Ordinary Meeting of Council

24 June 2020

ATTACHMENTS – UNDER SEPARATE COVER

ITEM 9.2 - PROPOSED QUEANBEYAN CEMETERY SITE

Item 9.2 Proposed Queanbeyan Cemetery Site

QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2	PROPOSED QUEANBEYAN CEMETERY SITE
ATTACHMENT 1	ABORIGINAL HERITAGE DUE DILIGENCE REPORT

A TETRA TECH COMPANY

ECO LOGICAL AUSTRALIA PTY LTD
ABN 87 096 512 088
www.ecoaus.com.au

Arthean McBride
Senior Strategic Town Planner
Queanbeyan-Palerang Regional Council
PO Box 90 Queanbeyan NSW 2620

REF: 17MUD_9096

7th June 2018

Dear Arthean

Aboriginal Archaeological Due Diligence Assessment – proposed development of Lot 2 DP 112382, 1241 Old Cooma Road, Googong NSW 2620 and Lot 126 DP 754881, 1187 Old Cooma Road, Googong NSW 2620.

Eco Logical Australia (ELA) has been engaged by Queanbeyan-Palerang Regional Council (QPRC) to conduct an Aboriginal Due Diligence (ADD) assessment to support a planning proposal for the proposed redevelopment of Lot 2 DP 112382, 1241 Old Cooma Road, Googong NSW 2620 and Lot 126 DP 754881, 1187 Old Cooma Road, Googong NSW 2620 (**Figure 1**).

This assessment follows the Due Diligence Code of Practice as set out in the NSW Office of Environment and Heritage's (OEH) *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (hereafter referred to as 'the Code') (DECCW 2010).

This due diligence process provides a framework for determining whether Aboriginal objects will be harmed by the proposed works, as required under Part 6 of the NSW *National Parks and Wildlife Act 1974* (NPW Act). The Code sets out the reasonable and practicable steps which individuals and organisations need to take to:

1. Identify whether or not Aboriginal objects are, or are likely to be, present in an area;
2. Determine whether or not their activities are likely to harm Aboriginal objects (if present); and
3. Determine whether an Aboriginal Heritage Impact Permit (AHIP) from OEH or further assessment is required.

This assessment has been prepared by Dr Tristen Jones, ELA Archaeologist (PhD, Australian National University), and reviewed and authorised by Alistair Grinbergs, ELA Principal Consultant (Bachelor of Arts [Honours], Australian National University; Graduate Diploma of Applied Science, University of Canberra).

Yours sincerely

Alistair Grinbergs
Principal Consultant - Heritage Strategy & Development

Legislative framework for due diligence

Aboriginal objects and places in NSW are afforded protection under the NPW Act regardless of whether they are registered on the Aboriginal Heritage Information Management System (AHIMS) register or not. Strict penalties apply for harm to an Aboriginal object or place without a defence under the Act. Under Section 87 of the Act there are five defences to causing harm to an Aboriginal object:

- The harm was authorised under an AHIP.
- By exercising due diligence and being able to demonstrate this.
- The actions compiled with a code of practice as described in the *National Parks and Wildlife Regulation 2009*, for example, undertaking test excavation in accordance with the '*Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*'.
- It was a low-impact activity, or omission under the regulation, or where there was no knowledge of an Aboriginal object already present.
- Was an exemption under Section 87A, for example emergency fire-fighting act or bush fire hazard reduction work within the meaning of the *Rural Fires Act 1997*.

If an AHIP application is required, OEH necessitates that it is supported by an Aboriginal Cultural Heritage Assessment (ACHA) prepared in accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2010), and a copy of approval for the development or infrastructure issued under Part 4 or Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Purpose and aim of the due diligence assessment

The aims of this Aboriginal archaeological due diligence assessment are to:

- Undertake a search of the AHIMS register maintained by OEH to establish if there are any previously recorded Aboriginal objects or places within the study area.
- Undertake a search of the NSW State Heritage Inventory, the Australian Heritage Database, and the Queanbeyan Local Environmental Plan (LEP) 2012 Schedule 5 (Environmental Heritage) to determine if there are any sites of Aboriginal significance or sensitivity located within the study area.
- Undertake a desktop review of relevant previous archaeological assessments to understand the local archaeological context and assist in predicting the likely occurrence of unrecorded archaeological sites or objects.
- Undertake a site inspection to identify any Aboriginal sites and areas of sensitive landforms.
- Prepare a letter style Aboriginal due diligence assessment determining if known objects or additional unrecorded objects are present within the study area, as well indicate whether further assessment and/or an AHIP is required.

No consultation has been undertaken as part of this due diligence. The local Aboriginal Land Council and other stakeholder groups may be contacted to provide a cultural assessment for the area if required.

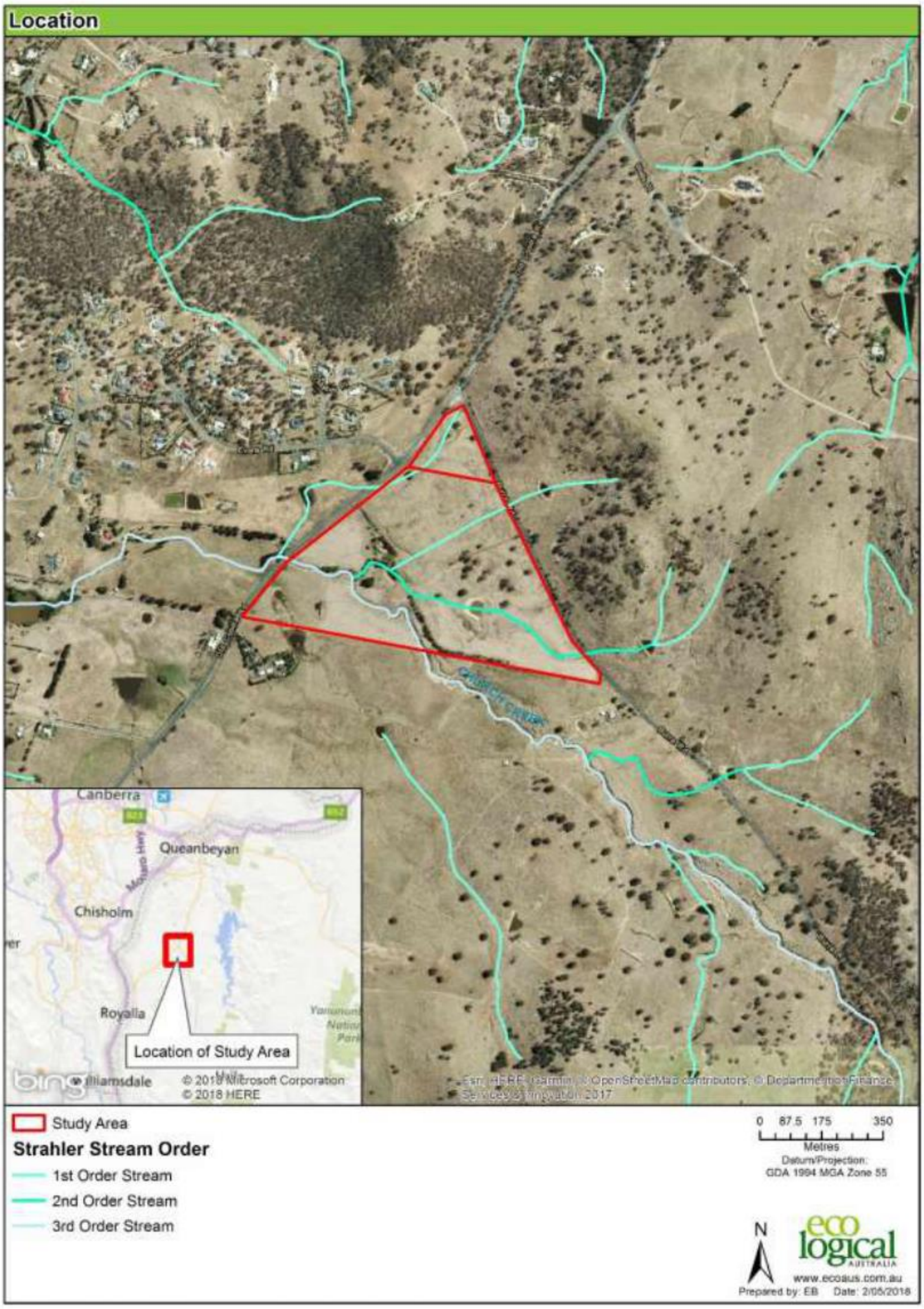

Figure 1: Study area

Previously recorded Aboriginal sites

Heritage Database Searches

Searches of the Australian Heritage Database, the State Heritage Inventory (SHI) and Queanbeyan LEP (2012) utilising the terms "Googong", "Burra", "Old Cooma Road" and "Fernleigh Park" NSW were conducted on 22nd March 2018 to determine if any places of Aboriginal significance are located within proximity to the study area.

A single heritage item listed for both European and Aboriginal heritage significance was identified on the Commonwealth Heritage List (Table 1). No other Aboriginal heritage items were identified on the registers. However, there were six further European heritage items listed on the Queanbeyan LEP 2012.

Table 1: Commonwealth Heritage Listed Items in proximity to the study area

Place Name	LGA	Location	Place ID	Legal Status
Googong Foreshores Cultural and Geodiversity Heritage Areas	Queanbeyan-Palerang	London Bridge Rd, Burra, NSW	106072	Listed place (03/11/2017)

AHIMS search

An extensive search of the AHIMS database was conducted on 12 February 2018 for Lot 2, DP112382 with a buffer of 1000m (Attachment A). A total of 23 AHIMS sites were identified during this search. A breakdown by site feature is presented in Table 2 below, with the locations illustrated in Figure 2.

Table 2: Types of Aboriginal sites recorded within approximately 1 km of the AHIMS search area

Site feature	Number of sites	Percentage of all sites
Artefact	8	35
Artefact Scatter	12	52
Scar Tree	3	13
Total number of sites	23	100%

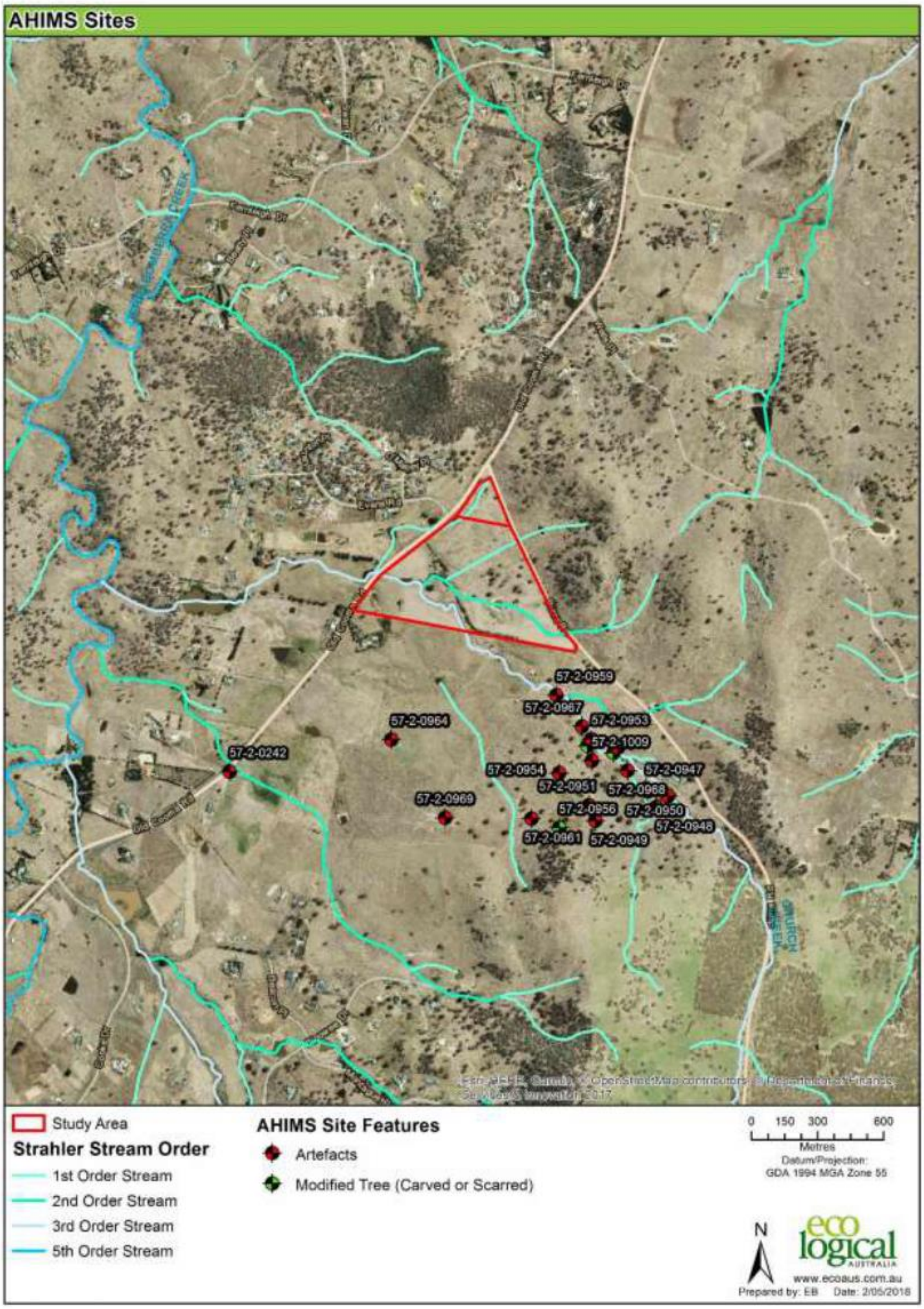

Figure 2: Previously recorded Aboriginal sites in proximity to the study area

Ethnographic context

The southern Canberra / Queanbeyan / Googong region is the traditional lands of three clan groups: the *Ngunnawal*, *Ngarigo* and the *Walgalu* (Tindale 1974). The *Ngunnawal* Clan was recorded from Queanbeyan to Yass, Tumut to Boorowa, and east to beyond Goulburn; on highlands west of the Shoalhaven River. The *Ngarigo* Clan was recorded as being distributed across the Monaro tableland north to Queanbeyan; Bombala River from near Delegate to Nimmitabel; west to divide of the Australian Alps. *Walgalu* Clan lands were reported to span from the headwaters of the Murrumbidgee, and Tumut rivers; at Kiandra; south to Tintaldra; northeast to near Queanbeyan.

From the ethnohistorical accounts it is clear that the region was situated in cross over country. Clan boundaries were historically constructed according to language boundaries, with social interaction, ceremony, trade, exchange and resource procurement across boundaries common.

The study area is located within a resource rich landscape comprised of both freshwater and open woodlands and grasslands environments and includes semi-permanent water sources in Church Creek, a third order tributary of Jerrabomberra Creek. This environment would have provided reliable food resources (aquatic, avian, plant and faunal) for traditional Aboriginal people.

Previous Aboriginal archaeological studies

Local archaeological context

Indigenous people have been known to occupy the south eastern zone of NSW for at least the last 20,000 years. This date is derived from radiocarbon age determinations from wood charcoal present in the lowest occupation layers of the Burrill Lake archaeological site located on the south coast (Lampert 1971: 9). Archaeological excavations at what is now Lake Crackenback resort in the Snowy Mountains produced radiocarbon dates demonstrating Aboriginal occupation from 4,000 years before present (BP) (Kamminga 1992). Furthermore, a double burial with rare grave goods, including a kangaroo tooth necklace, with a date of 7,000 years BP has also been recorded in *Ngarigo* country near Cooma (Feary 1996). It is most likely that indigenous occupation of the eastern coastal, hinterland and tablelands zones was greater than that recorded owing to the fact that human presence is evident at Lake Mungo in western NSW from 50,000 years (Bowler *et al*. 2003).

The first permanent European settlement in the Canberra region occurred in the 1820's with pastoral use and development occurring rapidly. Generally detailed ethnohistoric accounts are limited for the Canberra region with early observers failing to take any interest in, or to record, their observations of Aboriginal landed associations (Kwok 2013:48). It is argued that in the Canberra region Aboriginal groups suffered from rapid depopulation and dislocation, most likely accelerated by the impact of European diseases such as smallpox, influenza and measles (Flood 1980; Butlin 1983). However, some early historical accounts detail the movement of the peoples in the summer months to the highlands for the exploitation of Bogong moths (*Agrotis infusa*) (Flood 1973,1980, Kwok 2013). These large scale seasonal resource exploitation events by the tribes of the region also permitted intertribal gatherings and included social, ceremonial and exchange activities. Flood (1980:168-169) hypothesised that this pattern of resource exploitation and large-scale movement of peoples could be supported by the archaeological record, thus providing a predictive archaeological model for the region. This archaeological signature would consist of the following:

- Small seasonal summer camps above the snowline (1525m) characterised by small artefact scatters (two to twenty artefacts), unmodified river pebbles and ground edge hatchet heads, used for moth grinding and processing.

- Small to medium sized seasonal summer camps situated below snowline (1500m – 1200m) characterised by numerically small to medium artefact scatters (two to 100 artefacts), unmodified river pebbles and ground edge hatchet heads.
- Larger campsites below 1200m in montane valleys, at the foot of mountain peaks occupied throughout the year. These sites should be located within 1km of water, 2-3km² in size with more than 1500 artefacts. An example of such a site would be Pialligo, an archaeological site adjacent to the Molonglo River which contained > 4000 artefacts (cf. Saunders 1989).

Flood also acknowledged the existence of medium sized lowland camps associated with major water courses such as the Molonglo and Murrumbidgee Rivers.

The occupation model presented by Flood has been hotly debated in the archaeological literature. Recent studies have questioned the reliance upon and the dominance of the resource exploitation of Bogong moths, and the occupation model resultant from the Bogong moth hypothesis (Bowdler 1981). Studies such as Grinbergs (1992) research in the Lower Snowy River region concluded that the spatial diversity and artefact assemblages of recorded sites indicated diverse economic resource strategies of the inhabitants. This conclusion was further supported by a detailed analysis and review of archaeological sites within the Brindabella Valley and Southern Highlands more generally (Argue 1995). Argue also concluded that the year-round high resource availability of the low altitude valleys within the Southern Highlands would provide a conducive environment for occupation by family groups and that the archaeological sites demonstrated a full range of occupation activities (Argue 1995:35).

Previous investigations in the immediate area

No Aboriginal heritage assessments were identified to have been conducted over the current study area. The "Mount Pleasant" property neighbouring the study area on its southern boundary has been the subject of an archaeological investigation and Aboriginal cultural heritage assessment (ACHA) undertaken by Navin Officer Heritage Consultants (2015).

This investigation identified 20 Aboriginal sites:

- Five isolated artefacts.
- Thirteen artefact scatters.
- Two culturally modified trees.

An area of potential archaeological deposit was also identified.

Archaeological sub-surface investigations undertaken as part of the assessment revealed that the artefact scatters were generally sparse with little stratigraphic depth – most artefacts were recorded in the top 10cm of deposit with only one artefact recovered from deposits below 10cm. The sub-surface artefact assemblage was dominated by quartz unretouched flakes, however artefacts made from siliceous and igneous rock and quartzite were also recorded. The test pits excavated closest to Church Creek yielded the greatest number of artefacts.

Predictive model

The predictive model outlined in Table 3 below has been developed for the study area based on the AHIMS Search results, and the regional and local Aboriginal archaeological context outlined above.

Table 3: Predictive model

Site Type	Description
Open Camp Sites / Stone Artefact Scatters / Isolated Artefacts	Open camp sites represent past Aboriginal subsistence and stone knapping activities and include archaeological remains such as stone artefacts and hearths. This site type usually appears as surface scatters of stone artefacts in areas where vegetation is limited and ground surface visibility increases. Such scatters of artefacts are also often exposed by erosion, agricultural events such as ploughing, and the creation of informal, unsealed vehicle access tracks and walking paths. These types of sites are often located on dry, relatively flat land along or adjacent to rivers and creeks. Camp sites containing surface or subsurface deposit from repeated or continued occupation are more likely to occur on elevated ground near the most permanent, reliable water sources. Flat, open areas associated with creeks and their resource-rich surrounds would have offered ideal camping areas to the Aboriginal inhabitants of the local area. Isolated artefacts may represent a single item discard event or be the result of limited stone knapping activity. The presence of such isolated artefacts may indicate the presence of a more extensive, in situ buried archaeological deposit, or a larger deposit obscured by low ground visibility. Isolated artefacts are likely to be located on landforms associated with past Aboriginal activities, such as ridgelines that would have provided ease of movement through the area, and level areas with access to water, particularly creeks and rivers. Artefact scatters and isolated artefacts are the most common site types found in association with fresh water, and/or food resource gathering areas. Artefact scatters and isolated finds are reported to be the most common archaeological site type in the Googong region with silcrete and quartz the dominant raw material types. Additionally, the study area is close to a reliable water source (Church and Jerrabomberra Creeks). Consequently, this site type would be highly likely to be present in the study area.
Potential Archaeological Deposit	Potential Archaeological Deposits (PADs) are areas where there is no surface expression of stone artefacts, but due to a landscape feature there is a strong likelihood that the area will contain buried deposits of stone artefacts. Landscape features which may feature in PADs include proximity to waterways, particularly terraces and flats near 3rd order streams and above, ridge lines and ridge tops and sand dune systems. This study area is located on valley floor and slope termination landforms and it has a third order stream offering a reliable water source (Church Creek) as a result this site type would be considered moderately likely to be present in the study area.
Middens	Middens are the remains of edible shell fish and fish bones typically after cooking and eating. Middens may also contain animal bones, charcoal from cooking and stone artefacts. Middens may be the remains of single meal or many meals over a long period of time. Middens may be found on coastal sand dunes and beaches, estuaries and swamps on along the banks of inland rivers and creeks. Middens may contain a variety of edible shellfish, depending on the environment. Shellfish species are dependent on the environment, either coastal, estuarine or inland rivers and creeks. There is a low reported incidence of midden sites in proximity to the study area. Therefore, this site type would be considered not likely to be present in the study area.
Burial	Aboriginal burial of the dead often took place relatively close to camp site locations. This is because most people tended to die in or close to camp (unless killed in warfare or hunting accidents), and it is difficult to move a body long distances. Soft, sandy soils on, or close

Site Type	Description
	to, rivers and creeks allowed for easier movement of earth for burial; and burials may also occur within rock shelters or middens. Aboriginal burial sites may be marked by stone cairns, carved trees or a natural landmark. Burial sites may also be identified through historic records, or oral histories. There is a low reported incidence of burial sites in proximity to the study area. Therefore, this site type would be considered not likely to be present in the study area.

Due Diligence Assessment process

Due diligence is defined in the Code as "taking reasonable and practical steps to determine whether a person's actions will harm an Aboriginal object and, if so, what measures can be taken to avoid that harm". The following section relates to the generic due diligence process as applied to the study area.

Step 1 – Will the activity disturb the ground surface or any culturally modified trees?

Yes. The works for proposed development of Lot 2 DP 112382, 1241 Old Cooma Road, Googong NSW 2620 and Lot 126 DP 754881, 1187 Old Cooma Road, Googong NSW 2620 will require grading and excavation works which will result in ground disturbance.

There are no recorded culturally modified trees within the study area.

Step 2 – Are there any a) relevant confirmed site records on AHIMS, other sources of information, or b) landscape features that are likely to indicate presence of Aboriginal objects?

Consequently, if your proposed activity is:

- **Within 200m of waters, or**
- **located within a sand dune system, or**
- **located on a ridge top, ridge line or headland, or**
- **located within 200m below or above a cliff face, or**
- **within 20m of or in a cave, rock shelter, or a cave mouth;**
- **and is on land that is not disturbed land then you must go to step 3.**

"Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable.

*Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks."(*DECCW 2010)

A search of the AHIMS register identified 23 Aboriginal sites in within 1000m of the study area. Most of these sites were located on the flat creek terraces and lower ridge locations. Also present in the study area is a semi-permanent water source – the third order stream, Church Creek. This landform indicates that previously unrecorded Aboriginal archaeological sites are likely to occur in the study area. Additionally, previous archaeological assessments both in the region, and more specifically in the land formations present in the study area, are commonly known to be areas of high archaeological sensitivity.

From the desktop assessment, mapping indicates that the study area is likely to have sustained a range of historic land use impacts. These include:

- Clearing of native vegetation.
- Construction of dams and contour drains.
- Construction of farm buildings, cattle yards, fences, and livestock watering facilities.
- Erosion of the banks of Church Creek.
- Pasture improvement.

Based on the material evidence and range of archaeological sites recorded in the region, Aboriginal people have been utilising the land and resources intensively within the Burra region for thousands of years. While there is evidence of historic disturbance in the study area, material evidence of previous Aboriginal occupation is still likely to be present in spatial association with Church Creek. This is reinforced by the finds adjacent to the study area (Navin Officer 2015). The desktop assessment concludes that there are parts of the study area that can be considered to be archaeologically sensitive.

To satisfy the Code, a field survey by a suitably qualified archaeologist was required. Subsequently a pedestrian field survey was undertaken by ELA archaeologists Dr Tristen Jones and Alistair Grinbergs on the 1st of March 2018. No Aboriginal community representatives were present for the survey.

Step 3 – Can harm to Aboriginal objects listed on AHIMS or identified by other sources of information and/or can the carrying out of the activity at the relevant landscape features be avoided?

No. Excavation resulting in ground disturbance will be required for the proposed cemetery. Measures to minimise the extent of the ground disturbance footprint may be adopted by QPRC in the planning phase.

Step 4 – Does the desktop and visual assessment confirm that there are Aboriginal objects or that they are likely?

Eleven Aboriginal archaeological sites were recorded during the field the survey: seven isolated artefacts (Table 4) and four artefact scatters (Table 5).

Table 4: Isolated Artefacts

Site Name	Type	Artefact Details		Comment
		Material	Reduction Stage	
Googong-01	Flake	Quartz	Tertiary	Flake in eroded river bank section
Googong-02	Flake	Silcrete	Secondary	-
Googong-03	Flake	Quartz	Tertiary	Flake in eroded river bank section
Googong-04	Flake	Quartz	Tertiary	Broken. Two pieces conjoining
Googong-05	Flake	Silcrete	Secondary	-
Googong-06	Flake	Quartz	Tertiary	-
Googong-07	Flake	Quartz	Tertiary	-

Table 5: Artefact Scatters

Site Name	No. Artefacts	Materials Present
Googong-08	<5	Quartz, silcrete
Googong-09	<10	Quartz, silcrete
Googong-10	<10	Quartz, silcrete
Googong-11	>20	Quartz, silcrete, chert

The 11 sites were all located within 100m of the channel of Church Creek on what appeared to be redeposited silty clay sediments, as shown below in Figure 3. All sites had sustained some form of disturbance from livestock trampling, vehicles or erosion of the banks of Church Creek. Sites Googong-01, Googong-03 and Googong-08 are located on the immediate banks of Church Creek and artefacts were visible in the eroded section of the creek bank indicating that there was potential for sub-surface and potentially *in situ* deposits of cultural material.

The findings of the field survey suggest that the margins of Church Creek are likely to be archaeologically sensitive, and it is likely that there are additional deposits of Aboriginal artefacts along the creek in a sub-surface and possibly *in situ* context. The archaeologically sensitive zone is shown below in Figure 4.

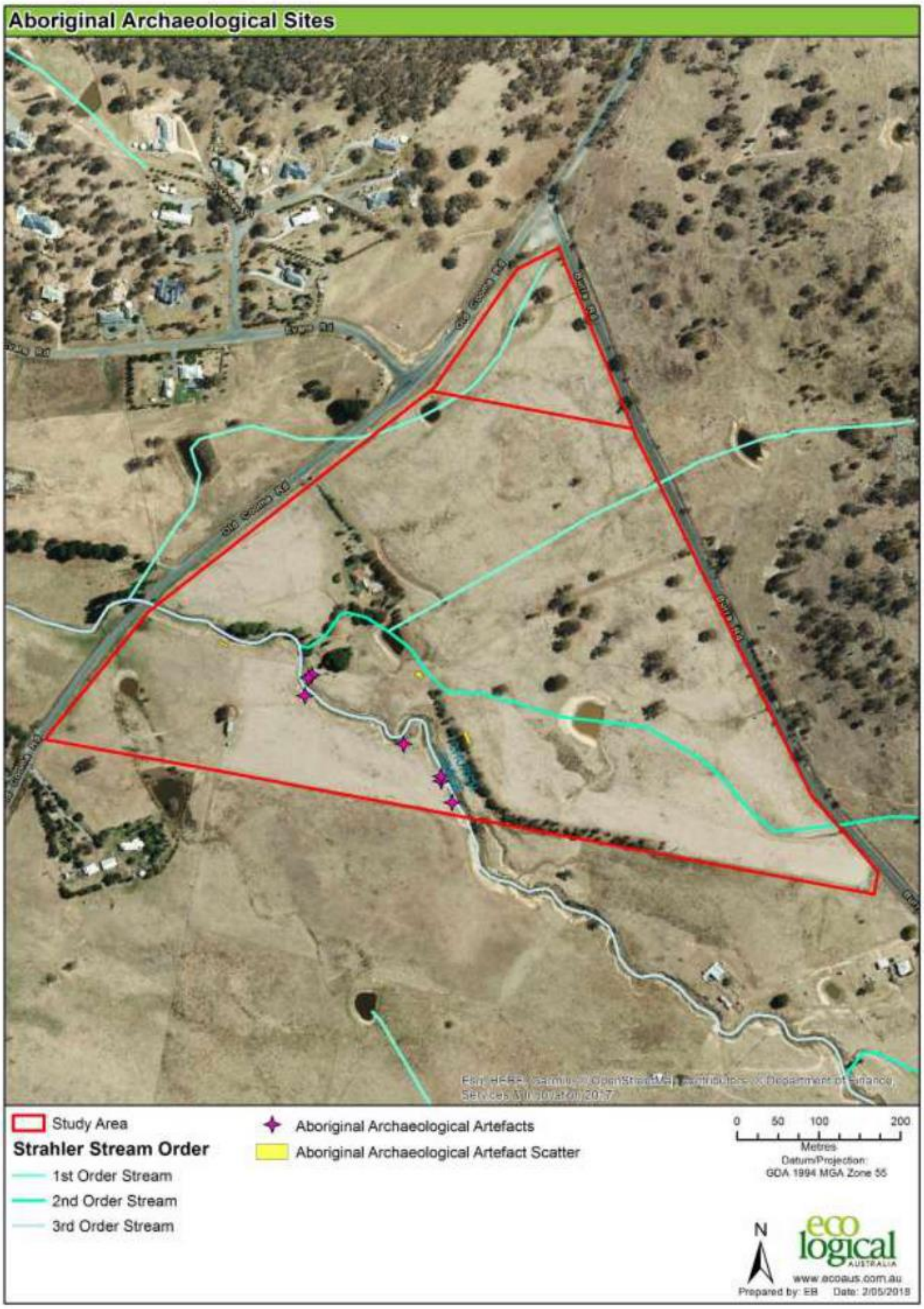

Figure 3: Aboriginal sites recorded during the field survey

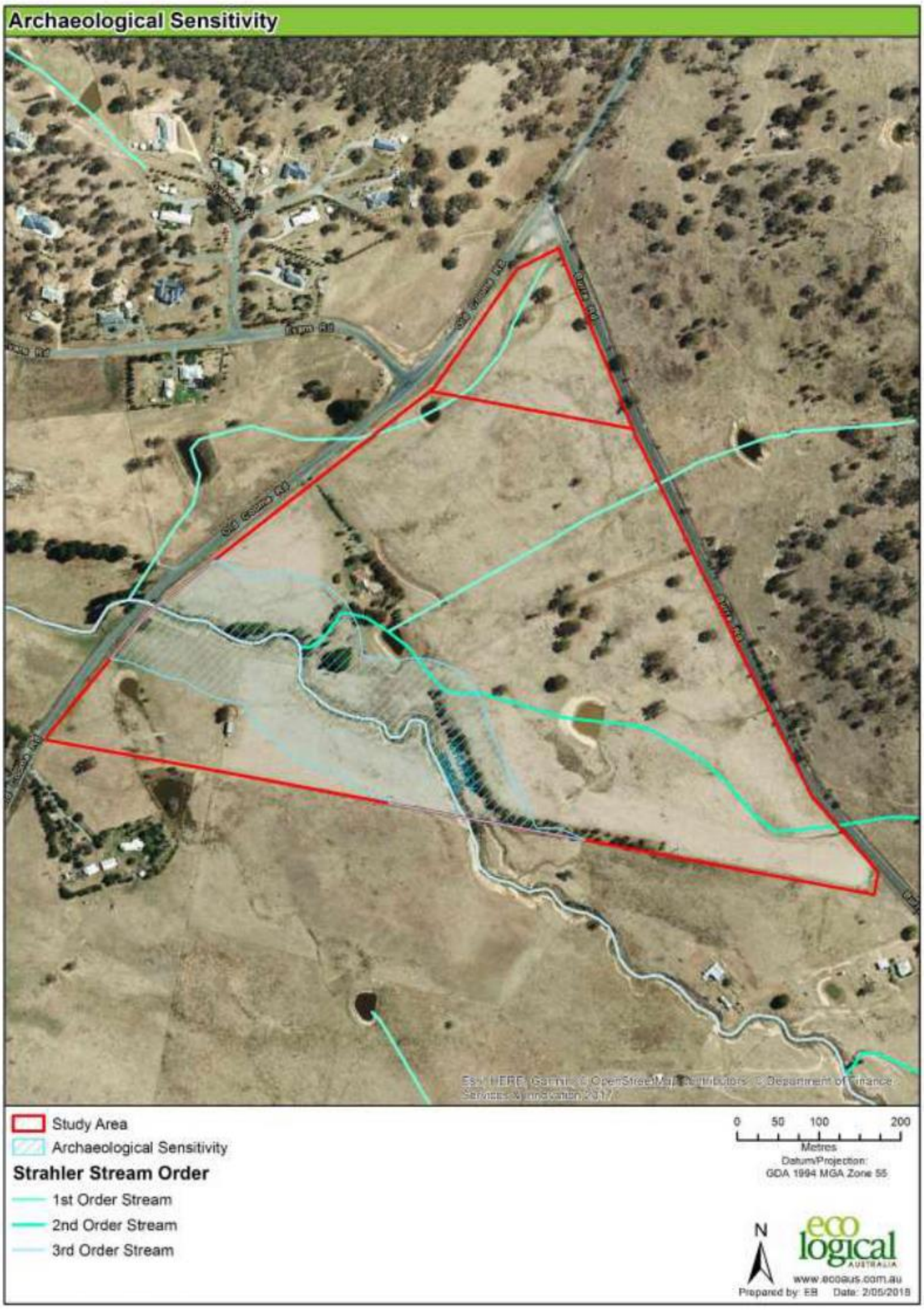

Figure 4: Zone of archaeological sensitivity associated with Church Creek

Conclusion

The Aboriginal Due Diligence Assessment aims to identify registered Aboriginal sites and/or sensitive landforms which may indicate the presence of Aboriginal sites and may therefore require further assessment and approval under Part 6 of the NPW Act. An extensive search of the relevant databases and literature enabled development of a predictive model for study area, identifying potential archaeological sensitivity and most common site types (Table 3).

The predictive model identified that the margins of Church Creek were likely to be archaeologically sensitive, which was then confirmed during the visual field survey during which 11 Aboriginal archaeological sites were identified. All sites were within 100 m of the channel of Church Creek. Based on these findings it is highly likely that there are additional deposits of Aboriginal artefacts along the creek in a sub-surface and possibly *in situ* context.

Recommendations

Based on the findings of this due diligence and the requirement of the NPW Act the following is recommended.

Recommendation One – Known sites cannot be Impacted without an AHIP

All the eleven Aboriginal archaeological sites identified during this assessment are protected under the NPW Act. It is an offence to disturb or damage these sites without first having obtained an Aboriginal Heritage Impact permit (AHIP) from OEH. To obtain an AHIP further archaeological assessment in the form of an Aboriginal Cultural Heritage Assessment (ACHA), including sub-surface testing, will be required. This process will take a minimum of 20 weeks and include mandatory consultation periods with Aboriginal stakeholders.

