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# Appendix E

## Statement of heritage impact

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# **Upper Canal Koala Crossings**

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Prepared for Department of Planning and Environment

June 2023

# Upper Canal Koala Crossings

## Statement of heritage impact

Department of Planning and Environment

E220901 RP2

June 2023

| Version | Date         | Prepared by | Approved by | Comments |
|---------|--------------|-------------|-------------|----------|
| 1       | 27 June 2023 | [REDACTED]  | [REDACTED]  |          |
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# TABLE OF CONTENTS

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|          |  |           |
|----------|--|-----------|
| <b>1</b> | <b>Introduction</b>                              | <b>1</b>  |
| 1.1      | Location   | 1         |
| 1.2      | Assessment guidelines and requirements           | 1         |
| <b>2</b> | <b>Proposed activities</b>                       | <b>4</b>  |
| 2.1      | Koala crossings                                  | 4         |
| 2.2      | Camera monitoring                                | 12        |
| 2.3      | Alternatives considered                          | 15        |
| <b>3</b> | <b>Planning framework</b>                        | <b>19</b> |
| 3.1      | Overview   | 19        |
| 3.2      | Environmental Planning and Assessment Act 1979   | 19        |
| 3.3      | Heritage Act 1977                                | 20        |
| 3.4      | Heritage status                                  | 21        |
| <b>4</b> | <b>Existing environment</b>                      | <b>23</b> |
| 4.1      | Upper Canal                                      | 23        |
| 4.2      | Landscape overview                               | 24        |
| 4.3      | Archaeological potential                         | 27        |
| <b>5</b> | <b>Historical context</b>                        | <b>28</b> |
| 5.1      | Historical summary                               | 28        |
| 5.2      | Assessment of significance                       | 28        |
| <b>6</b> | <b>Statement of heritage impact</b>              | <b>34</b> |
| 6.1      | Introduction                                     | 34        |
| 6.2      | Consideration of alternatives                    | 34        |
| 6.3      | Impact assessment – crossing installations       | 35        |
| 6.4      | Impact assessment – wildlife camera installation | 38        |
| <b>7</b> | <b>Conclusion and recommendations</b>            | <b>40</b> |

## Tables

|           |   |    |
|-----------|---|----|
| Table 1.1 | Conservation management plan policies relevant to the installations | 2  |
| Table 3.1 | Heritage register search  | 21 |
| Table 4.1 | Ousedale Creek Precinct inventory items                             | 23 |
| Table 5.1 | Assessment of significance The Upper Canal System                   | 29 |

|                |   |    |
|----------------|---|----|
| Table 6.1      | Assessment of impact  | 36 |
| <b>Figures</b> |   |    |
| Figure 2.1     | Location of ‘Under-fence’ structures  | 5  |
| Figure 2.2     | Location of ‘over pipe’ structure   | 8  |
| Figure 2.3     | Location of ‘log climb’ structure   | 11 |
| Figure 2.4     | Existing crossing – north   | 16 |
| Figure 2.5     | Existing crossing - north – CPCP mapping. Orange indicates Urban Capable Land   | 16 |
| Figure 2.6     | Existing crossing – south   | 17 |
| <b>Plates</b>  |   |    |
| Plate 2.1      | Under-fence crossing design. Source: TBLD   | 6  |
| Plate 2.2      | Over pipe crossing design. Source: TBLD   | 9  |
| Plate 2.3      | Log climb crossing design. Source: TBLD   | 12 |
| Plate 2.4      | Wildlife camera – tree-mounted  | 13 |
| Plate 2.5      | Picket-mounted wildlife camera  | 13 |
| Plate 2.6      | Proposed signage for wildlife camera operations   | 14 |
| Plate 3.1      | Upper Canal heritage listings and installation location. The blue hatched area indicates State heritage listing. The red outline indicates the section of the Upper Canal proposed for the koala crossings. Source: NSW Planning Portal, 2023 | 22 |
| Plate 4.1      | View south-east across Design Solution 1, Crossing U2 showing Upper Canal access road   | 24 |
| Plate 4.2      | View north-east across Design Solution 1, Crossing U2 showing Upper Canal access road and slope   | 24 |
| Plate 4.3      | View south-east across Design Solution 1, Crossing U7 showing Upper Canal access road   | 25 |

# 1 Introduction

EMM Consulting, in collaboration with Thompson Berrill Landscape Design (TBLD), prepared a feasibility study (2022) for the Department of Planning and Environment (DPE) that considered the behaviour and movement patterns of koalas (*Phascolarctos cinereus*), for possible design solutions for the construction of crossings over or under the Upper Canal at Ousedale Creek. Other aspects considered in the design included the local landscape and assets. The feasibility study determined that koala crossings would augment the movement of the animals and six installations have been proposed. The estimated construction cost is in the order of \$145,000 or less. This estimate of construction value was prepared by TBLD Architects, designers for the proposed facilities.

The Upper Canal is an operational WaterNSW asset listed on the State Heritage Register (SHR) as Upper Canal System (Pheasants Nest Weir to Prospect Reservoir), item #01373, hereafter Upper Canal. The significance of the Upper Canal System is managed under a conservation management plan (CMP) prepared by the Government Architects Office (NSW Government Architect's Office 2016). The CMP relies on the descriptions and archaeological assessments in the superseded 2001 version of the CMP (Higginbotham 2001).

The reason for the project is to deliver on commitments made in the *Cumberland Plain Conservation Plan (CPCP)*, which is one of the largest strategic conservation plans to be undertaken in Australia, covering 200,000 hectares of Western Sydney, from Wilton in the South to Windsor and Kurrajong in the north. It was developed in response to the projected population growth in Western Sydney while protecting biodiversity values, such as threatened plants and animals.

The koala population in the south-western Sydney region is one of the biodiversity values to be protected under the CPCP. The *CPCP Sub-Plan B: Koalas* outlines the measures proposed for koala management. The proposed Ousedale Creek crossing would help in the delivery of koala connectivity.

The proposed koala crossings would be constructed in the SHR curtilage of the Upper Canal, requiring approval under Section 60 of the *Heritage Act 1977* (Heritage Act), under which Act the SHR is constituted. This statement of heritage impact (SoHI) has been prepared to support the review of environmental factors (REF) and to submit for approval under section 60. A separate assessment of the potential for the proposed koala crossings to impact on Aboriginal heritage has been prepared; this SoHI addresses historical heritage and archaeology only.

## 1.1 Location

The site is within the Wollondilly local government area (LGA). The installations would be in the suburb and parish of Appin, county Cumberland, in the Wollondilly LGA, specifically in Lot 1 DP 625921 and Lot 2 DP 625921.

## 1.2 Assessment guidelines and requirements

This historical heritage assessment and SoHI has been prepared in accordance with the relevant government assessment requirements, guidelines, and policies. The report and field survey were undertaken using the principles of *The Australian International Council on Monuments and Sites, Charter for Places of Cultural Significance* (also known as the *Burra Charter*, Australia ICOMOS 2013) and the *New South Wales (NSW) Heritage Manual* (Heritage Office 1996 with regular additions). Use of these documents satisfies the requirements of the SEARs.

*The Burra Charter: The Australian ICOMOS charter for places of cultural significance* (ICOMOS (Australia) 2013) sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance including owners, managers and custodians. The *Burra Charter* defines the concept of cultural significance as ‘aesthetic, historic, scientific, social or spiritual value for past, present or future generations’ (Australia ICOMOS 2013, Article 1.2). It identifies that conservation of an item of cultural significance should be guided by the item’s level of significance. The Charter provides specific guidance for physical and procedural actions that should occur in relation to significant places. A copy of the charter can be accessed online at <http://icomos.org/australia>.

The Burra Charter consists of 34 articles, arranged into five sections: definitions, conservation principles, processes and practice. The principal articles of the Burra Charter are:

- conservation is based on significance
- a cautious approach is required – changing as much as necessary, but as little as possible
- maintenance is fundamental to conservation.

Further articles relate to preservation (maintaining fabric in its current state), restoration and reconstruction, adaptation and the introduction of new structures or extensions.

The *Heritage Manual* comprises the following guidance documents:

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

These documents have been used to guide this SoHI.

Furthermore, this SoHI has relied on the CMP. However, the CMP did not foresee the type of installations assessed in this SoHI. However, the concepts in a number of policies, including policies 50 and 51 that relate to new structures, can be applied to the consideration of the installations. The relevant policies are outlined in Table 1.1.

**Table 1.1 Conservation management plan policies relevant to the installations**

| Policy number | Policy   |
|---------------|--|
| 3             | <p>Elements of Exceptional Significance</p> <p>Retain all elements of Exceptional Significance as a priority.</p> <ul style="list-style-type: none"> <li>• Aim to retain all original fabric of elements of exceptional significance as a first conservation option. Where this will affect the safe operation or structural integrity of the Upper Canal, renew elements using matching components. Undertake all new work in accordance with the policies in this CMP.</li> <li>• Avoid adding new fabric, where this will result in a negative impact on significance.</li> <li>• If adaptation is necessary for the continued use of the place, minimise changes unless such changes would result in the removal of intrusive elements or will have minimal impacts on significance.</li> <li>• Give preference to changes that are reversible.</li> <li>• Prior to any major change, full archival recording is essential.</li> </ul> |

**Table 1.1 Conservation management plan policies relevant to the installations**

| Policy number | Policy   |
|---------------|--|
| 4             | <p>Elements of High Significance</p> <p>Retain a representative sample of elements of High Significance within each type.</p> <ul style="list-style-type: none"> <li>• Changes to fabric of high significance should be minimal.</li> <li>• Alterations that detract from significance should be removed to recover significance to enhance the ability of the item to demonstrate significance.</li> <li>• Aim to retain the original fabric of these or renew using matching components.</li> <li>• Give preference to changes that are reversible.</li> <li>• Some adaptation of elements may be acceptable, particularly where this process might assist in the continuing use of the site for water provision and any new work complies with the policies of this CMP and does not detract from the significance of the Canal.</li> <li>• Prior to major changes full archival recording is recommended.</li> </ul> |
| 23            | <p>Seek advice from relevant heritage specialists when planning or implementing conservation works, repairs and maintenance or when proposing major changes to the place.</p>  |
| 35            | <p>Make decisions requiring change to the Upper Canal with a clear understanding of the implications for the identified heritage values of the Canal and seek to minimise negative heritage impacts.</p>   |
| 37            | <p>Prepare a Heritage Impact Statement for all works requiring an exemption notification or application for approval under the NSW <i>Heritage Act, 1977</i>.</p>  |
| 40            | <p>Undertake formal archival recording in accordance with NSW Heritage Council guidelines when undertaking major changes to elements of Exceptional and High heritage significance.</p>  |
| 41            | <p>Keep and archive ongoing, informal records of changes to the Canal.</p>   |
| 43            | <p>Obtain any necessary heritage and planning approvals or exemptions prior to undertaking changes to the place. Carry out the works in accordance with any conditions placed on these approvals.</p>  |
| 51            | <p>Ensure new buildings or structures are unobtrusive and set back from elements of Exceptional significance where those structures would have a negative visual or physical impact on those elements.</p>   |
| 52            | <p>Construct new buildings and structures using quality materials and workmanship.</p>   |
| 58            | <p><b>New Walkways, Steps and Handrails</b></p> <p>Replace existing walkways, steps and handrails or construct new walkways, steps and handrails in steel, which is compatible with historic construction materials for these elements.</p> <p>Where the walkway, steps and handrails are new (i.e. they are not replacing existing elements), give preference to locations that do not impact on elements of Exceptional heritage significance.</p>   |
| 61            | <p>Do not cover extensive sections of the open canal as this would have substantial negative heritage impacts on both the setting and exceptionally significant fabric of the Upper Canal as a whole.</p>  |

## 2 Proposed activities

The activities proposed will include the installation of three types of facilities which enable koala movement across the Upper Canal infrastructure, including the local fences, aqueduct, and the pipeline, at Ousedale Creek.

