charles Scrivener would also appear to be an important figure in Australian history for his role in the development of the national capital. The dam may have a special association with him as a realised feature for the national capital which Scrivener provided indicative planning for.	**No impact.**

Consistency with Relevant Conservation Policies and Strategies

Another way to assess impacts is to consider the consistency of the proposed works with any relevant conservation policies. The following conservation policy and strategy extracts are drawn from the heritage management plan for the dam (GML 2009).

Relevant Conservation Policies and Strategies	Consistency/Comment
C3-1 Maintain the structural and design integrity of the dam, to ensure its long-term conservation as an integral aspect of the heritage values of the Lake Burley Griffin Study Area.	**Consistent** – the works are intended to ensure structural integrity, and the proposed changes reflect the original design.
C3-1.5 Undertake regular monitoring of the structural integrity of the dam and the state of conservation of its component materials to identity areas where corrective or preventative action may be required to delay degradation of materials.	**Consistent** – the works arise because of such monitoring.

Other Comments

In addition to the comments about impacts noted above, there are a few other matters worth noting.

Firstly, the new concrete elements of the dissipator and training walls will appear as bright, clean concrete when first installed. However, it is expected that these will patinate over time, and become less noticeable.

The works also involve erosion armouring on the downstream slopes either side of the dam. In this case, the works will be concealed by remediated lawn areas.

The project will also involve construction phase impacts, such as the downstream construction access roads, material handling areas, main compound, coffer dam and cranes. These will be noticeable features, such as the cranes rising above the dam wall. However, they will be temporary, and the landscape remediated after construction is completed.

6. CONCLUSIONS

Having considered the proposed works to Scrivener Dam, it is concluded that the works will:

- have **very minor impacts** on several values, given changes to the original dissipator as a component of the dam. However, the original form of the dissipator will be sympathetically reflected in the modifications;
- have **no impacts** on a range of other values; and
- be **consistent** with several conservation policies or strategies.

While the new concrete elements will appear as bright, clean concrete when first installed, it is expected that these will patinate over time, and become less noticeable. In addition, the project will also involve temporary construction phase impacts.

However, based on the apparent threshold being applied by the Department of Climate Change, Energy, the Environment and Water, in no case or overall are these impacts considered to be a significant impact within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. Therefore an EPBC Act referral under Part 7 of the Act would not seem warranted unless certainty is required.

In addition, these very minor impacts also could be regarded as *adverse impacts* within the meaning of the Act. Section 341ZC states,

> A Commonwealth agency must not take an action that has, will have or is likely to have an adverse impact on the National Heritage values of a National Heritage place or the Commonwealth Heritage values of a Commonwealth Heritage place, unless:
> (a) there is no feasible and prudent alternative to taking the action; and
> (b) all measures that can reasonably be taken to mitigate the impact of the action on those values are taken.

While these provisions do not require a referral, the NCA should still consider them.

In addition to these conclusions, it is recommended:

- the NCA ensure that a good record (photographs and plans) is made of the dissipator in its original configuration, and that this record is archived for future reference; and
- the landscape affected by the temporary construction phase impacts should be remediated upon completion of the project.

7. REFERENCES

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APPENDIX A: HERITAGE VALUES

The following text is drawn from the Commonwealth Heritage List place record for Lake Burley Griffin and Adjacent Lands (DCCEEW 2022).

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Official Values

Criterion A Processes
The Lake Burley Griffin and Adjacent Lands place has significant historic heritage value. Characteristics of the place with significant historic value include the following.

From the early days of Canberra's establishment as the national capital, the gradual formation of Lake Burley Griffin marked major milestones in the capital city's creation. As a substantial national project, the construction and completion of Lake Burley Griffin demonstrates the push for national development during the years immediately after Federation and before the First World War, and again after the Second World War, under the Menzies government.

Lake Burley Griffin is associated with the original city competition brief for the design of Canberra. Its final form at completion is consistent with the original guiding intentions set out in the competition brief. This link with the original brief connects us to the aspirations and vision Australians had for Federation and its capital city at the beginning of the twentieth century.