Recommendation Two – More detailed archaeological investigation

If any works or activity that could potentially disturb the ground surface including earthworks, construction, installation of services, landscaping (including planting and stream bank stabilisation measures) are proposed within the identified zone of archaeological sensitivity (Figure 4) then an ACHA including sub-surface testing will be required.

Recommendation Three - General measures

- Aboriginal objects are protected under the NPW Act regardless if they are registered on AHIMS or not. If suspected Aboriginal objects, such as stone artefacts or midden material (shell) are discovered during future works, works must cease in the affected area and an archaeologist called in to assess the finds. If the finds are found to be Aboriginal objects, the OEH must be notified under section 89A of the NPW Act. Appropriate management and avoidance or approval under a section 90 AHIP should then be sought if Aboriginal objects are to be moved or harmed.
- In the extremely unlikely event that human remains are found, works should immediately cease, and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, the OEH may also be contacted at this time to assist in determining appropriate management.

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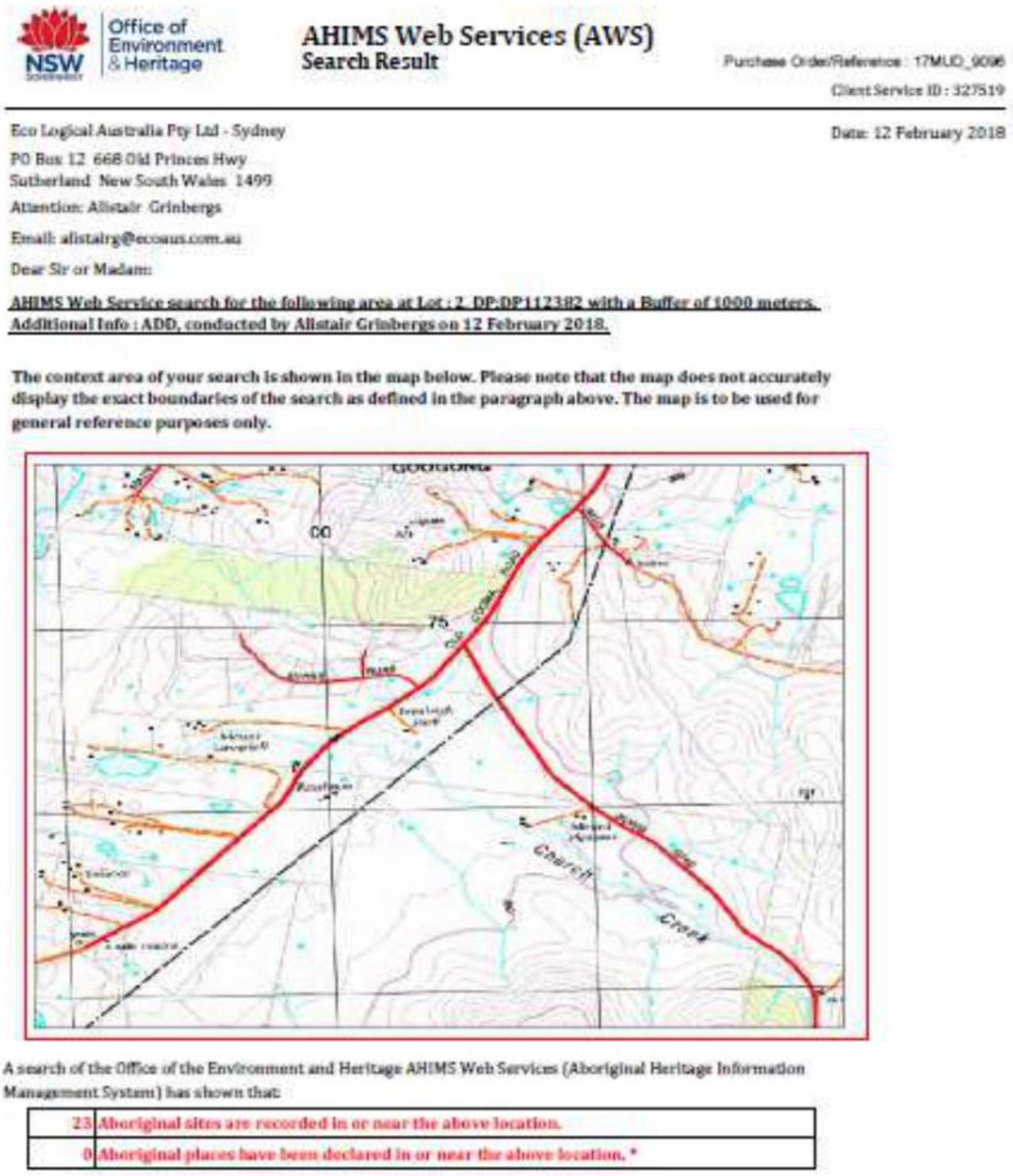
Attachment A – Basic and Extensive AHIMS searches on 12 February 2018



AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : 17MUD_9096
Client Service ID : 327519

Eco Logical Australia Pty Ltd - Sydney
PO Box 12 668 Old Princes Hwy
Sutherland New South Wales 1499
Attention: Alistair Grinbergs
Email: alistairg@ecoaus.com.au

Date: 12 February 2018

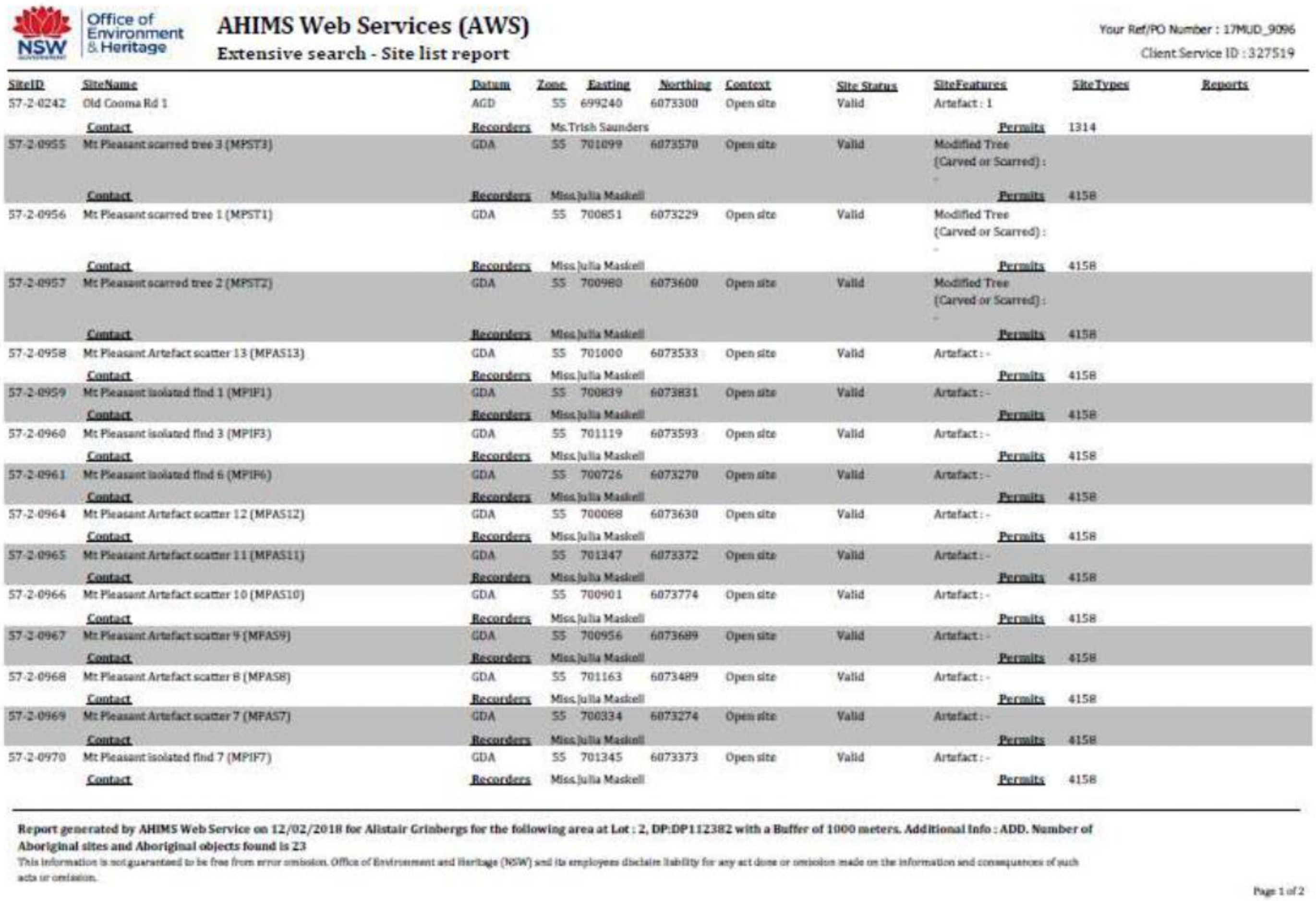
Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 2, DP:DP112382 with a Buffer of 1000 meters. Additional Info : ADD, conducted by Alistair Grinbergs on 12 February 2018.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

23	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *



Office of Environment & Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 17MUD_9096
Client Service ID : 327519

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
57-2-0242	Old Cooma Rd 1	AGD	55	699240	6073300	Open site	Valid	Artefact : 1		
	Contact	Recorders	Ms.Trish Saunders					Permits	1314	
57-2-0955	Mt Pleasant scarred tree 3 (MPST3)	GDA	55	701099	6073570	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0956	Mt Pleasant scarred tree 1 (MPST1)	GDA	55	700851	6073229	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0957	Mt Pleasant scarred tree 2 (MPST2)	GDA	55	700980	6073600	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0958	Mt Pleasant Artefact scatter 13 (MPAS13)	GDA	55	701000	6073533	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0959	Mt Pleasant isolated find 1 (MPIF1)	GDA	55	700839	6073831	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0960	Mt Pleasant isolated find 3 (MPIF3)	GDA	55	701119	6073593	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0961	Mt Pleasant isolated find 6 (MPIF6)	GDA	55	700726	6073270	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0964	Mt Pleasant Artefact scatter 12 (MPAS12)	GDA	55	700088	6073630	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0965	Mt Pleasant Artefact scatter 11 (MPAS11)	GDA	55	701347	6073372	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0966	Mt Pleasant Artefact scatter 10 (MPAS10)	GDA	55	700901	6073774	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0967	Mt Pleasant Artefact scatter 9 (MPAS9)	GDA	55	700956	6073689	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0968	Mt Pleasant Artefact scatter 8 (MPAS8)	GDA	55	701163	6073489	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0969	Mt Pleasant Artefact scatter 7 (MPAS7)	GDA	55	700334	6073274	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	
57-2-0970	Mt Pleasant isolated find 7 (MPIF7)	GDA	55	701345	6073373	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Julia Maskell					Permits	4158	

Report generated by AHIMS Web Service on 12/02/2018 for Alistair Grinbergs for the following area at Lot : 2, DP:DP112382 with a Buffer of 1000 meters. Additional Info : ADD. Number of Aboriginal sites and Aboriginal objects found is 23

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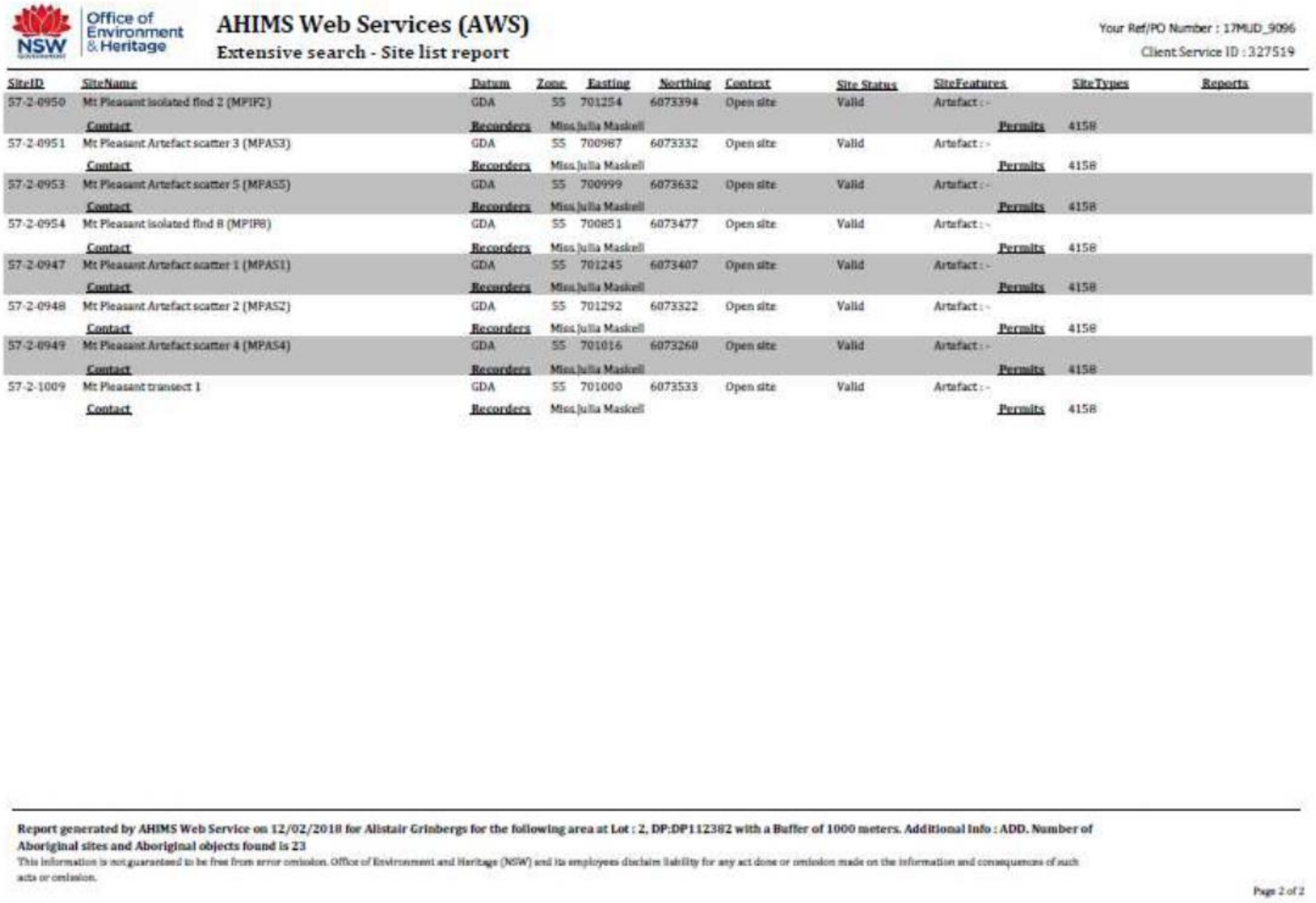

Office of Environment & Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 17MUD_9096
Client Service ID : 327519

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
57-2-0950	Mt Pleasant isolated find 2 (MPIF2) Contact	GDA Recorders	55 Miss Julia Maskell	701254	6073394	Open site	Valid	Artefact : - Permits	 4158	
57-2-0951	Mt Pleasant Artefact scatter 3 (MPAS3) Contact	GDA Recorders	55 Miss Julia Maskell	700987	6073332	Open site	Valid	Artefact : - Permits	 4158	
57-2-0953	Mt Pleasant Artefact scatter 5 (MPAS5) Contact	GDA Recorders	55 Miss Julia Maskell	700999	6073632	Open site	Valid	Artefact : - Permits	 4158	
57-2-0954	Mt Pleasant isolated find 8 (MPIF8) Contact	GDA Recorders	55 Miss Julia Maskell	700851	6073477	Open site	Valid	Artefact : - Permits	 4158	
57-2-0947	Mt Pleasant Artefact scatter 1 (MPAS1) Contact	GDA Recorders	55 Miss Julia Maskell	701245	6073407	Open site	Valid	Artefact : - Permits	 4158	
57-2-0948	Mt Pleasant Artefact scatter 2 (MPAS2) Contact	GDA Recorders	55 Miss Julia Maskell	701292	6073322	Open site	Valid	Artefact : - Permits	 4158	
57-2-0949	Mt Pleasant Artefact scatter 4 (MPAS4) Contact	GDA Recorders	55 Miss Julia Maskell	701016	6073260	Open site	Valid	Artefact : - Permits	 4158	
57-2-1009	Mt Pleasant transect 1 Contact	GDA Recorders	55 Miss Julia Maskell	701000	6073533	Open site	Valid	Artefact : - Permits	 4158	

Report generated by AHIMS Web Service on 12/02/2018 for Alistair Grinbergs for the following area at Lot : 2, DP:DP112382 with a Buffer of 1000 meters. Additional Info : ADD. Number of Aboriginal sites and Aboriginal objects found is 23

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QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2	PROPOSED QUEANBEYAN CEMETERY SITE
ATTACHMENT 2	STATEMENT OF EUROPEAN HERITAGE IMPACT REPORT

eco logical AUSTRALIA
A TETRA TECH COMPANY

ECO LOGICAL AUSTRALIA PTY LTD
ABN 87 096 512 088
www.ecoaus.com.au

Arthean McBride
Senior Strategic Town Planner
Queanbeyan-Palerang Regional Council
PO Box 90 Queanbeyan NSW 2620

REF: 17MUD_9096

5th July 2018

Dear Arthean

Statement of Heritage Impact – proposed development of Lot 2 DP 112382, 1241 Old Cooma Road, Googong NSW 2620 and Lot 126 DP 754881, 1187 Old Cooma Road, Googong NSW 2620.

Eco Logical Australia (ELA) has been engaged by Queanbeyan-Palerang Regional Council (QPRC) to conduct a heritage assessment and prepare a Statement of Heritage Impact (SoHI) to support a planning proposal for the proposed redevelopment of Lot 2 DP 112382, 1241 Old Cooma Road, Googong NSW 2620 and Lot 126 DP 754881, 1187 Old Cooma Road, Googong NSW 2620 (Figure 1).

This SoHI has been prepared in accordance with the NSW Heritage Manual '*Statements of Heritage Impact*' (2002) and '*Assessing Heritage Significance*' (2001) guidelines. The philosophy and process adopted is that guided by the *Australia ICOMOS Burra Charter* 1999.

The proposal has been assessed in relation to the relevant controls and provisions contained within the Queanbeyan Local Environmental Plan (LEP) 2012 and the Queanbeyan Development Control Plan (DCP) 2012.

Yours sincerely

Alistair Grinbergs
Principal Consultant - Heritage Strategy & Development

Legislative Context

Heritage Act 1977

The NSW *Heritage Act 1977* (*Heritage Act*) provides protection of the environmental heritage of the State which includes places, buildings, works, relics, movable objects or precincts that are of State or local heritage significance. A key measure for the identification and conservation of State significant items is listing on the State Heritage Register (SHR) as provided in Part 3A of the *Heritage Act*.

Listing on the SHR means that any proposed works or alterations (unless exempted) to listed items must be approved by the Heritage Council or its delegates. Proposals to alter, damage, move or destroy places, buildings, works, relics; moveable objects or precincts protected by an IHO or listed on the SHR require an approval under section 60.

Section 57(2) of the *Heritage Act* provides for a number of potential exemptions to Section 57(1) approval requirements to reduce the need for approval of minor or regular works. Exempted development does not require prior Heritage Council approval. ‘Standard’ exemptions generally include minor and non-intrusive works such as maintenance, minor repairs and repainting.

Under Section 170 of the *Heritage Act*, all state government agencies must keep and administer a database of heritage assets called a Section 170 Heritage and Conservation Register. The Section 170 Register is an important resource to be used for making decisions about maintaining, conserving and making changes to heritage assets.

Archaeological features and deposits are afforded statutory protection by the ‘relics provision’. Section 4(1) of the Heritage Act (as amended 2009) defines ‘relic’ as 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.

The ‘relics provision’ requires that no archaeological relics be disturbed or destroyed without prior consent from the Heritage Council of NSW. To determine if an area has historical archaeological potential or relics an assessment is be made using the guidelines *Assessing Significance for Historical Archaeological Sites and Relics* (Heritage Branch 2009). The Heritage Council must be notified on the discovery of a relic under Section 146 of the *Heritage Act 1977*.

Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) requires that consideration is given to environmental impacts as part of the land use planning process. In NSW, environmental impacts are interpreted as including cultural heritage impact. Proposed activities and development are considered under different parts of the EP&A Act, including:

- Major projects (State Significant Development under Part 4.1 and State Significant Infrastructure under Part 5.1), requiring the approval of the Minister for Planning.
- Minor or routine development requiring local council consent, are usually undertaken under Part 4. In limited circumstances, projects may require the Minister’s consent.
- Part 5 activities which do not require development consent. These are often infrastructure projects approved by local councils or the State agency undertaking the project.

The Act also controls the making of Environmental Planning Instruments (EPIs) such as LEPs and State Environmental Planning Policies (SEPPs). LEPs commonly identify and have provisions for the protection of local heritage items and heritage conservation areas.

The Queanbeyan LEP 2012 lists heritage items, archaeological sites and heritage conservation areas in Schedule 5 (Environmental Heritage).

Part 5 - Miscellaneous Provisions in the Queanbeyan LEP provides objectives and actions that are applicable to all heritage items, these include:

5.10 Heritage conservation

The objectives of this clause are as follows:

a) to conserve the environmental heritage of Snowy River,

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.

Under Section 5.10(5) Heritage Assessment

The consent authority may, before granting consent to any development:

e) on land on which a heritage item is located, or

f) on land that is within a heritage conservation area, or

g) on land that is within the vicinity of land referred to in paragraph (a) or (b),

require a heritage management document to be prepared that assesses the extent to which the carrying out of the proposed development would affect the heritage significance of the heritage item or heritage conservation area concerned.

Study Area Description

The study area a consists of Lot 2 DP112382 and Lot 126 DP754881, Old Cooma Road and covers an area of approximately 35.5Ha (Figure 1). The land is cleared (with the exception of a number of mature eucalypts in both lots and a planted windbreak in Lot 2 DP112382. Plantings of introduced deciduous and ornamental trees are present within Lot 2 DP112382. The property is and divided into a series of paddocks with post and wire fencing. The property falls within the boundaries of the Queanbeyan-Palerang Regional Council (QPRC). The study area is bounded by Old Cooma Road on the east, Burra road to the west and a neighbouring grazing property to the south. Church Creek flows through the property from the south east to the north west.

Historical Context

The first recorded Colonial visitor to the Googong locality was Captain Mark Currie who lead a party that passed through the area in 1823 while returning from an expedition to the Murrumbidgee River and Mt Tennant to the south east. Within five years of that first visit Colonial settlers, squatters and graziers had taken up land in the area. Early recorded landholders included John McAuley (640 acres), John Swan (over 700 acres) and James, Edward and William Gibbs (total holding 440 acres), William Ryan (600 acres), WC and MG Beresford (487 acres) (Parish of Googong, County of Murray maps 1906).

John Gibbs succeeded Ewan Cameron as the overseer of Robert Campbell's Mt Campbell property (to the south of the study area) in 1852. James Gibbs subsequently succeeded his father as overseer of Mt Campbell. He also acquired land adjacent to the Church glebe in the 1860s and over the ensuing years became one of the largest resident landowners in the area (Moore 1981).

The St Pauls church was built in 1867 and opened in 1868, its construction paid for by the land owners on the Googong area including the Campbell family.

A 1905 map of the Parish of Googong (NSW Land Registry Services) (**Figure 2**) shows the land included in Lot 2 and Lot 126 as belonging to William Gibbs. The Gibbs family continued to be significant landowners in the Googong area until the 1980s (Moore 1981).

Methodology

This assessment of potential heritage impacts included the following:

- A search of the NSW State Heritage Inventory, the Queanbeyan LEP 2012 and the Australian Heritage Database to determine if there is any additional information on places of heritage significance in or near to the proposed activity area;
- A site-based visit that included assessment of the potential for the proposal to impact upon neighbouring or nearby listed heritage places;
- Consideration of the questions posed in the NSW Heritage Office's 'Statement of Heritage Impact' guidelines; and
- Consideration of the relevant questions posed in the requirements of the Queanbeyan LEP 2012.

Figure 1: Site location and proximity of Heritage listed items

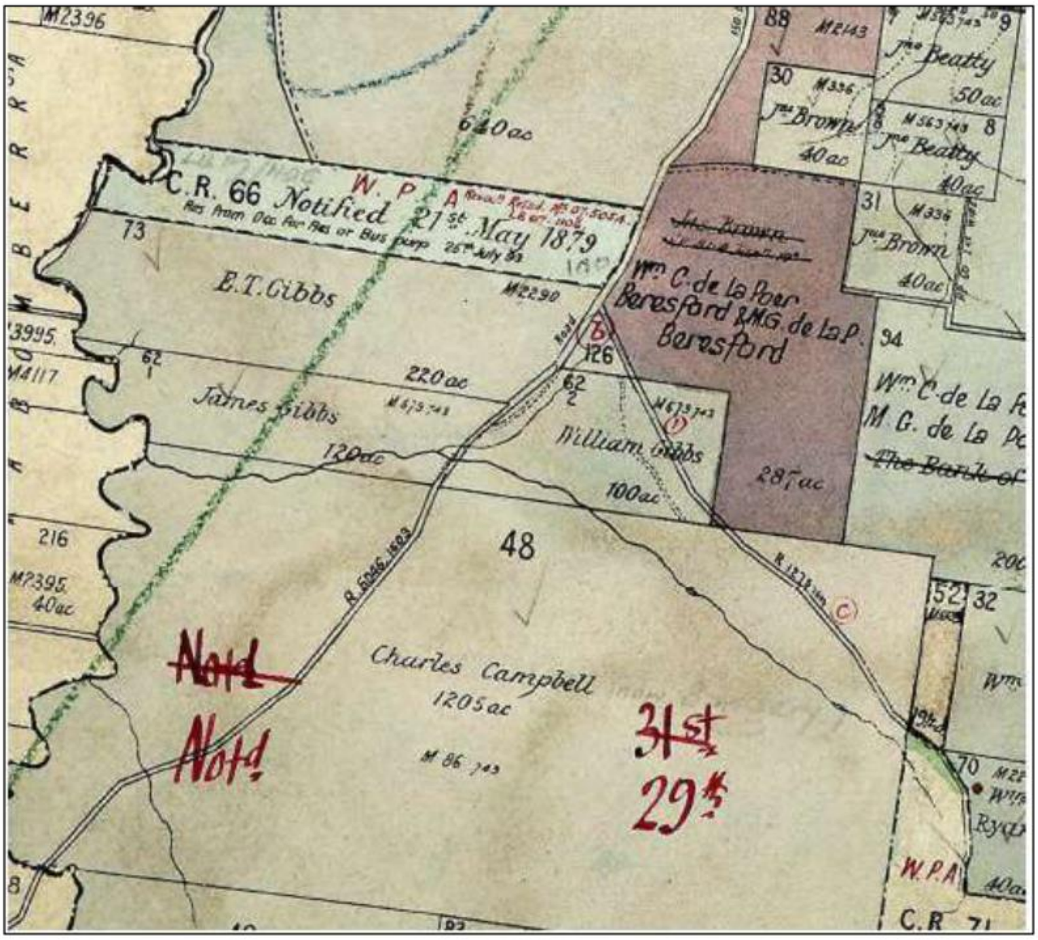

Figure 2: Extract of Parish of Googong map (1905) showing William Gibbs as the owner of the property

Listed Heritage Items

There are two listed heritage items in the vicinity of the proposed development, detailed in **Table 1**.

Table 1: Listed heritage items

Item	Location	Listing
Mt Campbell	1260 Old Cooma Road, Googong Lot 18 DP270301	Queanbeyan LEP
St Pauls Church of England	1290 Old Cooma Road, Googong Lot 1 DP151940	Queanbeyan LEP

Details of Mount Campbell is included at Attachment 1: Heritage Listing for Mt Campbell with St Paul's Church of England included at Attachment 2: St Paul's Church of England.

Site based assessment

A site-based assessment of the potential historic heritage values present within Lot 2 DP112382 and Lot 126 DP754881, Old Cooma Road was undertaken on Thursday 1st March 2018 by ELA archaeologists Dr Tristen Jones and Alistair Grinbergs.

The assessment involved a comprehensive visual assessment of the land and any features that could potentially be associated with the past use of the land as a grazing property since the 1850s. Three sites of possible historic interest were identified during the inspection:

- Water pump
- Copse of exotic trees
- Brick rubble and bottle dump.

All three items were inspected, photographed and assessed for their potential historic value.

Figure 3: Water pump

A steel construction, belt driven, mechanical water pump was identified approximately 30m above the northern banks of Church Creek. It would appear to service a bore to draw ground water. Water pumps would have been a common agricultural device that would likely have been used to water stock crops and possibly for a range of other non-potable uses. This item was not considered to possess any historic heritage significance.

Figure 4: Copse of trees

Plantings of exotic or introduced, non-native species can sometimes reveal the location of old homesteads or other farm buildings long after the structures themselves have disappeared. Within the study area there were poplars growing along the northern banks of Church Creek and a stand of exotic deciduous small leaved trees of undetermined species. A thorough visual inspection was undertaken in and around the copse to determine whether there was any other evidence of potentially historic fabric. None was identified.

Near the copse of trees, on the northern side of Church Creek was a fallen tree with numerous whole and broken red bricks and broken and whole brown glass “longneck” beer bottles. This area was thoroughly inspected to assess whether it was a dump of these items or the remains of an earlier structure. The bricks all appeared to be kiln dried manufactured bricks rather than handmade clay brick or the "Canberra Red" variety common in the regions from around the 1920s. It is possible that these bricks are surplus from the construction of the existing dwelling on the property. The bottles were assessed as not being particularly old based on an assessment of weight and observation of the thickness of the base. They were all of the crown seal variety suggesting that they most likely date to before the 1990s when the twist top bottle became more prevalent. The brick and bottle dump has been assessed as not being an historical archaeological deposit.

Figure 5: Brick and bottle dump

NSW Heritage Office guidelines

The proposed works are addressed in relation to relevant questions posed in the Heritage Office's 'Statement of Heritage Impact' guidelines, the details of which are shown below in **Table 2**.

Queanbeyan Local Environment Plan

The proposed works are addressed in relation to the relevant questions posed in the requirements of the Queanbeyan LEP 2012, the details of which are shown below in **Table 3**.

Table 2: Statement of Heritage Impact guidelines

Question	Mount Campbell	St Pauls Church of England
The following aspects of the proposal respect or enhance the heritage significance of the item or conservation area for the following reasons:	No impact	No impact
The following aspects of the proposal could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:	No impact	No impact
The following sympathetic solutions have been considered and discounted for the following reasons:	Not applicable	Not applicable
Demolition of a building or structure Have all options for retention and adaptive re-use been explored? Can all of the significant elements of the heritage item be kept, and any new development be located elsewhere on the site? Is demolition essential at this time or can it be postponed in case future circumstances make its retention and conservation more feasible? Has the advice of a heritage consultant been sought? Have the consultant's recommendations been implemented? If not, why not?	The proposed activity will not result in demolition of any building or structure within the curtilage of this listed item	The proposed activity will not result in demolition of any building or structure within the curtilage of this listed item
Partial Demolition Is the demolition essential for the heritage item to function?	The proposed activity will not result in demolition of any building or structure within the curtilage of this listed item	The proposed activity will not result in demolition of any building or structure within the curtilage of this listed item

Question	Mount Campbell	St Pauls Church of England
Are important features of the item affected by the demolition (e.g. fireplaces in buildings)? Is the resolution to partially demolish sympathetic to the heritage significance of the item? If the partial demolition is a result of the condition of the fabric, is it certain that the fabric cannot be repaired?		
Major partial demolition Is the demolition essential for the heritage item to function? Are particular features of the item affected by the demolition (e.g. fireplaces in buildings)? Is the detailing of the partial demolition sympathetic to the heritage significance of the item (e.g. creating large square openings in internal walls rather than removing the wall altogether)? If the partial demolition is a result of the condition of the fabric, is it certain that the fabric cannot be repaired? How is the impact of the addition on the heritage significance of the item to be minimised? Can the additional area be located within an existing structure? If no, why not? Will the additions visually dominate the heritage item? Is the addition sited on any known or potentially significant archaeological deposits?	The proposed activity will not result in demolition of any building or structure within the curtilage of this listed item	The proposed activity will not result in demolition of any building or structure within the curtilage of this listed item

Question	Mount Campbell	St Pauls Church of England
Is the resolution to partially demolish sympathetic to the heritage significance of the item? If the partial demolition is a result of the condition of the fabric, is it certain that the fabric cannot be repaired?		
Minor additions How is the impact of the addition on the heritage significance of the item to be minimised? Can the additional area be located within an existing structure? If no, why not? Will the additions visually dominate the heritage item? Is the addition sited on any known or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered? Are the additions sympathetic to the heritage item? In what way (e.g. form, proportions, design)?	The proposed activity will not result in any additions to, or modification of, any building or structure within the curtilage of this listed item	The proposed activity will not result in any additions to, or modification of, any building or structure within the curtilage of this listed item
Major additions How is the impact of the addition on the heritage significance of the item to be minimised? Can the additional area be located within an existing structure? If not, why not? Will the additions tend to visually dominate the heritage item? Are the additions sited on any known or potentially significant archaeological deposits? If so, have	The proposed activity will not result in any additions to, or modification of, any building or structure within the curtilage of this listed item	The proposed activity will not result in any additions to, or modification of, any building or structure within the curtilage of this listed item

Question	Mount Campbell	St Pauls Church of England
alternative positions for the additions been considered? Are the additions sympathetic to the heritage item? In what way (e.g. form, proportions, design)?		
Change of use Has the advice of a heritage consultant or structural engineer been sought? Has the consultant's advice been implemented? If not, why not? Does the existing use contribute to the significance of the heritage item? Why does the use need to be changed? What changes to the fabric are required as a result of the change of use? What changes to the site are required as a result of the change of use?	The proposed activity will not result in any change of use to any building or structure within the curtilage of this listed item	The proposed activity will not result in any change of use to any building or structure within the curtilage of this listed item
New development adjacent to a heritage item		
How does the new development affect views to, and from, the heritage item?	The proposed development may not be visible from the built elements of the listed place which is approximately 500m east of the boundary of the proposed development. It will be visible from the boundaries of the property that the listed item is situated within.	The proposed development will be visible from the listed place
What has been done to minimise negative effects?	No measures are proposed	No measures are proposed

Question	Mount Campbell	St Pauls Church of England
How is the impact of the new development on the heritage significance of the item or area to be minimised?	The proposed development will not impact upon the heritage significance of the listed item	The proposed development will not impact upon the heritage significance of the listed item
Why is the new development required to be adjacent to a heritage item?	The proposed development is allowed under the Queanbeyan LEP	The proposed development is allowed under the Queanbeyan LEP
How does the curtilage allowed around the heritage item contribute to the retention of its heritage significance?	The will be no impact upon the curtilage of the heritage item	The will be no impact upon the curtilage of the heritage item
Is the development sited on any known, or potentially significant archaeological deposits? If so, have alternative sites been considered? Why were they rejected?	An assessment of the footprint of the proposed development failed to identify any known or potentially significant historic archaeological deposits. For Aboriginal heritage matters please refer to the Aboriginal Due Diligence assessment prepared by Eco Logical Australia Pty Ltd.	
Is the new development sympathetic to the heritage item? In what way (e.g. form, siting, proportions, design)?	The proposed development may not be visible from the built elements of the listed place. It will be visible from the boundaries of the property that the listed item is situated within.	The proposed development will be visible from the listed place
Will the additions visually dominate the heritage item? How has this been minimised?	The proposed development will not visually dominate the listed place. It may be visible from the boundaries of the property that the listed item is situated within.	The proposed development will be visible from the listed place although the nature of the proposed development – being a cemetery and crematorium – could be considered to be visually compatible with that of an Anglican church in a rural setting.
Will the public, and users of the item, still be able to view and appreciate its significance?	Yes (to the extent possible under existing ownership and management arrangements)	Yes

Question	Mount Campbell	St Pauls Church of England
Subdivision How is the proposed curtilage allowed around the heritage item appropriate? Could future development that results from this subdivision compromise the significance of the heritage item? How has this been minimised? Could future development that results from this subdivision affect views to, and from, the heritage item? How are negative impacts to be minimised?	The proposed activity does not involve the subdivision of any part of the curtilage of this listed item	The proposed activity does not involve the subdivision of any part of the curtilage of this listed item
Repainting Have previous (including original) colour schemes been investigated? Are previous schemes being reinstated? Will the repainting effect the conservation of the fabric of the heritage item?	Not applicable	Not applicable
Re-roofing/re-cladding Have previous (including original) roofing/cladding materials been investigated (through archival and physical research)? Is a previous material being reinstated? Will the re-cladding effect the conservation of the fabric of the heritage item? Are all details in keeping with the heritage significance of the item (e.g. guttering, cladding profiles)?	Not applicable	Not applicable

Question	Mount Campbell	St Pauls Church of England
Has the advice of a heritage consultant or skilled tradesperson (e.g. slate roofer) been sought?		
New services (e.g. air conditioning, plumbing) How has the impact of the new services on the heritage significance of the item been minimised? Are any of the existing services of heritage significance? In what way? Are they affected by the new work? Has the advice of a conservation consultant (e.g. architect) been sought? Has the consultant's advice been implemented? Are any known or potential archaeological deposits (underground and under floor) affected by the proposed new services?	Not applicable	Not applicable
Fire upgrading How has the impact of the upgrading on the heritage significance of the item been minimised? Are any of the existing services of heritage significance? In what way? Are they affected by the new work? Has the advice of a conservation consultant (e.g. architect) been sought? Has their advice been implemented? Are any known or potential archaeological deposits (underground or under floor) affected by the proposed new services?	Not applicable	Not applicable

Question	Mount Campbell	St Pauls Church of England
Has the advice of a fire consultant been sought to look for options that would have less impact on the heritage item? Will this advice be implemented? How?		
New landscape works (including car parking and fences) How has the impact of the new work on the heritage significance of the existing landscape been minimised? Has evidence (archival and physical) of previous landscape work been investigated? Are previous works being reinstated? Has the advice of a consultant skilled in the conservation of heritage landscapes been sought? If so, have their recommendations been implemented? Are any known or potential archaeological deposits affected by the landscape works? If so, what alternatives have been considered? How does the work impact on views to, and from, adjacent heritage items?	Not applicable	Not applicable
Tree removal or replacement Does the tree contribute to the heritage significance of the item or landscape? Why is the tree being removed? Has the advice of a tree surgeon or horticultural specialist been obtained?	Not applicable	Not applicable

Question	Mount Campbell	St Pauls Church of England
Is the tree being replaced? Why? With the same or a different species?		
New signage How has the impact of the new signage on the heritage significance of the item been minimised? Have alternative signage forms been considered (e.g. free standing or shingle signs). Why were they rejected? Is the signage in accordance with section 6, Areas of Heritage Significance', in Outdoor Advertising: An Urban Design-Based approach? (1) How? Will the signage visually dominate the heritage item/ heritage conservation area or heritage streetscape? Can the sign be remotely illuminated rather than internally illuminated?	Not applicable	Not applicable

Table 3: Queanbeyan Local Environment Plan 2012

Objective	Lot 2 DP112382 & Lot 126 DP754881	Mount Campbell	St Pauls Church of England
To conserve the environmental heritage of Queanbeyan	The proposal will not impact upon identified environmental heritage values of Queanbeyan.	No impact	No impact
To conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views	There is no heritage listing for this property	No impact	No impact
To conserve archaeological sites	No significant or potentially significant historic archaeological sites have been identified.	No impact	No impact
To conserve Aboriginal objects and Aboriginal places of heritage significance	Please refer to the Aboriginal Due Diligence assessment prepared by Eco Logical Australia Pty Ltd.	Not applicable	Not applicable

Conclusion

There are no significant heritage sites present which may be impacted by the proposed development of a cemetery at Lot 2 DP112382 and Lot 126 DP754881, Old Cooma Road. The proposal will not have a deleterious impact on the heritage values of the neighbouring heritage sites Mt Campbell and St Pauls Church of England.