The six crossing installations are:

- under-fence crossings (x 4 locations)
- over pipe crossing (x 1 location)
- log climb crossing (x 1 location).

There will also be ongoing monitoring of the crossings using fixed motion-sensor-activated cameras to better understand koala behaviour, and the behaviour of other animals, at the crossing points. This will assist DPE and other interested parties in determining the suitability of the various crossing designs and their potential future application in other locations where there may be impediments to koala movement.

### 2.1 Koala crossings

#### 2.1.1 Under-fence crossings

It is proposed to install four structures to enable koala movement under existing boundary fences at Ousedale Creek. The locations of the under-fence crossings are shown at Figure 2.1 and identified as U2, U7, U12 and U14.

The 'under-fence' design provides functional koala and fauna access beneath fences. The under-fence crossings would be lined with WPC (wood plastic composite) profile to deter additional digging, with an agricultural drain to manage surface water flow to grassed areas downslope. The crossings would be hidden within retained grassy vegetation.

The under-fence design is illustrated at Plate 2.1. More detailed designs are provided in the drawings prepared by TBLD (refer to Appendix C of the REF).

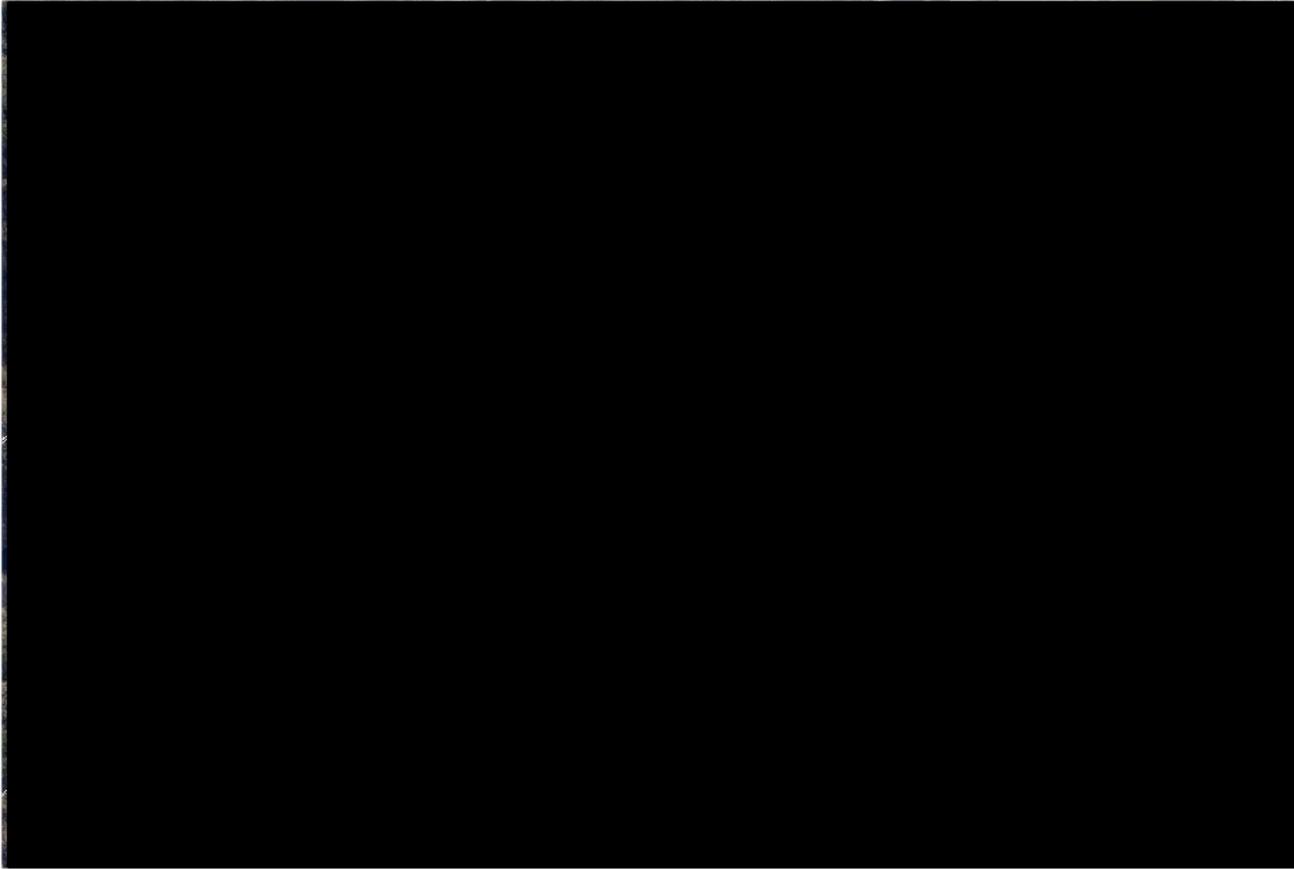
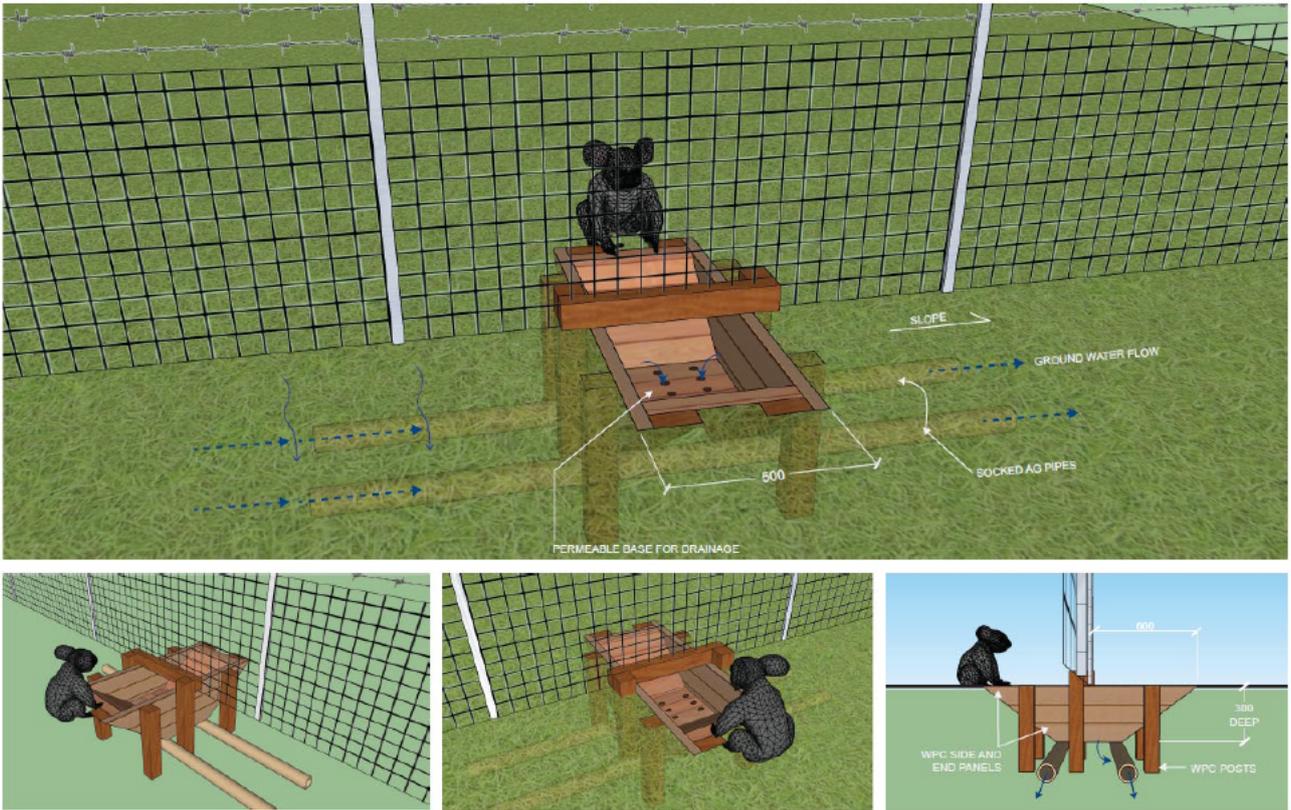


Figure 2.1 Location of 'Under-fence' structures

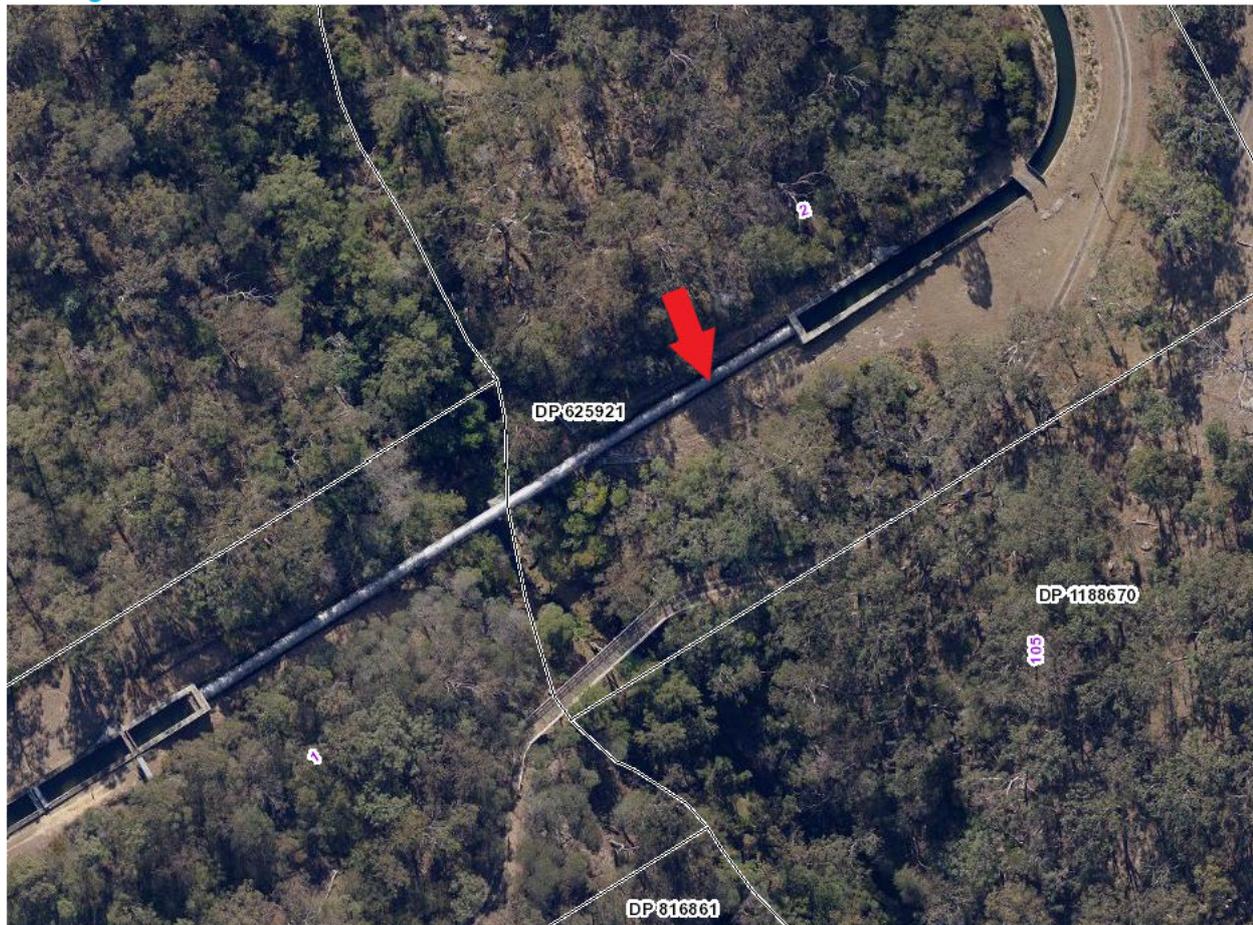


**Plate 2.1 Under-fence crossing design**

Source: TBLD

## 2.1.2 Over pipe crossing

One over pipe crossing is proposed approximately 35 m north of Ousedale Creek. The location of the over pipe crossing is shown at



**Figure 2.2.** The structure will have trusses placed on either side of the pipe with an overall footprint of approximately 7 m by 1 m.