The Lake's design and form reflect the story of its development including the tensions between designers, administrators and politicians in the development of the capital.

The Lake's design reflects the influence of three major urban design movements including the City Beautiful movement, the Garden City movement and International Modernism. The use of City Beautiful and Garden City theories and ideas is reflected in the use and design of the lake to fulfill aesthetic, open space and outdoor recreation functions. The lake also forms part of the water axis and has been designed in parts to include symbolic, ceremonial, formal and informal and active and passive recreation space. The design influences of International Modernism can be seen in the engineering works within the place including the fish belly flap gates of Scrivener Dam, Commonwealth Avenue Bridge and Kings Avenue Bridge.

The central area of Lake Burley Griffin provides an aesthetic and symbolic backdrop for many military and civil memorials along its foreshore. National events and ceremonies have and continue to be staged around, near and over the lake because of its beauty and function within the central national area.

Stirling Park has a layered collection of Indigenous, pastoral and early capital city features including Aboriginal stone artefacts and arrangements, a scarred tree, old routes and tracks, exotic plantings, remnant mining sites, campsite and homestead sites and the remaining remnant structures of the former Westlake workers settlement. Westlake provided accommodation for early Canberra builders and tradesmen working on the construction of buildings like Old Parliament House, East Block, West Block and Hotel Canberra. The remnant layout of the Westlake settlement is still legible in the landscape demonstrating the living conditions of those early workers and their families who came to Canberra as builders and tradesmen. Over time this settlement became a strong community remembered today by former residents and their families.

Roman Cypress Hill is a significant historic planting area. The remnant historic planting of *Cupressus sempervirens* was planted in 1919--1921 when the first planning and layout for Griffin's Canberra was being undertaken. Charles Weston's work to establish the landscape of the city is also partly demonstrated here. Today it is a remnant of Griffin's plan for the treatment of the western horizon. Only part of the hill planting remains in its original setting, the remaining planting area is located across the highway to the west.

The Lindsay Pryor Arboretum is associated with the history of urban landscaping and city horticulture in Canberra. The historic planting in the arboretum area demonstrates some of Pryor's experimental work on the growth of a variety of tree species for potential use in the city's parks and streets. The planting and surrounding water areas also form part of the attractive parkland and water views from Government House.

Features which express the significant historic values of the place include, but are not limited to: the lake as a whole including its edge treatments, the Captain Cook Water Jet, the Commonwealth and Kings Avenue

bridges, Scrivener Dam, lake islands, the Lake's contribution to the geometry of Griffin's plan for Canberra; the remnant historic plantings of *Cupressus sempervirens* trees located on part of the hill known as Roman Cypress Hill; the remnant historic plantings within the Lindsay Pryor Arboretum; the site and remnant structures of the former Westlake settlement; the No 1 sewer vent in Stirling Park and the layered historic landscape of Stirling Park representing the Indigenous, pastoral and early capital city periods of Canberra.

Criterion B Rarity

The Lake Burley Griffin and Adjacent Lands place has significant rarity value because of the place's possession of uncommon, rare and endangered aspects of Australia's natural and cultural history. These rare aspects of the place are described below.

City Beautiful and Garden City exemplar

Lake Burley Griffin is an important exemplar design site which can demonstrate design and planning devices characteristic of the two most important town planning movements of the twentieth century; the City Beautiful and Garden City movements. Canberra is one of the few planned twentieth century cities in Australia and in the world. The city's national capital function provided planners and designers, like Griffin, with an opportunity to use their best and most innovative planning ideas drawing from the town planning practices of their time.