The Mt Campbell property is significant for its long and historic association with the European settlement of the Googong region and subsequent pastoral activity in the area which date back to the 1830s when it was established as an outstation of Charles Campbell's property - Duntroon.

St Pauls Church of England was built with funds raised by the local community. It's foundation stone was laid in 1867 and the church opened in 1868. The church possesses high historic value and enduring social and community value for its association with the provision of religious service to the surrounding Googong community.

The heritage significance of both items rests in specific elements of the fabric of those places, their association with historic figures and importance to the Googong community, both past and present. The proposed development of Lot 2 DP112382 and Lot 126 DP754881 will not affect the fabric of these places and is unlikely to have any observable impact upon the setting or social values associated with these places.

References

Moore, B 1982. *Burra County of Murray: A history of Burra in the county of Murray in the Queanbeyan District*. Self published. Canberra.

Attachment 1: Heritage Listing for Mt Campbell

Item details

Name of item:	Mount Campbell
Type of item:	Landscape
Group/Collection:	Landscape - Natural
Category:	Landform site or area
Primary address:	1260 Old Cooma Road, Googong, NSW 2620
Local govt. area:	Queanbeyan

All addresses

Street Address	Suburb/town	LGA	Parish	County	Type
1260 Old Cooma Road	Googong	Queanbeyan			Primary Address

Statement of significance

Significant for its long and historic association with European settlement and subsequent pastoral activity of the area. Mount Campbell's associations go back to Charles Campbell in the 1830s when the place as initially established as an outstation of Duntroon.
Date significance updated: 18 November 2011
Note: There are incomplete details for a number of items listed in NSW. The Heritage Division intends to develop or upgrade statements of significance and other information for these items as resources become available.

Description

Physical description:	Mt Campbell is a single-storey house that appears to be constructed from weatherboard with a corrugated iron roof and probably built in stages. The house is set amongst introduced vegetation including

	poplars and pines. The land was subdivided circa 2000 and there is now a modern residential subdivision to the east.

History

Historical notes:	The 'Mount Campbell' property was established by Charles Campbell in the 1830s as an outstation of 'Duntroon'. As the Campbells had decided early on that it was better to employ free immigrants rather than convicts on their properties, Charles Campbell appointed Ewen Cameron to be overseer (or manager) of the 'Mount Campbell' station soon after he and his family arrived from Scotland in October 1836. This implies that a homestead had been erected on the property by this time. (Moore: 5, 7, 13) (Procter: 37) In 1843, Campbell moved Cameron to take charge of 'The Waterholes' property at Michelago. In his place as overseer of 'Mount Campbell', he appointed John Gibbs who had arrived from his native England in September 1838. Gibbs moved onto his own property at Primrose Valley in the 1850s and his son James succeeded him as overseer at 'Mount Campbell'. Following the passage of the Free Selection Act in 1861, James and one of his brothers, Edward, began to take up land around the church glebe at 'Mount Campbell' either through selections or outright purchases. Edward later moved on to become the licensee of the Little Tinderry Run, but was residing at Primrose Valley when he died in June 1870. James, meanwhile, had become the largest resident landowner in the 'Mount Campbell' area and eventually acquired the homestead itself. After James Gibbs died in February 1902, the 'Mount Campbell' property was inherited by his son Edward Thomas Gibbs and his wife Eliza (née McLaughlin). Edward Thomas died in November 1931, but his widow lived on until January 1975. It was during her residence on 'Mount Campbell' that the 'Roselawn' homestead was erected nearby. This occurred sometime during the 1930s and it became Eliza's residence. The property today is notable for its garden and is often open for inspection under the 'Open Garden' scheme. In the meantime, 'Mount Campbell' had passed to Edward Thomas and Eliza Gibbs' son, James William. He predeceased his mother, dying in October 1973. The property, however, appears to have remained in the hands of the Gibbs family. (Moore: 13, 54) (Procter: 114, 115).

Historic themes

Australian theme (abbrev)	**New South Wales theme**	**Local theme**
3. Economy-Developing local, regional and national economies	Agriculture-Activities relating to the cultivation and rearing of plant and	(none)-

	animal species, usually for commercial purposes, can include aquaculture	

Listings

Heritage Listing	Listing Title	Listing No.	Gazette Date	Gazette No.	Gazette Page
Local Environmental Plan	Mount Campbell		23 Nov 12	125	

Study details

Title	Year	Number	Author	Inspected by	Guidelines used
Queanbeyan Heritage Survey - 2010	2010		Pip Giovanelli		Yes

References, internet links & images

Type	Author	Year	Title	Internet Links
Written	Moore		Burra County of Murray	
Written	Procter		Biographical Register of Canberra and Queanbeyan	

Attachment 2: St Paul's Church of England

Item details

Name of item:	St Paul's Church of England
Type of item:	Built
Group/Collection:	Religion
Category:	Church
Primary address:	1290 Old Cooma Road, Googong, NSW 2620
Local govt. area:	Queanbeyan

All addresses

Street Address	**Suburb/town**	**LGA**	**Parish**	**County**	**Type**
1290 Old Cooma Road	Googong	Queanbeyan			Primary Address

Statement of significance:

Designed by Reverend Alberto Dias Soares and built by his brother Gaulter with funds raised by the local community. Foundation stone laid in 1867 and the church opened in 1868. The building has high local historic value for its association with the provision of religious service in the area, plus long and enduring social and community values. It is particularly attractive, being constructed from local stone. The protective band of trees creates an appropriate backdrop, and its historic character is further enhanced by the remains of the old post and rail fence that defines the garden.
Date significance updated: 18 Nov 11
Note: There are incomplete details for a number of items listed in NSW. The Heritage Division intends to develop or upgrade statements of significance and other information for these items as resources become available.

Description

Designer/Maker:	Reverend Alberto Dias Soares
Builder/Maker:	Gaulter Dias Soares

Construction years:	1867-1868
Physical description:	A small stone church with steeply pitched roof, set within grassed surrounds, defined by old post and rail fence and mature trees. Roof may be asbestos sheet tiles. There is a partially demolished stone addition to the rear part off the altar.

History

Historical notes:	From the time of his appointment as the pioneer rector for the whole of south-eastern NSW in July 1838, the Reverend Edward Smith conducted monthly services at the Campbell family's 'Mount Campbell' property. The services were held in the home of the Campbells' overseer, John Gibbs. George Campbell of 'Duntroon' made a gift of 210 acres as a glebe to endow a church, but it was James Gibbs of 'Mount Campbell' who donated land on which a church could be erected. In 1857, the Reverend Smith was succeeded by the Reverend Alberto Dias Soares, who was also a trained architect and civil engineer. Soares continued his predecessor's custom of holding services in the residence occupied by the Gibbs family at 'Mount Campbell'; a room in the house was made available especially for the services. Soares, however, wanted to build a proper church. He called a meeting of parishioners where he secured support for his plan. His brother, Gaulter, who was also studying for the ministry, set about fundraising in the district. Eventually, sufficient funds were gathered to enable the foundation stone of St Paul's to be laid by Gaulter Soares on 14 December 1867. His brother was the architect of the church and served as clerk-of-works during its construction. The church was opened and dedicated by Bishop Messac Thomas on 23 May 1868. It was entirely free of debt. The first wardens of the church were locals John Gibbs, John Beatty and William Feagan. In 1887, a small vestry was added to the church, and later commemorative east windows were installed in memory of Rebecca Symonds who died in March 1891 at the age of 40. In 1924, Richard Moore of Culbookie, a warden of the church, 'completely renewed the floor of the church, bearing the cost and doing the work himself.' After a hundred years, the church's original shingle roof had deteriorated and was leaking. The replacement of the shingles with metal sheeting was wholly funded by descendants of Richard Moore. (Moore: 13, 54, 61-2, 174) (Cross: 179)

Historic themes

Australian theme (abbrev)	**New South Wales theme**	**Local theme**
8. Culture-Developing cultural institutions and ways of life	Religion-Activities associated with systems of faith and worship	(none)-

Listings

Heritage Listing	Listing Title	Listing No.	Gazette Date	Gazette No.	Gazette Page
Local Environmental Plan	St Paul's Church of England		23 Nov 12	125	

Study details

Title	Year	Number	Author	Inspected by	Guidelines used
Queanbeyan Heritage Survey - 2010	2010		Pip Giovanelli		Yes

References, internet links & images

Type	Author	Year	Title	Internet Links
Written	Cross		Bygone Queanbeyan	
Written	Moore		Burra County of Murray	

QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2 PROPOSED QUEANBEYAN CEMETERY SITE

ATTACHMENT 3 FLORA AND FAUNA ASSESSMENT REPORT

eco logical AUSTRALIA

Old Cooma Road Cemetery – Planning Proposal

Flora and fauna study

Prepared for
Queanbeyan-Palerang Regional Council

21 June 2018

DOCUMENT TRACKING

Item	Detail
Project Name	8391 Old Cooma Road Cemetery BAM Assessment
Project Number	17CAN-8391
Project Manager	Sarah Dickson-Hoyle Level 2, 11 London Circuit Canberra, ACT 2601
Prepared by	Sarah Dickson-Hoyle, Jennie Powell
Reviewed by	Jennie Powell, Kalya Abbey
Approved by	Jennie Powell
Status	Draft
Version Number	V2
Last saved on	21 June 2018
Cover photo	Paddock trees within study area. Photo credit S. Dickson-Hoyle

This report should be cited as 'Eco Logical Australia 2018. *Old Cooma Road Cemetery Planning Proposal – Flora and Fauna Study* Prepared for Queanbeyan-Palerang Regional Council.'

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Template 29/9/2015

Contents

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Abbreviations

Abbreviation	Description
BAM	Biodiversity Assessment Methodology
BC Act	*Biodiversity Conservation Act 2016*
CEEC	Critically Endangered Ecological Community
cm	Centimetres
DBH	Diameter at breast height
EEC	Endangered Ecological Community
ELA	Eco Logical Australia
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ha	hectares
HBT	Hollow-bearing Tree
KFH	Key Fish Habitat
LEP	Local Environment Plan
m	metres
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
QPRC	Queanbeyan-Palerang Regional Council
TEC	Threatened Ecological Community
WM Act	*Water Management Act 2000*

1 Introduction

Eco Logical Australia Pty Ltd (ELA) was engaged by Queanbeyan-Palerang Regional Council (QPRC) to undertake a Flora and Fauna Study to inform and support a planning proposal for a new cemetery site at Lot 2 DP 112382 and Lot 126 DP754881, Old Cooma Road, Burra (hereon referred to as the "study area").

ELA understands that QPRC are proceeding with a planning proposal to amend schedule 1 of the Queanbeyan Local Environment Plan 2012 to allow for the additional permitted uses of "cemetery" within the study area, which is zoned E4 - Environmental Living.

A Gateway Determination was issued for the planning proposal by NSW Department of Planning and Environment, with the condition that a detailed flora and fauna study be undertaken for the study area. A biodiversity study was undertaken for the study site in 2008, which informed the zonings contained in the Queanbeyan Local Environment Plan 2012. However, a detailed study is required to support the current planning proposal.

This study has been undertaken to identify the ecological values and constraints present within the study area. This report presents the results of the FFA, identifies areas of low, medium and high ecological constraint, and presents recommendations for mitigating impacts associated with the proposal.

1.1 Study area

The study area is located within the Queanbeyan-Palerang Local Government Area, and has a total area of 36.4 hectares (ha) (**Figure 1**). It is currently zoned E4 – Environmental Living under the Queanbeyan Local Environment Plan 2012 (LEP), and is covered by the Terrestrial Biodiversity layer associated with the LEP, identifying areas of high conservation value.

The study is area wholly located within the South Eastern Highlands IBRA region (Monaro sub-region), in the Murrumbidgee catchment.

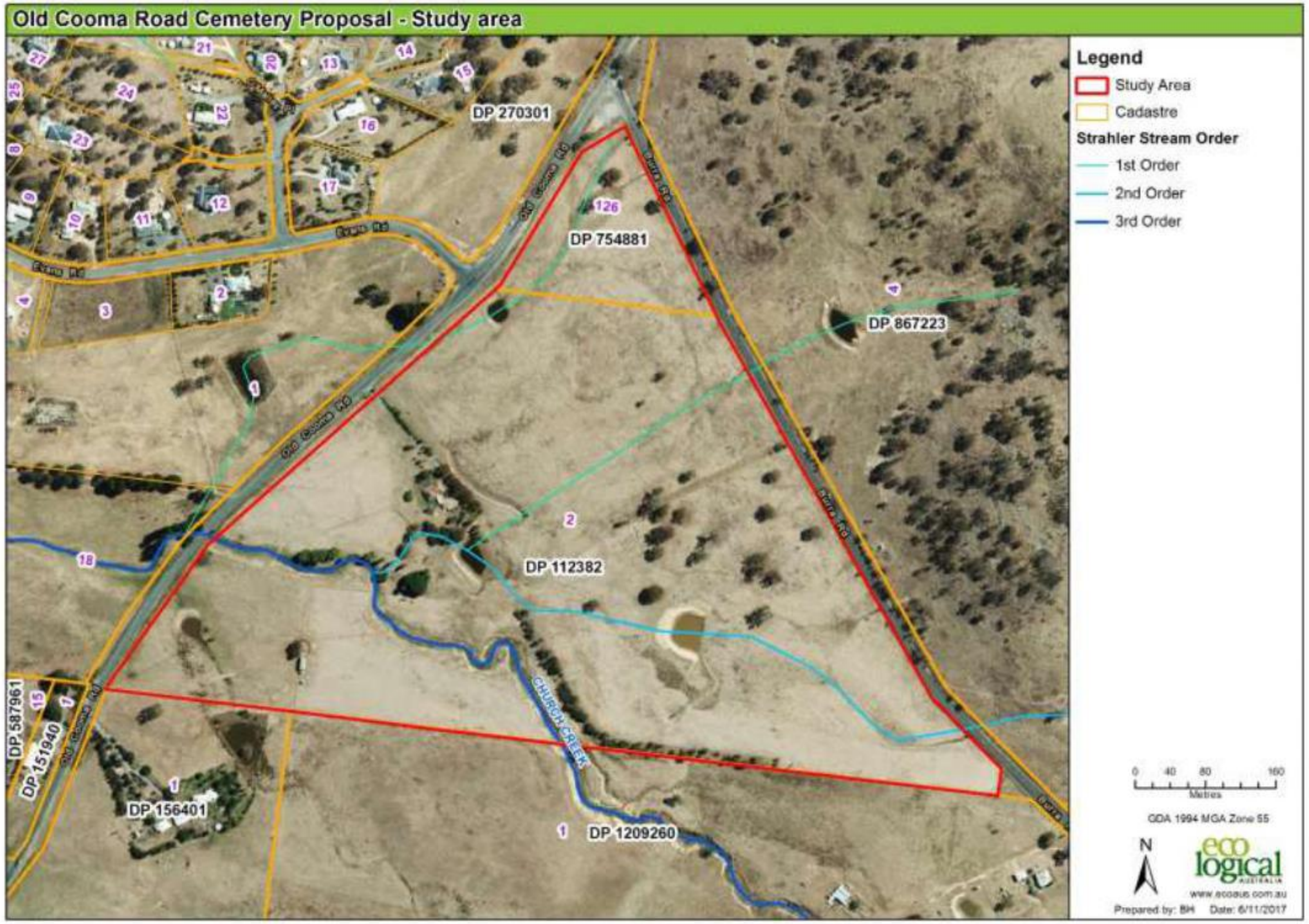

Figure 1: Study area

2 Methods

2.1 Data audit

The following databases and data sources were reviewed prior to conducting the field surveys:

- BioNet / Atlas of NSW Wildlife Search (OEH, 2017a) covering an area from latitude -35.35 to -35.55 and longitude 149.10 to 149.30 (Datum GDA94).
- EPBC Act Protected Matters Search Tool (DotEEa, 2017) using a radius of 10 km around the coordinates -35.45, 129.21 (Datum GDA94).
- BioNet Vegetation Classification (OEH, 2017b).
- *Basic Vegetation Assessment for the Preliminary Environmental Review of 1187 Old Cooma Road, Googong* (QPRC 2017).
- *Planning Proposal for Cemetery and Crematorium, Lot 2 DP112382 and Lot 126 DP754881* (QPRC undated).
- Queanbeyan Local Environment Plan 2012.
- Aerial photography.

2.2 Field survey

A field survey was undertaken by ELA ecologists Jennie Powell and Sarah Dickson-Hoyle on November 2 and 3, 2017. Vegetation surveys were undertaken in accordance with the NSW Biodiversity Assessment Method (BAM) (OEH 2017c).

2.2.1 Plant Community Type identification and mapping

The field survey involved traversing the full extent of the study area in order to identify and map vegetation community type and condition. Boundaries between vegetation communities were logged with a handheld GPS. Each vegetation community encountered was described in the field in terms of structure, condition and composition, corresponded to a Plant Community Type (PCT) as defined in the BioNet Vegetation Classification database, and qualitatively assigned to a condition class.

Descriptions were based on (often multiple) rapid survey assessments conducted within each vegetation community. Rapid assessments involved describing the vegetation structure (dominant species and cover within each vegetation strata), as well as topographic position, soils and any other relevant abiotic factors.

Where vegetation communities were highly degraded and lacking in native species richness, quantitative assessments to identify the corresponding PCT were not deemed possible. In these instances, PCTs were determined qualitatively based on an assessment of remnant native species (in particular, dominant canopy species), surrounding vegetation in the broader locality, and biotic factors such as landform and soils.

2.2.2 Vegetation integrity survey plots

Two vegetation integrity survey plots were undertaken in the single vegetation zone. The minimum required number of plots was calculated in accordance with Table 4 of the BAM, reproduced as **Table 1** below. An additional plot undertaken to ensure a representative sample was taken for the vegetation.

Table 1: Minimum number of transects/plots required per zone area

Vegetation zone area (ha)	Minimum number of transects/plots
<2	1 plot/transect
>2-5	2 plots/transects
>5-20	3 plots/transects
>20-50	4 plots/transects
>50-100	5 plots/transects
>100-250	6 plots/transects
>250-1000	7 plots/transects; more maybe needed if the condition of the vegetation is variable across the site
>1000	8 plots/transects; more maybe needed if the condition of the vegetation is variable across the site

Survey methods followed those outlined in Section 5.3.4 of the BAM. Within each plot, the following data relating to vegetation composition, structure and function was collected:

- Native and exotic species richness, cover and abundance, and growth form within 20 m x 20 m plot
- Identification of High Threat Exotic species
- The number of large trees (defined as greater than the large tree benchmark for each PCT) and trees with hollows within 20 m x 50 m plot
- Length of fallen logs greater than 10 cm diameter, and presence of tree regeneration and trees within defined tree stem size classes within 20 m x 50 m plot
- Litter cover, assessed within five 1 m x 1 m quadrats within 20 m x 50 m plot.

Data from vegetation integrity plot assessment were used to calculate the vegetation integrity score for the relevant vegetation zone, utilising the BAM Credit Calculator.

2.2.3 Paddock tree assessment

Paddock trees were identified, mapped and assessed in accordance with the definition and methodology outlined in Appendix 1 of the BAM.

Each paddock tree was assigned into one of the following classes:

- Class 1: paddock trees that are ≤20 cm DBH, or trees that meet the definition of trees with negligible biodiversity value as defined in Appendix 1 of the BAM
- Class 2: paddock trees that are ≥20 cm DBH and less than the large tree benchmark for the most likely plant community type
- Class 3: paddock trees that are greater than or equal to the large tree benchmark for the most likely plant community type

For all Class 2 and Class 3 paddock trees, the following data were collected:

- Presence of hollows or other important habitat features (e.g. mistletoe)
- Habitat suitability for threatened species
- Species

2.2.4 Threatened flora and fauna

Habitat suitability for threatened fauna and flora species that cannot be predicted by habitat surrogates (species credit species) was assessed in accordance with Section 6.1 of the BAM. Targeted surveys were conducted in areas of suitable habitat for the threatened flora species *Leucochrysum albicans* var. *tricolor* (Hoary Sunray), *Swainsona sericea* (Silky Swainson-pea) *Swainsona recta* (Small Purple-pea) and *Rutidosis leptorrhynchoides* (Button Wrinklewort).

2.3 BAM Calculator

Biodiversity credits required to offset the clearance of native vegetation or threatened species habitat on the site were calculated using the BAM calculator as a Part 4 Developments (Small Area) assessment type. The plot data were entered into the calculator to derive the current vegetation integrity score. The future integrity score was "0" because complete clearance of native vegetation was assumed.

The number of ecosystem credits required to offset impacts on native vegetation is calculated in an equation using the loss in the vegetation integrity score, vegetation zone area and the biodiversity risk weighting of a threatened ecological community or threatened species predicted to have habitat in the vegetation zone. The number of species credits required to offset impacts on threatened fauna and flora species, which cannot be predicted by habitat surrogates, is calculated in an equation using the biodiversity risk weighting of a threatened species, area of habitat, and for all fauna species and some flora species the condition of the habitat.

The calculator also provides a price per credit estimated by the biodiversity offset payment calculator should a proponent choose to purchase their offset requirement from the Biodiversity Conservation Fund. The price includes an estimate for market value with an added administrative and risk loading component.

3 Results and discussion

3.1 Data audit

3.2 Vegetation zones and additional vegetation

One vegetation zone, and two additional planted and/or non-native vegetation communities were identified and mapped within the study area.

These were:

- Vegetation zone: PCT 1330 Yellow Box – Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion
- Additional vegetation communities:
    - Native vegetation (planted, no PCT)
    - Exotic Vegetation

The distribution of this zone and these additional vegetation communities within the study area is shown in **Figure 2**. These are described in greater detail below.

Vegetation zone 1: PCT1330 Yellow Box – Blakely's Reg Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion (poor condition)

PCT1330 was present as three discrete patches of vegetation within the study area. This vegetation zone was present as a highly modified form of PCT1330, with a partially cleared canopy consisting of *Eucalyptus melliodora* (Yellow Box), *E. blakelyi* (Blakely's Red Gum) and *E. bridgesiana* (Apple Box) over an exotic ground cover dominated by the exotic pasture grasses *Hordeum leporinum* (Barley Grass), *Lolium perenne* (Perennial Ryegrass) and *Phalaris aquatica* (Phalaris), and exotic forbs including *Hypochaeris radicata* (Catsear) and *Acetosella vulgaris* (Sheep Sorrell). The native perennial grasses *Austrostipa scabra* (Spear Grass) and *A. bigeniculata* were present as scattered individuals, predominantly on low rocky rises with shallower soils.

Equivalent vegetation communities are presented in **Table 2** below.

Table 2: PCT1330 and corresponding vegetation

PCT	BC Act listing	EPBC Act listing	Total area (ha)
PCT 1330 Yellow Box – Blakely's Reg Gum grassywoodland on the tablelands, South Eastern Highlands Bioregion	White Box – Yellow Box – Blakely's Red Gum Woodland	None – too degraded	1.65

Any direct impacts to PCT 1330 require offsets above an impact threshold which relates to the vegetation integrity score of the vegetation zone. Section 10.3 of the BAM states that an offset is required for a vegetation zone that has a vegetation integrity score of ≥ 15 where the PCT is representative of an endangered or critically endangered community. The vegetation zone has been assessed as a highly degraded form of an endangered ecological community (EEC) (see below). The estimated offsets calculated by the BAM calculator for impacts to 1.65 ha of this vegetation zone was 12 credits, with an estimated cost of $20,180.65 (ex. GST). However, the vegetation integrity score for the vegetation zone was 14.2, therefore offsets for the impacts to the vegetation zone are not required under BAM.

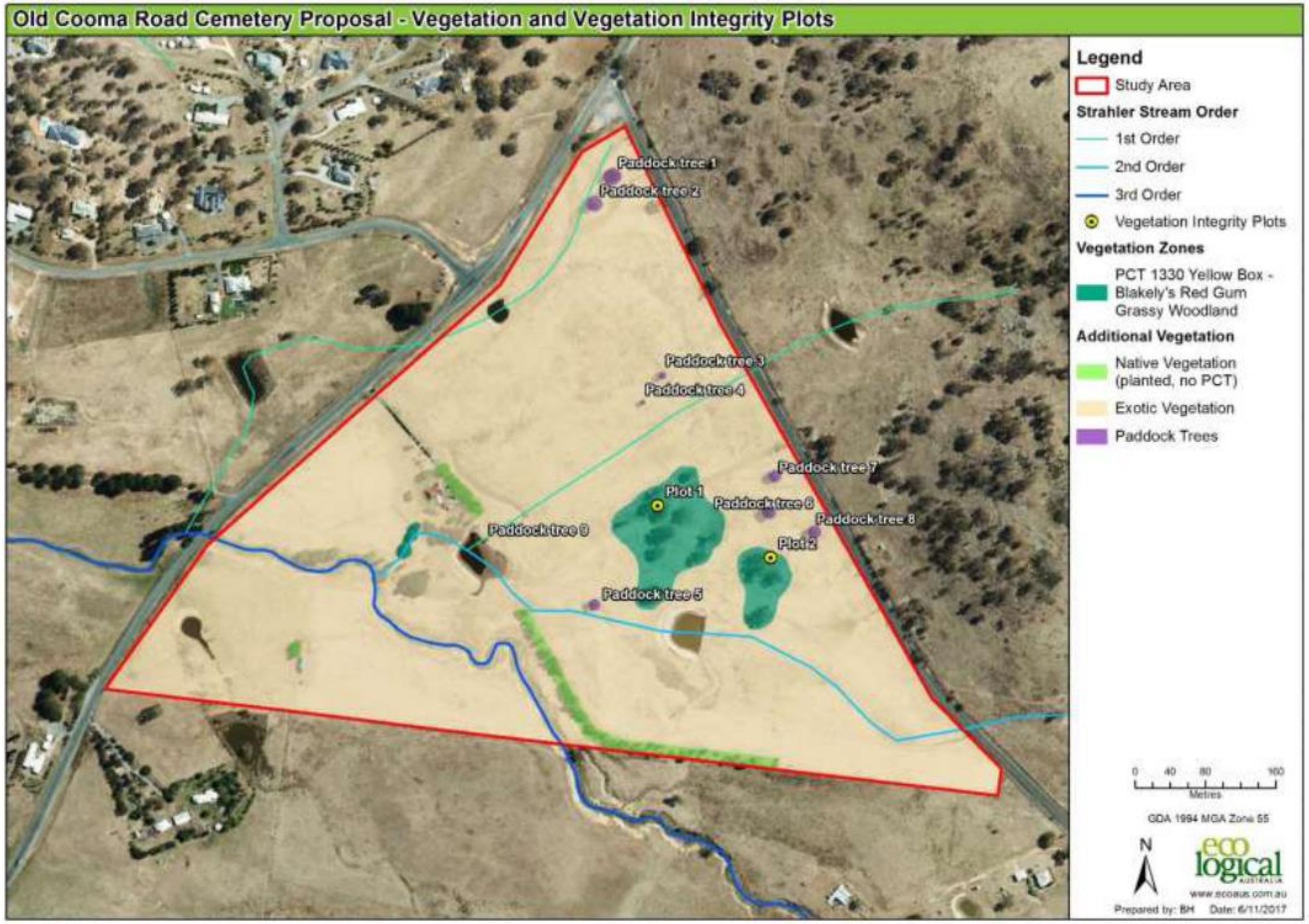

Figure 2: Vegetation zones and additional vegetation within the study area

Vegetation Zone 1 was too degraded to meet the condition requirements for listing as the EPBC Act Critically Endangered Ecological Community (CEEC) *White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grassland* (DotEE) due to the predominantly exotic perennial ground cover.

Assessment against the NSW Scientific Committee determination for the TSC Act listed EEC *White Box Yellow Box Blakely's Red Gum woodland* (NSW Scientific Committee 2002) indicates that Vegetation Zone 1 is a highly degraded form of this EEC: the relatively small size of the patches, the isolated and fragmented occurrence surrounded by exotic pasture, and the heavily degraded ground cover means that this patch is not considered to be a viable remnant of the above EEC in the long term without restoration intervention as natural ecological processes are likely disrupted.

Native vegetation (planted, no PCT)

Native vegetation plantings were present throughout the study area, predominantly as a long linear fenced planting towards the southern boundary, as well as linear plantings along the driveway and a small stand of planted trees near a farm shed (**Figure 2**). This vegetation community comprised a native canopy and shrub layer, consisting of locally native species such as *E. viminalis* (Ribbon Gum), *E. mannifera* (Brittle Gum), *E. albens* (White Box), *Acacia decurrens, A. dealbata* (Silver Wattle) and *A. baileyana* (Cootamundra Wattle), over a tall grassy ground cover dominated by exotic pasture species, primarily *P. aquatica*.

A total of 0.65 ha of Native Vegetation (planted) was mapped within the study area. While this vegetation community has biodiversity values, including supporting habitat for smaller woodland birds (as indicated by the higher bird species diversity and abundance compared to other vegetation zones), it was not considered as being equivalent to a PCT or native vegetation community due to it being a mixed native planting.

Exotic vegetation

Exotic Vegetation dominated across the study area. This vegetation is predominantly exotic pasture dominated by *H. leporinum* in association with the exotic pasture grasses *L. perenne, P. aquatica*, *H. lanatus* (Yorkshire Fog) and *Dactylis glomerate* (Cocksfoot), and the exotic forbs *Trifoliunm subterraneum* (Subterranean Clover), *H. radicata* and *Plantago lanceolata* (Plantain). In lower lying drainage lines there are small patches of native sedges and rushes including *Carex appressa* (Tall Sedge) and *Juncus filicaulis*. Native grasses and forbs including *A. bigeniculata, Cotula australis* (Common Cotula), and *Leptorhynchos squamatus* were recorded at various locations throughout, however never in high covers or abundances.

The area mapped as Exotic Vegetation also includes exotic woody species such as *Salix* sp. (Willow) and *Populus* spp. (Poplars) - predominantly found along creeklines - and planted ornamental vegetation surrounding the existing house.

A total of 32.6 ha of Exotic Vegetation was mapped within the study area. There are no equivalent PCTs or TECs for this vegetation.

3.2.1 Paddock Trees

A total of nine paddock trees were identified and assessed within the study area (**Figure 2**). A summary of these is presented in **Table 3** below.

Table 3: Summary of paddock trees

Paddock Tree No.	Species	Class	Habitat features	Potential threatened species
1	*E. melliodora*	3	None	None
2	*E. bridgesiana*	3	Hollows, mistletoe	*Callocephalon fimbriatum* (Gang-gang Cockatoo) *Calytorhynchos lathamii* (Glossy-black Cockatoo) *Polytelis swainsonii* (Superb Parrot) *Myotis macropus* (Southern Myotis)
3	*E. rubida*	3	Decorticating bark, exposed hollow	*Myotis macropus* (Southern Myotis)
4	*E. rubida*	3	Decorticating bark, exposed hollow	*Myotis macropus* (Southern Myotis)
5	*E. rubida*	3	Decorticating bark	*Myotis macropus* (Southern Myotis)
6	*E. melliodora*	3	None	None
7	*E. blakelyi*	3	None	None
8	*E. melliodora*	3	None	None
9	*E. blakelyi*	1	None	N/A

3.2.2 Vegetation integrity survey plots

The site attribute results from the vegetation integrity survey plot assessment are presented in **Table 4**. A full list of all flora species recorded within each plot is included in **Appendix A**. Photographs of each plot and transect are included below.