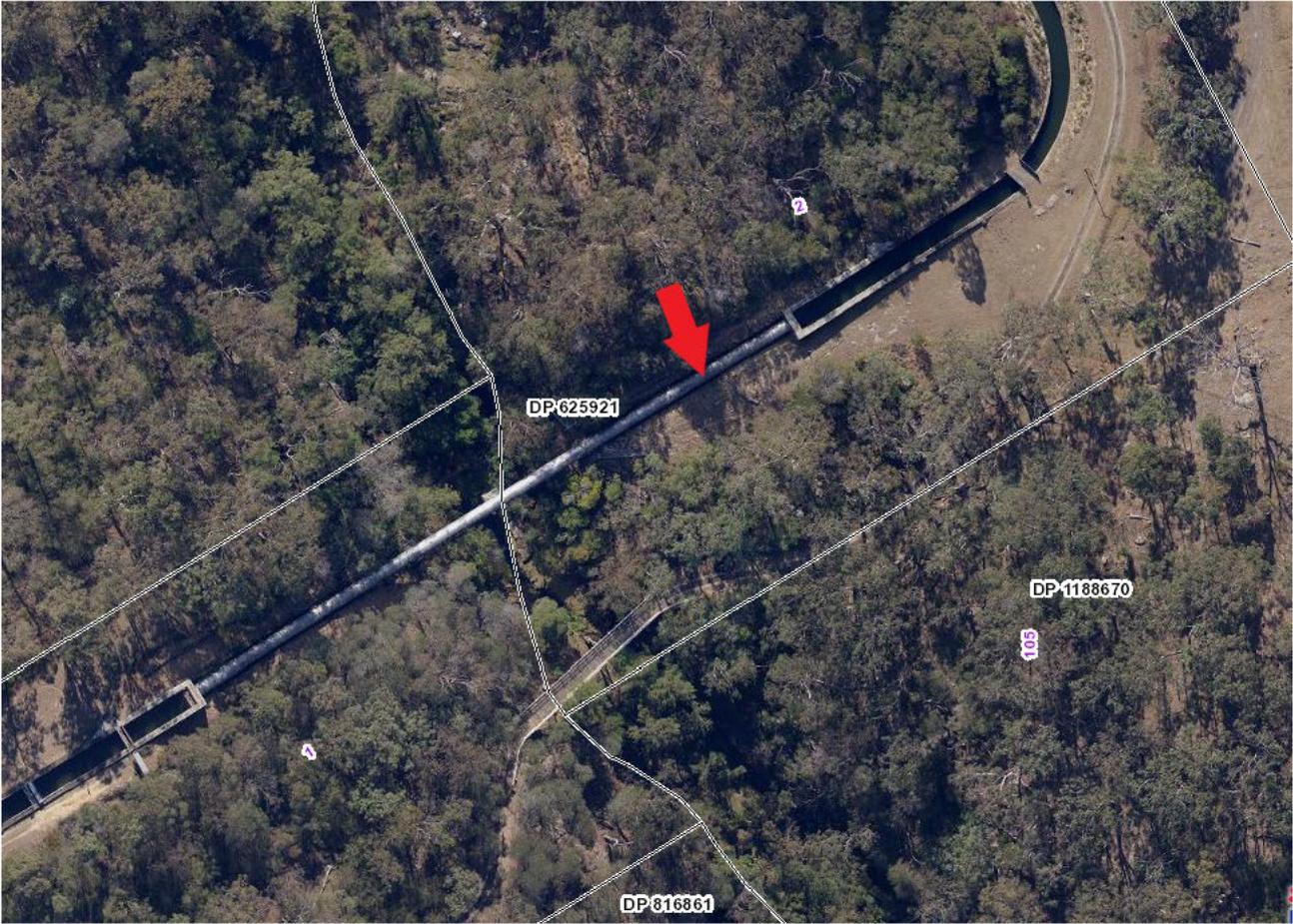


Figure 2.2 Location of 'over pipe' structure

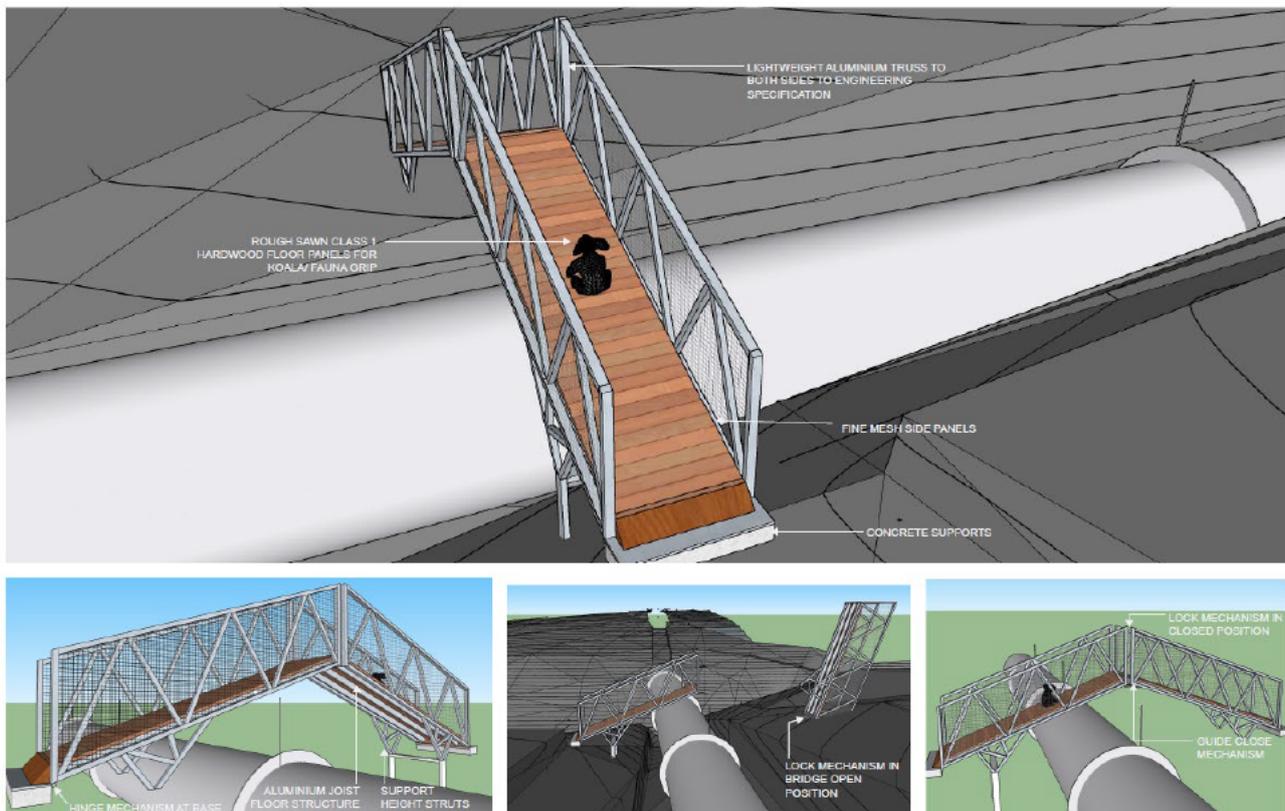
The over pipe structure requires the installation of a lightweight ramp panel structure, comprising two ramp components which meet and lock to form a secure and stable bridge. Each ramp section has an incline and functionality suited for ease of koala crossing or access by humans for pipeline maintenance. The design intent includes ensuring that each ramp section of the bridge can be easily opened (i.e. lifted out of the channel area if required for maintenance etc.) or closed again to form the bridge, by one adult.

The bridge structure would have sufficient infill on the floor and side panels to prevent fauna falling onto pipeline. The ramps extend from the two banks of the sandstone channel, secured in the middle, and with non-invasive supports to the sides.

The over pipe structure is proposed to be installed at the location where pipeline embedment is deepest in the ground, to minimise ramp height and to encourage fauna to cross over across the pipeline. This is the only viable placement for the structure as all other locations would not allow for clearance of the support/safety wires used by maintenance staff for the pipeline. The structure is designed to safely support human use and loads if used by maintenance staff.

The over pipe crossing design is illustrated at Plate 2.2.

More detailed design particulars are provided in the drawings at Appendix C of the REF.



**Plate 2.2** Over pipe crossing design

Source: TBLD

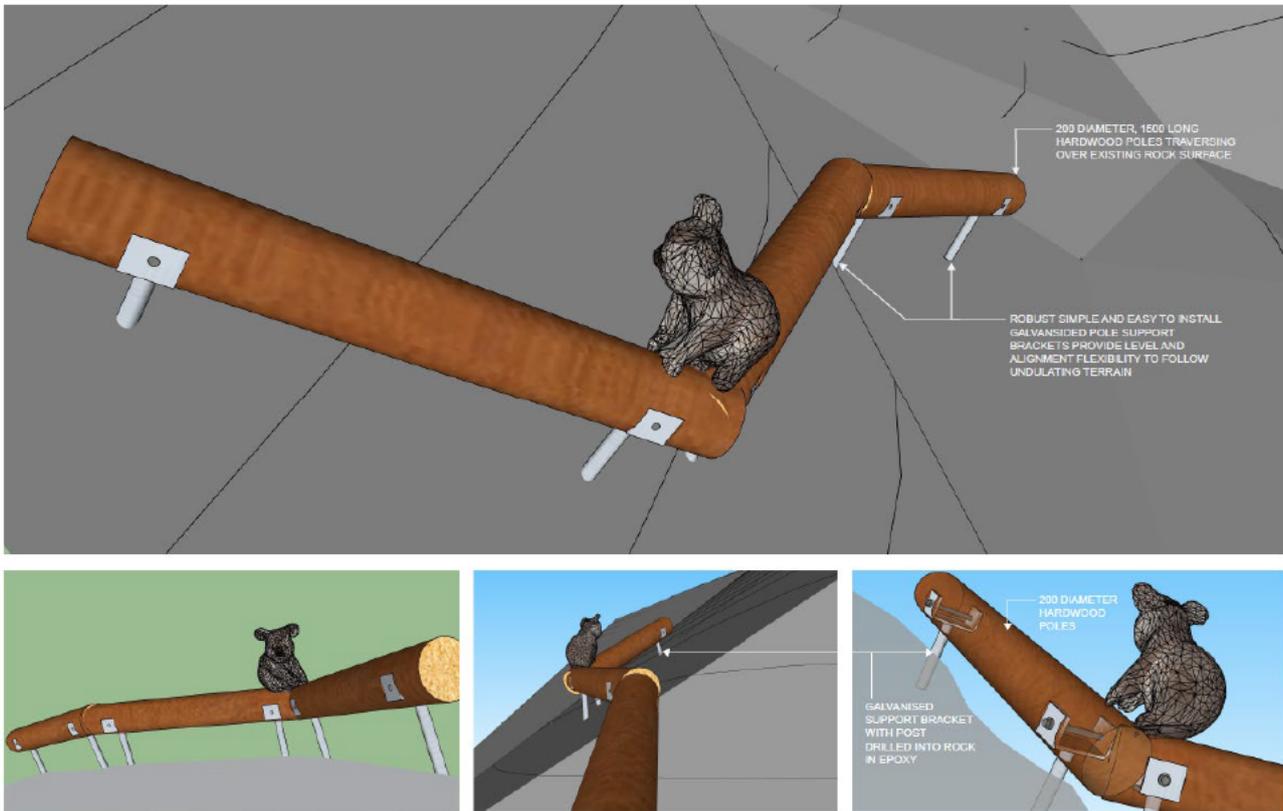
### 2.1.3 Log climb crossing

One log climb crossing is proposed. The location of the log climb crossing is shown in Plate 2.3. The log climb crossing would be located on the north west side of the pipe line and would allow access to the bank of Ousedale Creek via an existing scree pile.