In particular, the lake forms part of the water axis which Griffin used to arrange city elements and connect surrounding natural features. The grand scale of lake vistas along the water axis and in other areas gifts the National Triangle and city a sense of grandeur and beauty. The lake overall, also provides long water vistas which feature the surrounding, sometimes snow covered, Brindabella Mountains. Viewed from high vantage points like Black Mountain, Mt Ainslie and Red Hill, the lake is a distinctive character element providing a lake setting for its urban, residential and national capital activities and spaces. The lake also integrates the northern and southern sides of the central city. The formal areas of the lake also provide a water setting for national institutions which are showcased on its foreshore.

The use of visual follies like the lake's islands, the National Carillon and the Captain Cook Memorial [water] Jet are examples of visual devices informed by the City Beautiful movement.

From a Garden City perspective, the lake provides a variety of recreation spaces and is itself a huge open space in the middle of the central city area of Canberra. The lake area is almost twice the size of Central Park in New York. Stirling Park and Yarrumundi Reach are part of an extensive and generous system of parks and open space along the lake's foreshore. The treatment of Roman Cypress Hill also demonstrates the careful management of visual experiences which were planned deliberately in a dynamic way to enhance the visual experience of the city and National Triangle.

The features which express these rarity values include but are not limited to the lake as a whole including its edge treatments, the Captain Cook Memorial Jet, the lake's two bridges, Scrivener Dam, lake islands, the lake's contribution to the realisation of the water axis, the Roman Cypress Hill planting, the use allocation of Stirling Park and Yarramundi reach as parkland, the long uninterrupted lake vistas and views (from the Lake) of the Brindabella Mountains and the many long water vistas afforded from the foreshore and for those using the lake for boating.

Engineering techniques

The 'fish-belly' flap gates of Scrivener Dam enable the lake's water levels to be controlled to a precise degree. The technology identified and built at Scrivener Dam (fish-belly-flap gates) is rare in Australia and represents the development of standards in hydrology and dam engineering in its time.

Natural areas

The large surviving grassy woodland area, now modified to grassland, at Yarramundi Reach displays important characteristics of the remnant Natural Temperate Grassland ecological community. This ecological community is recognised at a territory and national level as a threatened ecological community. The grassland at Yarramundi Reach provides habitat for the Striped Legless Lizard which is recognised at a territory and national level as a threatened species and the Perunga Grasshopper, also recognised as a threatened species.

The White Box-Yellow Box-Blakely's Red Gum Grassy Woodland ecological community of Stirling Park is a recognised threatened ecological community. This community provides habitat for another threatened species, the Button Wrinklewort, and may provide suitable habitat for the vulnerable Gang-gang Cockatoo and Superb Parrot.

Both the remnant Natural Temperate Grassland of Yarramundi Reach and the derived native grassland in the

western section of Stirling Park may also provide important habitat for the critically endangered Golden Sun Moth.

Wetland environments at Yarramundi Inlet, Acacia Inlet and Warrina Inlet, comprising reed beds, fringing terrestrial vegetation and open water, provide habitat for a diverse population of waterfowl and land birds. Latham's Snipe, the Common Greenshank, the Red-necked Stint and the Sharp-tailed Sandpiper, listed migratory wetland species, are recorded from these wetlands. Other locally rare species recorded here include the Greater Crested Grebe, the Little Bittern, the Little Grassbird and the Musk Duck.

The wider aquatic ecosystem of the lake provides habitat for the threatened Murray Cod.

Below the waters and along the shoreline of the lake are occurrences of limestone, including a limestone cave; rare examples of a feature from which the original post-contact settlement name for the Canberra locality, the 'Limestone Plains,' is derived. Early descriptions of the area often refer to limestone, but most examples have since been either built on or submerged under the lake.

The features which express the natural rarity values include but are not limited to the whole area of designated grassland on Yarramundi Reach; the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland community on the slopes of Stirling Ridge; the lake habitat of the Murray Cod comprising the waterbody, aquatic vegetation and lake bed; the grassland habitat of the Striped Legless Lizard, Perunga Grasshopper and Golden Sun Moth, which includes the whole area of designated grassland on Yarramundi Reach and the western section of Stirling Park; the habitat of the Button Wrinklewort which includes the upper slopes of the central and western parts of Stirling Park; the wetland bird habitats along the foreshores and shallows of the two inlets along Yarramundi Reach and the one inlet to the east of Government House; the Acacia Inlet wetland at the northern end of Yarramundi Reach, extending south along the reach and including the majority of reed beds along the Reach foreshores, and the limestone formations occurring both above and below the surface of the lake.