Table 4: Vegetation integrity plot data

Plot No.	No. native species	No. high threat weeds	Litter cover (%)	Stem size classes (DBH)	No. trees with hollows	No. large trees	Regen .	Total length fallen logs (m)
1	2	1	49	80cm+	1	1	N	9
2	6	1	35	80cm+	2	1	N	37

The BAM calculator determined the current vegetation integrity score for zone 1 as 14.2.

Photograph 1: Vegetation integrity survey plot 1 (view from start of transect)

Photograph 2: Vegetation integrity survey plot 2 (view from start of transect)

3.3 Flora

A total of 52 flora species were recorded within the study area (including species recorded within vegetation integrity survey plots), 24 of which were exotic.

Suitable habitat was not identified for the threatened flora species identified in **Section 2.2.4**, and targeted surveys within Vegetation Zone 1 did not identify these species. As the surveys were conducted during known flowering time, these species, nor other threatened flora species listed under the BC Act and/or the EPBC Act, are considered unlikely to occur within the study area.

3.4 Aquatic ecology

The riparian corridor categories within the study area were assessed in relation to the *Water Management Act 2000* (WM Act). The watercourses within the subject land are identified, under the Strahler stream order classification, as first, second, third and fourth order streams (**Figure 1**).

The required vegetated buffer zones for these stream classifications is shown in **Table 5**.

Table 5: NSW DPI Water recommendedriparian corridor widths

Watercourse Type (Strahler)	Vegetated Riparian Zone Width (each side of watercourse from TOB)	Total width
1st Order	10 m	20 m
2nd Order	20 m	40 m
3rd Order	30 m	60 m
4th Order or greater	40 m	80 m

While the 1st and 2nd order drainage lines within the study area are ephemeral and did not contain water at the time of survey, the 3rd order Church Creek contained a number of permanent pools. These were fringed with and/or had dense in-stream vegetation consisting of dense stands of the native sedges and rushes *Typha* sp., *Eleochaeris* sp., *C. appressa* and *Juncus* spp. (**Photo 3**) and in moderate to good condition. In addition, there were four farm dams, which were observed as providing habitat for a range of common waterbirds associated with agricultural environments, such as *Chenonetta jubata* (Australian Wood Duck). The common native frog species *Crinia signifera* (Common Eastern Froglet) and *Limnodynastes tasmaniensis* (Spotted Marsh Frog) were heard calling from the small dam in the far south-western corner of the study area.

Church Creek is classed as Key Fish Habitat (KFH) by DPI Fisheries (**Figure 3**). Church Creek is a third order stream, which is classed as key fish habitat (KFH) by DPI Fisheries. There is approximately 3.5 km of KFH upstream of the study area. The classification begins when Church Creek becomes a third order stream (joining an unnamed second order stream). The waterway is rated as **Class 2** (moderate key fish habitat) with a sensitivity rating of **Type 2** (moderately sensitive key fish habitat) (Fairfull 2013). These ratings are perceived from field observations.

Photograph 3: Aquatic habitat within Church Creek

Freshwater fish community status is unmapped by DPI. The downstream receiving waterway, Jerrabomberra Creek, has been mapped as 'Poor'. No threatened freshwater fish communities have been found, or modelled within Church Creek. Although the creek is, at times, hydrologically connected to Lake Burley Griffin, where Eel Tailed Catfish (*Tandanas tandanas*) are modelled to occur the habitats are vastly different. It is unlikely that catfish would travel upstream (approximately 25 km) to the site because of the significant barriers posed by dense in-stream vegetation and large reaches of dry streambed. There are also no deep pools at the site to create suitable catfish habitat. *Euastacus armatus* (Murray Crayfish), *Macquaria australasica* (Macquarie Perch), *Maccullochella macquariensis* (Trout Cod) occur in the Murrumbidgee River, downstream of Lake Burley Griffin, but would be unable to migrate upstream beyond Scrivener Dam.

An unpublished study by ELA (Ian Dixon 2016 – 2017) used a backpack electrofisher near Googong in creeks of similar size and recorded *Anguilla australis* (Shortfinned Eel), *Anguilla reinhardtii* (Longfinned Eel) and small bodied fish including *Galaxias olidus* (Mountain Galaxias) and *Gobimorphus coxii* (Cox's Gudgeon. These species and other hardy small bodied fish are most likely to use this creek when flows are suitable. No other threatened aquatic invertebrates have expected distributions in the region (DPI Primefact publications).

No threatened fish are likely to occur near the study area, therefore, the proposal is not likely to directly impact threatened fish or their habitats.

Direct impacts to aquatic habitat would arise if works are proposed instream or on waterfront land (Waterfront land includes bed and bank of any river, lake or estuary and all land within 40 m of the highest bank - *Water Management Act 2000*). Indirect impacts to downstream habitats may occur if mitigation measures are not put in place during works. Indirect impacts include turbid water, sediment deposition and oil/pollutant spills. Both direct and indirect impacts can reduce water quality, decrease light penetration through the water column and fill pools with sediment. This may alter the plant and animal production that supports the aquatic food web. If works occur when the creek is dry, or exists as a series of isolated pools, impacts would be limited to the immediate area.

3.5 **Fauna and fauna habitats**

Key fauna habitat features identified within the study area are shown on **Figure 3**. These consisted of hollow-bearing trees, active wombat burrows, mistletoe, small patches of outcropping (embedded) rock, and active bird nests, as well as aquatic habitats associated with farm dams and Church Creek (for aquatic ecology please see **Section 3.5** below). The farm dams and Church Creek may support potential foraging habitat for the threatened microchiropteran bat species *Myotis macropus* (Southern Myotis).

The outcropping rock habitat may provide refuge habitat for a range of small reptile species. However, the rock habitat within the study area was not considered to be the partially embedded rock habitat that constitutes potential habitat for the threatened *Aprasia parapulchella* (Pink-tailed Worm Lizard).

One bird nest was observed in an outer fork of a *E. blakelyi* (**Figure 3**). This was likely a nest of *Cracticus tibicens* (Australian Magpie).

The hollow-bearing trees (including stags) supported a range of small (< 5 cm diameter), medium (5-20 cm diameter) and large (>20 cm diameter) hollows. These hollows may provide potential denning, roosting or nesting habitat for a range of bird, arboreal mammal and microchiropteran bat species that are known from the locality and that utilise agriculturally modified habitats.

The *E. blakelyi* and *E. melliodora* hollow-bearing trees containing large hollows may support nesting habitat for the threatened bird species *Polytelis swainsonii* (Superb Parrot). One *E. bridgesiana* (Paddock Tree 1) had dense infestations of mistletoe (greater than five individual mistletoe plants), providing potential nesting and foraging habitat for the threatened bird species *Grantiella picta* (Painted Honeyeater) (note: this species was not identified as a candidate species in the BAM calculator). Threatened species requiring further assessment in accordance with the BAM are detailed in **Section 3.4.1** below. One individual *Cacatua galerita* (Sulphur-crested Cockatoo) was observed emerging from a large hollow in an *E. bridgesiana*. An active nest of the introduced pest species *Sturnus vulgaris* (Starling) was present in a hollow-bearing stag.

Twenty-three fauna species were opportunistically recorded during field surveys. This consisted of 19 native and one exotic bird species, two native frog species and one native mammal species. The majority of the bird species recorded were either larger common bird species such as *Platycercus elegans* (Crimson Rosella), *Cracticus tibicens* and *Eolophus roseicapilla* (Galah), or smaller bird species commonly associated with open grasslands and modified habitats, such as *Anthus nocaeseelandiaea* (Australasian Pipet) and *Rhipidura leucophrys* (Willie Wagtail).

Evidence of cattle was observed within the study area. QPRC confirmed that the tenants occupying the study area were still grazing cattle at the time of survey.

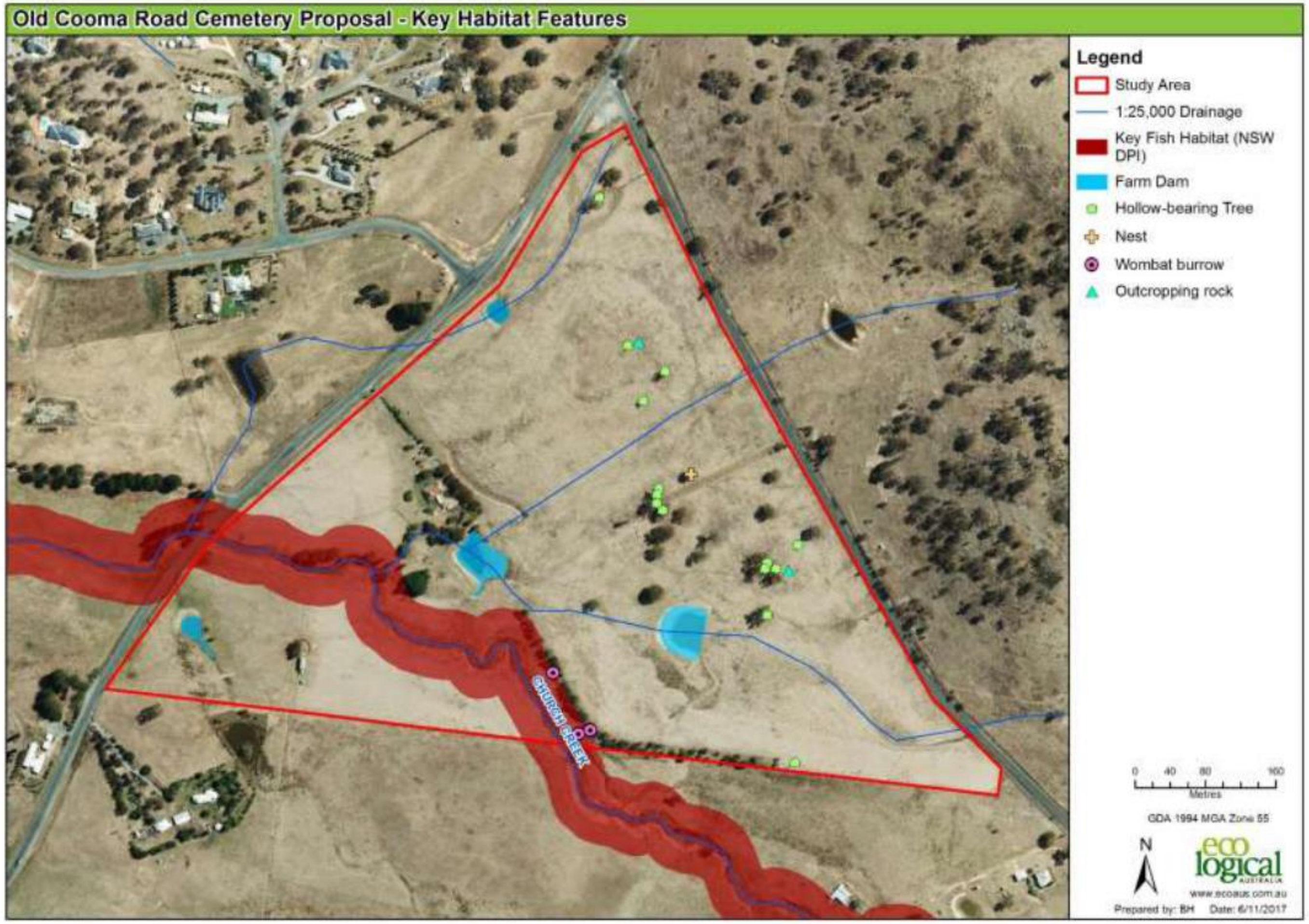

Figure 3: Key habitat features

3.5.1 Predicted fauna species

The following fauna species listed in **Table 6** are listed as Ecosystem Credit Species, and are predicted to be associated with PCT 1330. No additional surveys are required for these species. Ecosystem Credits (offsets) would apply to these species if impacts were to occur to PCT 1330.

Table 6: Fauna species reliably predicted to occur in PCT 1330

Scientific name	Common name
Anthochaera phrygia	Regent Honeyeater
Artamus cyanopterus cyanopterus	Dusky Woodswallow
Chthonicola sagittata	Speckled Warbler
Climacteris piculmus victoriae	Brown Tree-creeper
Glossopsitta pusilla	Little Lorikeet
Lathamus discolour	Swift Parrot (note: does not breed on mainland)
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat
Petroica boodang	Scarlet Robin
Petroica phoenicea	Flame Robin (note: does not breed inland)
Polytelis swainsonii	Superb Parrot
Stagonopleura guttata	Diamond Firetail

Note: three Ecosystem Credit Species predicted to be associated with PCT 1330 have been excluded from the **Table 6**, due to a confirmed lack of key habitat constraints within the study area or the species is considered a vagrant in the Monaro IBRA subregion. These are *Haliaeetus leucogaster* (White-bellied Sea Eagle); *Dasyurus maculatus* (Spotted-tailed Quoll); *Phascolarctos cinereus* (Koala) and *Pteropus poliocephalus* (Grey-headed Flying Fox).

Table 7 lists Species Credit fauna species for which breeding habitat potentially exists within the study area. These species all breed in hollow-bearing trees. Targeted surveys for these species in the appropriate survey months would be required to confirm the absence of these species within the study area. Otherwise, Species Credits (offsets) would apply, should the proposal impact upon hollow-bearing trees.

Table 7: Fauna species requiring targeted survey

Scientific name	Common name
Callocephalon fimbriatum	Gang-gang Cockatoo
Calyptorhynchos lathami	Glossy Black Cockatoo
Myotis macropus	Southern Myotis
Ninox strenua	Powerful Owl
Polytelis swainsonii	Superb Parrot

Note: the Species Credit species *Hieraaetus morphnoides* (Little Eagle) was excluded by ELA from **Table 7** due to no nest trees being recorded in the study area, and *Cercartetus nanus* (Eastern Pygmy Possum) was excluded due to the lack of required vegetation structural diversity. Furthermore, while the Powerful Owl has been listed in the table above, it is considered unlikely to be reliant on habitats within the study area, due to its lack of reliance on paddock trees. However, targeted surveys would be required to confirm this absence.

3.6 **Summary of ecological constraints**

A summary of the key ecological constraints present within the study area is shown in **Figure 4**.

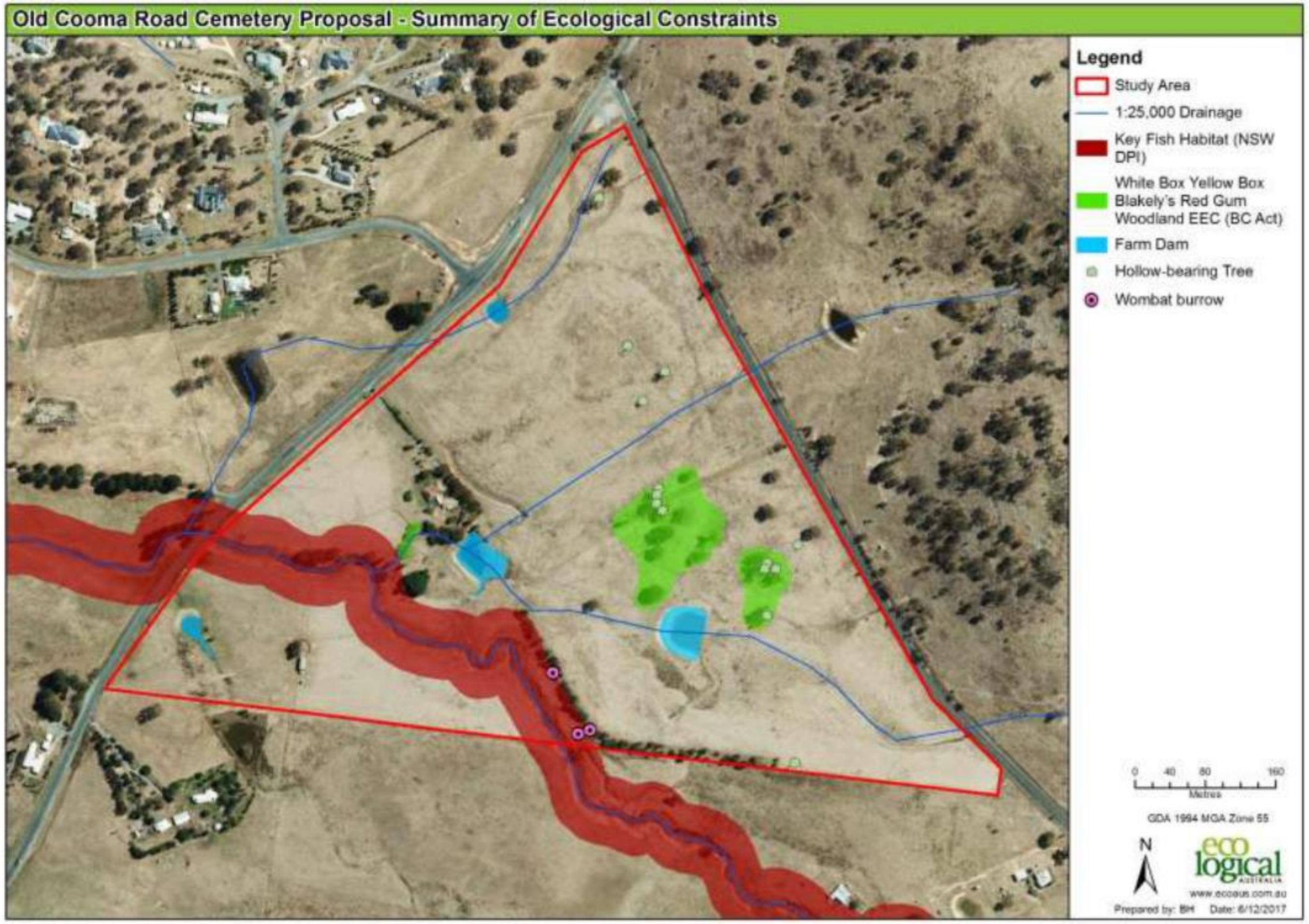

Figure 4: Summary of ecological constraints

4 Recommendations and conclusion

The majority of the study area poses a low ecological constraint to the proposal, due to the highly modified and disturbed vegetation and lack of important habitat features. However, the key habitat features shown in **Figure 4**, in particular the hollow-bearing trees, provide potential breeding habitat for a range of threatened fauna species. Furthermore, despite being highly modified, Vegetation Zone 1 is considered equivalent to the TEC White Box Yellow Box Blakely's Red Gum Woodland, an endangered ecological community listed under the NSW BC Act. There is the potential for the proposal to incorporate measures to effectively manage and enhance this vegetation for biodiversity outcomes.

A series of measures to minimise or mitigate the impacts associated with the proposal are recommended as follows:

- Design the proposal to avoid direct impacts to any hollow-bearing trees, paddock trees, or the area of TEC White Box Yellow Box Blakely's Red Gum Grassy Woodland
- Consider developing a Vegetation Management Plan for the site, with a particular emphasis on managing and restoring aquatic habitats and the TEC
- Retain the planted native vegetation. Additional plantings should utilise native species of local provenance to the greatest extent possible
- Any waterway crossings should be designed and constructed in accordance with the national guidelines entitled 'Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings' (Fairfull and Witheridge 2003). Crossings are to be designed to allow adequate fish passage during operation. The crossings are on Class 2 – Moderate key fish habitat
    - Bridge, arch structure, culvert or fords are the preferred crossing type (in that order) for Class 2 waterways
- Develop a Construction Environmental Management Plan (CEMP) to address potential pollution and contamination issues, such as silt control and oil/fuel/chemical storage/spill management, which could arise during construction
- The timing of works should coincide with low flow periods
- If dewatering of pools or farm dams is required, engage a qualified aquatic ecologist to relocate fish and other aquatic fauna upstream

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Appendix A Flora and fauna species recorded

Flora species

Scientific name	Common name	Native/Exotic
Acacia baileyana	Cootamundra Wattle	Native
Acacia dealbata	Silver Wattle	Native
Acacia decurrens	Black Wattle	Native
Acacia sp.	Wattle	Native
Acetocella vulgaris	Sheep Sorrell	Exotic
Aristida sp.	-	Native
Austrostipa bigeniculata	-	Native
Austrostipa scabra	Spear Grass	Native
Avena barbata	Bearded Oats	Exotic
Bromus catharticus	Prairie Grass	Exotic
Bromus sp.	-	Exotic
Carex appressa	Tall Sedge	Native
Cirsium vulgare	Spear Thistle	Exotic
Cotula australis	Common Cotula	Native
Dactylus glomeratus	Cocksfoot	Exotic
Einadia nutans	Climbing Saltbush	Native
Eleochaeris sp.	-	Native
Eleusine tristachya	Goose Grass	Exotic
Erodium cicutarium	Common Storksbill	Exotic
Eucalyptus albens	White Box	Native
Eucalyptus blakelyi	Blakely's Red Gum	Native
Eucalyptus bridgesiana	Apple Box	Native
Eucalyptus mannifera	Brittle Gum	Native
Eucalyptus melliodora	Yellow Box	Native
Eucalyptus ovata	Swamp Gum	Native
Eucalyptus rubida	Candlebark	Native
Eucalyptus stellulata	Black Sallee	Native
Eucalyptus viminalis	Ribbon Gum	Native
Geranium solanderi	Native Geranium	Native

Scientific name	Common name	Native/Exotic
Holcus lanatus	Yorkshire Fog	Exotic
Hordeum leporinum	Barley Grass	Exotic
Hypochaeris radicata	Catsear	Exotic
Juncus filicaulis	-	Native
Juncus sp.	-	Native
Lactuca serriola	Prickly Lettuce	Exotic
Leptorhynchos squamatus	-	Native
Lolium perenne	Perennial Rye Grass	Exotic
Malva sp..	-	Exotic
Onopordum acanthium	Scotch Thistle	Exotic
Phalaris aquatica	Phalaris	Exotic
Plantago debilis	-	Native
Plantago lanceolata	Plantain	Exotic
Poa annua	Winter Grass	Exotic
Poa labillardierei	River Tussock	Native
Populus sp.	Poplar	Exotic
Rumex brownii	Swamp Dock	Native
Rumex crispus	Curly Dock	Exotic
Rytidosperma sp.	A Wallaby Grass	Native
Salix sp.	Willow	Exotic
Trifolium dubium	Yellow Suckling Clover	Exotic
Trifolium subterraneum	Subterranean Clover	Exotic
Vulpia sp.	-	Exotic

Fauna species

Scientific name	Common name	Native/Introduced
Birds		
Anas superciliosa	Pacific Black Duck	Native
Anthochaera carunculata	Red Wattlebird	Native
Anthus novaeseelandiaea	Australasian Pipet	Native
Cacatua galerita	Sulphur-crested Cockatoo	Native
Cacomantis pallidus	Pallid Cuckoo	Native

Scientific name	Common name	Native/Introduced
Chenonetta jubata	Australia Wood Duck	Native
Coracina novaehollandiae	Black-faced Cuckoo-shrike	Native
Cracticus tibicen	Australian Magpie	Native
Eolophus roseicapilla	Galah	Native
Gerygone albogularis	White-throated Gerygone	Native
Malurus cyaneus	Superb Fairy-wren	Native
Manorina melanocephala	Noisy Miner	Native
Pachycephala rufiventris	Rufous Whistler	Native
Pardalotus striatus	Striated Pardalote	Native
Platycercus elegans	Crimson Rosella	Native
Platycercus eximius	Eastern Rosella	Native
Psephotus haematonotus	Red-rumped Parrot	Native
Rhipidura albiscapa	Grey Fantail	Native
Rhipidura leucophrys	Willie Wagtail	Native
Sturnus vulgaris	Common starling	Introduced
Frogs		
Crinia signifera	Common Eastern Froglet	Native
Limnodynastes tasmaniensis	Spotted Marsh Frog	Native
Mammals		
Vombatus ursinus	Common Wombat (active burrows)	Native

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QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2	PROPOSED QUEANBEYAN CEMETERY SITE
ATTACHMENT 4	HYDROLOGY ASSESSMENT REPORT JULY 2018

eco logical AUSTRALIA

Proposed cemetery site, Old Cooma Road

Hydrological assessment

Prepared for
Queanbeyan-Palerang Regional Council

19 July 2018

DOCUMENT TRACKING

Item	Detail
Project Name	QPRC Cemetery Background Studies
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Project Manager	Kalya Abbey
Prepared by	Andrew Herron, Rizwana Rumman
Reviewed by	Richard Cresswell, David Bonjer
Approved by	Richard Cresswell
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Version Number	6
Last saved on	19 July 2018
Cover photo	Church Creek in the study area (Photo credit: Sarah Dickson-Hoyle)

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Template 29/9/2015

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Abbreviations, acronyms and initialisms

Abbreviation	Description
AEP	Annual Exceedance Probability
AIP	Aquifer Interference Policy
ARI	Annual Recurrence Interval
BoM	Bureau of Meteorology
ELA	Eco Logical Australia Pty Ltd
GDE	Groundwater Dependent Ecosystems
HEC-RAS	Hydrologic Engineering Centre's River Analysis System
IFD	Intensity-Frequency-Duration
MDB	Murray Darling Basin
NOW	NSW Office of Water (now DPI Water)
QPRC	Queanbeyan-Palerang Regional Council
RFFE	Regional Flood Frequency Estimation
WSP	Water Sharing Plan

Executive summary

Eco Logical Australia (ELA) has been engaged by the Queanbeyan-Palerang Regional Council (QPRC) to undertake a hydrogeological and hydrological review and constraints assessment for the proposed development and use of a cemetery site located within Lot 2 (DP112382) and Lot 126 (DP754881) of Old Cooma Road, Queanbeyan.

The assessment was undertaken to identify any potential hydrological and hydrogeological impacts and impacted areas to assess the suitability of the site for the proposed activity. In addition to a desktop review and data search, drainage and flood modelling was undertaken to assess potential flood constraints for the project.

The project area is located within the Murrumbidgee River catchment. The proposed development Site contains a section of Church Creek, a creek line that drains local farmland and a new housing development currently under development. There are no other major creek lines within the study area. Overland flow paths, however, exist from culverts that drain the roads surrounding the site.

Sheet flow from surface water run-off during large rainfall events may potentially cause impacts in isolated areas. These are unlikely to pose a risk to the site with appropriate stormwater management. Aside from the potential for overland flow downstream of the road culverts, the Site is not expected to be significantly affected by flooding, with hydrological and hydraulic modelling indicating flows in the creek are likely to be retained within the existing banks up to at least the 1% Annual Exceedance Probability design event.

Whilst no groundwater level or quality data is reported from a high-level assessment of available national databases, numerous (38) registered local stock and domestic bores do exist, though all tap deep (>20m) groundwaters in the underlying fractured rock systems. Ten shallow auger holes, drilled to a depth of 3.5 m below ground surface within the study area during a recent geotechnical investigation, did not encounter groundwater (ACT Geotechnical Engineers, 2017) and risk to and from local groundwater resources is not predicted to occur, based on a qualitative assessment.

No potentially significant aquatic or terrestrial groundwater dependent ecosystems were identified within a 2 km buffer of the study area and the project is determined to pose minimal risk as defined by the NSW Aquifer Interference Policy.

1 Introduction

Eco Logical Australia (ELA) has been engaged by the Queanbeyan-Palerang Regional Council (QPRC) to undertake a hydrogeological and hydrological review and constraints assessment for the proposed development and use of a cemetery site located within Lot 2 (DP112382) and Lot 126 (DP754881) of Old Cooma Road, Queanbeyan (**Figure 1-1**).

The assessment was undertaken to identify any potential hydrological and hydrogeological impacts and impacted areas to assess the suitability of the site for the proposed activity.

1.1 Project Background

The Queanbeyan Lanyon Drive Cemetery currently services the Queanbeyan region and is expected to reach capacity during the next five years, based on a forecasted population growth of approximately 36% by 2031 (QPRC, 2017). The Queanbeyan region includes the main growth centres of Googong, Tralee/South Jerrabomberra and infill units in Queanbeyan (QPRC, 2017).

To meet the future cemeterial needs of the region, the Queanbeyan-Palerang Regional Council (QPRC) has been engaged in a process of strategic planning to identify a new cemetery site, as well as undertaking works to prolong the serviceability of the existing Lanyon Drive Cemetery. As part of the planning proposal for the new cemetery site, QPRC is required by the New South Wales Department of Planning and Environment (DPE) to undertake background studies to characterise the existing environment at the site and identify potential areas that may impact upon the proposed development.

1.2 Study Area

The study area is approximately 36.4 hectares and is located approximately 11 kilometres south-west of Queanbeyan, and approximately 5 km west of the Queanbeyan River (**Figure 1-1**). The site is triangular in shape and bounded by Old Cooma Road to the west and Burra Road to the east. The Burra Road – Old Cooma Road intersection is located at the northern point of the site.

The site is currently used for grazing and agricultural purposes and has been farmed since the 1800's (QPRC, 2017). An existing dwelling is located near the centre of the site. Outside the site, the surrounding area comprises land that is zoned for environmental living purposes with the Mount Campbell community title development located to the west of the site, containing dwellings on smaller rural lots (QPRC, 2017).

1.3 Objectives of the assessment

The objectives of this assessment are to identify any potential hydrological and hydrogeological constraints with the proposed site use and provide advice on the assessment and management of such issues. Should issues be identified through this assessment, they will be documented with:

- A clear description of the potential issue or impact.
- Presentation of the potential issue or impact (as needed).
- Assessment of the potential issue or impact
- Identification of options to address / mitigate the potential issue or impact.
- Suggestion of aspects that need to be considered in the final design to avoid the potential issue or impact.
- At the completion of the study, a final recommendation on the suitability of the site for the proposed use.

Figure 1-1: Study Area (the line across the top shows two lots associated with this site)

2 Statutory requirements

The following sections detail the relative State legislative requirements for the Project, applied to hydrological and hydrogeological aspects.

2.1 *Environmental Planning and Assessment Act 1979* (EP&A Act)

The EP&A Act is the principal planning legislation for NSW, providing a framework for the overall environmental planning and assessment of development proposals. A variety of other legislation and environmental planning instruments, such as the *Water Management Act 2000* are integrated with the EP&A Act.

Section 9.1 (formerly S117) Direction 4.3 Flood Prone Land provides that a draft Local Environmental Plan (LEP) shall not rezone land within flood planning areas from Special Area, Recreation, Rural or Environmental Protection Zones to a Residential, Business, Industrial or Special Area Zone, unless the relevant planning authority can satisfy the Director General that the planning proposal is in accordance with a floodplain risk management plan, or the provisions of the planning proposal that are inconsistent are of minor significance.

2.2 *Water Management Act 2000* (WM Act)

The main objective of the WM Act is to manage NSW water in a sustainable and integrated manner that will benefit current generations without compromising future generations' ability to meet their needs. The WM Act is administered by DPI Water and establishes an approval regime for development on waterfront land, defined as the land 40 m from the highest bank of a river, lake or estuary.

Section 91E of the Act creates an offence for carrying out a controlled activity within waterfront land without approval. According to Section 38 of the *Water Management (General) Regulations 2011*, a public authority is exempt from Section 91E of the Act. Therefore, if works are undertaken under Part 5 of the EP&A Act then a Controlled Activity Approval (CAA) will not be required. If works are undertaken under Part 4 of the EP&A Act however, then development within 40 m will require a CAA and DPI Water may also require a Vegetation Management Plan (VMP) to be prepared.

The Act also recognises the need to allocate and provide water for the environmental health of the State’s rivers and groundwater systems, whilst also providing licence holders with more secure access to water and greater opportunities to trade water through the separation of water licences from land. The main tools within the Act for managing the State's water resources are Water Sharing Plans (WSPs), which establish rules for sharing water between different water uses such as town supply, rural domestic supply, stock watering, industry and irrigation and ensures that water is provided for the health of the system.

The following WSPs (Murrumbidgee Water Management Area) have been identified as relevant to surface water and groundwater environments within the subject lots:

- Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources (2011) and
- Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources (2012, current version January 2017 to date)

The Queanbeyan Water Source in *Unregulated Murrumbidgee Above Burrinjuck Dam Extraction Management Unit* forms part of the NSW Murrumbidgee Unregulated and Alluvial Water Sources WSP.

The Queanbeyan River is a major river system in this area and one of the seven surface water sources within the WSP area identified as having high instream values, i.e. likelihood of presence of known and expected threatened species. Some of these threatened species are highly sensitive to low flow extraction, whilst other threatened species, such as plants that occur in the riparian zone, are less sensitive. The shallow alluvial aquifer associated with surface water drainage lines within the site area can also be identified as potentially being impacted in relation to impacts on groundwater level and quality due to the possibility of excavations intercepting the water table (construction dewatering if required, contaminants from construction equipment etc.) during construction works.

The Murrumbidgee Unregulated River WSP also includes rules on the location of new works and extraction from existing works to protect high priority groundwater dependent ecosystems (GDE), high priority karst systems and other environmentally sensitive areas and provides conditions on works undertaken in the vicinity of GDEs.

The Aquifer Interference Policy (AIP) was established to define the assessment process for development applications in terms of their potential impacts on aquifers, to clarify the requirements for obtaining water licenses for aquifer interference activities, and to define the considerations for assessing potential impacts on key water-dependent assets. The policy focuses on activities that remove water from aquifers for non-water supply purposes.

The WM Act defines an aquifer interference activity as that which involves any of the following:

- The penetration of an aquifer.
- The interference with water in an aquifer.
- The obstruction of the flow of water in an aquifer.
- The taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.
- The disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

The AIP clarifies water licensing requirements and details how these potential interference activities will be assessed under relevant planning and approvals processes. The policy provides ‘minimal impact considerations’ to evaluate potential impacts on groundwater levels, pressures, and quality for different categories of groundwater sources. The policy also includes provisions for water take from a source following the cessation of the aquifer interference activity.

According to the AIP, a water licence is required under the WM Act (unless an exemption applies, or water is being taken under a basic landholder right) where any act by a person carrying out an aquifer interference activity causes:

- the removal of water from a water source; or
- the movement of water from one part of an aquifer to another part of an aquifer; or
- the movement of water from one water source to another water source, such as:
  - from an aquifer to an adjacent aquifer; or
  - from an aquifer to a river/lake; or
  - from a river/lake to an aquifer.

According to the AIP, the assessment of impacts on surface water sources, groundwater and GDEs is based on the project proponents’ ability to demonstrate:

1. The capacity to obtain the necessary licences to account for the take of water from a given source, or if licences are unavailable, that the Project has been designed to prevent the take of water;
2. That adequate arrangements will be in place to meet the 'minimal impact considerations' defined in the policy; and
3. Proposed remedial actions for impacts greater than those that were predicted as part of the relevant approval.

The 'minimal impact considerations' provided in the AIP have been developed for impacts on groundwater sources, connected water sources, and their dependent ecosystems, culturally significant sites and water users. These considerations are defined for 'highly productive' and 'less productive' groundwater sources, both of which are further grouped into categories according to aquifer type (e.g. alluvial, coastal sands, fractured rock, etc.). Two levels of 'minimal impact considerations' are provided, and if the predicted impacts are less than the Level 1 impact considerations, the impacts from the project would then be considered acceptable. If the predicted impacts are greater than the Level 1 considerations, studies would be required to fully assess these impacts.

For the purposes of this study, a desk-top assessment of the potential impact of the proposed works on the Lachlan Fold Belt MDB Groundwater Source (which forms part of the Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources, 2011) and Alluvial Water Sources (Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources, 2012) has been undertaken based on the criteria described in the AIP and re-produced in **Table 2-1**.

Table 2-1: Minimal Impact Considerations for Aquifer Interference Activities (Level 1)

Aquifer	Water table	Water pressure	Water quality
Alluvial Water Sources	Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic “post-water sharing plan” [1] variations, 40m from any high priority groundwater dependent ecosystem or high priority culturally significant site listed in the schedule of the relevant water sharing plan; or A maximum of a **2 m** decline cumulatively at any water supply work.	A cumulative pressure head decline of not more than 40% of the post-water sharing plan” pressure head above the base of the water source to a maximum of a **2 m** decline, at any water supply work.	(a) Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity; and (b) No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. Redesign of a highly connected[2] surface water source that is defined as a “reliable water supply” [3] is not an appropriate mitigation measure to meet considerations (a) and (b) above.
Lachlan Fold Belt MDB Groundwater Source		A cumulative pressure head decline of not more than 40% of the “post-water sharing plan” pressure head above the top of the relevant aquifer[4] to a maximum of a **3 m** decline, at any water supply work.	