The log climb involves the installation of durable hardwood Eucalyptus sp. logs to create a log climb structure in location that best matches potential koala movement routes over the unstable rock scree piles near the riparian area of Ousedale Creek. The log climb will be located near the end of decommissioned pipeline towards the north-eastern side of the pipeline over large, exposed rock faces and rock spoil areas. More detailed design particulars are provided in the drawings in Appendix C of the REF).



Figure 2.3 Location of 'log climb' structure



**Plate 2.3** Log climb crossing design

Source: TBLD

## 2.2 Camera monitoring

This project provides an opportunity to advance our understanding of the behaviour of koalas and other fauna when crossings are required to overcome barriers such as fences or infrastructure. It is therefore proposed to install 18 wildlife cameras for a period of up to five years. Locations are identified in Figure 2.7 of Chapter 2 of the REF.

The cameras will be wildlife monitoring cameras (HyperFire 2 Professional White Flash Cameras or similar), which are capable of automatically taking both daytime and night-time images (with flash) when triggered by movement. The cameras will be either mounted on the trunks of trees (Plate 2.4) or on star pickets (Plate 2.5). Where star pickets are used these will be driven approximately 20 cm into the ground with a mallet.

Note that wildlife cameras were previously installed on a temporary basis at 10 locations. The temporary installation provided data about existing fauna movements in the absence of any interventions. Those cameras have been removed and it proposed to reinstall those cameras so as to enable comparisons between the 'base case' before the introduction of crossings and the behaviour of fauna when the crossings are installed. There will also be eight new wildlife cameras installed that focus on the use of the specific crossing structures to monitor use.

The installation of the original wildlife cameras was the subject of a successful section 60 Fast track application.



Plate 2.4 Wildlife camera – tree-mounted



Plate 2.5 Picket-mounted wildlife camera

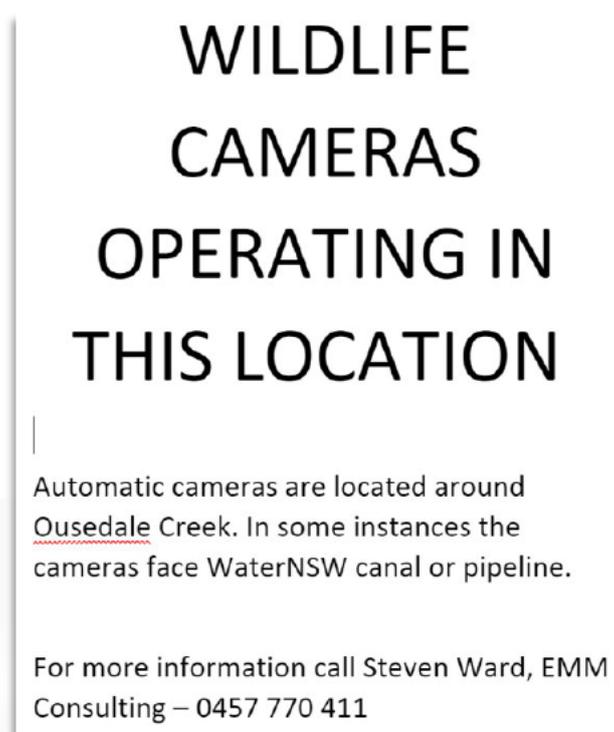
As the cameras are automated, signs will be attached or installed in suitable locations within the project area to notify WaterNSW staff or contractors of the presence of the cameras via laminated A4 notices (refer to Plate 2.6).

The process for erecting cameras on site will be:

- Fauna monitoring experts go to the selected location. The locations will be selected based on optimal vision of the crossing path or point.
- Wherever possible the camera will be erected on a tree. Where this is not possible a location for installation of a star picket of 120 cm length will be selected.
- Where installed on trees the camera will be mounted via a strap around the trunk; or where mounted on a star pickets, a mounting bracket will be used.

Cameras will be checked periodically (likely every two months) to download images and change batteries.

When monitoring is complete all cameras, star pickets, brackets or other mounts, and signs will be removed.



**Plate 2.6** Proposed signage for wildlife camera operations

## 2.3 Alternatives considered

### 2.3.1 Do nothing

The 'do nothing' option was, in many respects, considered by the NSW Government in preparing the *Cumberland Plain Conservation Plan: Sub-plan B: Koalas* (DPE 2022) and the commitment to establish the Georges River Koala Reserve. The actions outlined in the CPCP respond to the requirements of the reports of the Office of the NSW Chief Scientist and Engineer<sup>1</sup>. Specifically, Ousedale Creek is identified in the CPCP: Sub-plan B: Koalas as "the most important east–west movement corridor in the Greater Macarthur Growth Area" (p 13) and with regard to the Upper Canal site, the CPCP: Sub-plan B: Koalas states "If feasibility investigations conclude that a crossing is warranted, the project will proceed to design, environmental assessment and construction" (p 23).

Hence a 'do nothing' option is not considered further, and the alternatives considered are limited to design solutions to facilitate the desired fauna movement corridor at Ousedale Creek.

### 2.3.2 Use of existing crossing points

There are two existing crossings approximately 110 m north-east and 100 m southwest of Ousedale Creek.

The crossing to the north (refer to Figure 2.4) is likely to be used by some fauna including potentially koalas. There are however two key constraints:

- the fauna which utilise this crossing need to navigate an area without tree cover
- the existing crossing is close to land which is 'urban certified' under the CPCP (refer to Figure 2.5) and will, in future, support development which may further impede the use of the existing crossing by koalas.

The crossing structure to the south (refer to Figure 2.6) is constructed with open grill metal walkways which are unsuited to use by koalas and other fauna. The absence of any evidence of fauna using this crossing point suggests that the material or location are unsuitable.

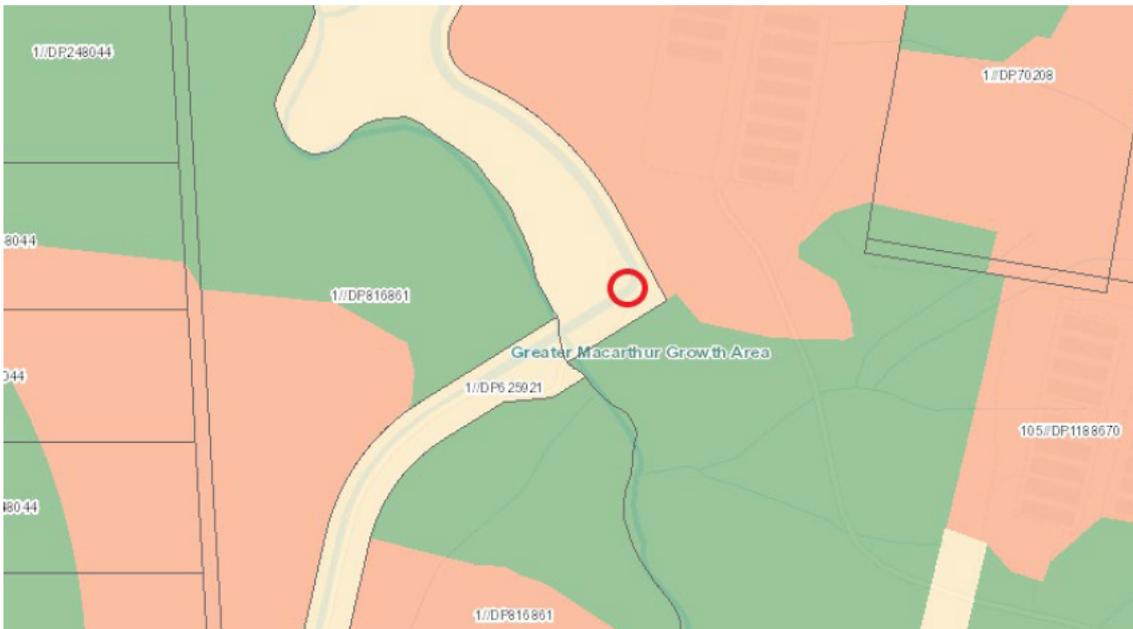
There are other crossing structures several hundred metres to the north and south of Ousedale Creek which provide access over the open canal sections of the Upper Canal. These are considered to be too distant to service the need for koala movement in the Ousedale Creek locality (as required pursuant to CPCP: Sub-plan B: Koalas).

<sup>1</sup> Office of the NSW Chief Scientist and Engineer (2020) *Report of the Independent Review on the Advice on the protection of the Campbelltown koala population*. Office of the NSW Chief Scientist and Engineer (2021) and *Report of the Independent Review on the Advice regarding the protection of koala populations associated with the Cumberland Plain Conservation Plan*



**Figure 2.4 Existing crossing – north**

Source: Google Earth (EMM adapted)



**Figure 2.5 Existing crossing - north – CPCP mapping. Orange indicates Urban Capable Land**

Source: CPCP Viewer (EMM adapted)



**Figure 2.6** Existing crossing – south

Source: Google Earth (EMM adapted)

### 2.3.3 Design alternatives

Design alternatives were informed by the significant experience of Thompson Berrill Landscape Design (TBLD) in landscape infrastructure and functional analysis of fauna movement.

As part of the project development, TBLD consulted with the Sydney Zoo to benefit from their research into koala behaviour. TBLD were provided with a detailed informal and anecdotal briefing by experienced koala keepers as to the various aspects and characteristics of koala behaviour and how it could inform the development and effectiveness of the TBLD koala crossing designs. Matters which were the subject of those consultations were:

- consideration of observed behaviours as to how do koalas move in the wild and the extents, range and characteristics of their movement patterns
- characteristics of materials and surfaces the koalas may not prefer to encounter
- characteristics of materials and surfaces that koala are comfortable encountering and climbing
- general behavioural patterns that inform movement, searching and access across ground surfaces
- general behavioural patterns with regard to climbing, walking, leaping and other movements.

The design and feasibility process for the proposed activities was subject to a rigorous process of options identification, concept development and prioritisation.

This process included:

- discussions with koala experts to determine the most suitable design and choice of materials to meet the known behavioural needs of koalas and other fauna
- workshopping a range of designs with representatives from WaterNSW and DPE
- preparation of a Prioritisation Matrix to assist the design selection process.

One design, known as the 'under pipe crossing' was considered but was not recommended for the purposes of this project due to the risks associated with possible vibration impacts on the Upper Canal pipeline.

The under pipe option required cutting and excavation of the currently fractured rock faces on both sides of pipeline at the identified location on an existing fauna movement line. The rock slope would be widened, the angle of slope lowered and the surface heavily scabbled to improve grip, providing opportunity for koala and fauna to climb down, pass under the low pipeline supports. It was noted however that construction of rock ramps may cause disturbance to pipeline lining and the heritage fabric of the Upper Canal.

#### 2.3.4 Designs considered

There are three design solutions which have been examined.

TBLD has prepared Concept Design drawings for three designs:

- Design Solution 1 – Under-fence
- Design Solution 2 – Over Pipeline
- Design Solution 3 – Log Climb.

Full descriptions and drawings are provided in Appendix C of the REF.