Criterion C Research
The Lake Burley Griffin and Adjacent Lands place has significant research value because of the place's potential to yield information that will contribute to an understanding of Australia's history and practice of urban planning, architecture and landscape architecture. Indigenous sites and natural sites are also able to yield important information. Specific areas or characteristics able to yield information are described below.

Design and planning studies
Lake Burley Griffin and its many 'design layers' is a source of information about key theories, practices and histories associated with urban planning, architecture and landscape architecture. Evidence of the work of key practitioners including Walter Burley Griffin, Marion Mahoney, John Sulman, Charles Weston, Lindsay Pryor, Sir William Holford, Dame Sylvia Crowe, Richard Clough, Peter Harrison, Trevor Gibson, and John Overall are also evident and are a valuable historic resource for further study and examination. The fish belly flap gates of Scrivener Dam and the two major bridges also provide the opportunity for further research and teaching potential associated with engineering practice and design technologies.

The features which express these significant historic research values include but are not limited to Lake Burley Griffin and its designed and planned features associated with the design practitioners mentioned above.

Natural Science
The occurrence of threatened species in the Yarramundi grasslands (particularly the Striped Legless Lizard and Perunga Grasshopper) and at Stirling Park (Button Wrinklewort), and the ecological communities themselves (Natural Temperate Grassland and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland) provide opportunities for ecological research on habitat and population relationships. The lake's wetlands offer similar opportunities for the study of resident and migratory birds. The freshwater ecosystems of the wider lake also provide research opportunities for the study of aquatic ecosystems. This research would be particularly focused within the context of artificially impounded water bodies in urban environments.

The features which express these significant natural heritage research values include the whole area of designated grassland on Yarramundi Reach, the upper slopes of the central and western parts of Stirling Park and the lake waters, including the small wetland pockets near and around Yarramundi Reach.

Indigenous history
Indigenous sites within the place have the potential to reveal evidence of traditional lifeways and the

economy of Indigenous people in the Canberra region prior to European settlement. The features which express these significant Indigenous research values include the Indigenous sites (12) at Yarramundi Reach and Stirling Park.

Criterion D Characteristic values
The Lake Burley Griffin and Adjacent Lands place has important representative values. The aspects or characteristics of the place which have representative value are as follows.

City Beautiful Design exemplar
The design and final form of Lake Burley Griffin demonstrate key aspects of important design philosophies and styles from the early twentieth century, including the City Beautiful Movement and the Garden City Movement. The influence of International Modernism from the mid- twentieth century is also evident. Lake Burley Griffin is representative of a small group of designed urban environments in Australia containing areas of water used primarily for ornamental purposes and is one of the largest and best-known examples.

Natural areas
Some areas within the place possess remnant vegetation. Collectively these areas represent the characteristics of the pre-1820s natural environment. These areas include:
- adjacent to Yarramundi Inlet there is a surviving individual *Eucalyptus viminalis* representing the original Molonglo River riparian forest. This tree is the sole indicator of the past riparian forest in the study area;
- small remnants of the Natural Temperate Grassland community which exist in patches between Alexandria Drive and the lake foreshore from Blue Gum Point to Attunga Point. These areas represent remnant examples of the pre-1820s vegetation;
- a large grassy woodland area, now modified to grassland, located at Yarramundi Reach. This area displays the significant characteristics of the Natural Temperate Grassland community;
- a large remnant of the original White Box-Yellow Box-Blakely's Red Gum Grassy Woodland on the slopes of Stirling Ridge in Stirling Park;
- a remnant eucalypt dry open forest, characteristic of north and west facing slopes in the ACT, located on the eastern ridge of Stirling Park; and
- a re-growth Snow Gum stand at the northern end of Yarramundi Reach. This stand is characteristic of the natural woodland/forest transition in the southern tablelands.
The features which express these significant representative values include but are not limited to Lake Burley Griffin surrounds and the natural features described above.