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1 “post-water sharing plan” – refers to the period after the commencement of the first water sharing plan in the water source, including the highest pressure head (allowing for typical climatic variations) within the first year after commencement of the first water sharing plan;

2 “Highly connected” surface water sources are identified in the Regulations and will be based those determined during the water sharing planning process;

3 “Reliable water supply” is as defined in the SRLUP

4 “relevant aquifer” in relation to alluvial water sources is defined in the relevant WSP and relates to that part of the aquifer that can be utilised for productive purposes.

2.3 ***Fisheries Management Act 1995*** (FM Act)

The FM Act provides for the protection, conservation, and recovery of threatened species defined under the Act. It also makes provision for the management of threats to threatened species, populations, and ecological communities defined under the Act, as well as the protection of fish and fish habitat in general. In particular, the FM Act has mechanisms for the protection of mangroves, seagrasses and seaweeds on public water, land and foreshores. It is an offence to harm marine vegetation without a permit from NSW Department of Industry and Investment (Fisheries).

None of these protected matters are present onsite are therefore do not represent constraints to development, however, DPI Water have mapped Church Creek within the site as Key Fish Habitat. Where possible, future works should avoid disturbances to the creek bed and bank including riparian vegetation to protect Key Fish Habitat. Any future works under Part 4 of the EP&A Act involving the dredging of the creek bed, land reclamation, excavations to the bed or bank or obstruction of fish passage may require a Part 7 Permit under the FM Act and consultation with DPI Water. For works under Part 5 of the EP&A Act clauses 199 and 200 of the Act apply depending on whether dredging or reclamation works are being undertaken by or on behalf of a council or a pubic authority other than a council. Clauses 199 and 200 specify where a permit is required and where notification to the Minister is required.

2.4 NSW Government Flood Prone Land Policy

The primary objective of the NSW Government Flood Prone Land Policy is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible.

The Policy devolves the management of flood prone land, primarily, to local government. The Floodplain Development Manual 2005 has been prepared by the government to guide councils in the implementation of the Policy. In addition, the NSW Department of Planning and Environment has a lead role in the development of regional strategies and plans under the EP&A Act and therefore Councils need to be cognisant of regional strategies and plans, when determining standards and implementation arrangements for flood prone land in their service areas.

It is recommended that a detailed flood study or a refinement of the work undertaken here be undertaken after detailed survey information is captured at the site. This would confirm flood extents and allow the placement of proposed development features that need to be clear of surface water flows.

2.5 Queanbeyan Local Environmental Plan 2012

The Queanbeyan LEP (2012) makes local environmental planning provisions for land in the Queanbeyan-Palerang Regional Local Government Area (LGA) in accordance with the relevant standard environmental planning instrument under section 3.20 of the EP&A Act.

The subject lots are located on land which is currently zoned as E4 Environmental Living. Council has prepared a planning proposal to allow for a cemetery on the subject land. This requires the definition of 'cemetery' to be added to Schedule 1 Additional Permitted Uses as this land use is otherwise prohibited in the E4 Environmental Living zone. This will be done as an amendment to the Queanbeyan Local Environmental Plan 2012.

Pursuant to clause 7.2 the objectives of the LEP with regards to flood planning include minimising the flood risk to life and property associated with the use of land, allowing development on land that is compatible with the land's flood hazard and taking into account climate change and avoiding significant adverse impacts on flood behaviour and the environment. The clause applies to land at or below the flood planning level. For the purposes of the LEP, “land at or below the flood planning level” means the level of a 1:100 ARI (Average Recurrence Interval) flood event plus 0.5 metres freeboard. Further assessment is required to understand the flooding extent of the site and determined what portions of the site are within the flood planning level.

Pursuant to clause 7.4 the objective of the LEP with regards to riparian land and watercourses includes protecting and maintaining water quality within water courses, stability of bed and banks, aquatic and riparian habitats and ecological processes. This clause applies to land identified as “Watercourse” on the Riparian Lands and Water Courses Map and all land within 40 m of the top of the bank of each watercourse on that land. Before determining a development application, council must consider all potential adverse impacts to riparian and watercourses, whether the development is likely to increase water extraction and any appropriate measures to avoid minimise and mitigate impacts of the development. Church Creek which flows through the Site is also marked on the LEP Riparian and Watercourses Map.

3 Methodology

This hydrology and hydrogeology assessment was undertaken using the steps outlined in the sections below covering:

- Data collation and review;
- Site conceptualisation;
- Hydrological and hydraulic modelling; and,
- Environmental constraints assessment.

3.1 Data collation and review

Data was collated from several online sources, including spatial databases, the Bureau of Meteorology (BoM) and government legislative sites. Data was categorised as:

- General information;
- Groundwater information; or,
- Surface water information.

The general information included spatial datasets, climate data and any relevant reports or associated project data.

Groundwater information consisted of the current NSW legislation data sets and any previous hydrogeological studies in the area. Online databases were also accessed to identify existing groundwater use in the area and the locations of any significant/registered groundwater dependent ecosystems (GDEs). Surface water information included any relevant previous studies and collated hydrological data, such as contour information and watercourses.

The following data sources were interrogated during this assessment:

- Previous studies, including but not limited to:
    - Groundwater Report on Beatty Hill, Old Cooma Road Development Application, 2001, Hyrdroilex Geological Consultants
    - Geotechnical Investigation Report, 1241 Old Cooma Road, Googong, NSW, ACT Geotechnical Engineers, 2017, Geotechnical Engineers Pty Ltd,
    - Flood analysis and concept culvert design, Rural Residential Subdivision, Burra Road, Mount Pleasant, 2015, CIC Australia P/L.
- Intensity-Frequency-Duration (IFD) information, Bureau of Meteorology
- NSW Office of Water (NOW) PINNEENA Groundwater database;
- Bureau of Meteorology (BoM) Groundwater Explorer database; and
- BoM GDE Atlas.
- Local contour maps

The above information was synthesised to aid in the development of the site conceptualisation and environmental constraints assessment. The outcomes are discussed in **Section 4**.

3.2 Site conceptualisation

A conceptual understanding of the site was developed as part of the desktop study. The conceptualisation incorporated hydrological systems, hydrogeological systems and any existing human or environmental receptors (determined through the data collation and review stage). The outcome of this conceptualisation is discussed in **Section 4.1**

3.3 Hydrological and hydraulic modelling

To categorise the existing design flood conditions from Church Creek at the site, the use of regionalised flood models was required as no appropriate water level or flow information exists in or near the catchment of interest. The flood volumes and levels were determined using a combination of models that build on each other. Thus, the Regional Flood Frequency Estimation (RFFE) model (University of Western Sydney) provides representative runoff rates to calibrate the RORB model in the absence of local gauged data. The RORB model generates likely flow conditions for designated drainage lines which are fed in to the HEC-RAS model together with local site information (e.g. land cover) to calculate water level conditions and hence potential for flooding as defined by over-banking under specific rainfall conditions.

3.4 Environmental constraints assessment

The environmental constraints assessment utilised the site conceptual model as well as various other data sources to identify potential areas of concern or limitations to be considered. Constraints that were examined included water quality, water quantity, groundwater flows and flood behaviour. Constraints were categorised according to risk and gaps in the available data requiring further investigation were identified.

4 Existing environment

4.1 Site conceptualisation

Church Creek is a third order watercourse within the Project Site marked on the LEP Riparian and Watercourses Map, that crosses the site from the south to the west (**Figure 4-2**). The creek receives discharge from several smaller tributaries, and the flow direction is to the north-west. There are a number of other smaller non-defined overland flow paths that cross the site from culverts under the roads that border the site.

Two other unnamed first and second order water courses have also been mapped from the local contour maps as feeding into Church Creek (shown in **Figure C-1** in Appendix C) however it is unclear if these watercourses actually exist or if they meet the definition of a river under the WM Act. Further site survey and Top of Bank mapping would be required to confirm which watercourses within the subject lots meet the definition of a river under the Act.

The Guidelines for Riparian Corridors on Waterfront Land (DPI Water) recommends Vegetated Riparian Zones (VRZs) have a width based on watercourse order as classified under the Strahler System. The width of the VRZ should be measured from the top of highest bank on both sides of the water course. **Table 4-1** below lists DPI Water recommended riparian corridor (RC) widths based on Strahler Stream Order.

Table 4-1: Recommended riparian corridor (RC) widths

Watercourse type	VRZ width	Total RC width
1st order	10 metres	20 m + channel width
2nd order	20 metres	40 m + channel width
3rd order	30 metres	60 m + channel width
4th order and greater	40 metres	80 m + channel width

A review of the NSW Office of Water (NOW) surface water database identified no registered stream flow monitoring gauges near the site, with the closest stream gauge (# 410770) located on the Queanbeyan River at the ACT border (approximately 12.5 km north of the Project site).

Groundwater flow dynamics in the study area are also not fully delineated as no active monitoring bores could be identified in or around the study area to allow for monitoring of groundwater levels. However, there is an old well located on the site that may have been used as a water source in the past.

Aspects of this conceptualisation are discussed in greater detail in the sections below.

4.1.1 Climate

Rainfall and temperature data was obtained from the Bureau of Meteorology (BoM) online climate database for the Tuggeranong (Isabella Plains) AWS (BoM site 070339) located approximately 10.2 km west of the study area. The regional climate is categorised as cool temperate, with year-round rainfall (average annual rainfall 631.3 mm) with a seasonal distribution showing greater rainfall in the summer months (**Figure 4-1**). Mean maximum temperatures range from 11.8 °C in July to 29 °C in January (**Figure 4-1**).

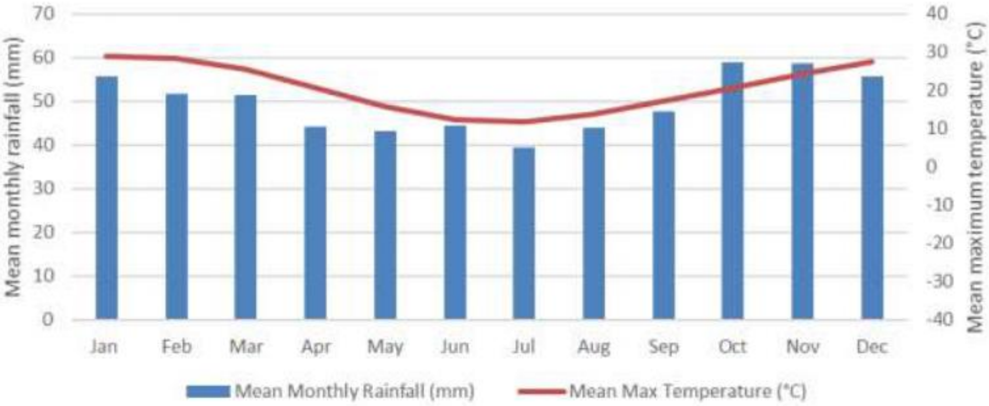

Figure 4-1: Monthly rainfall and temperature near the study area

4.1.2 Hydrology

The study area falls within the Murrumbidgee catchment (**Figure 4-2**). The Church Creek passes through the southern portion of the site in a south-east to north-west direction that drains local farmland (and a soon to be constructed housing development (**Figure 4-2**).

Sheet flow from surface water run off during rainfall events may potentially cause impacts in isolated areas and may enhance local recharge to any perched water tables.

4.1.1 Regional geology

The regional geological setting of the property is shown in **Figure 4-3**. The study area is located within a complex structural corridor within rock sequences of Silurian age, regionally described as the Canberra Graben. This structural feature is bounded to the west by the Murrumbidgee Batholith, comprised of granodioritic intrusives, and to the east by the Cullarin Horst, a complex geological province represented by deformed Ordovician-aged sediments intruded by granites (HGC, 2001).

The 1:100,000 Canberra Geology map indicates that the site is located mostly on the Colinton Volcanics bedrock, with a small part south of the study area located on the Williamsdale Volcanics. Two faults separate the Colinton Volcanics from the Deakins Volcanics approximately 3.5 km west and from Cappanana formation approximately 4 km east of the study area.

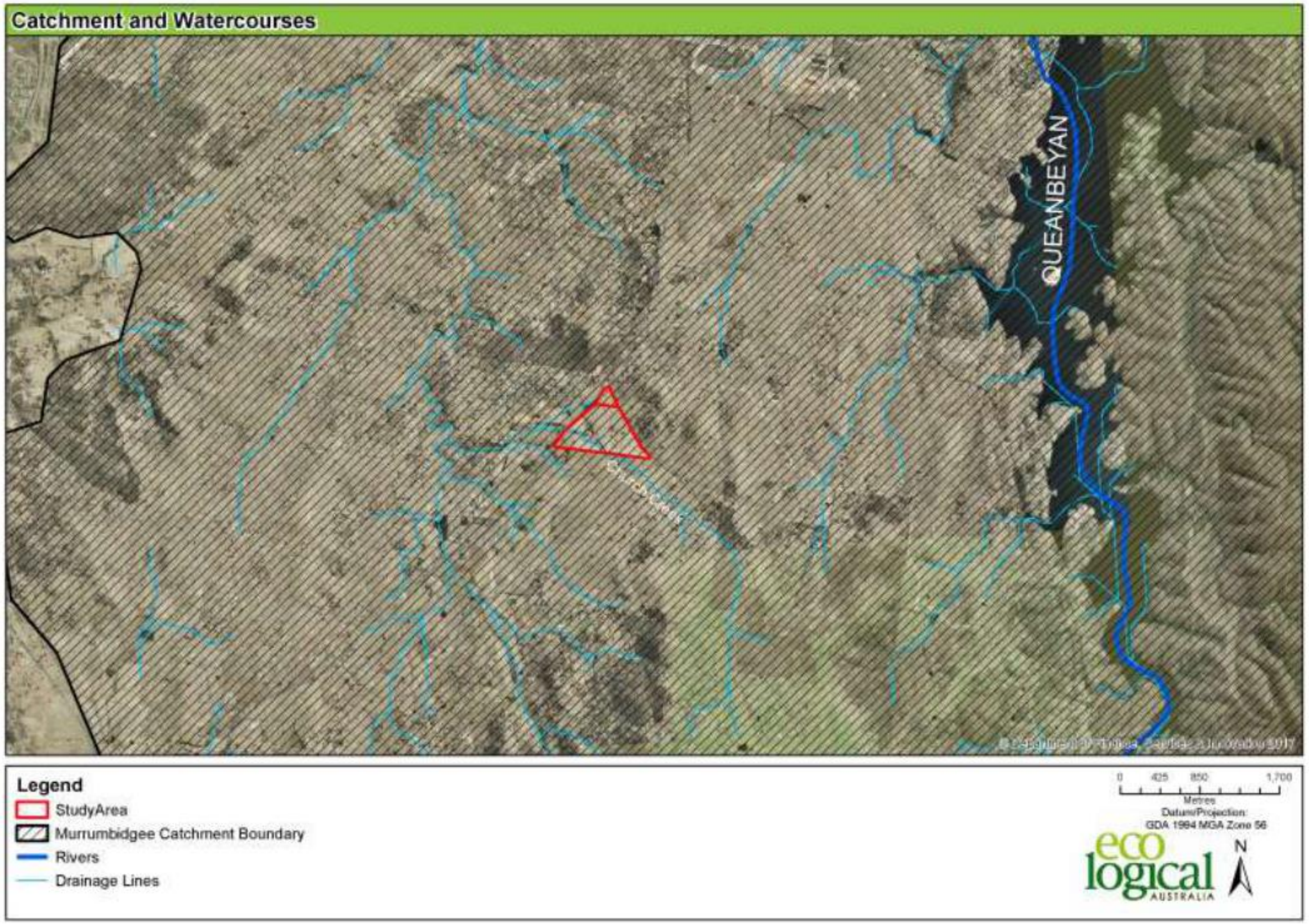

Figure 4-2:Catchment and watercourses in the study area

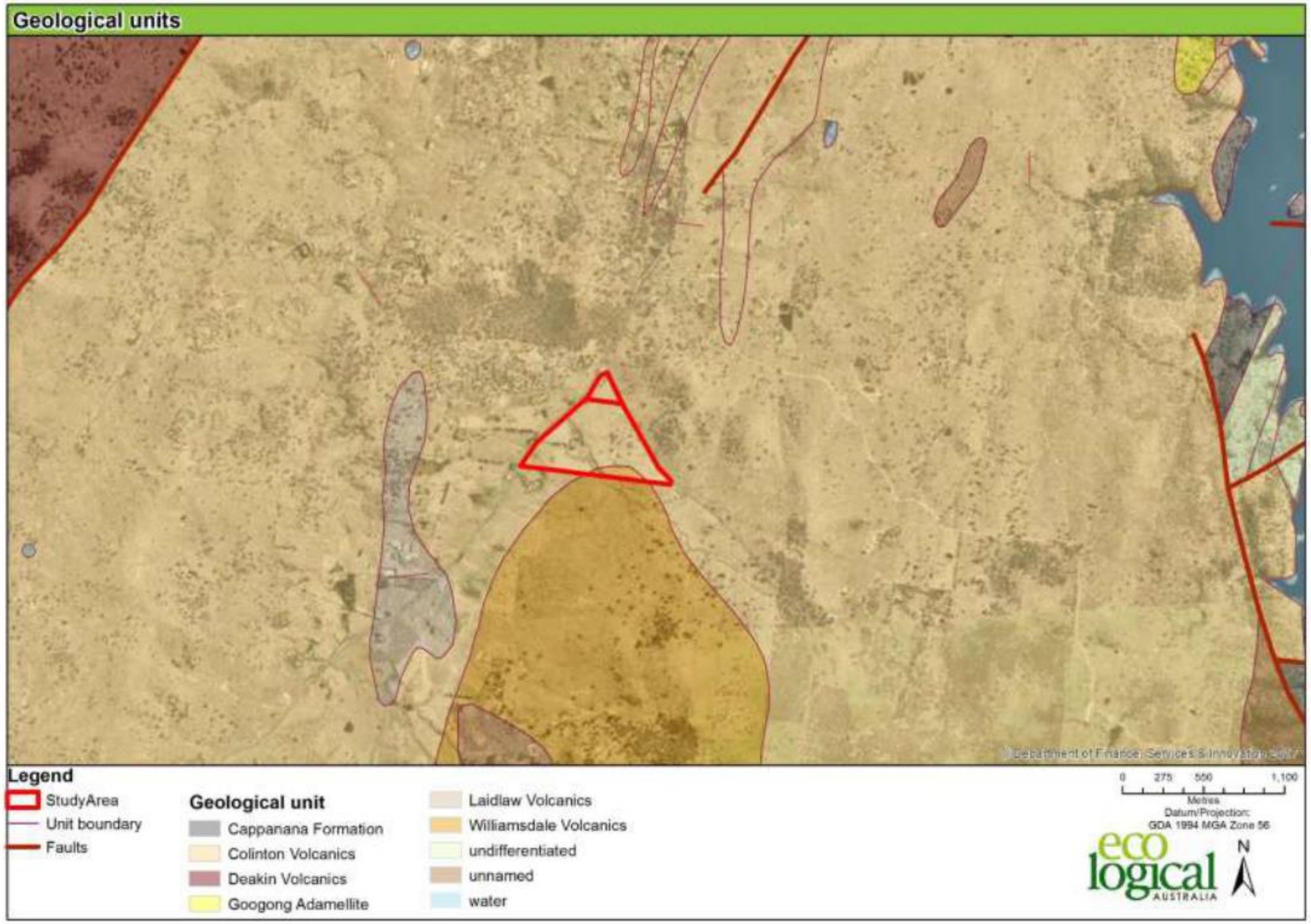

Figure 4-3: Geological units

4.1.2 Subsurface soil profile

The subsurface conditions near the study site was investigated via ten auger holes (ACT Geotechnical Engineers, 2017) and is summarized in **Table 4-2**, below.

Table 4-2: Generalised soil and sub-soil conditions at the site (ACT Geotechnical Engineers, 2017)

Geological profile	Typical Depth Interval	Description
Topsoil	0 m to between 0.1m and 0.2m	SILTY SAND; fine to coarse sand, low plasticity silt, brown, some grass roots, dry to moist, loose.
Slopewash	Between 0.1m and 0.2m to between 0.4m and 0.6m	SILTY SAND; fine to medium sand, low plasticity silt, pale grey-brown, dry to moist, medium dense.
Alluvial/ Residual Soil	Between 0.1mto 0.6 m to between 0.3m and >3.5m	SILTY SANDY CLAY, SILTY CLAYEY SAND, & SANDY CLAY; fine to coarse sand, low to medium and some medium to high plasticity clay, red-brown, orange-brown, brown, grey, dry to moist and moist, stiff to very stiff and dense.
Bedrock	Typically, from 0.2 to 1 m and below	DACITE; fine to coarse grained, orange brown, grey, highly weathered (HW) and weak rock grading to moderately weathered (MW) and medium strong rock.

4.1.3 Hydrogeology

Interrogation of the NOW online groundwater database and the BoM Groundwater Explorer database identified 38 registered groundwater bores within approximately 2 km of the project area, with only two of the 38 bores located within the project area as shown in **Figure 4-4**. No water level/quality data for these bores were available in the NOW PINNEENA database. The five registered bores within (or within 200m of) the project boundary were all drilled in the 1950s and are unlikely to be functioning today. All other bores were drilled since 1986 for stock and domestic use (29 for household use; two for stock use and two of unknown use). As such, there is no requirement for these bores to monitor or report level or quality information, though property owners may have this information.

A summary of registration details for these bores is provided in **Appendix A.** Thirty-four of the 38 bores were drilled to about 20 m or deeper, giving good evidence that local groundwaters are deep and in the fractured rock aquifers. The lithology of two of the shallow bores is not provided and these likely represent perched lenses in the weathered regolith as the other two shallow bores are reportedly completed in clay.

Groundwater in the area is expected to be associated with fractures within bedrock and contained within joints, fractures, faults and fissures in the rock mass (HGC, 2001). The closest fault observed was approximately 1.5 km north of the study area (**Figure 4-3**). A recent geotechnical investigation at this site (ACT Geotechnical Engineers, 2017) augered ten holes to a maximum depth of 3.5 m within the project area (**Figure 4-5**). No groundwater was encountered in any of the augered holes, with the soils mostly dry to moist. Temporary, perched seepages might be expected following rainfall within the more pervious soils in the southern area, with shallow hard rock encountered in the north (**Figure 4-5**).

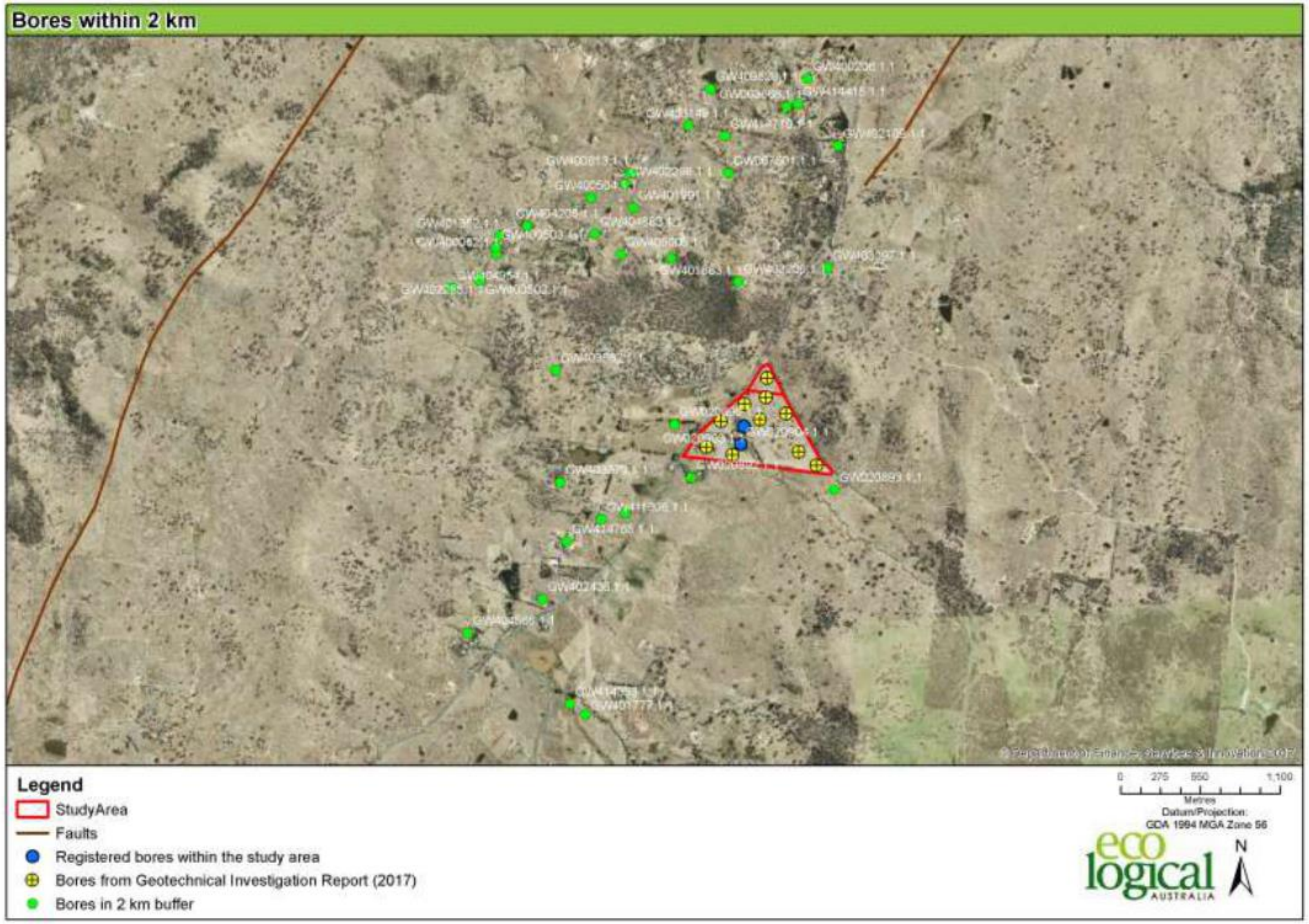

Figure 4-4: Groundwater bores around the study area

Figure 4-5: Groundwater bores within the project area.

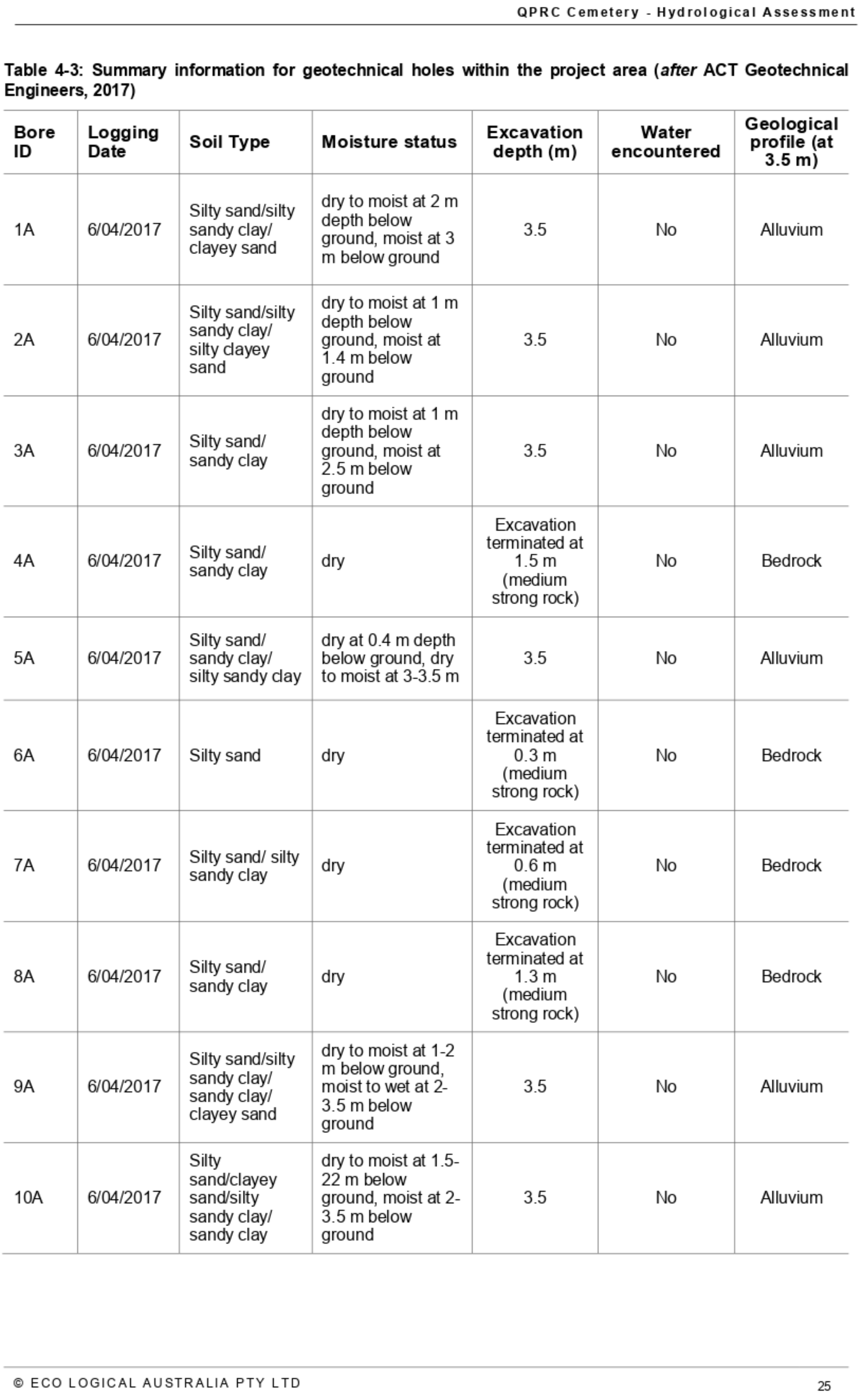

Table 4-3: Summary information for geotechnical holes within the project area (*after* ACT Geotechnical Engineers, 2017)

Bore ID	Logging Date	Soil Type	Moisture status	Excavation depth (m)	Water encountered	Geological profile (at 3.5 m)
1A	6/04/2017	Silty sand/silty sandy clay/ clayey sand	dry to moist at 2 m depth below ground, moist at 3 m below ground	3.5	No	Alluvium
2A	6/04/2017	Silty sand/silty sandy clay/ silty clayey sand	dry to moist at 1 m depth below ground, moist at 1.4 m below ground	3.5	No	Alluvium
3A	6/04/2017	Silty sand/ sandy clay	dry to moist at 1 m depth below ground, moist at 2.5 m below ground	3.5	No	Alluvium
4A	6/04/2017	Silty sand/ sandy clay	dry	Excavation terminated at 1.5 m (medium strong rock)	No	Bedrock
5A	6/04/2017	Silty sand/ sandy clay/ silty sandy clay	dry at 0.4 m depth below ground, dry to moist at 3-3.5 m	3.5	No	Alluvium
6A	6/04/2017	Silty sand	dry	Excavation terminated at 0.3 m (medium strong rock)	No	Bedrock
7A	6/04/2017	Silty sand/ silty sandy clay	dry	Excavation terminated at 0.6 m (medium strong rock)	No	Bedrock
8A	6/04/2017	Silty sand/ sandy clay	dry	Excavation terminated at 1.3 m (medium strong rock)	No	Bedrock
9A	6/04/2017	Silty sand/silty sandy clay/ sandy clay/ clayey sand	dry to moist at 1-2 m below ground, moist to wet at 2-3.5 m below ground	3.5	No	Alluvium
10A	6/04/2017	Silty sand/clayey sand/silty sandy clay/ sandy clay	dry to moist at 1.5-22 m below ground, moist at 2-3.5 m below ground	3.5	No	Alluvium

4.1.4 Water chemistry

No salinity data was recorded from the 38 registered bores located within 2 km distance of the study area. A previous study at Old Cooma Road (HGC, 2001), located approximately 3 km south-west of the project area, reported that the likely total salinity is expected to be in the range of 500-800 mg/L, with elevated bicarbonate and total hardness in the range of 300-500 mg/L. The significant number of local stock and domestic bores suggests that deeper, fractured rock, aquifers provide water of reasonable quality.

4.1.5 Groundwater Dependent Ecosystems (GDEs)

No potentially significant GDEs could be identified within a 2 km buffer around the site based on a high level, desk-top assessment of available data (**Figure 4-6**).

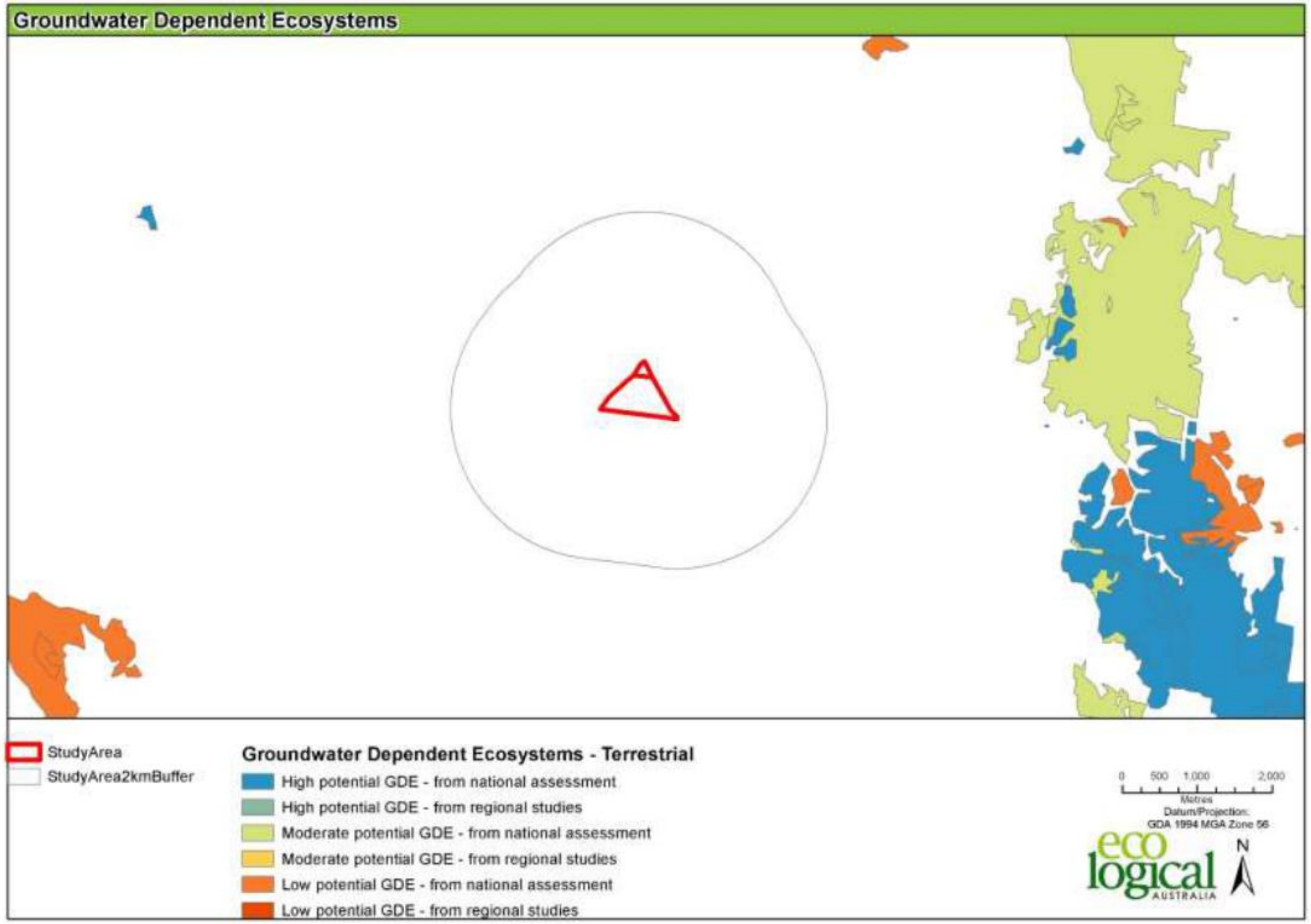

Figure 4-6: Groundwater Dependent Ecosystem map

5 Hydrological and Hydraulic modelling

5.1 Flooding assessment

For the purposes of identifying the flood conditions for the site, only catchments that drained to the defined Church Creek waterway were modelled. Drainage from other catchments were visually identified based on aerial photography and site survey as they contained no defined waterways.