## 3 Planning framework

### 3.1 Overview

The purpose of all assessment processes is to consider impacts to, among other things, cultural heritage items and places as well as archaeological sites and deposits associated with the proposal and to identify measures to avoid, mitigate or ameliorate impacts.

In NSW, two main Acts (discussed below) give legal protection to items that have been assessed as worthy of protection on the basis of their environmental, which includes heritage, significance. The State Heritage Register (SHR), the S170 registers, and heritage schedules of local environment plans (LEPs) are statutory listings that identify specific items and places that require management to ensure that change does not diminish their significance.

### 3.2 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes the framework for development assessment within NSW, with one of the objects of the Act being to promote the sustainable management of built and cultural heritage, including Aboriginal cultural heritage.

As the majority of development assessment and consent is undertaken by Local Government (council), the EP&A Act directs council to prepare a local environmental plan (LEP) and development control plans (DCPs) for their local government. LEPs are to be developed under the standard instrument, which provides planning consistency across the State. Schedule 5 of the Standard Instrument provides a list of identified environmental heritage items within the LGA, impacts to which are to be considered during the development assessment and approval process. DCPs provide policies that are specific to the local environment and character of the LGA or a subset of the LGA. The NSW department with responsibility for planning may also prepare state environmental planning policies (SEPPs) to guide planning across the State.

#### 3.2.1 State Environmental Planning Policy (Biodiversity and Conservation) 2021

Recent amendments to the *State Environmental Planning Policy (Biodiversity and Conservation) 2021* ('the B&C SEPP') resulted in provision being made, under Part 13.2 of Chapter 13, for koala fencing and fauna crossings:

##### 13.6 Koala fences and fauna crossings

(1) Development involving the erection, maintenance or modification of a fauna crossing or koala fence may be carried out by or on behalf of a public authority without development consent if the crossing or fence is consistent with the Cumberland Plain Conservation Plan.

(2) In this section—

*fauna crossing* means a crossing to facilitate the movement of fauna across the land.

*koala fence* means a fence used to impede the movement of koalas towards roads and urban land, whether or not the fence is also used for another purpose.

The *Cumberland Plain Conservation Plan* (CPCP) provides for infrastructure to be installed for the purpose of fauna crossings (p 37) and a key deliverable of the conservation program is "installing crossings and fences in key areas to protect koalas and facilitate their safe movement" (p52).

CPCP *Sub-plan B: Koalas* also makes a specific reference as follows (p 23):

#### **Upper Canal crossing**

The department is working with Water NSW to investigate a potential crossing at the western end of the Ousedale corridor to improve koala movement across the Upper Canal. If feasibility investigations conclude that a crossing is warranted, the project will proceed to design, environmental assessment and construction. The proposed crossing would improve east–west koala movement from the Georges River through the Ousedale corridor to the Nepean River

Our finding is therefore that all of the options are classified as development permitted without consent and hence Part 5.1 of the EP&A Act applies, and a REF is required to inform a determination to be made by DPE.

### **3.2.2 Wollondilly Local Environmental Plan 2011**

Part 5, Section 5.10 addresses the conservation of heritage significance within the LGA. The objectives of the LEP in relation to heritage are:

- a) to conserve the environmental heritage of Wollondilly
- b) to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views
- c) to conserve archaeological sites
- d) to conserve Aboriginal objects and Aboriginal places of heritage significance.

To achieve these objectives, development consent is required to demolish, move, alter, disturb or excavate a heritage item, an Aboriginal object or a building, work, relic or tree within a heritage conservation area. Schedule 5 of the LEP provides a list of heritage items, conservation areas and archaeological sites within the LGA. The Upper Canal is listed in Schedule 5 as an item of State significance.

### **3.3 Heritage Act 1977**

The Heritage Act is the primary piece of State legislation affording protection to items of environmental heritage (natural and cultural) in NSW that are listed in the SHR. Under the Heritage Act, 'items of environmental heritage' include places, buildings, works, relics, moveable objects and precincts identified as significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. State significant items listed on the SHR are given automatic protection under the Heritage Act against activities that may damage an item or affect its heritage significance.

Section 57 of the Heritage Act lays out works that cannot be undertaken to a place except with approval under Subdivision 1 of Division 3 of the Act. The Upper Canal is included on the SHR (#01373) and is therefore subject to protection under the Heritage Act. Proposed development in the curtilage of the Upper Canal requires approval under section 60 of the Heritage Act. Depending on the nature and extent of the proposed development, the proposal can require either:

- A Section 60 fast track works approval, applicable to projects that meet the following criteria:
  - to an item listed on the State Heritage Register or subject to an interim heritage order
  - that will have **little or no adverse impact on the heritage significance of an item**, in the opinion of the Heritage Council (or its delegate)
  - that are not listed as a standard exemption or site-specific exemption under the *Heritage Act 1977*

- that have an estimated cost of up to \$150,000
- that accord with relevant guidelines.
- A Section 60 works approval, applicable where the criteria for a fast track Section 60 works approval are not met.

Section 38A of the Heritage Act allows for the preparation and endorsement of CMPs to identify the State heritage significance of an item, and set out policies and strategies for the retention of its significance. *The Upper Canal: Pheasants Nest To Prospect Reservoir Conservation Management Plan* (NSW Government Architect’s Office 2016) has been prepared to guide the management and conservation of the Upper Canal.

The Heritage Act also protects 'relics', regardless of their listing status. It applies to all land in NSW, except Commonwealth land. Section 4(1) of the Heritage Act (as amended 2009) defines ‘relic’ as follows:

A “relic” means any deposit, artefact, object or material evidence that:

- (a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and
- (b) is of State or local heritage significance.”

Section 139(1) of the Heritage Act states that:

A person must not disturb or excavate any land knowingly or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit.

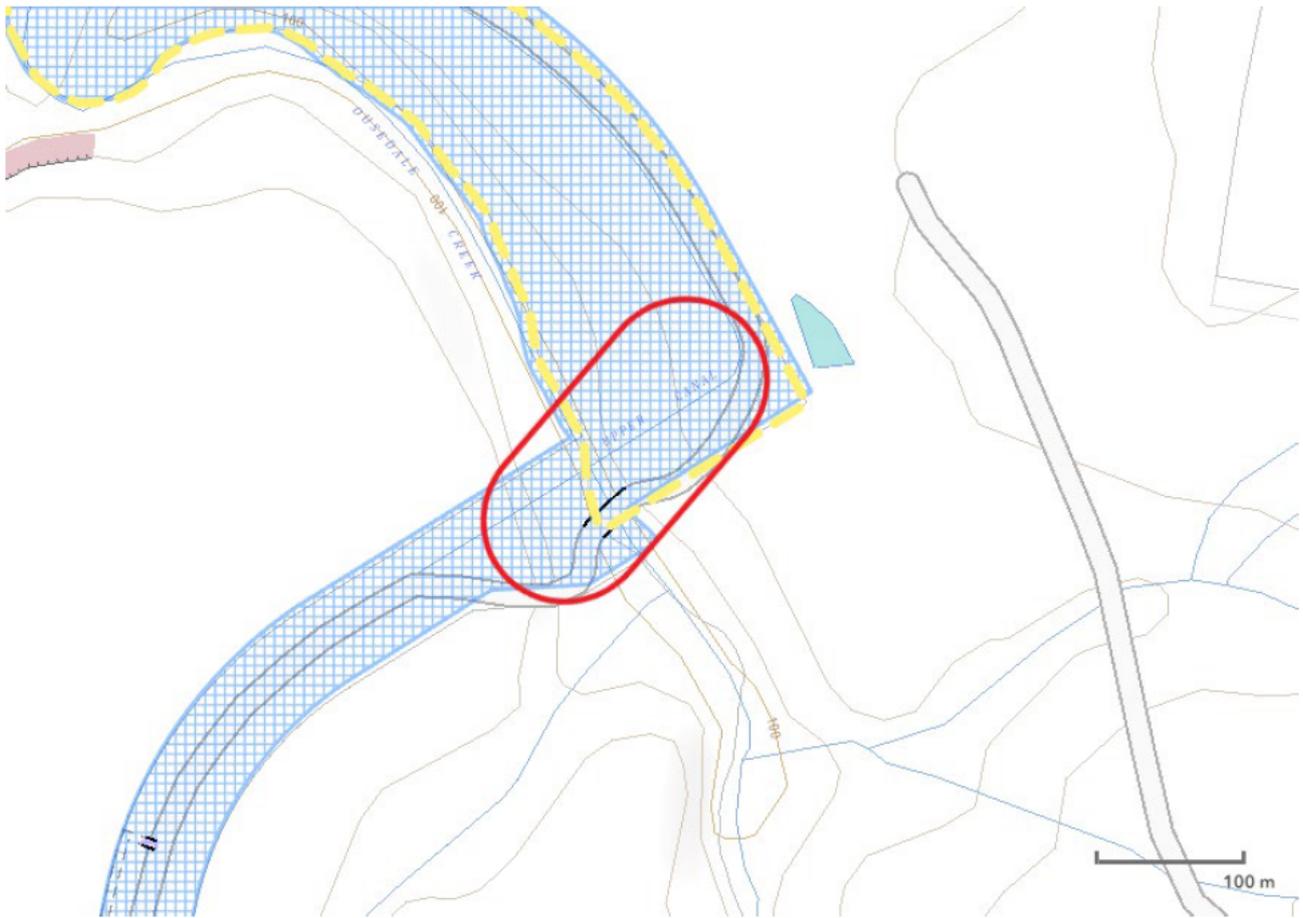
The Heritage Act identifies the category of ‘works’, which refers to past evidence of infrastructure, and is viewed as separate to that of archaeological relics under the Heritage Act. Works may be buried, and are therefore archaeological in nature, but exposing a work does not trigger reporting obligations under the Heritage Act unless it is considered that the item is of State significance.

### 3.4 Heritage status

A search of the relevant heritage registers was undertaken on 20 February 2023 and the site is identified on a SHR and LEP, as indicated in Table 3.1 and partially demonstrated on Plate 3.1.

**Table 3.1 Heritage register search**

| Jurisdiction | Heritage Register                               | Listing   |
|--------------|---|---|
| Federal      | World Heritage List                             | Nil   |
|              | Commonwealth Heritage Register                  | Nil   |
|              | National Heritage Register                      | Nil   |
|              | Register of the National Estate (non-statutory) | Nil   |
| State        | State Heritage Register                         | Upper Canal System (Pheasants Nest Weir To Prospect Reservoir) #01373 |
| Local        | Wollondilly Local Environmental Plan            | Upper Nepean Scheme – Upper Canal #16                                 |



**Plate 3.1** Upper Canal heritage listings and installation location. The blue hatched area indicates State heritage listing. The red outline indicates the section of the Upper Canal proposed for the koala crossings

Source: NSW Planning Portal, 2023

## 4 Existing environment

### 4.1 Upper Canal

The Upper Canal stretches for 64.53 km from Pheasants Nest weir to Prospect Reservoir. Upper Canal includes 44.3 km of open channel, 12 aqueducts and 15 tunnels. To assist in the management, the Upper Canal has been divided into 12 sections of varying lengths. The installations would occur in section 2, which runs from the termination of the Cataract Tunnel to the commencement of Devine’s Tunnel No. 2. section 2 has been further divided into six precincts, with the Ousedale Creek Precinct being the precinct in which the crossings would be installed. Individual elements of note have been assigned inventory numbers, which in the Ousedale Creek Precinct are provided in Table 4.1.