Criterion E Aesthetic characteristics
Lake Burley Griffin and Adjacent Lands place has important aesthetic characteristics valued by:

For Australians
Lake Burley Griffin is recognised as a beautiful feature of Canberra. In particular the Lake provides an attractive water setting for national institutions, lakeside parklands and lakeside memorials. Lake Burley Griffin is also featured in many promotions of Canberra to the extent that it has become a landmark and signature element of the city and its presentation as the capital of Australia.

For the Canberra Community
Lake Burley Griffin is appreciated by Canberrans as a beautiful part of their city. Its visual appeal during the day and night is appreciated as an essential part of their city and as a 'signature' element of Canberra as a place. Some particular characteristics appreciated by Canberrans include the presence of large areas of water, the reflections and seasonal variations on the water surface, the formal water basins near the national institutions and Parliament buildings and the more natural, quieter areas of the lake like Yarramundi Reach. Views to the water are also valued because of the 'calm presence' it provides in an individual's experience of the nearby city area.

The features which express these aesthetic values include but are not limited to the large size and varied shape of the lake; the lake's quiet and peaceful areas (particularly the secluded areas in the lower reaches); the water body and surface of the lake (including the maintenance of its water level); and the reflective qualities of the water.

Criterion F Technical achievement
The lake's design, development and final completion is considered by experts to be an achievement of creative genius and demonstrates a high level of technical engineering and urban design achievement. This high level of achievement is demonstrated by the following aspects or characteristics of the place.

Lake Burley Griffin is an essential element of the Griffin plan for the capital city of Canberra. Its design has

been purposefully developed to reflect Canberra's function and status as the nation's capital. The lake is used as a unifying design element and incorporates key aesthetic and functional roles within the overall plan for the city.

The design of Lake Burley Griffin strongly reflects two key periods of creative and technical accomplishment. In the early period of the lake's development the lake's design is associated with the City Beautiful and Garden City town planning movements. Work undertaken from the 1950s is associated with International Modernism. The overall form of the lake is most strongly associated with its original conception set out in the city design competition brief. The lake's edge treatments and details, such as islands, are more reflective of later periods of construction.

The lake's form also reflects the way the designers made use of the city site and the Molonglo River's features. West Lake, in particular, is evidence of the original 'river' form of the city site. The basins are evidence of the former river flood plain as well as evidence of the ancient Molonglo Lake.

The final form of the lake closely resembles Griffin's 1918 plan with the exception of the deletion of East Lake. This similarity provides evidence of the essential integrity of the plan for the lake as conceptually developed by Griffin while he was in Canberra. The design of the lake includes formal and informal parts and reflects some of Griffin's geometric devices. The lake's integration of government and civic functions (on its opposite banks) has also been retained, although the intensity of the planned relationship has been weakened in implementation.

The design of Lake Burley Griffin and Associated Lands provides evidence of tensions over time between Griffin's primarily City Beautiful plan and the interplay of Garden City ideas and the influence of Holford and the National Capital Development Commission.

Lake Burley Griffin demonstrates a number of urban design approaches and styles. These occur within a designed and richly symbolic environment which is absent in many other more contemporary urban places. This richness demonstrates a sophisticated design approach to the urban design of the lake and its surroundings. Some key features of this include: the link between the axes and landscape features; the inclusion of formal and informal lake areas; the purposeful links with both close and distant topography; the relationship between vertical and horizontal elements (like the National Carillon and the Captain Cook Memorial Jet); the mirroring of foreshore and surrounding natural features, the lake's provision of water frontage for national institutions; the relationship between areas of distinctive character planting (around the lake) which makes use of seasonal colour and texture and the lake's contribution to the presentation of the city area as a city in a natural landscape.