To categorise the existing design flood conditions from Church Creek at the site, the use of regionalised flood models was required as no appropriate water level or flow information exists in or near the catchment of interest. The flood volumes and levels were determined by the Regional Flood Frequency Estimation (RFFE) model (University of Western Sydney), RORB (Monash University and Hydrology and Risk Consulting) and Hydrologic Engineering Centre's River Analysis System (HEC-RAS) (U.S. Army Corps of Engineers) programs, which calculate flow and water level conditions.

The RFFE model was parameterised using GIS datasets. The model was used to determine representative runoff rates to calibrate the RORB model in the absence of local gauged data. The RORB model was parameterised using GIS datasets, Bureau of Meteorology's Intensity-Frequency-Duration (IFD) information, the Australian Rainfall and Runoff (2016) data hub and the RFFE outputs. The HEC-RAS model was parameterised using GIS datasets, RORB model outputs and local site information (e.g. land cover).

Event durations from 10 minutes to 7 days were run through the RORB model to determine the critical flood duration and volume for the 10% Annual Exceedance Probability (AEP), 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP events. AEP is defined as the likelihood (e.g. 1%) each year that a flood of a particular magnitude will be exceeded. The AEP may be directly compared to the Average Recurrence Interval (ARI) which reports the probability (e.g. 1 in 100 year) that a flood of a particular magnitude will be exceeded. The AEP and ARI are two ways of expressing the same information (i.e. the 1% AEP is essentially equivalent to the 1 in 100 ARI) and they are approximately the inverse of each other (1/100-year ARI ≈ 1% AEP). As it is statistically feasible to have multiple ARI events within the designated interval, the ARI has fallen out of favour in deference to reporting the AEP for a given location.

As the AEP numbers become smaller the magnitude of the flows increases to a maximum flow which designates the probable maximum flood (PMF). The PMF is generally only used as a design criterium for dam construction and structures that should not get flooded (e.g. electrical sub stations) with a risk level based on a specific AEP (generally 1% – or an ARI equivalent of 1 in 100 years) is commonly used for flood assessment purposes.

The critical event duration (the event with the highest peak flow) for the study catchment was 6 or 12 hours, depending on the AEP event examined. The peak flows from these events are outlined in at the downstream end of the RORB model (as shown in **Figure B-3** in Appendix B). Please note that unless a specific catchment (relating to the RORB model) or chainage (reported in the HEC-RAS model) location is specified, all table results in this document refer to the downstream end of these catchments.

Table 5-1: Peak flows for existing conditions

AEP (%)	Catchment Peak flow (m^3/s)
10%	7.064
1%	18.879
0.5%	22.081
0.2%	27.069
0.1%	32.230

The flows for the relevant sub-catchments were used as inputs to the HEC-RAS model. The water levels within Church Creek adjacent to the existing dwelling for each of the peak flow events are shown in **Table 5-2**. The depths are the depth of water from the surface to the lowest point in the cross section.

Table 5-2: Peak water levels for existing conditions

AEP (%)	Catchment Water Depths (m)
10%	1.98
1%	2.57
0.5%	2.73
0.2%	2.98
0.1%	3.06

Due to detailed survey information not being available, the extent of these flows across the landscape cannot be precisely determined. However, based on the results, it is likely that the flow events up to the 1% AEP event would be contained within the banks and for some sections, larger events would be contained. It should be noted that the sections used here were derived from field estimates of approximate heights and distances and were not surveyed sections. Detailed field survey is required to provide accurate potential flood extents mapping.

It should also be noted that the RORB and HEC-RAS modelling relies on the accuracy of the existing DEM and any available stream bathymetry. The resolution of the most accurate available DEM was still insufficient to define the bathymetry of Church Creek and its tributaries which limits the ability to accurately define potential flood extents (i.e. to be able to compare the modelled drainage with the mapped creeks in **Figure B-3** in Appendix B).

The cross-sections are numbered in HEC-RAS based on their respective chainage calculated from the end of the model (i.e., starting from 0 at the downstream end of the model and working towards the upstream end). Each of these cross sections are identified in HEC-RAS base on their chainage. The modelled cross-sections are listed in **Table 5-3** with their corresponding HEC-RAS chainages.

Table 5-3: HEC-RAS cross sections with chainages

Cross-section ID	Chainage from downstream end
1	1.4864
2	35.2087
3	73.5788
4	110.5611
5	136.689
6	173.6859
7	210.2461
8	248.3667
9	293.1794
10	321.1871
11	353.0161
12	393.1465
13	423.6517
14	446.6596
15	465.8139
16	477.9417
17	519.0018
18	537.7618
19	571.1563
20	602.9097

Figure 5-1 to **Figure 5-6** show selected cross-sections from Church Creek with corresponding modelled water depths for indicated AEP (labelled as corresponding ARIs in the model). Locations of cross-sections are shown on **Figure B-7** in **Appendix B**. Figures start (**Figure 5-1)** at the upstream entry to the project area and finish beyond the western margin (**Figure 5-6**) to the west of the main road. This latter site shows flow extending outside the channel and is an artefact of the modelling, therefore the flows would be contained within the channel extent.

Whilst the section at location 4 appears to indicate over-topping for the 1% AEP, this site was only approximately surveyed and the influence of local topography needs to be considered in further detail. The site is downstream of the confluence of a modelled drainage line (at section 7) that is likely to amplify the actual modelled impact.

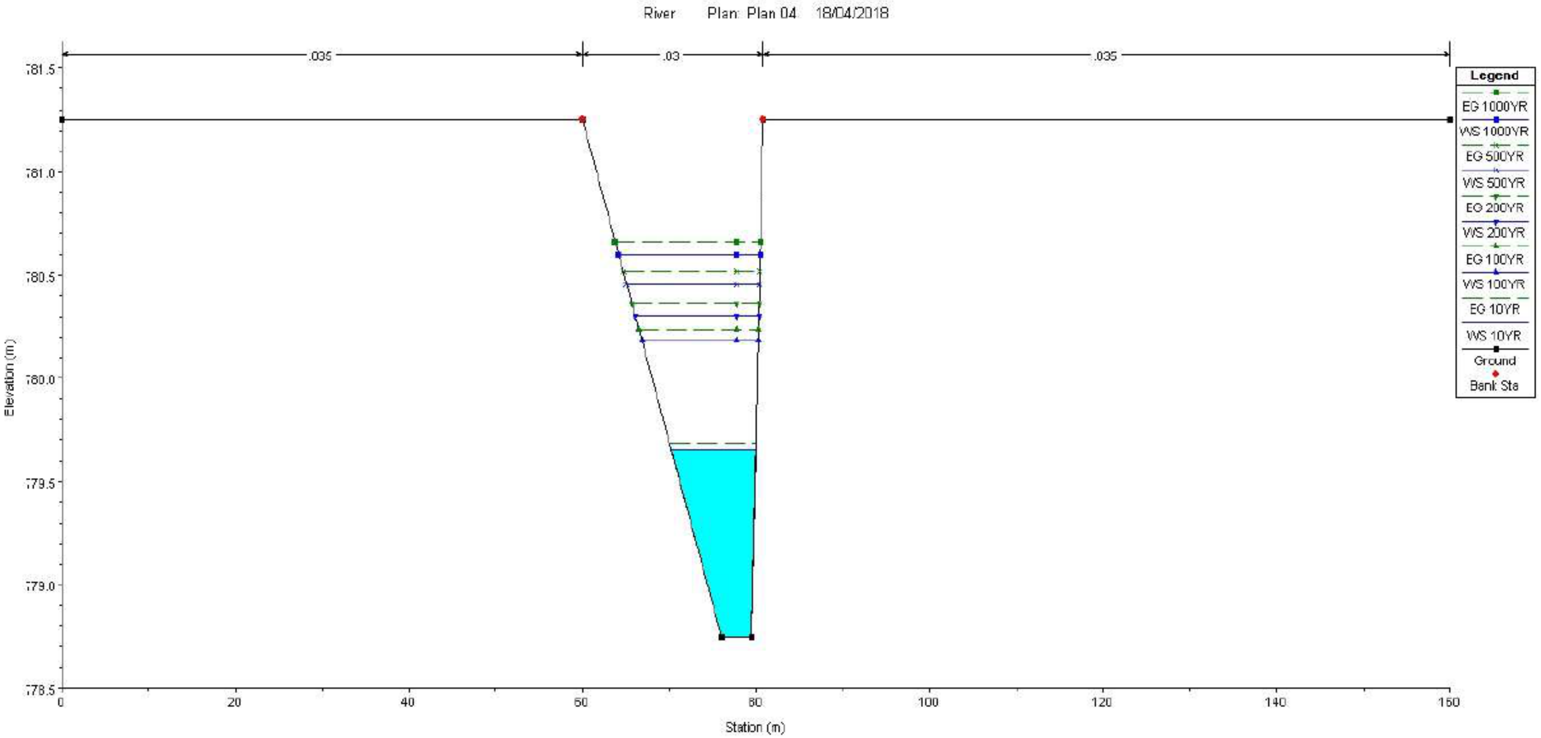

Figure 5-1: Water level elevations (m) at cross-section 20 (Chainage 602.9097) for the 10% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP events[5].

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[5] Note: WS=Water Surface, EG = Energy Grade.

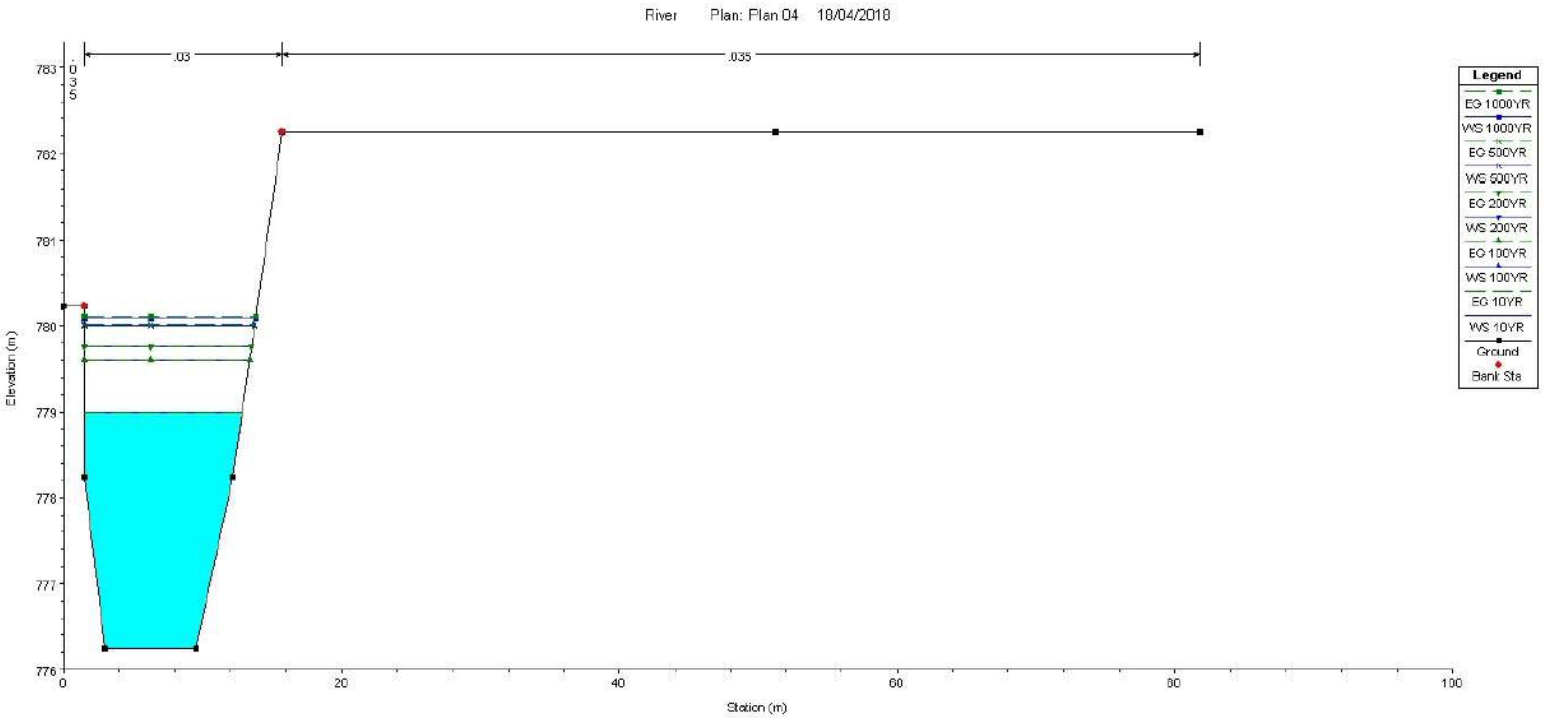

Figure 5-2: Water level elevations (m) at cross-section 16 (Chainage 477.6417) for the 10% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP events.

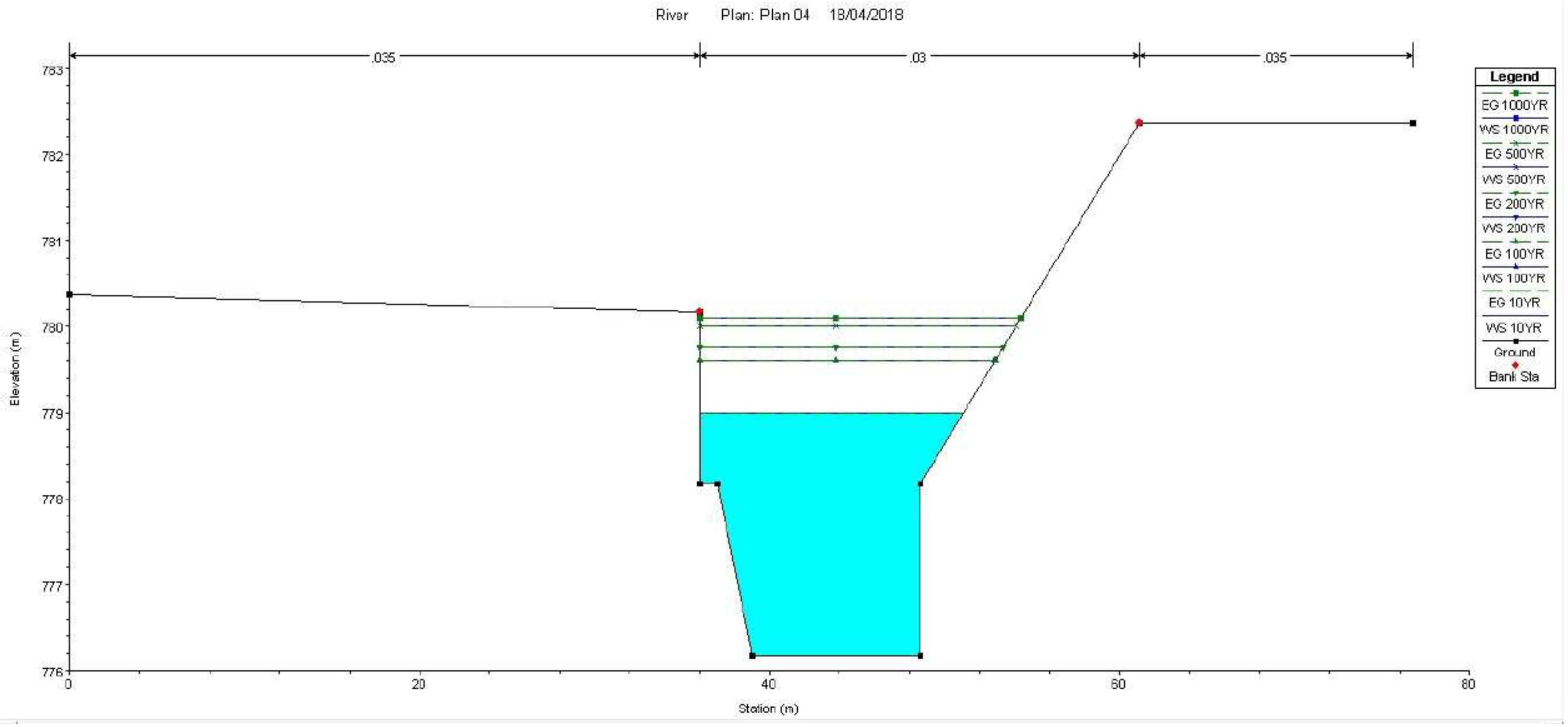

Figure 5-3: Water level elevations (m) at cross-section 13 (Chainage 423.6517) for the 10% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP events.

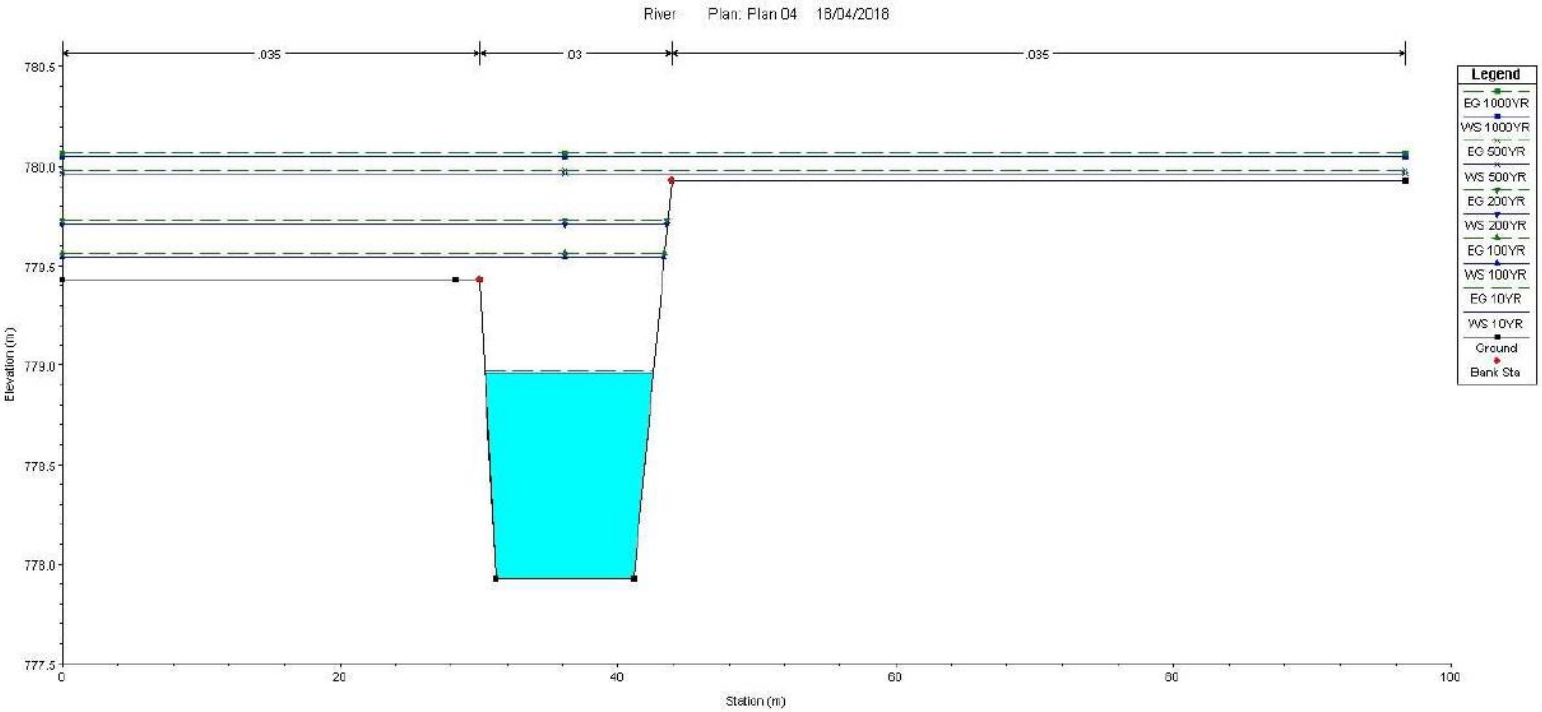

Figure 5-4: Water level elevations (m) at cross-section 7 (Chainage 210.2481) for the 10% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP events.

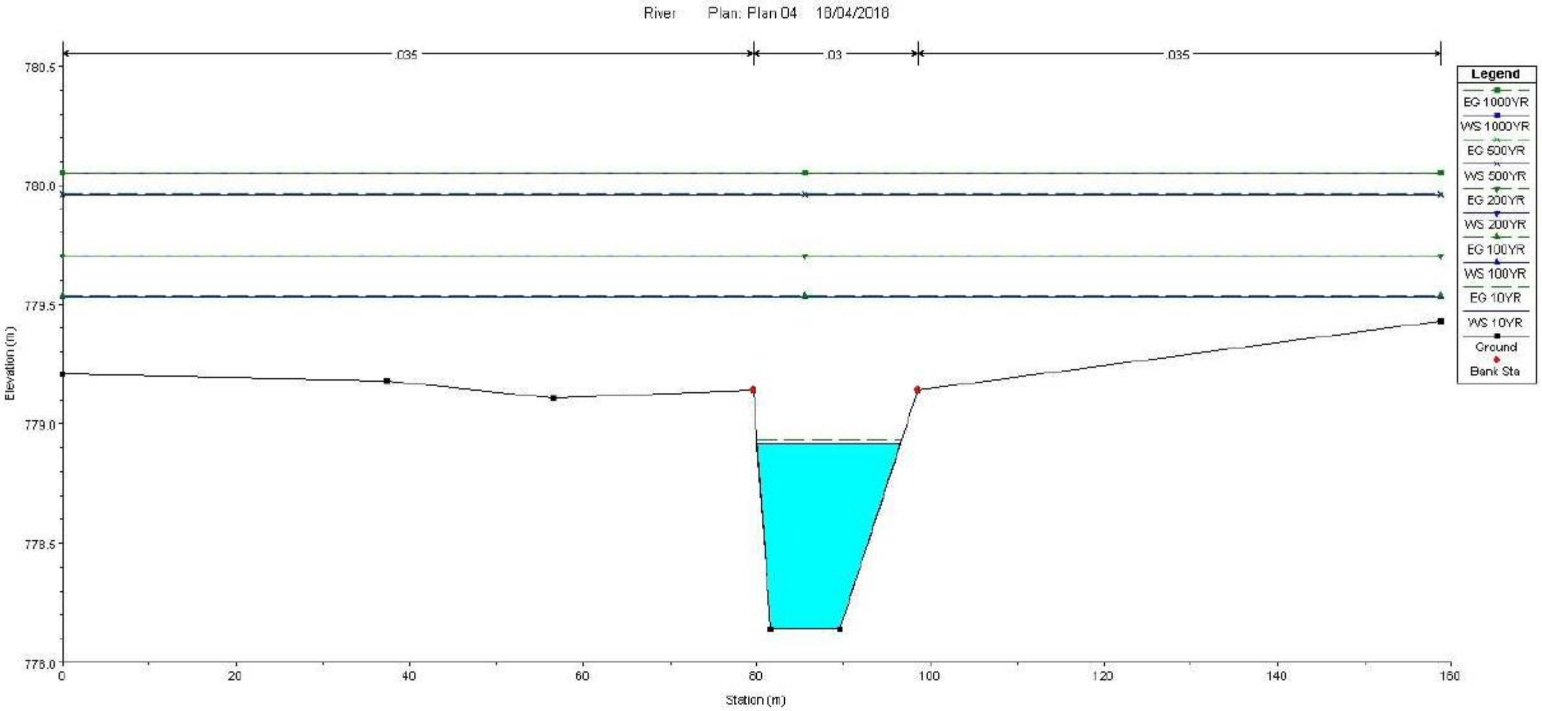

Figure 5-5: Water level elevations (m) at cross-section 4 (Chainage 110.5611) for the 10% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP events.

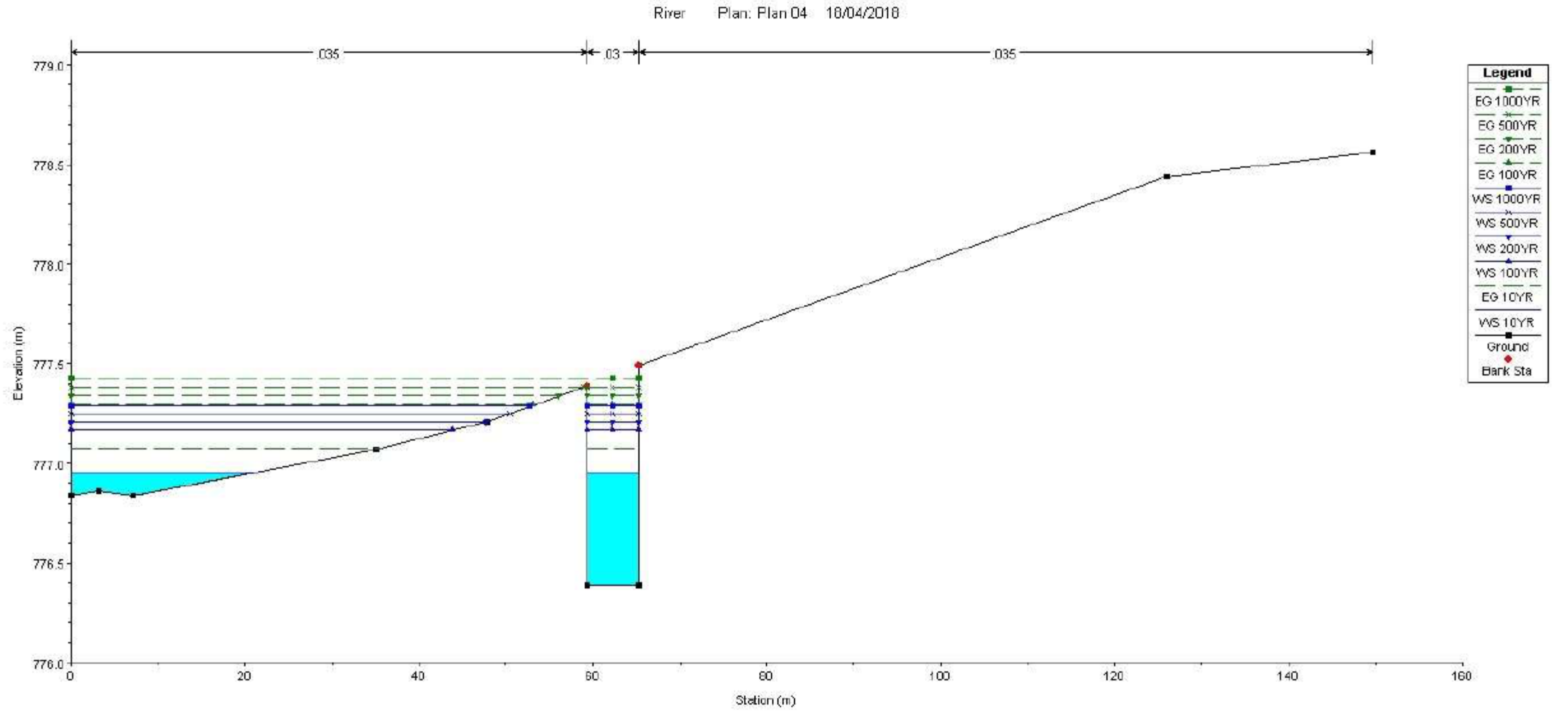

Figure 5-6: Water level elevations (m) at cross-section 1 (Chainage 1.4864) for the 10% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP events. Noting that the water on the left hand side of the cross section is an artefact of modelling and that the flow would be contained within the cross section.

5.1.1 Implications of results for the Proposed Development

Modelling results indicate that flooding from Church Creek is unlikely to expand widely across the property and is therefore likely to have a limited to no impact on the use of the property as a cemetery.

It is recommended that a refinement of the modelling be undertaken following detailed survey information captured at the site. This would confirm flood and overland flow extents and allow considered placement of any proposed development features that need to be clear of surface water flows.

6 Constraints assessment

6.1 Hydrology

The hydrology constraints assessment assesses whether the proposed development has the potential to alter existing surface water flow patterns, affect drainage capacity and modify the existing flood regime. Any alteration of surface permeability has the potential to increase peak surface water flows, sheet flow and runoff volumes.

Table 6-1: Hydrology Constraint 1

Item	Description
Issue	*Flooding from Church Creek* Flood waters from the Church Creek have the potential to inundate the site. This would only occur during high flow events.
Map/Figure	**Figure 5-1** to **Figure 5-6**
Assessment of Issue	**Figure 5-4** to **Figure 5-6** show cross-sections from HEC-RAS models with potential water levels above the banks at the downstream end. Potential flooding under extreme (<1% AEP) events may occur downstream of cross section 7. Provided key infrastructure is set back from the creek this should not cause an issue.
Mitigation option(s)	Once modelling has occurred with detailed survey data, some mitigation options may need to be considered, though would be expected to be minor in nature (e.g. earthworks to form levees).
Final design consideration	To be confirmed based on revised modelling.

Table 6-2: Hydrology Constraint 2

Item	Description
Issue	*Drainage through site* The alteration of the land use of the site will require existing culvert drainage onto the property to be controlled and diverted through the site. This would be combined with the drainage within the site that would need to be managed and controlled through to Church Creek.
Map/Figure	Figure B-3 in Appendix B
Assessment of Issue	It is expected that adequate surface drainage features would be constructed to manage surface water.
Mitigation option(s)	Appropriately designed stormwater infrastructure
Final design consideration	As above.

Table 6-3: Hydrology Constraint 3

Item	Description
Issue	*Water quality / Erosion* The potential for surface water flows to interact with the proposed construction of the cemetery along with its operational activities poses a potential risk that water quality through increased erosion or pollution from chemicals including hydrocarbons. Church Creek is also an erosive stream that over time may change its course due to erosion from flows down the channel.
Map/Figure	Examples of erosion within Church Creek are presented in **Figure 6-1** and **Figure 6-2**.
Assessment of Issue	It is expected that drainage and diversion infrastructure within the site would capture, store and/or discharge surface water appropriately to minimise its impact on Church Creek. The banks within Church Creek may need to be armoured to protect the surrounding site from encroachment from the Creek. Any alterations within the creek would need to manage any impact to existing (or potential) Aboriginal artefacts within and on the banks of the creek.
Mitigation option(s)	Appropriately designed stormwater infrastructure and armouring of creek banks.
Final design consideration	As above.

Figure 6-1: Example 1 of erosion within Church Creek

Figure 6-2: Example 2 of erosion within Church Creek

6.2 Hydrogeology

The hydrogeology constraints assessment assesses whether the proposed development has the potential to impact groundwater in the area. Potential hydrogeological constraints are identified in the following tables and these are followed by an assessment against the minimal impact criteria of the NSW Aquifer Interference Policy.

Table 6-4: Hydrogeology Constraint 1

Item	**Description**
Issue	*Absence of groundwater quality data* An investigation on the NOW PINNEENA online groundwater database and the BoM Groundwater Explorer database showed no available groundwater level and quality data for the thirty-eight registered bores identified within 2 km distance of the study area.
Map/Figure	**Figure 4-4**
Assessment of Issue	A high level / qualified assessment of available online databases could not identify water quality/ water level data from the registered bores within the study area. Available information on bore construction, however, indicates that groundwater levels are deep (>20m) and unlikely to impact on the site. Shallow auger holes (to 3.5m) did not encounter groundwater, indicating dry conditions at least to this depth.
Mitigation option(s)	Conduct sampling rounds for water quality assessments/ water level measurements to validate information cited from previous studies in this area (e.g., HCG, 2001, ACT Geotechnical Engineers, 2017.)
Final design consideration	N/A

Table 6-5: Hydrogeology Constraint 2

Item	**Description**
Issue	*Potential groundwater contamination due to increased recharge* Potential groundwater contamination due to water entering the water table from the grave sites.
Map/Figure	N/A
Assessment of Issue	Surface water flow or sheet flow during a high rainfall event can increase recharge to shallow perched groundwater sources. Increased recharge is likely to result in localised water-level rise and has the potential to enter grave sites which can create potential groundwater contamination issues.

Item	**Description**
	Existing information suggests this not to be an issue, but it is recommended to undertake groundwater monitoring at the site to monitor local conditions.
Mitigation option(s)	Appropriately designed stormwater infrastructure and groundwater monitoring bores.
Final design consideration	N/A

Table 6-6: Hydrogeology Constraint 3

Item	**Description**
Issue	<u>*Reduction of groundwater quantity to impact Groundwater Dependent Ecosystems (GDEs).*</u> Lowering of the groundwater table, and/or disruption of groundwater flow to GDEs if groundwater dewatering is required at any excavated areas (including grave sites), could have the potential to impact on ecosystems. Areas of high groundwater risk may indicate areas of high environmental sensitivity.
Map/Figure	<u>N/A</u>
Assessment of Issue	A high level / qualified assessment of potential GDE occurrence has been made using data from the BoM GDE Atlas (2017). Data suggests that there are no likely aquatic/ terrestrial GDEs present within the study area. There are no water level data observed in the registered bores within the study area to assess the potential for any possible terrestrial vegetation species to be accessing groundwater. A recent study did not encounter groundwater to 3.5 m deep in bores dug in different locations within the study area and the soils were mostly dry to moist (ACT Geotechnical Engineers, 2017). It may be considered that the terrestrial vegetation in the Site is unlikely to be dependent on groundwater to maintain ecosystem health.
Mitigation option(s)	Establish regional baseline groundwater level dataset that includes seasonal variation to confirm depths to groundwater, and whether dewatering is likely to be necessary.
Final design consideration	N/A

Table 6-7: Hydrogeology Constraint 4

Item	Description
Issue	<u>*Salinisation/contamination of groundwater*</u> Impediment of shallow groundwater flow may result in elevation of groundwater tables and transport of salt to the soil zone, inducing salinisation and scalding at the surface. Construction activities (including grave excavations) and interaction of groundwater with the occupied grave sites may result in deterioration of groundwater quality and areas with high environmental sensitivity.
Map/Figure	N/A
Assessment of Issue	The proposed interments will be to a maximum depth of 3.5 m (quadruple occupation). Since groundwater was not encountered within 3.5 m of the local ground surface, the impacts on groundwater of these activities are likely to be minimal.
Mitigation option(s)	Install two monitoring bores to establish baseline groundwater level or quality dataset that includes seasonal variation to confirm depths to groundwater, flow directions and water quality. Minimise interaction with groundwater during construction activities.
Final design consideration	N/A

6.2.1 Aquifer Interference Policy

A preliminary assessment of the proposed activities against the 'minimal impact considerations' outlined in the AIP suggests the local groundwater level (>3.5 metres below ground level) is unlikely to be significantly impacted during construction and operational activities and hence no impacts to groundwater level or quality are anticipated. No impacts are therefore expected under the Water Management Act 2000 to existing groundwater users, including groundwater dependent ecosystems.

Our assessment therefore conservatively considers potential impacts to the Lachlan Fold Belt MDB Groundwater Source falls within the Level 1 impact considerations as defined in **Table 2-1**.

As minimal hydrogeological data (specifically groundwater level and quality) is available for the site and the surrounding area, these findings are indicative only and require on-ground assessment and validation through hydrogeological and geotechnical studies at the site and within the regional area to better assess the potential threats to groundwater. As a minimum, the assessments should consist of an updated survey of groundwater levels and sampling at the existing bores identified within the study area (**Figure 4-4**) to establish a baseline dataset. Collection of the monitoring data should be undertaken to capture changes due to seasonal variation.