**Table 4.1 Ousedale Creek Precinct inventory items**

| Inventory number and name      | Construction date | Description   | Significance |
|--------------------------------|-------------------|---|--------------|
| 2.60 – South Headwall          | 1888              | Reinforced concrete   | Exceptional  |
| 2.61 – Aqueduct                | 1888              | There are 9 wrought iron pipe aqueducts carrying the water across creek crossings or other obstacle (railway line). Pipes are generally 2.4 m in diameter and constructed of ¼ inch riveted wrought iron plate in sections, with each join supported by an iron saddle and base plate on to intermediate sandstone piers. In the 1930s the inside of the pipes were lined with a 30 mm thick cement mortar, and several pipes were relined c2000.   | Exceptional  |
| 2.62 – Bypass                  | c. 1911           | Cast iron by-pass   | Considerable |
| 2.63 – North Headwall          | c.1886            | Elements of the Hudson Emergency Scheme are located at each of the creek crossings within Sections 2–3 and include cut off pipe sections within the headwalls, dry stone retaining walls and early road crossings.  | Exceptional  |
| 2.64 – Hudson’s Scheme Feature |                   |   |              |
| 2.65 – Road Bridge             | 1935–1937         | Steel trestle road bridges are provided at the majority of creek crossings (with the exception of the Menangle Creek crossing). This steel trestle bridge consists of a timber deck supported on steel joists/girders, timber kerb beams, and timber post and rail balustrade. The bridges are supported by intermediate steel trestles; however, the bridge over Woodhouse Creek is supported by sandstone piers dating from 1977.   | High         |
| 2.66 – Road                    | c.1886            | Elements of the Hudson Emergency Scheme are located at each of the creek crossings within Sections 2–3 and include cut off pipe sections within the headwalls, dry stone retaining walls and early road crossings.  | Exceptional  |
| Boundary fences                | Various           | <p>The original boundary fence to the Upper Canal easement was originally a split timber post and rail fence. It is assumed by EMM that the current fence is on the original boundary line.</p> <p>This fencing has been replaced over time, however, generally remains low (approximately 1m high), and is a wire, barbed wire or wire mesh fence with concrete, timber or metal posts.</p> <p>Illegal access into the Canal easement has also prompted the installation of higher chain wire fencing, often topped with barbed wire, to areas with adjacent suburban development, at locations of higher risk (e.g. power sub-station or water treatment facility) and at several of the larger road crossings.</p> | Not assigned |

Source: NSW Government Architect’s Office 2016

## 4.2 Landscape overview

The project area sits within a transitional landscape bordering parts of the Woronora Plateau and the Southern Highlands. These areas are generally at the interface of Hawkesbury Sandstone and Wianamatta Shale geology and represent favourable conditions for rockshelter habitation, stone hatchet manufacture and open camp site occupation. Essentially, rugged sandstone landscapes transition into open rolling hills within just a few kilometres.

The local landscape is characterised by deeply incised creek valleys and sandstone outcrops interspersed with sloping to flat landforms. Design Solution 1 (DS1) crossings (including U2, U7, U12 and U14) were located underneath the wire fence line to the east and south of the access road adjoining Upper Canal (Plate 4.1 to Plate 4.8). These locations were inspected for surface archaeological resources and assessed for potential to contain subsurface archaeological deposits. Visibility was low to nil at U2 and moderate at U7, U12 and U14. Design Solutions 2 and 3 (DS2 and DS3) straddled the canal pipeline and featured sandstone outcrops. Visibility here ranged from low to moderate (Plate 4.9 to Plate 4.14).

All design solutions were situated on moderate to steep slopes in areas subject to previous disturbance. DS1 crossings are considered to have been disturbed by the establishment of the Upper Canal access road as well as the establishment of the wire fence line. DS2 and DS3 crossings have been highly disturbed through the quarrying of stone for the canal and pipeline cutting as well as the installation of footings for the pipeline. No archaeological resources were encountered during the site inspection. Where visibility was poor, the micro-environment was considered unsuitable (e.g. too steep) for intensive use or habitation.



Plate 4.1 View south-east across Design Solution 1, Crossing U2 showing Upper Canal access road



Plate 4.2 View north-east across Design Solution 1, Crossing U2 showing Upper Canal access road and slope



**Plate 4.3** View south-east across Design Solution 1, Crossing U7 showing Upper Canal access road



**Plate 4.4** View south-west across Design Solution 1, Crossing U7 showing Upper Canal access road and slope



**Plate 4.5** View south-east across Design Solution 1, Crossing U12 showing Upper Canal access road



**Plate 4.6** View south-east across Design Solution 1, Crossing U12 showing moderate visibility



**Plate 4.7** View south-east across Design Solution 1, Crossing U14 showing nil visibility



**Plate 4.8** View south-east across Design Solution 1, Crossing U14 showing nil visibility



**Plate 4.9** View south-west across Design Solution 2, showing moderate visibility and Upper Canal pipeline



**Plate 4.10** View north-east across Design Solution 2, showing moderate visibility and Upper Canal pipeline



**Plate 4.11** View south-west across Design Solution 3, showing Upper Canal pipeline crossing of Ousedale Creek (inventory number 2.61)



**Plate 4.12** View west across Design Solution 3, showing examples of disturbance from Upper Canal pipeline and associated infrastructure



**Plate 4.13** View east across Design Solution 3, showing examples of disturbance from Upper Canal pipeline and associated infrastructure



**Plate 4.14** View north-east across Design Solution 3, showing examples of disturbance from Upper Canal pipeline and associated infrastructure

### 4.3 Archaeological potential

The CMP identifies 13 archaeological sites, being the cottages and camps used by the construction and maintenance teams. None of the identified archaeological sites are located near the installation sites. As stated in Section 4.2, the site inspection did not identify historical archaeological resources or areas of potential at the installation sites.

## 5 Historical context

### 5.1 Historical summary

The following is a summary of the history of the Upper Canal presented in Section 2 of the Higginbotham CMP (2001 Vol 1, p.6-15).

Droughts and settlement growth continually strained Sydney's water sources since the first settlement was established in 1788. By 1867 Sydney's water supply, the Botany Swamps, could not support the burgeoning city into the future. In response Governor John Young appointed a Commission to secure a long-term and reliable supply of water to feed Sydney. In 1869 the Commission recommend the Upper Nepean Scheme, whereby water from the Upper Nepean, Avon, Cordeaux and Cataract Rivers would be transported to a storage reservoir constructed in Prospect via canals, tunnels, pipes and aqueducts. But no firm decision was made. In 1876 English civil engineer W. Clark was appointed to review all of the proposed water schemes and in 1877 Clark highly recommended the Upper Nepean Scheme

The *Appropriation Act* was passed in July 1877 and construction commenced in 1880. Construction was tendered to contactors who worked under the direction of the Harbours and Rivers Branch of the Public Works Department, headed by Edward Orpen Moriarty. Works proceeded rapidly but drought had affected the Botany Swamps and in June of 1885 Sydney had 10 days' worth of water remaining in the Swamps.

The Hudson Brothers firm (later to be incorporated as Clyde Engineering) were commissioned to provide a temporary supply of water to the Swamps by bridging gaps in the Upper Canal across a number of creeks, including Ousedale Creek, and construct temporary elevated fluming to carry water from the Pipe Head to the Botany Swamps. Work began in September 1885 and was completed in January 1886. The Hudson works were dismantled when the Upper Nepean Scheme was completed in 1888.

The Upper Canal was maintained by teams of Inspector's and maintenance men who were housed in cottages along the canal route. By the 1890s, a telephone network was installed along the length of the canal, and connecting roadways were under construction, although bridges across larger creeks were not completed until the 1930s. By 1900, some sections of the Canal had begun to be realigned and continual upgrades and maintenance have been necessary to increase the supply capacity to 150 million gallons per day.

### 5.2 Assessment of significance

The following assessment of significance is sourced from the CMP and compiled in Table 5.1 below.

**Table 5.1 Assessment of significance The Upper Canal System**

| Criterion     | Assessment  |
|---------------|---|
| a) Historical | <p>The Upper Canal, as part of the Upper Nepean Scheme, has been in use as a gravity-fed water supply system and a key part of Sydney’s water supply without substantial alteration to its fabric since its completion in 1888. It operates in essentially the same way as was originally envisaged as a gravity-fed system utilising open canals and closed tunnels and aqueducts to transport water over a long distance.</p> <p>As a key component in the Upper Nepean Scheme, the Upper Canal is related to the major NSW historic theme of utilities. The provision of potable water is a first priority in any settlement and influences the success of all settlement building endeavours. The Upper Canal supported the development and expansion of Sydney, NSW’s largest and most important settlement, particularly during the late nineteenth and early twentieth centuries, a period of rapid population growth and industrial development. The local water supplied from the Upper Canal also allowed the agricultural development of the areas along its route.</p> <p>The route of the Upper Canal is associated with a large number of early colonial estates, many of which have given the local areas their current names including Meadowvale, Beulah, Mount Gilead and its extant landmark mill ruin, Glenlee, Glen Alpine, Gledswood, Varroville, Denham Court, Ingleburn, Leppington, Horningsea Park and Horsley. The names of various elements along the Canal also record previous local names that no longer exist except within the Upper Canal easement, such as Molles Main and Devil’s Back. For over half of its route the Canal follows, and at one point, crosses the Old Cowpasture Road, which is one of the earliest European travel routes in Australia.</p> <p>The Upper Canal has STATE heritage significance under this criterion. These values are embodied in the:</p> <ul style="list-style-type: none"> <li>• key original components of the Canal including open canal sections, tunnels, aqueducts, weirs and offtakes and the support structures that allowed it to function such as flumes, access roads, depots, cottages, telegraph lines and bridges</li> <li>• ongoing use of the Canal as a gravity fed water supply system for Sydney and a key element in the Upper Nepean Scheme</li> <li>• names of the various sections of the Canal and individual elements within it</li> <li>• rural landscape setting of the Canal and the topography that allowed it to operate as a gravity fed system.</li> </ul> |

**Table 5.1 Assessment of significance The Upper Canal System**

| Criterion              | Assessment  |
|------------------------|---|
| b) Associative         | <p>The construction of the Upper Canal is strongly associated with Edward Orpen Moriarty, the head of the Harbours and Rivers Branch of the NSW Public Works Department who was a key figure in the development of plans for Sydney’s water supply in the 1870s and 80s. The successful completion of the Canal and its continuation of use as a major element in Sydney’s water supply system are a lasting testament to the professional capabilities of the late Victorian era generation of engineers of the Public Works Department including Moriarty.</p> <p>The operation of the Canal is strongly associated with the Board of Water Supply and Sewerage, established in 1888, but renamed the Metropolitan Water Sewerage and Drainage Board in 1924. The Board in both its incarnations was a powerful and influential government body throughout the late nineteenth and early to mid-twentieth centuries.</p> <p>The Upper Canal has STATE heritage significance under this criterion. These values are embodied in the:</p> <ul style="list-style-type: none"> <li>• key original components of the Canal including open canal sections, tunnels, aqueducts, weirs and offtakes and the support structures that allowed it to function such as flumes, access roads, depots, cottages, telegraph lines and bridges</li> <li>• remaining fabric relating to the phase of upgrading flumes and bridges by the Metropolitan Water Sewerage and Drainage Board in the 1920s and 30s.</li> </ul>   |
| c) Aesthetic/technical | <p><b>Technical</b></p> <p>The Upper Canal contributed to the major advance made by the Upper Nepean Scheme from depending on local water sources to harvesting water in upland catchment areas, storing it in major dams and transporting it to the city by means of major canals and pipelines.</p> <p>It is an excellent example of the ingenuity of late nineteenth century hydraulic engineering, in particular for its design as a gravity-fed water supply system through difficult terrain. It illustrates the techniques of canal building (often at extremely small grades), the progressive improvements in both pipe manufacture and pipeline construction and the construction of wrought iron aqueducts.</p> <p>The Upper Canal provides detailed and varied evidence of engineering construction techniques prior to the revolution inspired by reinforced concrete construction. Although concrete was later used to improve the durability of the System, much of the earlier technology is still evident along the Canal.</p> <p>It also provides extensive evidence of the evolution of engineering practice, such as the replacement of timber flumes by wrought iron flumes to be followed by concrete flumes. The early utilisation of concrete for many engineering purposes, also demonstrates the growing emergence of an engineering technology based upon man-made rather than natural materials.</p> <p>Many of the original control installations such as the ‘Stoney gates’, stop logs, penstocks, gate valves are still in service and continue to illustrate the technology of the original construction period of the Canal. Where these elements have been replaced it is generally with like technology using modern materials, thereby continuing the essential character of the Canal and its originally intended operation.</p> |

