

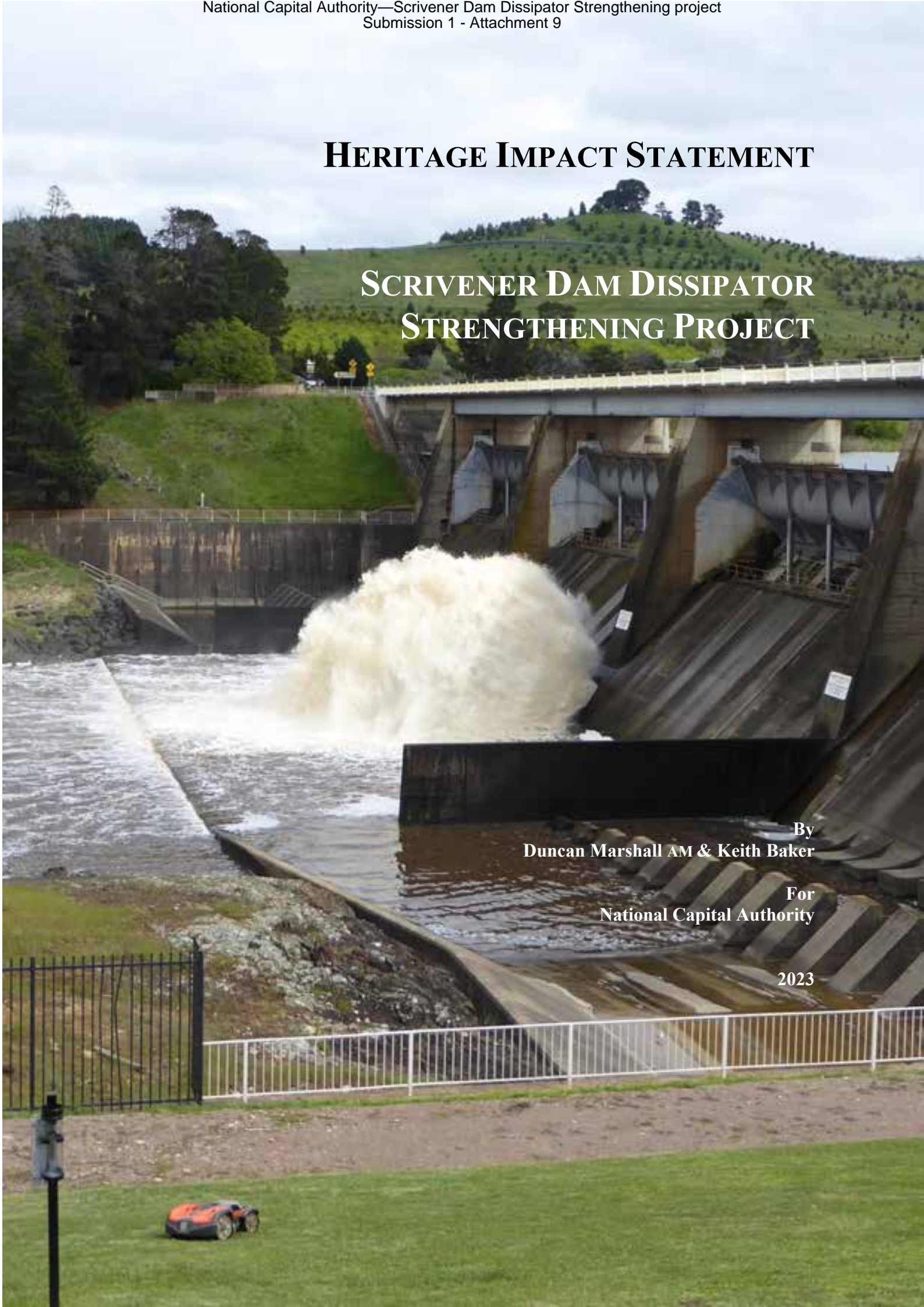
HERITAGE IMPACT STATEMENT

SCRIVENER DAM DISSIPATOR STRENGTHENING PROJECT

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For
National Capital Authority

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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.