Lake Burley Griffin also demonstrates a high degree of technical achievement in engineering. The construction of the two bridges and Scrivener Dam were projects which demonstrated high levels of achievement in their time.

The features which express these values include but are not limited to the lake as a whole, Scrivener Dam, Commonwealth and Kings Avenue bridges, the islands within the lake and the lake's function as part of the water axis.

Criterion G Social value
Lake Burley Griffin and Adjacent Lands place is important to various communities as a landmark and as a signature element of Canberra. It also acts as an important reference point in the construction of Canberra's place identity. The use of the lake has also created strong associations with recreation users like rowers, small watercraft users and walkers. Special associations with the Australian community are also present.

For Australians
Lake Burley Griffin plays an important role in representing the image of Canberra to the nation and potentially internationally. Its landmark value as part of the national capital's landscape is well recognised and widely valued. For Australians, especially those who have visited Canberra, Lake Burley Griffin is a well-recognised symbol of Canberra, forming the central focus of the national capital designed landscape. The lake is also valued as a place which provides an attractive setting for visitors walking or driving through the city and around key national institutions.

For the Canberra Community
Lake Burley Griffin is highly valued by the Canberra community as an important and essential part of Canberra. The lake contributes significantly to Canberra's place identity and provides a range of recreation opportunities for all Canberrans. The lake also connects Canberrans to Canberra's function and purpose as the

nation's capital as the lake is a central design element in the construction of the national capital. Canberrans are proud of the lake as a significant construction achievement. The unification of two parts of the city at completion of the lake is remembered.

Lake Burley Griffin is highly valued by the Canberra community as an important community gathering place which is also used as a setting for large public events. The lake remains a place which has been experienced and enjoyed by Canberrans for over 35 years for leisure and as a visual delight.

Lake Burley Griffin is highly valued by the Canberra community as a place that represents the realisation of the Griffin design for Canberra. The lake also creates a setting for community celebration and engagement. Lake Burley Griffin is also highly valued by the Canberra community as a place of personal memory and experience.

The Canberra community has a strong attachment to the lake as a whole, as well as to a range of individual places on and around the lake. These values are shared across the community, irrespective of the nature, length and frequency of association.

The features which express these social values include but are not limited to, the whole of Lake Burley Griffin.

Criterion H Significant people
Lake Burley Griffin and Adjacent Lands place has significant associations with people of importance in Canberra's history of development. These associations include the following.

Important people involved with the creative and technical aspects of the design and construction of Lake Burley Griffin include Walter Burley Griffin, Marion Mahony Griffin, Charles Scrivener, Sir William Holford, Dame Sylvia Crowe, Richard Clough and the National Capital Development Commission (NCDC). Lake Burley Griffin also has strong associations with Sir Robert Menzies who played pivotal role in the implementation of the lake's construction. His support is associated with the final push towards the lake's completion.

Walter Burley Griffin is an important figure in Australia's cultural history because of his contribution to the design of Canberra as Australia's capital city. In recognition of his contribution Lake Burley Griffin has been named in appreciation of his work.

Marion Mahony Griffin worked with Walter Burley Griffin on the design for Canberra. Her perspective drawings were a brilliant representation of the ideas presented in the competition drawings for Canberra. In recognition of her contribution the Marion Mahony Griffin view at Mt Ainslie has been named in appreciation of her work.

Charles Scrivener surveyed and recommended the Canberra site for Australia's capital city. He also made recommendations regarding the suitability of this site for ornamental waters which pointed to the eventual creation of Lake Burley Griffin.

British planner, William Holford, was engaged by the Menzies Government to recommend a way forward for the construction of Lake Burley Griffin. Holford did extensive work on the design of Lake Burley Griffin and its two bridges.

Sylvia Crowe and Richard Clough were prominent landscape architects involved with the landscape development and planting works around the lake, and, in particular, of Commonwealth Park.