**Table 5.1 Assessment of significance The Upper Canal System**

| Criterion | Assessment  |
|-----------|---|
|           | <p><b>Aesthetic</b></p> <p>Many of the surviving plantings along the Upper Canal function as major landmarks in the local rural landscape - either as strong linear designs (pine avenues) or distinctive small groups or solitary trees (Bunya and Hoop Pines). Plantings are used along the Canal to mark significant items of infrastructure and the arrival at Prospect Reservoir. The Canal itself is an impressive landscape element with its sandstone and concrete lined edges and serpentine route - based on gentle engineered curves - as it negotiates the complex topography along its route. In many sections it still retains its historic setting, although this is increasingly under threat from surrounding development for housing and light industry. The Upper Canal has STATE heritage significance under this criterion. These values are embodied in the:</p> <ul style="list-style-type: none"> <li>• key original components of the Canal including open canal sections, tunnels, aqueducts, weirs and offtakes and the support structures that allowed it to function such as flumes, access roads, depots, cottages, telegraph lines and bridges</li> <li>• ongoing use of the Canal as a gravity fed water supply system for Sydney and a key element in the Upper Nepean Scheme</li> <li>• rural landscape setting of the Canal and the topography that allowed it to operate as a gravity fed system</li> <li>• the contrast of the grass and introduced plantings within the Canal corridor with the stone, concrete and brick structures of the Canal</li> </ul> <p>planned historic plantings within the Canal corridor including avenues of pines and cultural plantings associated with depots and cottages.</p> |
| d) Social | <p>The social significance of the Upper Canal has not been formally assessed through community consultation. The Canal is not a public access area and many people, even in the local community are likely to be unaware of its existence and significance. Nevertheless it is likely that the Canal has heritage significance under this criterion. The Canal is recognised by the NSW Heritage Council; the National Trust of Australia; and a number of local councils along its route. It is expected that engineering heritage groups in NSW and across Australia would have a strong interest in, and association with, the Canal as an outstanding and rare example of its type of late nineteenth century hydraulic engineering.</p>  |

**Table 5.1 Assessment of significance The Upper Canal System**

| Criterion             | Assessment   |
|-----------------------|--|
| e) Research           | <p>The Upper Canal is an outstanding benchmark site demonstrating a range of late nineteenth century engineering techniques and innovations in water supply technology, over a long distance in complex topography.</p> <p>There may be some historical archaeological evidence of the original construction camps, providing an insight into life for the construction workers in temporary accommodation in the late nineteenth century that is not available in historic sources. There may also be some limited archaeological evidence associated with life for the maintenance men and their families in cottages along the Canal easement.</p> <p>Aboriginal sites within the Canal easement are likely to contribute further information about Aboriginal people in the local area prior to the construction of the Canal in the 1880s.</p> <p>The Upper Canal passes through various remnant indigenous vegetation communities. These are likely to have scientific interest and require further specific study.</p> <p>The Upper Canal has <i>local</i> heritage significance under this criterion. These values are embodied in the:</p> <ul style="list-style-type: none"> <li>• key original components of the Canal including open canal sections, tunnels, aqueducts, weirs and offtakes and the support structures that allowed it to function such as flumes, access roads, depots, cottages, telegraph lines and bridges</li> <li>• historical archaeological evidence at construction camp sites and cottage sites within the Canal corridor</li> <li>• Aboriginal sites within the Canal corridor</li> <li>• remnant native vegetation within the Canal corridor.</li> </ul> |
| f) Rarity             | <p>The Upper Canal has functioned as part of Sydney’s main water supply system for 125 years and continues to do so. It has changed little in its operational principles since it was completed in 1888, continuing to operate as a gravity fed system, utilising open canals and closed tunnels and aqueducts to transport water over a long distance.</p> <p>The Canal is unique in NSW, being the only extensive gravity fed water supply canal system to supply a large city and its population with fresh water from a distant source in the hinterland. This type of water supply system also appears to be rare in Australia. The rarity of the Canal is enhanced by its integrity and its continuing operation largely using the original infrastructure built in the 1880s which still operates as originally intended. Such intact systems demonstrating an array of nineteenth century engineering techniques are rare.</p>   |
| g) Representativeness | The site does not meet this criterion  |

Source: NSW Government Architect’s Office 2016:13-17

The Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) is listed as item 01373 on the SHR. The following statement of significance is sourced from the NSW Heritage Inventory and states the following:

The Upper Canal System is significant as a major component of the Upper Nepean Scheme. As an element of this Scheme, the Canal has functioned as part of Sydney's main water supply system since 1888. Apart from maintenance and other improvements, the Upper Canal has changed little.

As part of this System, the Canal is associated with Edward Moriarty, Head of the Harbours and Rivers Branch of the NSW Public Works Department. The Canal is aesthetically significant, running in a serpentine route through a rural bushland setting as an impressive landscape element with sandstone and concrete-lined edges.

The Canal is significant as it demonstrates the techniques of canal building, and evidence of engineering practice. The Canal as a whole is an excellent example of 19th century hydraulic engineering, including the use of gravity to feed water along the canal (BCubed Sustainability, 2/2006). The Upper Nepean Scheme is significant because:

- In its scope and execution, it is a unique and excellent example of the ingenuity of late 19th century hydraulic engineering in Australia, in particular for its design as a gravity-fed water supply system.
- It has functioned as a unique part of the main water supply system for Sydney for over 100 years, and has changed little in its basic principles since the day it was completed.
- It represented the major engineering advance from depending on local water sources to harvesting water in upland catchment areas, storing it in major dams and transporting it the city by means of major canals and pipelines.
- It provides detailed and varied evidence of the engineering construction techniques prior to the revolution inspired by reinforced concrete construction, of the evolution of these techniques (such as the replacement of timber flumes with wrought iron and then concrete flumes), and of the early use of concrete for many engineering purposes in the system.
- The scheme possesses many elements of infrastructure which are of world and national renown in technological and engineering terms.
- Many of the structural elements are unique to the Upper Nepean Scheme.

(Heritage NSW 2010)

## 6 Statement of heritage impact

### 6.1 Introduction

The assessment of a project's impacts to the heritage significance of a place or an item is to understand change, if it is beneficial to the place or item, and how changes can be managed to best retain significance. The historical landscape in Australia, be it rural or urban, is by social agreement, a significant aspect of our identity. That agreement is codified in legislation, the intent of which is to encourage the conservation of cultural heritage by incorporating it into development where feasible. In many situations avoiding impacts is impossible, but the aim is to reduce those impacts by either project re-design or managing the loss of information through methods that reduce and/or record significance before it is removed.

The framework around assessing significance and therefore suitable levels of impact is to understand how the place or item came to be, how important it was (and may be still) in the development of the local area or the state (the colony at the time) and providing guidance on its management.

### 6.2 Consideration of alternatives

#### 6.2.1 Do nothing

The 'do nothing' option was, in many respects, considered by the NSW Government in preparing the *Cumberland Plain Conservation Plan: Sub-plan B: Koalas* (DPE 2022) and the commitment to establish the Georges River Koala Reserve. The actions outlined in the CPCP respond to the requirements of the reports of the Office of the NSW Chief Scientist and Engineer<sup>2</sup>. Specifically, Ousedale Creek is identified in the CPCP: Sub-plan B: Koalas as "the most important east-west movement corridor in the Greater Macarthur Growth Area" (p 13) and with regard to the Upper Canal site, the CPCP: Sub-plan B: Koalas states "If feasibility investigations conclude that a crossing is warranted, the project will proceed to design, environmental assessment and construction" (p 23).

Hence a 'do nothing' option is not considered further, and the alternatives considered are limited to design solutions to facilitate the desired fauna movement corridor at Ousedale Creek.

#### 6.2.2 Use of existing crossing points

There are two existing crossings approximately 110 m north-east and 100 m southwest of Ousedale Creek.

The crossing to the north (refer to Figure 2.4) is likely to be used by some fauna including potentially koalas. There are however two key constraints:

- the fauna which utilise this crossing need to navigate an area without tree cover
- the existing crossing is close to land which is 'urban certified' under the CPCP (refer to Figure 2.5) and will, in future, support development which may further impede the use of the existing crossing by koalas.

The crossing structure to the south (refer to Figure 2.6) is constructed with open grill metal walkways which are unsuited to use by koalas and other fauna. The absence of any evidence of fauna using this crossing point suggests that the material or location are unsuitable.

<sup>2</sup> Office of the NSW Chief Scientist and Engineer (2020) *Report of the Independent Review on the Advice on the protection of the Campbelltown koala population*. Office of the NSW Chief Scientist and Engineer (2021) and *Report of the Independent Review on the Advice regarding the protection of koala populations associated with the Cumberland Plain Conservation Plan*

There are other crossing structures several hundred metres to the north and south of Ousedale Creek which provide access over the open canal sections of the Upper Canal. These are considered to be too distant to service the need for koala movement in the Ousedale Creek locality (as required pursuant to CPCP: Sub-plan B: Koalas).

### 6.2.3 Design alternatives

Design alternatives were informed by the significant experience of TBLD in landscape infrastructure and functional analysis of fauna movement.

As part of the project development, TBLD consulted with the Sydney Zoo to benefit from their research into koala behaviour. TBLD were provided with a detailed informal and anecdotal briefing by experienced koala keepers as to the various aspects and characteristics of koala behaviour and how it could inform the development and effectiveness of the TBLD koala crossing designs. Matters which were the subject of those consultations were:

- consideration of observed behaviours as to how do koalas move in the wild and the extents, range and characteristics of their movement patterns
- characteristics of materials and surfaces the koalas may not prefer to encounter
- characteristics of materials and surfaces that koala are comfortable encountering and climbing
- general behavioural patterns that inform movement, searching and access across ground surfaces
- general behavioural patterns with regard to climbing, walking, leaping and other movements.

The design and feasibility process for the proposed activities was subject to a rigorous process of options identification, concept development and prioritisation.

This process included:

- discussions with koala experts to determine the most suitable design and choice of materials to meet the known behavioural needs of koalas and other fauna
- workshopping a range of designs with representatives from WaterNSW, DPE and Heritage NSW
- preparation of a Prioritisation Matrix to assist the design selection process.

One design, known as the 'under pipe crossing' was considered but was not recommended for the purposes of this project due to the risks associated with possible vibration impacts on the Upper Canal pipeline.

The under pipe option required cutting and excavation of the currently fractured rock faces on both sides of pipeline at the identified location on an existing fauna movement line. The rock slope would be widened, the angle of slope lowered and the surface heavily scabbled to improve grip, providing opportunity for koala and fauna to climb down, pass under the low pipeline supports. It was noted however that construction of rock ramps may cause disturbance to pipeline lining and the heritage fabric of the Upper Canal.

## 6.3 Impact assessment – crossing installations

Two main types of impacts may occur as a result of the installations; these types are described below.

- Physical impacts are those impacts that will materially affect the features and sites that are present at the location of the proposed installations whether they were found or if they are unanticipated.
- Visual impacts are those impacts that will affect the views and the setting of the cultural landscape and nearby built items within the development footprint and surrounds.

The likelihood of impacts occurring for each of the installations is outlined in Table 6.1.