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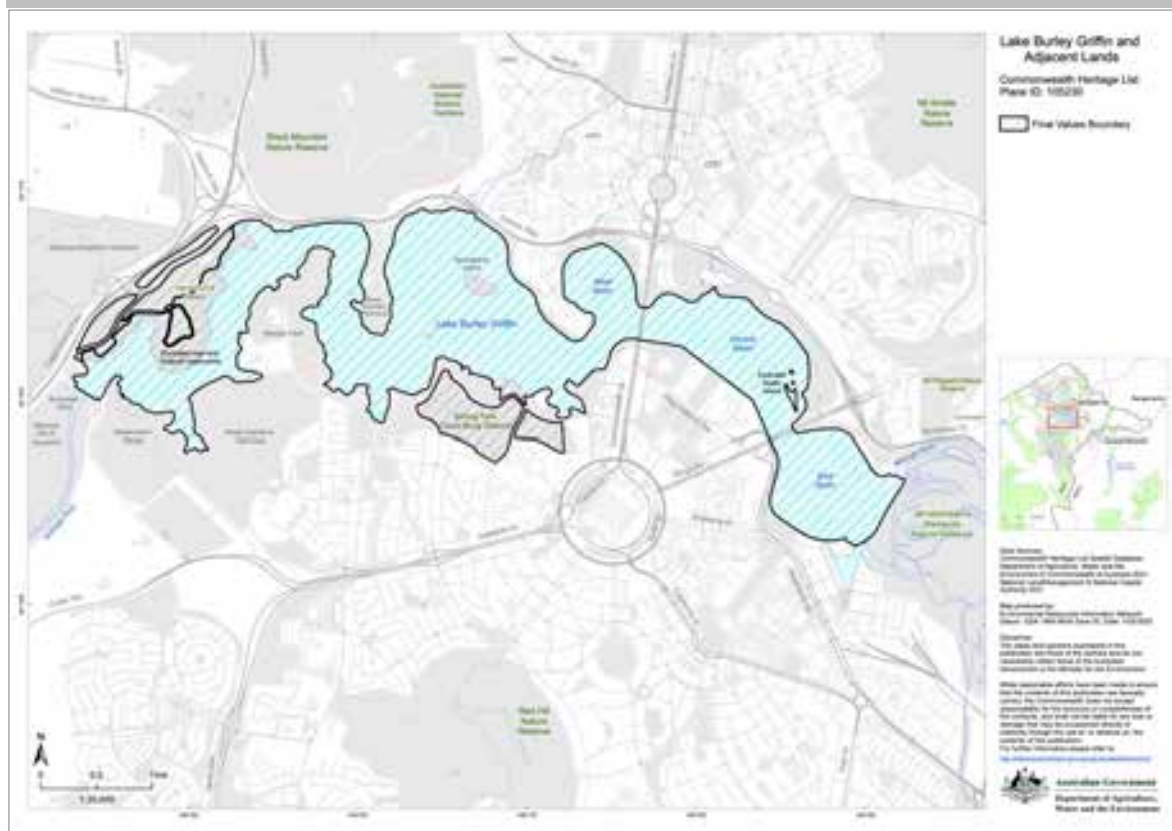
1. INTRODUCTION

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.

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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 2.4 m to a depth of 12.5 m upstream of the central baffles, and a grid of 2.9 x 2.9 m to a depth of 10 m 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, as provided as part of the Concept Design Report by GHD, 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, Brian 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	
<p>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.</p> <p>Lake Burley Griffin is associated with the original city competition brief for the design of Canberra...</p> <p>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</p>	<p>Very minor impact – given proposed changes to the original dissipator as a component of the dam which is part of the lake.</p> <p>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.</p> <p>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.</p>
<p>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...</p> <p>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.</p>	<p>No impact – the works will not affect the flap gates.</p> <p>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.</p> <p>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.</p>
<p>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.</p>	<p>No impact – the works will not affect the flap gates.</p> <p>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.</p>