7 Recommendations

The following recommendations are made in relation to hydrology, hydrogeology, water quality, and flooding, to better inform the project:

- A detailed survey of the land contours and creek bathymetry needs to be undertaken to be able to accurately model the likely flood extents from Church Creek.
- Hydraulic modelling should be updated based on the recommendation above to provide flood extents for the property from Church Creek
- A climate change assessment of the hydrological aspects in the project area might be undertaken based on Australian Rainfall and Runoff guidelines
- Further data and information on groundwater and potential GDEs in the study area should be collected through a census of the groundwater bores, installation of shallow piezometers (if data from the census suggests groundwater levels may be an issue) and a site-specific survey to verify the presence of any terrestrial GDEs.

8 References

ACT Geotechnical Engineers. 2017. *Geotechnical Investigation Report,* ACT Geotechnical Engineers Pty Ltd.

HGC 2001. *Groundwater investigation, Proposed Beatty Hill subdivision, Old Cooma Road, Williamsdale area.* Hydroilex Geotechnical Consultants.

QPRC 2012. *Planning Proposal for Cemetery and Crematorium, Lot 2 DP 112382 and Lot 126 DP 754881.* Queanbeyan-Palerang Regional Council.

SRLE, 2015. *Rural Residential Subdivision, Burra Road, Mount Pleasant: Flood Analysis and Concept Culvert Design*, Southern Region Land Engineering.

WSP 2012. *Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources.*

Appendix A Registered groundwater bore details

Hydro Code	Latitude	Longitude	Easting	Northing	Ref Elevation (mAHD)	Bore Depth (m)	Drilled Depth (m)	Drilled Date	Major Lithology	Lithological description	Function Type
GW400062.1.1	-35.442476	149.189309	698713	6075684	756	90	90	4/02/1992	DCIT	Dacite	Household Use
GW020893.1.1	-35.457886	149.214262	700940	6073924	793.14	0	13.7	1/10/1952	CLAY	Clay yellow	Unknown
GW020903.1.1	-35.453719	149.207595	700345	6074400	782.08	0	7.9	1/01/1953	CLAY	Clay yellow some sand	Stock water
GW020890.1.1	-35.453442	149.202317	699866	6074441	776.15	19.8	19.8	1/10/1952	PRPR	Porphyry water supply	Unknown
GW067501.1.1	-35.437996	149.207135	700342	6076145	789.09	42	42	12/10/1989	GRNT	Black granite	Household Use
GW400206.1.1	-35.43233	149.213428	700927	6076761	778.12	39.6	39.6	28/04/1997	None	Soft shale.	Household Use
GW401352.1.1	-35.441325	149.189609	698743	6075811	756.63	78	78	31/12/1991	SLTE	Slate, soft	Household Use
GW401068.1.1	-35.458808	149.198345	699493	6073854	775.49	36	36	21/10/1999	BRKN	Broken brown shale	Household Use
GW400503.1.1	-35.442026	149.189296	698713	6075734	758.72	60.8	60.8	28/11/1994	None	Topsoil	Unknown
GW400504.1.1	-35.439188	149.196655	699388	6076034	735.8	60.8	60.8	5/12/1994	DCIT	Dacite	Household Use
GW400813.1.1	-35.437753	149.199745	699672	6076187	759.01	54	54	22/04/1998	HDBD	Hard grey black granite	Household Use
GW401683.1.1	-35.443137	149.202545	699913	6075584	788.92	121	121	23/05/2001	GRNT	Granite, broken	Household Use
GW401777.1.1	-35.471224	149.194716	699133	6072484	784.25	84	84	20/08/2001	SHLE	Shale, highly weathered yellow	Household Use
GW402438.1.1	-35.463971	149.19178	698884	6073295	776.22	75	75	26/05/2003	TPSL	Topsoil, and clay	Household Use
GW402285.1.1	-35.443879	149.188005	698591	6075531	738.38	66	66	18/12/2002	DCIT	Dacite	Household Use
GW020904.1.1	-35.45483	149.207317	700317	6074277	780.21	19.8	19.8	1/02/1953	PRPR	Porphyry decomposed	Stock water
GW402298.1.1	-35.438405	149.199269	699627	6076116	752.54	85	85	24/03/2003	SHLE	Shale, soft yellow	Household Use
GW401991.1.1	-35.439906	149.199848	699676	6075948	753.75	48	48	5/02/1992	DCIT	Dacite	Stock water
GW063668.1.1	-35.433997	149.211761	700772	6076579	773.01	22.9	22.9	1/09/1986	GRNT	Granite soft bands water supply	Household Use
GW020892.1.1	-35.456775	149.203428	699959	6074069	780.38	20.4	20.4	1/11/1952	CLAY	Clay yellow	Unknown
GW402109.1.1	-35.436553	149.215528	701108	6076288	789.63	23	23	2/12/2002	SHLE	Shale, weathered soft yellow	Household Use
GW400502.1.1	-35.444078	149.187975	698588	6075509	736.75	38	38	23/11/1994	None	Volcanics	Household Use

Hydro Code	Latitude	Longitude	Easting	Northing	Ref Elevation (mAHD)	Bore Depth (m)	Drilled Depth (m)	Drilled Date	Major Lithology	Lithological description	Function Type
GW403097.1.1	-35.444116	149.214394	700986	6075451	808.53	100	100	22/04/2001	TPSL	Topsoil	Household Use
GW403206.1.1	-35.44473	149.207586	700366	6075397	850.52	156	156	13/01/2004	CLAY	Clay	Household Use
GW403582.1.1	-35.449801	149.193442	699070	6074863	756.62	42	42	30/10/2002	SFBD	Soft volcanics	Unknown
GW403149.1.1	-35.43495	149.204271	700090	6076489	773.08	42	42	1/07/2005	SHLE	Shale, brown	Household Use
GW403879.1.1	-35.45677	149.193501	699058	6074090	781.55	71	71	30/10/2006	CLAY	Clay/shale - fine	Household Use
GW404208.1.1	-35.440783	149.191723	698936	6075867	743.04	82	0	7/02/2003	n/a	n/a	Household Use
GW405005.1.1	-35.442774	149.198739	699568	6075632	757.28	66	66	22/09/2008	TPSL	Topsoil	Household Use
GW404566.1.1	-35.465893	149.186025	698357	6073093	775.42	42	0	28/06/1999	n/a	n/a	Household Use
GW404883.1.1	-35.441447	149.196842	699399	6075783	743.22	10	0	1/11/1991	n/a	n/a	Household Use
GW404954.1.1	-35.444451	149.185841	698393	6075472	755.25	102	102	11/12/2008	BSLT	Basalt	Household Use
GW411306.1.1	-35.459158	149.196508	699325	6073819	775.11	36	36	22/04/2010	CLAY	Clay - brown	Stock water
GW409828.1.1	-35.432707	149.206032	700255	6076734	751.92	45	45	20/12/2009	TPSL	Topsoil	Household Use
GW414710.1.1	-35.435691	149.206984	700334	6076401	765.88	60	0	26/11/2002	n/a	n/a	Household Use
GW414353.1.1	-35.470525	149.193577	699031	6072564	783	114	114	11/05/2010	GRNT	Granite, blue	Household Use
GW414415.1.1	-35.433867	149.212607	700849	6076592	778.35	23.5	0	10/09/2010	n/a	n/a	Household Use
GW414765.1.1	-35.460443	149.193788	699075	6073682	775.22	5	0	15/09/2011	n/a	n/a	Household Use

Green shaded bores occur within the project area; orange shaded bores occur within 200 m of the project boundary

Appendix B Technical Hydrological Modelling Details

Water Volume Modelling

This section outlines the flow volume modelling that was undertaken to determine flows into Church Creek that formed the basis for determining water levels from flooding of Church Creek.

Regional Analysis

To provide an estimate of the likely design flow volumes from the catchment the Regional Flood Frequency Estimation (RFFE) model (http://rffe.arr-software.org/) was used. It uses information from nearby similar catchments to provide an estimation of their 6-hour peak durations. The details required for this are:

- Catchment outlet location (latitude and longitude);
- Catchment centroid location (latitude and longitude); and,
- Catchment area.

The results of RFFE model the catchment is shown in **Figure B-1**.

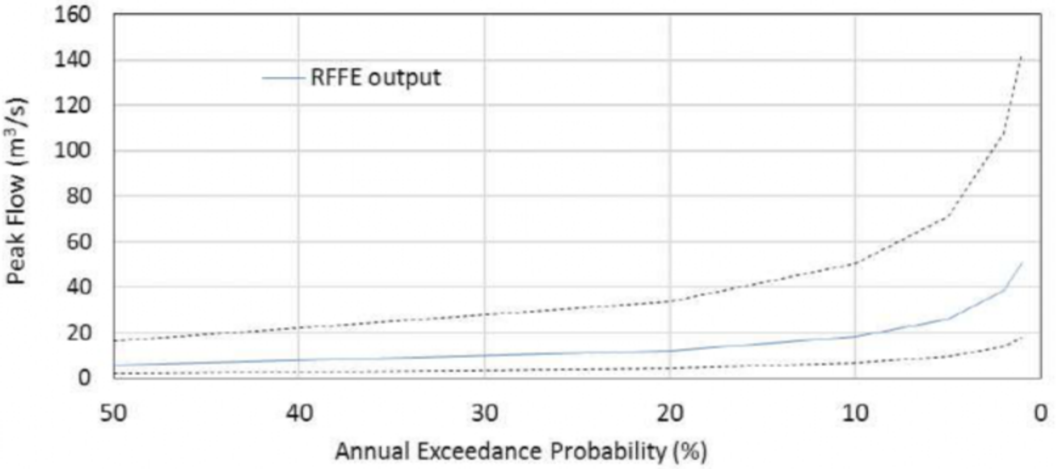

Figure B-1: RFFE 6-hour estimates for the study Catchment (dashed lines representing 5% and 95% confidence intervals).

Sub-catchment delineation

Figure B-2 shows the proposed site and the catchment determined based on the available DEM. The analysis of the proposed site and the DEM determined that the project boundary fell within one watershed region.

For the purposes of RORB modelling the modelled catchment was divided up into 12 sub-catchments. The catchment and link details for the existing that are applied to the RORB catchment file, shown in **Figure B-3**. The catchment characteristics and link parameters for the modelled catchment are shown in **Appendix C**.

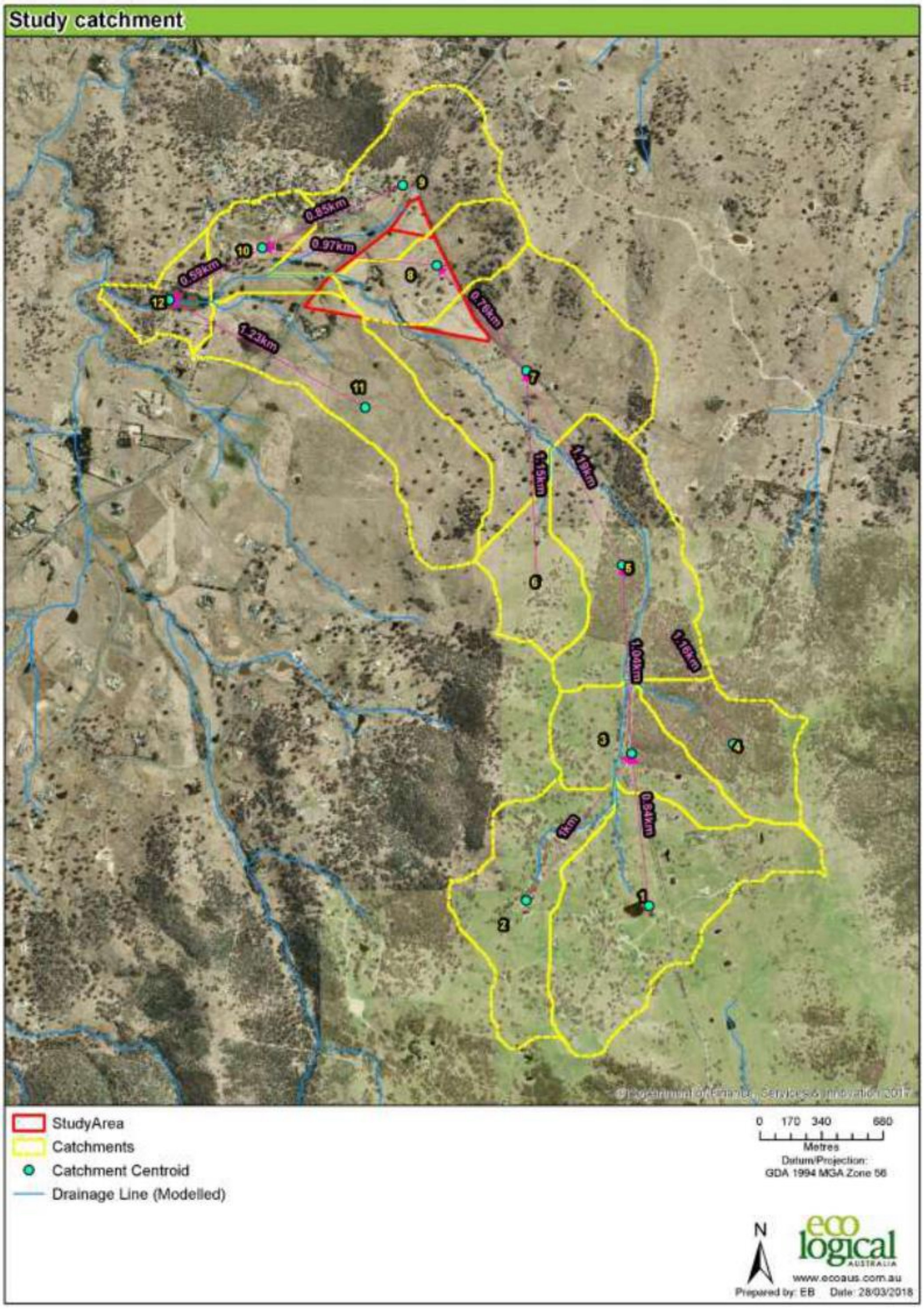

Figure B-2: Study catchments

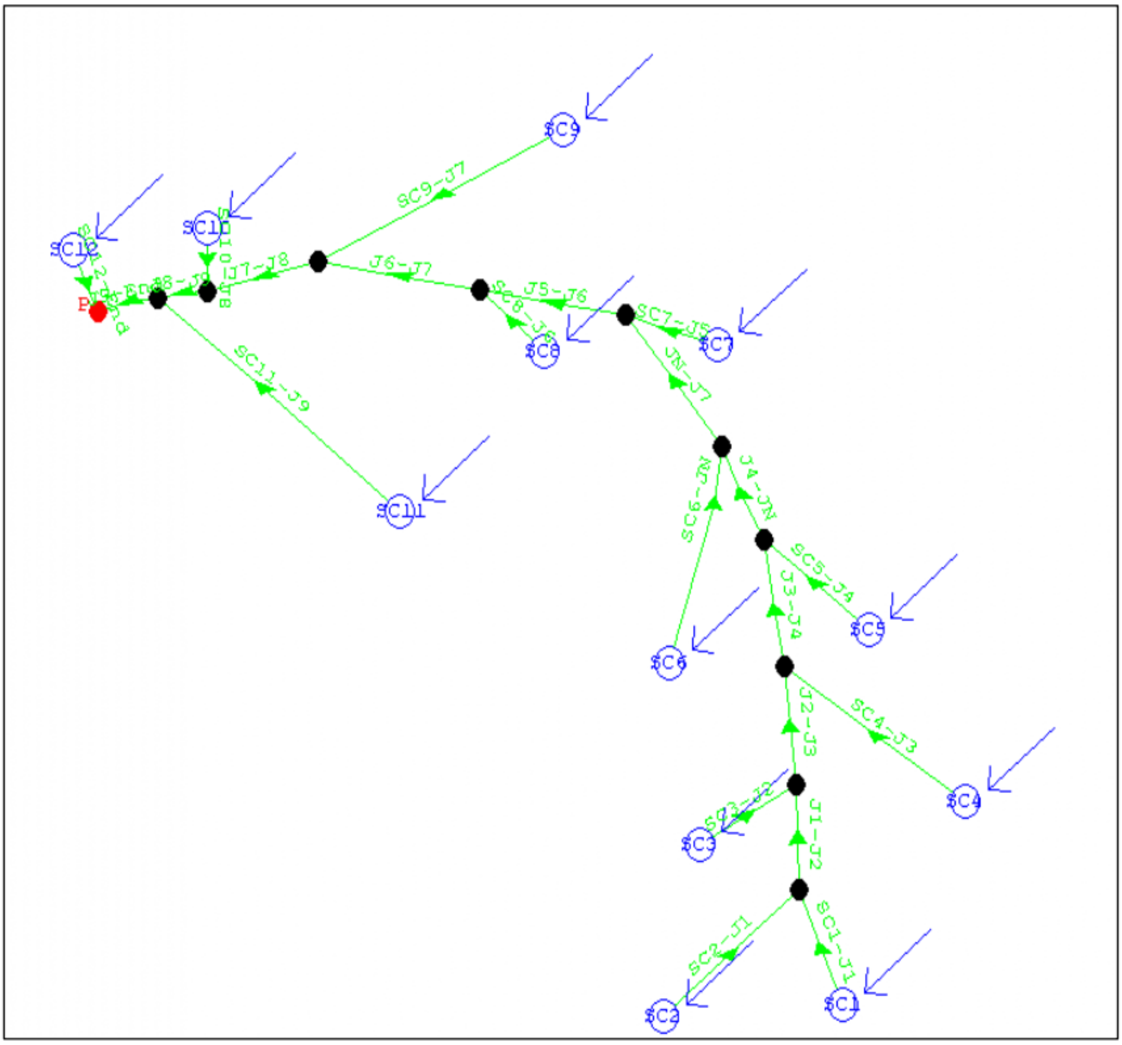

Figure B-3: RORB sub-catchment relationships for the study catchment

Intensity-Frequency-Duration (IFD) Information

The IFD information was sourced for the Site from the 2016 Bureau of Meteorology IFD curves on March 12, 2018 for coordinate 35.453985°S and 149.202299°E and is outlined in Table B-1. Exceedances rarer than the 1% AEP less than 24 hours in duration were not available on the BoM website and were infilled based on a logarithmic regression.

The temporal pattern used for this was sourced from Australian Rainfall and Runoff 2016 and is discussed in the following section, *Australian Rainfall and Runoff Information*.

Table B-1: IFD information for the Project site

Duration	Annual Exceedance Probability Rainfall Depths (mm)										
	63.2%	50%	20%	10%	5%	2%	1%	0.5%	0.2%	0.1%	0.05%
1 min	1.61	1.82	2.51	3.02	3.54	4.28	4.88	5.37	6.09	6.63	7.16
2 min	2.74	3.09	4.19	4.94	5.69	6.66	7.4	8.22	9.24	10.01	10.79
3 min	3.75	4.22	5.75	6.81	7.88	9.31	10.4	11.53	12.99	14.09	15.19
4 min	4.63	5.22	7.13	8.5	9.88	11.8	13.3	14.69	16.59	18.02	19.45
5 min	5.4	6.09	8.36	9.99	11.7	14	15.9	17.53	19.82	21.55	23.28
10 min	8.21	9.27	12.8	15.5	18.3	22.2	25.5	28.01	31.78	34.62	37.47
15 min	10.1	11.4	15.8	19.1	22.5	27.4	31.4	34.52	39.16	42.67	46.18
30 min	13.6	15.3	21.2	25.4	29.8	35.8	40.7	44.9	50.82	55.29	59.77
1 hour	17.6	19.8	27	32.1	37.2	44.2	49.7	54.95	61.96	67.27	72.58
2 hour	22.5	25.2	33.8	39.8	45.9	54.1	60.7	66.93	75.26	81.57	87.87
3 hour	26	29	38.6	45.4	52.2	61.8	69.4	76.31	85.77	92.93	100.09
6 hour	33.2	36.8	48.7	57.4	66.5	79.5	90.2	98.57	110.97	120.35	129.73
12 hour	42.1	46.5	61.8	73.5	86.1	104	120	130.3	147.2	159.97	172.75
24 hour	51.6	57.3	77.1	92.8	110	134	154	154	177	210	238
48 hour	60.6	67.8	92.9	113	134	162	185	185	207	240	267
72 hour	65.4	73.5	101	123	146	175	198	198	222	255	282
96 hour	68.8	77.5	107	129	153	183	206	206	232	267	295
120 hour	71.8	80.7	111	134	158	189	213	213	241	278	307
144 hour	74.6	83.7	115	138	162	194	220	220	248	289	321
168 hour	77.4	86.6	118	141	166	200	228	228	255	299	335

Australian Rainfall and Runoff Information

The other information required for setting up the RORB model was sourced from the Australian Rainfall and Runoff (2016) data hub (http://data.arr-software.org) for the same location as for the IFD information. The key information obtained were the temporal patterns and the losses. The division that these parameters are sourced from is the Murray-Darling Basin with the river region being Murrumbidgee River, SE Coast.

For this river region, the initial loss is 22.0 mm and the continuing loss is 5.2 mm/hr. For each temporal pattern duration, 30 patterns were available to be used by RORB. Patterns available for the durations are outlined in **Table B-2**. The shaded durations are durations where IFD information is not available (and therefore were not used in the modelling).

The temporal pattern information was used to provide inputs to the Monte Carlo model run in RORB.

Table B-2: Temporal Pattern Durations from Australian Rainfall and Runoff

Durations			
10 minute	1 hour	9 hour	48 hour
15 minute	1.5 hour	12 hour	72 hour
20 minute	2 hour	18 hour	96 hour
25 minute	3 hour	24 hour	120 hour
30 minute	4.5 hour	30 hour	144 hour
45 minute	6 hour	36 hour	168 hour

Parameter Files

As there are no observed flow data for this catchment, the RORB parameter file was set-up using the "Separate catchment and generated design storm(s)" option. The model operates using a single set of routing parameters for the whole model and an initial loss / continuing loss model. The design rainfall specification used is:

- A user defined IFD (detailed above in **Table B-1**);
- Monte Carlo simulation from 10 minute to 168 hour durations;
- Default time increments of 70;
- Uniform areal pattern; and,
- Constant losses.

The parameter specification is:

- main routing parameter for the overall catchment, k_c of 6.64 to calibrate to RFFE analysis (results shown below);
- dimensionless exponent for non-linear routing, m of 0.8; and,
- Initial loss and continuing loss based on the Australian Rainfall and Runoff values discussed above.

The Monte Carlo simulation details are:

- Number of rainfall divisions: 50 (default);
- Number of samples per division: 20 (default);
- Temporal patterns as described above;
- No pattern censoring; and
- Fixed initial loss.

Calibration Results

The RORB model was calibrated to the RFFE analysis to fit within the confidence limits of the results. This calibration targeted obtaining the best possible fit to the 1% AEP result (closet to best estimate) and be in line with a flood study undertaken for the upstream property (SRLE, 2015). The outcome of this is shown in **Figure B-4** which shows that the 1%, 2%, 5% and 20% AEP results fall within the confidence limits using the recommended k_c value (6.64). Adjusting the k_c value to fit the median RFFE output resulted in too much flow through the system.

The peak flow results from the RORB model for the existing conditions at the Site are shown in **Figure B-5**. **Figure B-6** shows the peak design flow (for existing conditions).

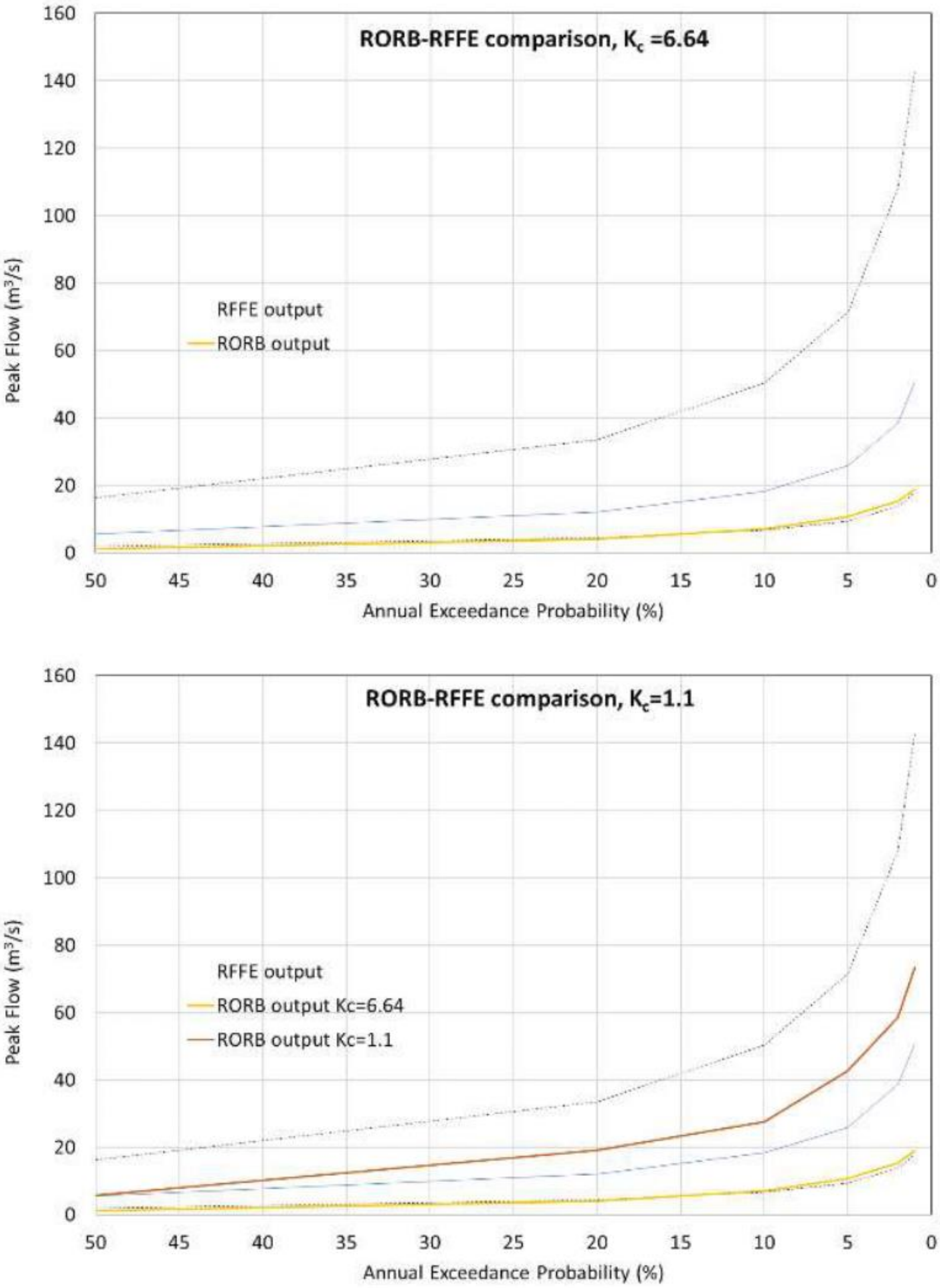

Figure B-4: RFFE – RORB calibration for the study catchment (Top panel, K_c = 6.64 and bottom panel, K_c = 1.1)

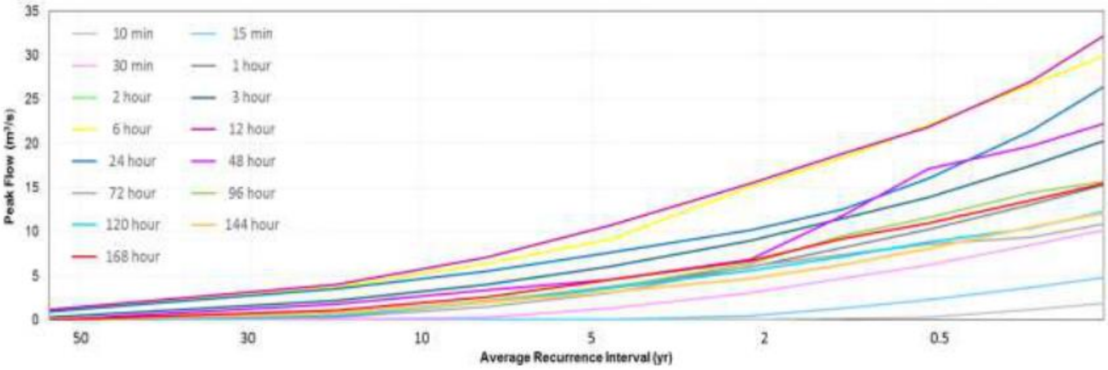

Figure B-5: RORB model results for existing conditions

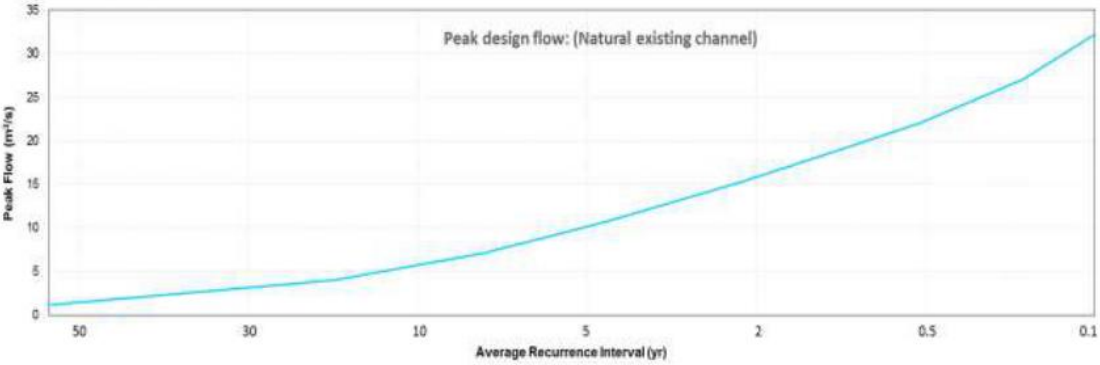

Figure B-6: Peak Design Flows

Technical Detail of Water Level Modelling

To model the water levels that correspond to the design flows produced by the RORB modelling a HEC-RAS model was developed to investigate the potential water levels from Church Creek.

Model Geometry

To set up the model required a number of GIS-based input sets and these were produced using the HEC-GeoRAS add-in to ArcMap. The key spatial datasets required were:

- The drainage centre line;
- Bank lines; and,
- The drainage cross sections.

The cross sections produced are shown in **Figure B-7**. These data were turned into a HEC-RAS specific geometry input file using HEC-GeoRAS. Once imported into HEC-RAS the following were defined for each cross section:

- Cross sections based on spot measurements from site visit;

- left and right overbank stations (i.e. point where main channel ends on left and right side) were defined for each of the cross sections based on the cross-section elevations; and,
- Manning's n (roughness) values for the left, right and channel regions of the cross section. Manning's n for the channel region was set to 0.03 and for the left and right regions was set to 0.035 based on the characteristics of the site.

The model requires flow conditions to be specified to allow the HEC-RAS calculations to determine the corresponding water levels. These flows can be specified for a number of profiles and at cross sections in the model. Flows were specified at cross sections that corresponded to the catchments from the RORB model for the 10%, 2%, 1%, 0.5%, 0.2% and 0.1% AEP. **Table C-3** in Appendix C shows steady flow data input for the HEC-RAS model. The cross-sections for the HEC-RAS model are shown in **Figure B-7**. **Table B-3** lists the calculated peak water levels at the downstream end of the model for existing conditions from the HECRAS model.