The experimental planting plots within the Lindsay Pryor Arboretum are strongly associated with the pioneering and extensive work planned and carried out by Lindsay Pryor and his team in the landscaping of the city scape of Canberra.

Many professions have been involved in planning, design and construction of Lake Burley Griffin including town planners, architects, landscape architects, engineers and surveyors. In the case of landscape architects and town planners in Australia, the growth of these professions in Australia has a strong association with Lake Burley Griffin and some of the adjacent lands within the place.

The features which express these values include but are not limited to: the lake as a whole, including all its designed and engineered elements; the Roman Cypress Hill stand of *Cupressus sempervirens* and Pryor's surviving trial plantings covering the southern portions of Yarramundi Reach.

APPENDIX B: HISTORY OF THE SCRIVENER DAM ENERGY DISSIPATOR

Energy dissipation on large dams has traditionally been by means of a large concrete stilling pond or basin to minimise erosion immediately downstream of the dam spillway. Turbulence within the basin is expected to dissipate the energy to an extent that fairly smooth flow results beyond the basin sill without damage to the dam structure or abutments.

Scrivener Dam has a USBR Type III stilling basin energy dissipator (Dissipator) which disperses much of the kinetic energy from the sluices and water spilling over the floodgates. It also assists to mitigate the damage that the water would otherwise cause below and to the dam itself (NCA 2022).

This type of dissipator was developed by the US Department of Agriculture at St Anthony Falls Hydraulic Laboratory, Minneapolis, and described by Project Supervisor F W Blaisdell in 1948 (Blaisdell 1948). The energy dissipator was named the SAF stilling basin, SAF (denoting "Saint Anthony Falls") to differentiate this design from other stilling basin designs. In size, this stilling basin was the smallest known based on limited research. This was achieved through the use of baffles and sills within the stilling basin to assist in the dissipation of the energy of water flowing at high velocities.

Figure 4. US Bureau of Reclamation Type III stilling basin showing proportions
Source: US Bureau of Reclamation, *Hydraulic Design of Stilling Basins and Bucket Energy Dissipators*, Engineering Monograph No. 25, September, 1958, page 29