Heritage Values	Potential Impact/Comments
<p>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.</p>	<p>No impact – the works will not affect the features of the dam reflecting International Modernism.</p>
<p>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...</p> <p>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.</p>	<p>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.</p> <p>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.</p>
<p>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.</p>	<p>No impact.</p>
<p>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.</p>	<p>No impact.</p>
Heritage Values arising from Additional Research	
<p>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.</p>	<p>Very minor impact – given proposed changes to the original dissipator as a component of the dam.</p>
<p>Rarity The dam is uncommon for the size of its flap gates, and the operating mechanism for the gates is also rare.</p>	<p>No impact.</p>
<p>Characteristic values Scrivener Dam is a fine example of a concrete gravity dam with a large gated spillway.</p>	<p>Very minor impact – given changes to the original dissipator as a component of the dam.</p>
<p>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.</p> <p>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.</p>	<p>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.</p>

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 in 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 identify 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

- Andrews, W C and others 1990, *Canberra's Engineering Heritage*, second edition, Canberra Division, The Institution of Engineers, Australia.
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- Smith, M and L Coltheart 1998, Scrivener Dam – Nomination for Listing on the Register of the National Estate, report prepared for the Australian Institution of Engineers.

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).



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

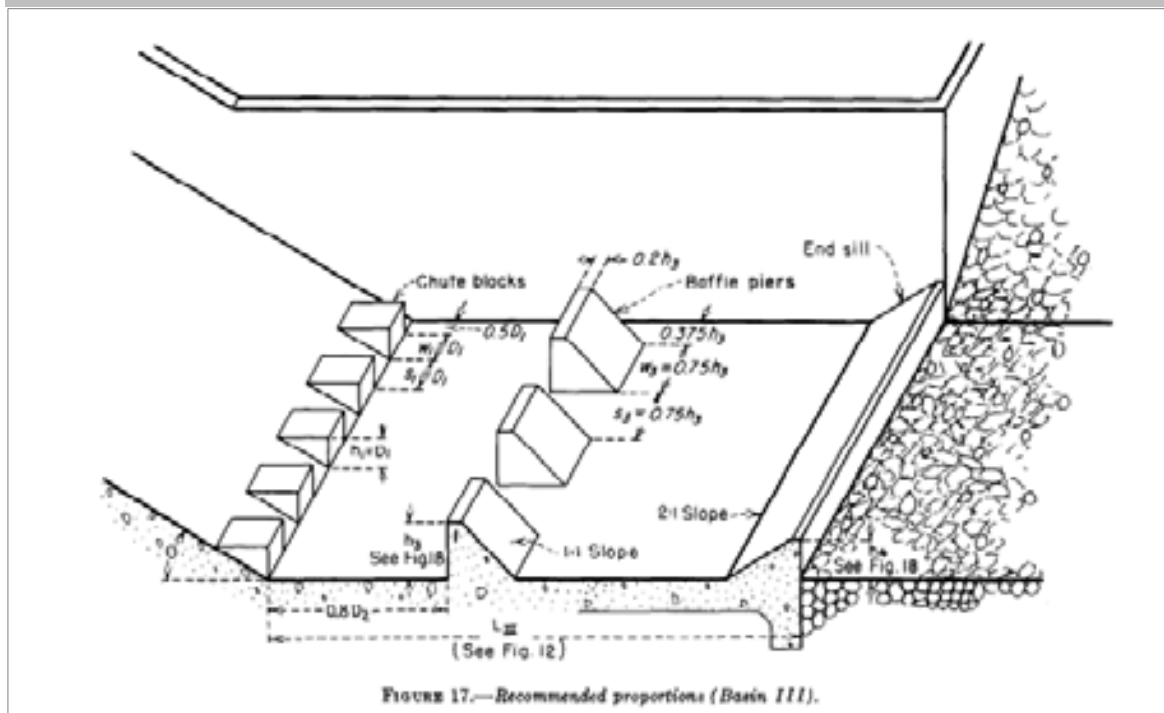
Energy dissipation on large dams has traditionally been by means of a large concrete stilling pond or basin to minimise erosion immediately downstream of the dam spillway. Turbulence within the basin is expected to dissipate the energy to an extent that fairly smooth flow results beyond the basin sill 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



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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