**Table 6.1 Assessment of impact**

| Installation   | Inventory item                  | Direct impact discussion  | Indirect impact discussion  | Summary   |
|----------------|---------------------------------|---|---|-----------|
| Under-fence 2  | Canal/pipeline                  | Approximately 32 m from road bridge, no direct impacts          | Not visible due to vegetation. No indirect impacts.   | No impact |
|                | Under-fence                     | Directly under, but no direct impact to the fabric of the fence | While the HMP identifies the fences and provides management measures, the fences themselves are identified as being contributory, but not of heritage significance. The management measures are related to the replacement of the fences and do not provide direction in relation to this type of installation. As the fences are contributory, it is concluded that the indirect alterations to the visual setting of the fence would not impact the heritage significance of the Upper Canal. | No impact |
| Under-fence 7  | Road bridge (inventory item 65) | Approximately 3 m from road bridge, no direct impacts           | Not visible due to vegetation. No indirect impacts.   | No impact |
|                | Canal/pipeline                  | Approximately 29 m from canal/pipeline, no direct impacts       | Not visible due to vegetation. No indirect impacts.   | No impact |
|                | Fence                           | Directly under, but no direct impact to the fabric of the fence | See discussion above regarding fencing  | No impact |
| Under-fence 12 | Road bridge (inventory item 65) | Approximately 20 m from road bridge, no direct impacts          | Not visible due to vegetation. No indirect impacts.   | No impact |
|                | Canal/pipeline                  | Approximately 67 m from canal/pipeline, no direct impacts       | Not visible due to vegetation. No indirect impacts.   | No impact |
|                | Fence                           | Directly under, but no direct impact to the fabric of the fence | See discussion above regarding fencing  | No impact |
| Under-fence 14 | Road bridge (inventory item 65) | Approximately 44 m from road bridge, no direct impacts          | Not visible due to vegetation. No indirect impacts.   | No impact |
|                | Canal/pipeline                  | Approximately 60 m from canal/pipeline, no direct impacts       | Not visible due to vegetation. No indirect impacts.   | No impact |
|                | Fence                           | Directly under, but no direct impact to the fabric of the fence | See discussion above regarding fencing  | No impact |

**Table 6.1 Assessment of impact**

| Installation       | Inventory item | Direct impact discussion  | Indirect impact discussion  | Summary      |
|--------------------|----------------|---|---|--------------|
| Over pipe          | Pipeline       | Directly adjacent, but the installation will be approximately 1,500 mm above the pipeline and set back from the cutting in which the pipeline sits by approximately 2,000 mm, in compliance with policy 51 of the CMP. Policy 58 requires that new walkways over the pipeline/canal do not impact on elements of exceptional significance. No direct impacts are anticipated, and the installation complies with the policies in the CMP. All elements, of all levels of significance will be retained as no demolition is proposed (CMP policy 3 and 4). | <p>The installation would result in a localised change in views of the pipeline, but the works are reversible, with no direct impacts to fabric of significance. Additionally, the materiality and form of the installation is not discordant with the industrial built form of the Upper Canal, looking much like a pedestrian/maintenance crossing and therefore adheres to policy 50 and 51 of the CMP.</p> <p>As stated, there will be no direct impacts to the fabric of the Upper Canals per policy 58 (which states: Where the walkway, steps and handrails are new (i.e. they are not replacing existing elements), give preference to locations that do not impact on elements of Exceptional heritage significance). The installation would be constructed over</p> <p>The aesthetic significance, as defined in the Statement of Significance, refers to the tree plantings and the sections of open canal, not the pipeline sections. Therefore, the visual impact has been located in an area of lesser aesthetic significance, thereby reducing the impact. There will be no impact, direct or indirect to the aesthetic tree plantings. Furthermore, the installation is located in an area that is not readily accessible to the general public. Those seeing the changes to the visual presentation of the pipeline would be limited to WaterNSW maintenance staff as the Upper Canal corridor is classified as a controlled area and public access is prohibited (NSW Government Architect’s Office 2016, 25).</p> <p>Furthermore, the installation would not interfere with the operation of the Upper Canal (technical significance) and also would not impact on the associations with Edward Orpen Moriarty or the Board of Water (associative significance).</p> | Minor impact |
| Log climb crossing | Pipeline       | The log climb crossing would not directly impact the pipeline, complying with policy 51 of the CMP. No direct impacts are anticipated.  | The log climb crossing is sensitive in terms of its being adjacent to the pipeline but not directly over or in contact with the pipeline (policy 51). Furthermore, the simple log and steel joinery design solution is considered as unobtrusive as it blends in with the foliage and the terrain, complying with policy 51 in that it will be unobtrusive.   | No impact    |

**6.3.1 Statement of heritage impact**

The installation of koala crossings is not an activity that aligns with the standard questions in the Statements of Heritage Impacts Guidelines (NSW Heritage Office 2002). EMM has therefore developed a set of questions that addresses the intent of the guidelines while taking in the proposed works.

### **Will the proposed koala crossing installations impact on the identified significance of the Upper Canal?**

No. As discussed in Table 6.1, the installations would not:

- directly impact on fabric of significance
- significantly alter the visual setting
- impact known archaeological resources or cultural landscape elements.

### **Will the installations visually dominate the heritage item?**

No. The Under-fence crossings will blend in with the surrounding native vegetation, being of a timber finish. Likewise, the log climb crossing will be constructed of timber and would be unobtrusive, as per policy 51 of the CMP.

The over pipe crossing would be constructed in a similar material to the pipeline, being steel, and would blend with the industrial aesthetic of the Upper Canal. While the installation will change the local visual presentation of the area, the installation will not visually dominate the Upper Canal pipeline. The height of the over pipe crossing has been carefully designed to avoid direct impacts, without being overly high; clearance of 1,500 mm above the pipeline is required to clear the handrail that sits on top of the pipeline to facilitate ongoing maintenance of the Upper Canal. The slope of the over pipe crossing has been calculated to encourage koalas to cross, while enabling the crossing to be opened to allow for maintenance of the pipeline.

### **Is the addition sited on any known, or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered?**

Higginbotham identified some areas of archaeological potential associated with the Upper Canal, which related to workers camps. These sites are listed in the CMP (NSW Government Architect's Office 2016, p.205-206). No workers camps or areas of archaeological potential have been identified in the vicinity of the proposed installations. An unexpected finds procedure is considered adequate to manage the residual risk.

## **6.4 Impact assessment – wildlife camera installation**

The proposed activity includes the installation of approximately 18 wildlife cameras. The cameras installed to collect the data used to design this activity were the subject of a successful section 60 Fast track application.

The cameras will be either mounted on the trunks of trees or on star pickets. Where star pickets are used these will be driven approximately 20 cm into the ground with a mallet.

Potential impacts arising from the installation are a change in the visual amenity of the area and impacts to archaeological resources when driving star pickets.

### **6.4.1 Statement of Heritage Impact – wildlife camera installation**

The installation of wildlife cameras is not an activity that aligns with the standard questions in the Statements of Heritage Impacts guidelines (NSW Heritage Office 2002). EMM have therefore developed a set of questions that addresses the intent of the guidelines while taking in the proposed works.

### **Will the proposed cameras impact on the identified significance of the Upper Canal?**

No. The cameras will not be fixed to the heritage fabric of the Upper Canal. Their installation will not result in damage to vegetation and are unlikely to impact on archaeological resources. As temporary (two years) and reversible works, no impact to the significance of the Upper Canal is identified.

**Will the additions visually dominate the heritage item?**

No. The wildlife cameras are small and unobtrusive, being in natural tones of green and brown to avoid spooking wildlife. The laminated A4 wildlife camera signs will stand out, but the visual impacts will be discrete areas and viewers will be limited to WaterNSW maintenance staff as the Upper Canal is a controlled area and public access is prohibited. This is considered acceptable as the impacts will be temporary. The removal of both the cameras and the installations can be undertaken with no impact to the fabric or significance of the Upper Canal.

**Is the addition sited on any known, or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered?**

Higginbotham identified some areas of archaeological potential associated with the Upper Canal, which related to workers camps. These sites are listed in the CMP (NSW Government Architect's Office 2016, p.205-206). No workers camps or areas of archaeological potential have been identified in the vicinity of the proposed wildlife cameras. No impacts to the ground surface will result from the mounting of wildlife cameras on trees. Where star pickets are to be used, the impact would be less than 150mm in diameter to a depth of 200 mm. This does not constitute a significant impact, particularly as the CMP has indicated that the archaeological potential outside of the workers camps is low.

In summary, it is concluded that the installation of the koala crossing installations and associated cameras would not impact on the heritage significance of the Upper Canal.

## 7 Conclusion and recommendations

EMM Consulting, in collaboration with TBLD, prepared a feasibility study (2022) for the Department of Planning and Environment (DPE) that considered the behaviour and movement patterns of koalas (*Phascolarctos cinereus*), the local landscape and assets, and possible design solutions for the construction of crossings at the Upper Canal at Ousedale Creek. The feasibility study determined that koala crossings would augment the movement of the animals and six installations have been proposed, being four under-fence crossings, one over pipe crossing and one log climb crossing. The estimated construction cost is in the order of \$145,000 or less. This estimate of construction value was prepared by TBLD Architects, designers for the proposed facilities.

The reason for the project is to deliver on commitments made in the *Cumberland Plain Conservation Plan (CPCP)*, which is one of the largest strategic conservation plans to be undertaken in Australia, covering 200,000 hectares of Western Sydney, from Wilton in the South to Windsor and Kurrajong in the north. It was developed in response to the projected population growth in Western Sydney while protecting biodiversity values, such as threatened plants and animals.

The Upper Canal is an operational WaterNSW asset listed on the SHR. The significance of the Upper Canal System is managed under a conservation management plan CMP prepared by the Government Architects Office (NSW Government Architect's Office 2016). An assessment of the proposed installations concluded that the works would not have more than a minor impact the heritage significance of the Upper Canal for the following reasons:

- The installation would result in a localised change in views of the pipeline, but the works are reversible, with no direct impacts to fabric of significance.
- The materiality and form of the installation is not discordant with the industrial built form of the Upper Canal, looking much like a pedestrian/maintenance crossing and therefore adheres to policy 50 and 51 of the CMP.
- There will be no direct impacts to the fabric of the Upper Canal as per policy 58. Further it is noted that the installations are reversible and there will be no damage to the Upper Canal or impact to its significance, if the structures are removed.
- The aesthetic significance, as defined in the Statement of Significance, refers to the tree plantings and the sections of open canal, not the pipeline sections. Therefore, the visual impact has been located in an area of lesser aesthetic significance, thereby reducing the impact.
- There will be no impact, direct or indirect to the aesthetic tree plantings.
- The installation is located in an area that is not readily accessible to the general public. Those seeing the changes to the visual presentation of the pipeline would be limited to WaterNSW maintenance staff as the Upper Canal corridor is classified as a controlled area and public access is prohibited.
- The installations comply with the relevant CMP policies, of particular relevance are policies 51, 52 and 58.

The following recommendations are made:

- Approval under section 60 of the Heritage Act is required as the works will occur within the SHR curtilage. It is EMM's opinion that the project meets the criteria for a fast track application, however, the proponent should consult with Heritage NSW to confirm prior to lodging the application.
- This SoHI should be lodged in support of the section 60 application, whether Fast track or otherwise.

- A photographic archival recording should be prepared in advance of works as per policies 3, 4 and 40 of the CMP.
- WaterNSW should be provided with documentation to include in their records regarding the changes made in the SHR curtilage, as per policy 41.
- In the unlikely event that archaeological resources are found during construction, an unexpected finds procedure must be included in the construction environmental management plan. The unexpected finds procedure must include notification of WaterNSW. Heritage NSW must be notified under section 146 of the Heritage Act if the find is deemed to be a relic.