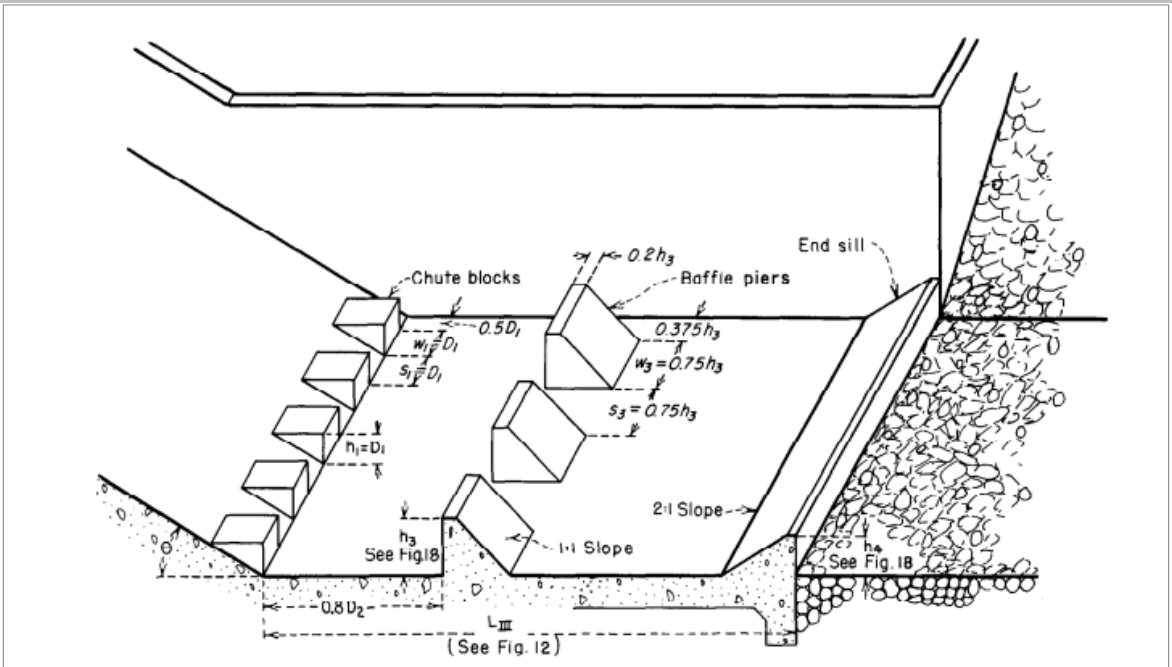

FIGURE 17.—*Recommended proportions (Basin III).*

Types of stilling basin dissipators were progressively standardised based on experience, observations and model studies by the US Bureau of Reclamation (Akan and Iyer 2021). The SAF stilling basin, with chute blocks, baffle blocks and end sill became synonymous with the USBR Type III basin, although the term SAF basin continued to be used (Farhoudi, Sadat-Helbar and Aziz 2010).

Tenders were called for the construction of the Canberra Lake Dam in March 1960 (*Canberra Times* 14 March 1960) based on a preliminary design with a schedule of rates,

while detailed design based on hydraulic scale modelling progressed. A 1:400 scale model of the Molonglo River flood plain had been constructed including the bridges and dam to determine the behaviour of the design flood (Condon 1964), and determine that the lake level of RL 1825 (556.3 metres) could be maintained in the central areas for most flood conditions. A more detailed model was required at a scale of 1:72 to enable the design of the stilling basin and flood gate operation of the dam (Kearsley 1964). A preliminary design of the overflow section of the dam had been prepared and the spillway model was under construction in November 1959 (NCDC and CDW 1959) for completion in December so that testing could commence and the design refined. Progress was reported in October 1960 (Department of Works ACT 1960) with several recommendations for modification of the design, including the addition of training walls.

Three main types of dissipator had been considered in the initial design for the Canberra Lake Dam including a bucket hydraulic jump and an intersecting jet type dissipator developed in India (New Delhi Central Board of Irrigation and Power 1961). One of the references in Kearsley's 1964 paper describing the project was to the work of the US Bureau of Reclamation (US Bureau of Reclamation 1958), which had standardised the optional types of dissipators, depending on the flow rate and head of the dam being designed. While the USBR Type is not specifically mentioned in Kearsley's paper, the diagrammatic cross section in his Figures 8 and 10 is clearly USBR Type III. The testing that he reported on in October 1960, before the dam was built, established that the level of the lake could be controlled within narrow limits for most expected levels of inflow. However, conditions that would cause unacceptable scouring downstream were demonstrated with some flap gates being operated under high design levels of flood water.

Different sequences of spillway bay gate lowering were tested since the bays were not symmetrical and the approaching flood water velocity distribution was affected by an upstream bend which was modelled. A sequence of gate operation was determined by modelling to optimise energy dissipation at increasing flood levels and avoid scouring, starting with lowering Gates 3 and 4, followed by 2 and finally 5 for the maximum discharge expected.

The addition of training walls was modelled along with varying the height of chute blocks, baffle piers and the sill, until a design was reached with acceptable performance and reasonable cost, adapting up-to-date international best practice. A recommendation was made which was subsequently adopted for training walls to be added to the sides of bays 3 and 4 and lowering of bays 1 and 5. Because of the wide range of conditions to be met, Kearsley concluded that the model study was most useful in assessing the effects of those flow conditions outside the limits set for standard design.

On completion of the renamed Scrivener Dam, the sluice valves were closed on 20 September 1963 by the Honourable Gordon Freeth, Minister for the Interior and Minister for Works, and the filling of Lake Burley Griffin officially began (Scrivener Dam Canberra, official opening brochure).

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