Table B-3: Peak water levels for existing conditions

AEP (%)	Catchment Water Depths (m)
10%	1.98
1%	2.57
0.5%	2.73
0.2%	2.98
0.1%	3.06

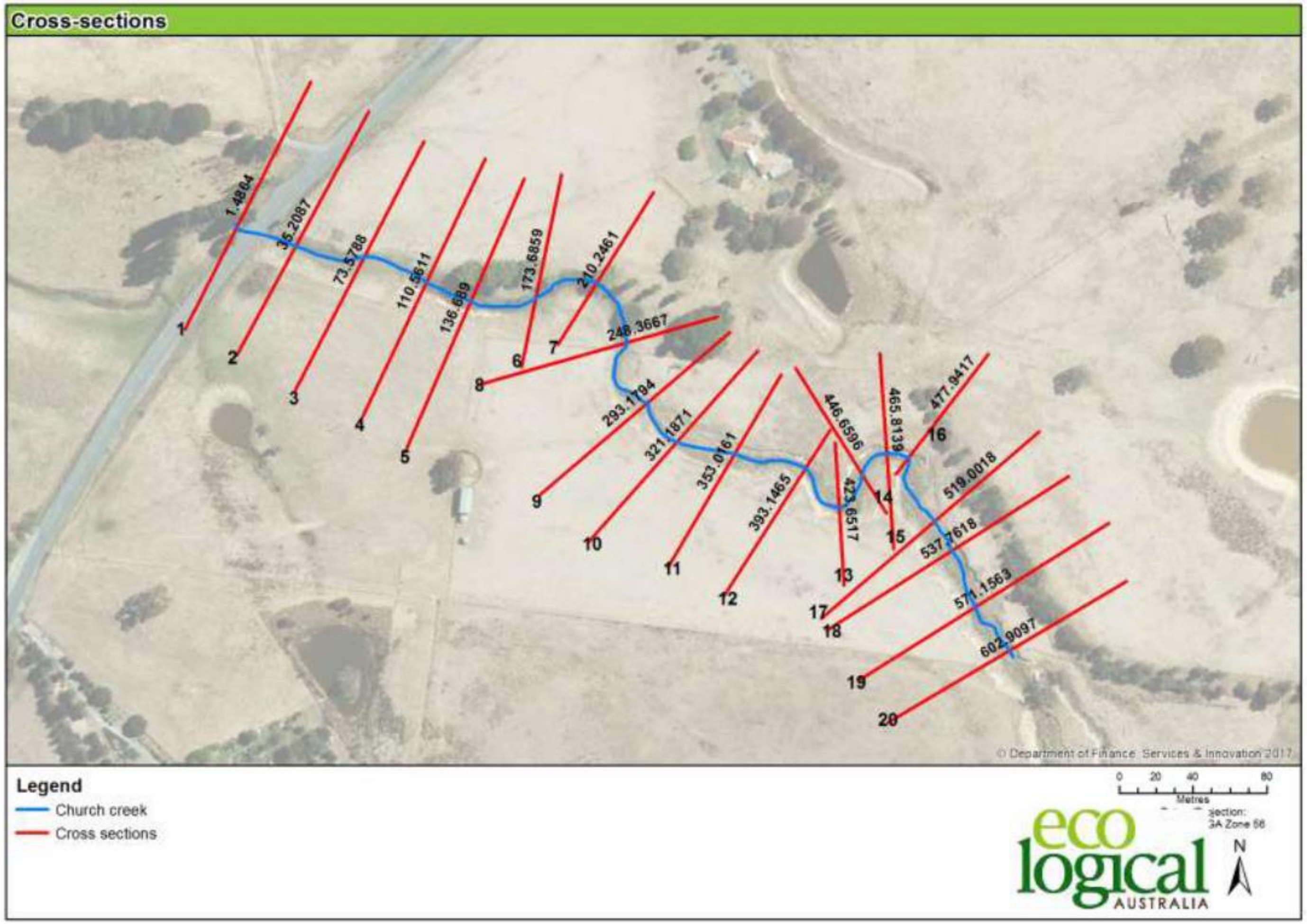

Figure B-7: Cross sections for the modelled creek

Appendix C Catchment Characteristics

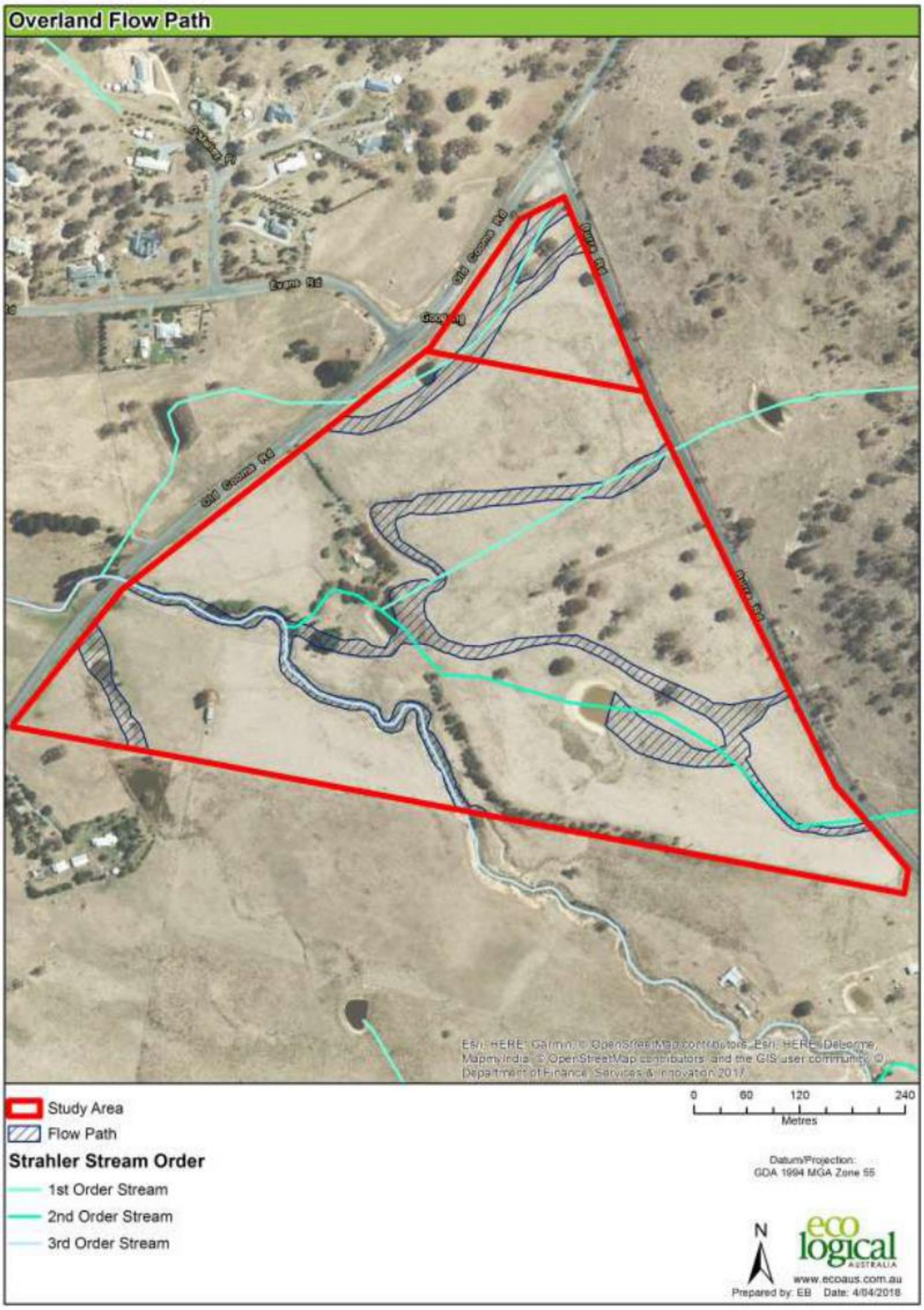

Figure C-1: Overland flow paths

Table C-1: Catchment characteristics

Node No	Sub Area	Area (km²)
1	SC2	0.637
2	SC1	1.084
5	SC3	0.445
6	SC4	0.425
9	SC5	0.892
10	SC6	0.343
12	SC7	1.587
14	SC8	1.587
16	SC9	0.671
18	SC10	0.281
20	SC11	0.936
21	SC12	0.208

Table C-2: Link parameters

Reach No	Reach Name	Length (m)	Reach Type
1	SC1-J1	0.84	Natural
2	SC2-J1	1	
3	J1-J2	0.26	
4	SC4-J3	1.16	
5	SC3-J2	0.26	
6	J2-J3	0.26	
7	J3-J4	0.26	
8	SC5-J4	0.397	
9	SC6-JN	1.15	
10	J4-JN	0.397	
11	JN-J7	0.397	
12	SC7-J5	0.38	
13	J5-J6	0.38	
14	SC8-J6	0.485	
15	J6-J7	0.485	
16	SC9-J7	0.85	
17	J7-J8	0.197	
18	SC10-J8	0.197	
19	J8-J9	0.197	
20	SC11-J9	1.23	
21	SC12-End	0.5	
22	J9-End	0.5	

Table C-3: Flow calculation for HEC-RAS Model

RORB Location	HEC-RAS cross section river station (m)	10% AEP flow (m³/s)	1% AEP flow (m³/s)	0.5% AEP flow (m³/s)	0.2% AEP flow (m³/s)	0.1% AEP flow (m³/s)
J5-J6	602.9097	4.5	12.2	14.4	17.4	20.6
0	293.1794	5.3	14	16.7	20	23.6
J6-J7	1.486383	6.1	15.8	19	22.7	26.6

eco logical AUSTRALIA

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bsi. AS/NZS 4801:2001 Occupational Health and Safety Management

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QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2 PROPOSED QUEANBEYAN CEMETERY SITE

ATTACHMENT 5 NOISE IMPACT ASSESSMENT REPORT

QUEANBEYAN-PALERANG REGIONAL COUNCIL

JULY 2018

New Cemetery at 1241 Old Cooma Road, Googong

Noise Impact Assessment

Question today
Imagine tomorrow
Create for the future

New Cemetery at 1241 Old Cooma Road, Googong
Noise Impact Assessment

Queanbeyan-Palerang Regional Council

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REV	DATE	DETAILS
D	05/07/18	Final issue incorporating client's comments

	NAME	DATE	SIGNATURE
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Reviewed by:	Jamie Hladky	05/07/2018	JHladky
Approved by:	Jamie Hladky	05/07/2018	JHladky

PS107892-Noise-REP-001-RevD July 2018

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GLOSSARY

'A' Frequency Weighting (dBA)	The 'A' frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child's scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The 'A' weighting is the most commonly used frequency weighting for occupational and environmental noise assessments.
Ambient Noise	The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Ambient Noise is usually assessed as an energy average over a set time period 'T' ($L_{Aeq, T}$).
'C' Frequency Weighting (dBC)	The 'C' frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.
Decibel	The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from 10 log10 (10(50/10) + 10(50/10)) and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.
Equivalent Continuous Sound Level, L_{Aeq}	Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/ averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the L_{Aeq} level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.
'F'(Fast) Time Weighting	Sound level meter design-goal time constant which is 0.125 seconds.
Frequency	The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

Octave band	Frequencies are divided into octaves. An octave band is defined as a range of frequencies extending from one frequency to exactly double that frequency. For example, the 1000 Hz octave band is centred at 1000 Hz and extends from 707 Hz to 1414 Hz.
One-third (1/3) octave band	Data in one-third octave bands allow an analysis of spectral characteristics of a noise event at a higher resolution. A one-third octave band is approximately one-third the width of an octave band. One of the more frequent application of one-third octave band data is for the analysis of noise sources with potentially tonal characteristics (i.e. more attention-drawing).
Hertz (Hz)	The unit used to measure frequency of sound expressed by cycles per second.
Human Response to Noise Level Changes	Less than 3 dBA = No perceivable difference 3 dBA = Barely perceptible difference 5 dBA = Readily perceptible difference 10 dBA = 'Doubling' (or 'halving') of performance
Maximum Noise Level, L_{AFmax}	The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.
Sound Pressure Level (SPL)	The basic unit of sound measurement is the sound pressure level. The pressures are converted to a logarithmic scale and expressed in decibels (dB).
Sound Power Level (SWL)	Sound power level is a logarithmic measure of the sound power in comparison to a specified reference level.
Sound Attenuation	A reduction of sound due to distance, enclosure or some other devise. If an enclosure is placed around a machine, or an attenuator (muffler or silencer) is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 20 dB reduces the sound energy by one hundred times.
Statistical Noise Levels, Ln	Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example: — The noise level, in decibels, exceeded for 1% of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as $L_{AF1, T}$. This may be used for describing short-term noise levels such as could cause sleep arousal during the night. — The noise level, in decibels, exceeded for 10% of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as $L_{AF10, T}$. In most countries the $L_{AF10, T}$ is measured over periods of 15 minutes, and is used to describe the average maximum noise level. — The noise level, in decibels, exceeded for 90% of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as $L_{AF90, T}$. In most countries the $L_{AF90, T}$ is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.
Steady Noise	Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady".
'Z' Frequency Weighting	The 'Z' (Zero) frequency weighting is 0 dB within the nominal 1/3 octave band frequency range centred on 10 Hz to 20 kHz. This is within the tolerance limits given in AS IEC 61672.1-2004: 'Electroacoustics - Sound level meters – Specifications'.

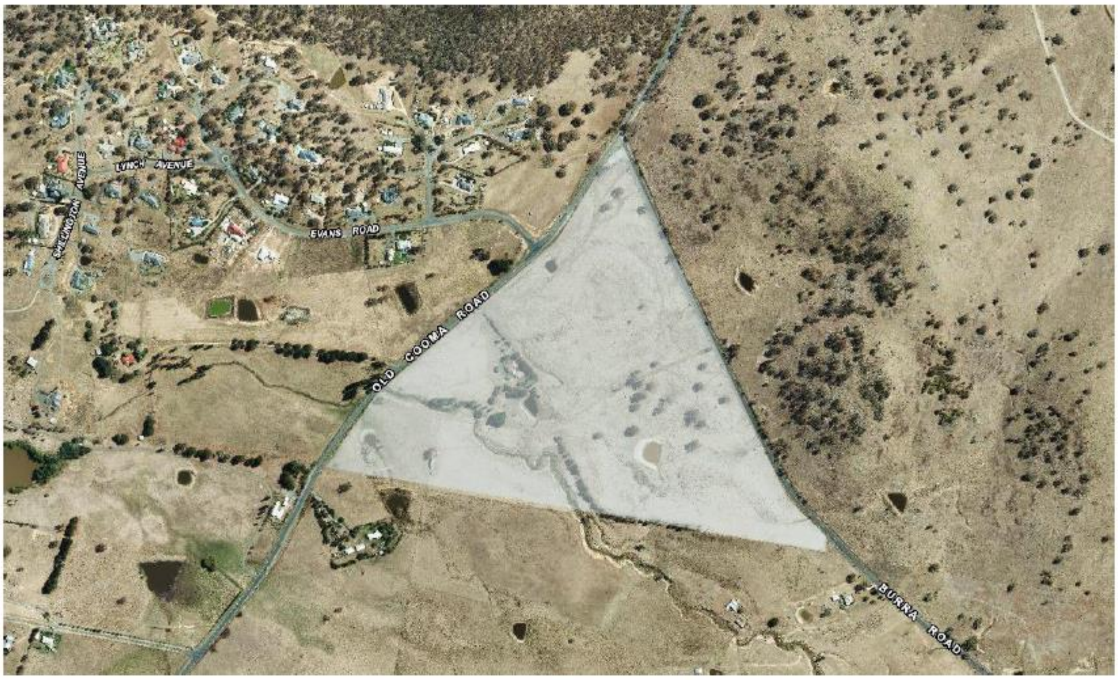
1 INTRODUCTION

1.1 BACKGROUND

Queanbeyan-Palerang Regional Council has prepared a planning proposal for a new cemetery on land located at 1241 Old Cooma Road, Googong, as indicatively shown in Figure 1.1. The site is located approximately 11 kilometres south of Queanbeyan and approximately four kilometres south of the Googong urban release area, on the eastern side of Old Cooma Road and the southern side of Burra Road.

The site is currently zoned as E4 – Environmental Living as part of the Queanbeyan Local Environmental Plan 2012 (LEP).

This report has been prepared to assess the potential noise impacts associated with the proposed development.



Source: NSW Land & Property Information, https://maps.six.nsw.gov.au/, visited 19 April 2018

Figure 1.1 Site location

1.2 DETAILS OF THE PROPOSAL

Once operational, the cemetery is expected to accommodate 3 to 4 burial/funerals per week.

Noise sources associated with this activity include light excavation equipment equivalent to a farm tractor or backhoe, small truck and cars associated with a funeral procession. Outside of these ceremonies routine maintenance will include ride-on lawn mowers, whipper-snippers and other garden equipment.

The typical hours of operation would be 7.00 am to 4.00 pm Monday to Friday, with most services occurring after 9.00 am, and the occasional service occurring on weekends or after 4.00 pm on a weekday.

1.3 REFERENCED DOCUMENTS

For the purpose of the noise assessment, the following documents have been used to inform the requirement planning requirements and assessment criteria:

- *Queanbeyan Local Environmental Plan 2012 (LEP)*
- NSW *Protection of the Environment Operations (Noise Control) Regulation 2017* (POEO)
- NSW EPA *Noise Guide for Local Government* (NGLG)
- NSW EPA *Noise Policy for Industry* (NPfI)
- NSW EPA *Road Noise Policy* (RNP)
- NSW *Interim Construction Noise Guideline* (DECC)

2 SITE INVESTIGATIONS

2.1 NOISE SURVEY

To quantify the existing ambient noise environment surrounding the proposed project site, unattended noise monitoring using remote noise logging equipment, as well as operator-attended observations were undertaken between 23 February to 9 March 2018 (inclusive). Measurements were conducted at one location at the Project Site as shown in Figure 2.1 along with the identified nearest sensitive receivers, with results as summarised in Table 2.1.

The objective of the noise monitoring is primarily to establish the existing ambient background noise levels, which in turn would be used to determine the project specific trigger levels. The monitoring results obtained from the established noise monitoring location is regarded to be representative of the nearest receivers potentially impacted by the proposed development.

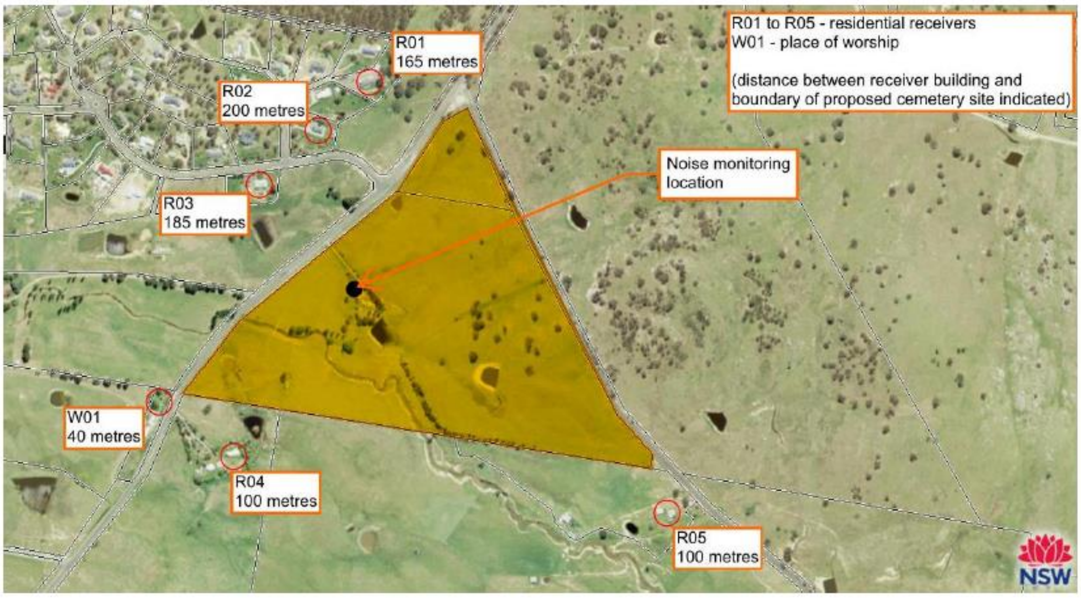


Figure 2.1 Aerial photograph indicating noise measurement position and nearby noise-sensitive receivers

Table 2.1 Summarised results of environmental noise survey

POSITION	DESCRIPTION	DATE & TIME	RESULT
Noise monitoring location (ARL EL-316 noise logger S/N 16-306-008)	Rating background noise level (RBL)	NPfI day period	RBL 33 dB $L_{A90\,(15min)}$
		NPfI evening period	RBL 36 dB $L_{A90\,(15min)}$
		NPfI night period	RBL 30 dB $L_{A90\,(15min)}$[1]
	Existing ambient noise level	NPfI day period	50 dB $L_{Aeq\,(15min)}$
		NPfI evening period	53 dB $L_{Aeq\,(15min)}$
		NPfI night period	44 dB $L_{Aeq\,(15min)}$

(1) Assumed to be 30 dBA, as per NPfI - if measured RBL is <30 dBA.

The local noise environment is generally dominated by road traffic noise along Old Cooma Road. Contributions from natural sounds such as birds and wind in the trees were also observed.

3 ACOUSTIC CRITERIA

3.1 KEY REQUIREMENTS

The key requirements for acoustic criteria applicable to the Project from each of the reference documents listed above are summarised in the subsections below.

3.1.1 QUEANBEYAN LOCAL ENVIRONMENTAL PLAN

The Project site is currently zoned as E4 – Environmental Living. The LEP does not however specifically contain any clauses in regard to noise.

3.1.2 PROTECTION OF THE ENVIRONMENT OPERATIONS (NOISE CONTROL) REGULATION

Part 4 Division 3 of the POEO prescribes maximum sound power levels associated with grass-cutting machines, as follow:

- Ride-on mowers ≤105 dBA
- Edge-cutters ≤100 dBA
- String trimmers ≤105 dBA

In addition, under *Part 4 Division 2 Air conditioners, Division 4 Power Tools* and *Division 5 Pumps and heat pump water heaters*, an air conditioner, pump or heat pump used on established premises must not be heard within any room in any other residential premises (that is not a garage, storage area, bathroom, laundry, toilet or pantry), whether or not any door or window to that room is open:

(i) before 8 am or after 10 pm on any Saturday, Sunday or public holiday, or

(ii) before 7 am or after 10 pm on any other day

The above requirement involves a subjective assessment of an internal noise level, which does not represent a quantifiable design parameter. It is common practice to derive an external noise level that is required to be achieved, based on the existing background noise level and a sound reduction of 10dB through an open window at the receiver location.

3.1.3 NOISE GUIDE FOR LOCAL GOVERNMENT

The NGLG provides guidance to council officers and planners with regard to planning and management of noise issues and the interpretation and application of the POEO. This document does not specifically address the use of cemetery, but it is expected that the outdoor machinery is similar to farm machinery (e.g. tractors), albeit in much less frequent and intensive use. The NGLG suggested implementation and consideration of reasonable and feasible best practices to manage any potential noise impact from these sources.

The NGLG requires that noise from these sources during operation must not be "offensive". In the absence of any specific requirement in the Queanbeyan LEP, it is recommended that the approach described in the NPfI (detailed below in Section 3.1.4) be used to develop noise criteria applicable during the day and evening period for any air conditioner, pump, heat pump, extraction fans associated with the proposed building/indoor areas as part of the cemetery development.

Section 4.3.3 of the NGLG provides regulations applicable to noise from motor vehicles, both in terms of restricted times of operation and an "offensive noise" condition. However, these requirements apply to the owner or operator of the motor vehicle and do not put any specific responsibility onto a developer to control vehicle noise within their project.

3.1.4 NOISE POLICY FOR INDUSTRY

The NPfI applies to industrial noise sources and is designed for large industrial and agricultural sources, but is also used as a planning instrument and referenced in the assessment of noise from other types of premises such as commercial premises. The assessment methodology of the NPfI is utilised to develop noise limits that can be nominated for the purposes of noise assessment of the proposed cemetery.

The NPfI process involves the determination of *project noise trigger levels*, which can then be adopted by the Responsible Authority as prescribed noise limits that can be nominated as a permit condition for a project.

- The project noise trigger level provides a benchmark which, if exceeded, indicates a potential noise impact.
- The project noise trigger level in each relevant time period (day, evening and night) is the lower value (i.e. more stringent) of the project intrusiveness noise level (based on existing background noise level) and the project amenity noise level (based on land use).
- The project noise trigger levels are summarised in Table 3.1. This is determined by considering both the intrusiveness noise levels and amenity noise levels per guidance provided in the NPfI. It should be noted that the intrusiveness noise levels alone are not used directly as regulatory limits. They should always be considered in conjunction with the amenity noise levels when determining the project noise trigger levels.

It is understood that the typical hours of operation would be 7.00 am to 4.00 pm Monday to Friday, with most services occurring after 9.00 am and the occasional service occurring on weekends or after 4.00 pm on a weekday. No activities are expected to occur during the night time period.

It should be noted that the following time periods are applicable for the NPfI:

- Day: 7.00 am to 6.00 pm Monday to Saturday or 8.00 am to 6.00 pm Sundays and public holidays
- Evening: 6.00 pm to 10.00 pm
- Night: remaining periods outside of the defined periods for day and evening.

Table 3.1 NPfI project noise trigger levels

LAND USE	NPfI NOISE LEVELS, dB $L_{Aeq, 15min}$		
	D[1]	E[1]	N[1]
Intrusiveness noise levels Residential	 38	 41	 35
Amenity noise levels[2]: Rural residential Place of worship (external, when in use)	 50 50[3]	 45 50	 40 50
Project noise trigger levels: Residential Place of worship	 38 50	 38[4] 50	Not applicable as any activities within the cemetery ground are unlikely.

(1) Day (D) = 7am to 6pm, Evening (E) = 6pm to 10pm and Night-time (N) = 10pm to 7am.

(2) It is assumed that no other industrial sources are likely to be introduced in the project area in the future and that the existing ambient environment is not affected by any industry.

(3) Based on the prescribed internal amenity noise level of 40 dBA with a partially opened façade. A partially opened façade is estimated to provide a noise reduction of 10 dB.

(4) The NPfI recommends that the evening intrusiveness noise level be set at no greater than the day time levels. The intrusiveness noise level for the day time has therefore been adopted for the evening time period.

3.1.5 ROAD NOISE POLICY

Traffic noise criteria from RNP apply to the Project in terms the proposed development having the potential to create additional traffic on local road network. The noise assessment will consider the potential additional road traffic introduced by the proposed development and the likely associated relative increase in road noise.

It should be noted that the following time periods are applicable for the RNP:

— Day: 7.00 am to 10.00 pm

— Night: 10.00 pm to 7.00 am

3.1.6 CONSTRUCTION

3.1.6.1 NOISE

Impacts from construction noise are assessed using the ICNG. The ICNG defines the assessment method and suggests noise management measures based on the length of the works, the number of people affected and the time the works occur.

The ICNG specifies that construction Noise Management Levels (NMLs) are defined using the RBL plus an additional allowance of 10 dB during standard hours and 5 dB outside of standard hours. The ICNG also states that where construction noise levels are above 75 dBA at residential receivers during standard hours, they are considered ‘highly noise affected’ and require additional considerations to mitigate potential impacts.

The ICNG assessment time periods are presented in Table 3.2.

Table 3.2 ICNG assessment periods

TIME OF DAY	NML, dB $L_{Aeq,\ 15min}$ ^{1,2}	HOW TO APPLY
Recommended standard hours: Monday–Friday 7:00am–6:00pm Saturday 8:00am– 1:00pm Sundays or public holidays: No work	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: — times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) — if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

TIME OF DAY	NML, dB $L_{Aeq,\ 15min}$ [1,2]	HOW TO APPLY
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

(1) Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

(2) The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NPfI.

3.1.6.2 CONSTRUCTION AIRBORNE NOISE MANAGEMENT LEVELS

The construction NMLs are calculated from the measured RBL for each assessment period for residential receivers and are presented in Table 3.3.

Table 3.3 Noise Management Levels (NMLs) at residential receivers

LAND USE	HIGHLY NOISE AFFECTED	STANDARD HOURS	OUTSIDE STANDARD HOURS	
		D[1]	E[1]	N[1]
RBL (Table 2.1)		33	36	30
NML correction (Table 3.2)		+10	+5	+5
Resulting NML dB $L_{Aeq,\ 15min}$, residential – areas with negligible transportation	**75**	**43**	**41**	**35**

(1) Day (D) = 7am to 6pm, Evening (E) = 6pm to 10pm and Night-time (N) = 10pm to 7am.

Table 3.4 lists the NMLs that have been adopted for non-residential sensitive receivers. The NMLs apply when premises are in use, during any time of day, evening or night.

Table 3.4 Noise Management Levels (NMLs) at sensitive land uses (other than residential)

LAND USE	NML $L_{eq(15\ MIN)}$ dBA
Commercial[1]	70
Place of Worship[2]	55
Active recreation	65
Passive recreation	60
Industrial[1]	75

(1) The external noise levels should be assessed at the most affected occupied point on the premises

(2) Assumed equivalent external noise level with windows open with a 10 dB external to internal noise level correction.

3.1.6.3 VIBRATION

In the worst cases, construction vibration can lead to:

- Cosmetic and structural building damage.
- Loss of amenity due to perceptible vibration, termed human comfort.

Importantly, cosmetic damage is regarded as minor in nature; it is readily repairable and does not affect a building's structural integrity. Damage of this nature is typically described as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks, and separation of partitions or intermediate walls from load bearing walls. If there is no significant risk of cosmetic damage then structural damage is not considered a significant risk and will not be assessed any further.

COSMETIC BUILDING DAMAGE

British Standard BS 7358-2 provides guidance on the 'evaluation and measurement of vibration in buildings' and defines guidance for categorising building damage in terms of 'cosmetic', 'minor' and 'major'; providing limits for each. The cosmetic damage limits are presented in Table 3.5.

Table 3.5 BS 7385 Cosmetic damage criteria

GROUP	TYPE OF STRUCTURE	PEAK COMPONENT PARTICLE VELOCITY, mm/s ^{1}		
		4–15 HZ	15–40 HZ	40 Hz AND ABOVE
1	Reinforced or framed structures Industrial or heavy commercial buildings	50		
2	Un-reinforced or light framed structures Residential or light commercial buildings	15 – 20^2	20 – 50	50

(1) Values referred to are at the base of the building, on the side of the building facing the source of vibration (where feasible).

(2) At frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded.

These peak vibration limits are set so that the risk of 'cosmetic' damage is minimal. They have been set at the lowest level above which damage has been credibly demonstrated. The limits also assume that the equipment causing the vibration is only used intermittently, however if the equipment is used continuously, then the limits may need to be reduced by up to 50 per cent. For 'minor' or 'major' vibrational damage to occur, the standard states that vibration need to be two times and four times (respectively for group 1 and group 2) the values shown in Table 3.5.

HERITAGE STRUCTURES

Building structures classified as being of heritage significance are to be considered on a case by case basis, as a heritage listed structure may not be assumed to be more sensitive to vibration unless it is structurally unsound which is unlikely for a regularly maintained structure. Where a historic structure is deemed to be sensitive to damage from vibration following inspection by qualified structural and / or civil engineers, more conservative superficial cosmetic damage criterion based on peak component particle velocity (PPV) (German Standard DIN 4150-3: 1999 *Structural Vibration – Part 3: Effects of vibration on structures* or equivalent) should be considered.

A conservative vibration damage screening (trigger) PPV level of 7.5 mm/s has been adopted for heritage structures and has been established with reference to the minor cosmetic damage criteria in British Standard BS 7385 Part 2-1993. The vibration levels specified in this standard are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have potential to cause damage to the main structure.

Buildings that are potentially at risk of threshold or cosmetic damage would be identified by the contractor prior to the commencement of construction works. A Construction Noise and Vibration Management Plan (CNVMP) should include management at these locations including building condition surveys before the commencement of construction activities and after construction is completed. Where a historic building is deemed to be sensitive to damage from vibration (structurally unsound), a conservative superficial cosmetic damage criterion of PPV 3mm/s peak component particle velocity (based on DIN 4150) may be applicable.

HUMAN COMFORT (AMENITY)

Vibration generated by construction works are generally considered as:

- Intermittent - where sources which operate intermittently, but which would produce continuous vibration if operated continuously.

As such, the limits Vibration Dose Values (VDV) above which there is considered to be a risk that the amenity and comfort of people occupying buildings would be affected by construction work are taken from *Assessing Vibration: A Technical Guideline* (NSW EPA, 2006). These are detailed in Table 3.6.

Table 3.6 Vibration limits for human exposure from intermittent vibration

LOCATION	**ASSESSMENT PERIOD**	**VIBRATION DOSE VALUE (VDV), m/s$^{1.75}$**	
		PREFERRED VALUES	MAXIMUM VALUES
Critical areas	Day or night-time	0.10	0.20
Residences	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions, and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

4 OPERATIONAL NOISE ASSESSMENT

This section provides an assessment of the noise sources likely to be associated during operational stages of the proposed cemetery.

4.1 MOBILE MACHINERY

For the cemetery, burial and outdoor component of the proposed development, a number of mobile machineries are expected to be required as summarised in Table 4.1.

Table 4.1 On-site mobile machineries associated with the cemetery grounds

ITEM	LIKELY QUANTITY	LIKELY PERCENTAGE OF OPERATION DURING ANY 15-MIN PERIOD	SOUND POWER LEVEL (dBA)
Small excavator	1	100%	83
Small tipper truck	1	25%	85
Ride-on mower	2	100%	82

Based on the equipment and usage factors identified above, noise predictions were undertaken for the nearest sensitive receivers, assuming all equipment to be operating concurrently at the shortest distance between the site and receivers. The predicted noise levels are shown in Table 4.2

Table 4.2 Predicted sound pressure level – outdoor mobile machinery

RECEIVER	SHORTEST DISTANCE TO CEMETERY SITE (METRES)	NOISE TRIGGER LEVEL, dB $L_{Aeq, 15min}$	PREDICTED SOUND PRESSURE LEVEL, dB $L_{Aeq, 15min}$	COMPLIES?
R01	165	38	37	Complies
R02	200	38	35	Complies
R03	185	38	36	Complies
R04	100	38	41	3 dB exceedance
R05	100	38	41	3 dB exceedance
W01	40	50	49	Complies
Minimum distance to achieve compliance	145	38	38	Complies

These results give the following findings:

- All identified representative receivers assessed were found to be compliant apart from at R04 and R05. It should however be noted that the assessment assumed all machinery to be operating concurrently and located at the nearest cemetery boundary. This is expected to be a conservative assumption and not likely to be a frequent occurrence.
- The minimum setback distance between any machinery and receiver building to achieve compliance with the noise trigger levels for residential receivers is approximately 145 metres, as presented graphically in Figure 4.1. The noise

trigger levels are only likely to be exceeded when mobile machineries are operated in a relatively small area of the entire site closest to receiver R04 and R05. The overall acoustic risk is therefore expected to be minor.

- The worst predicted exceedance of the trigger levels was up to 3 dB, which is just noticeable to the human ear and not considered significant. It is therefore regarded that consideration of mitigation is not necessary in practical terms.

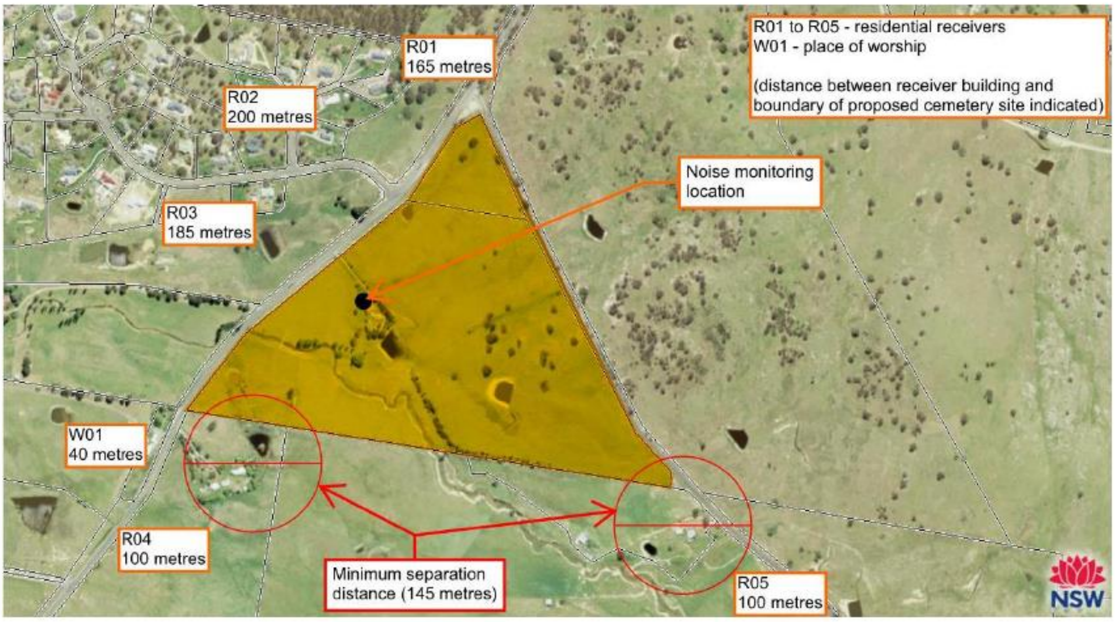


Figure 4.1 Recommended minimum separation distance for compliance for mobile machineries

4.2 FIXED PLANT

The proposed cemetery is likely to contain building(s) for use by staff members and members of the public for funeral purposes. Such buildings may contain fixed mechanical plant such as air conditioning, exhaust fans, pumps, indoor public announcement system for music and speech or the like.

The following approach is recommended:

- Where possible, position all buildings and fixed noise sources strategically on the subject development block (e.g. furthest from all sensitive receivers).
- Further detailed assessment should be undertaken during further planning and design stages to ensure compliance is achieved with the nominated noise limits.

It is generally practical and feasible to achieve the equipment noise limits with appropriate unit selection, acoustic screening, and maximising distance between the equipment and any potentially-affected dwelling.

4.3 ON-SITE VEHICLE MOVEMENTS

Vehicular movements and operation of a car park on site have the potential to cause noise concern and are assessable under the NPfI. As the location of the site access road is currently unknown, a quantitative assessment is therefore not conducted. It is however expected that, subject to further acoustic consideration and assessment, the site access road and car park can operate in compliance with the noise trigger levels. The following typical strategies can likely be considered:

- Position any access roads furthest away from the nearest sensitive receivers, where possible.
- Limit the speed of on-site vehicles.
- Avoid any discontinuities along the access road as well as car park areas. These include traffic calming devices, humps, joints, boom gates or the like.
- Signage to discourage noisy driving behaviour such as use of horns, excessive/unnecessary accelerating.
- Limit any truck's access to site to occur during the day and evening time periods only.

4.4 POTENTIAL INCREASES TO ROAD NOISE

Additional road traffic is likely to be generated in the surrounding road network due to the proposed development. Based on a recent traffic count in the surrounding road network, it is gathered that the daily traffic volume in Old Cooma Road was in the order of up to approximately 2,600 vehicles.

- It is understood that the proposed development could potentially host 3 to 4 funeral services per week.
- For the purpose of the noise assessment, it is assumed that up to 2 funeral services can occur on a single day.
- As a very conservative assumption, up to 150 vehicles can be generated by one funeral service.
- Taking into account both movements arriving and leaving site, this is equivalent to up to a total of 600 vehicle movements in a single day for two funeral services.

This conservative scenario equates to less than 25% of the existing traffic volumes along Old Cooma Road. To trigger a noise level increase of 2 dB or more, a change of road traffic volume in the order of 60% or more is required. From an acoustic perspective, a change of 2 dB is typically considered minor and not generally perceptible. It is therefore regarded that any potential increase in road traffic noise as a result of the propose development is likely to be insignificant.

5 CONSTRUCTION NOISE AND VIBRATION

Based on information available to date, it is understood the construction phase of the proposed cemetery is likely to include the following activities:

- General land clearing and earthworks;
- General landscaping work including the buffer zone around the perimeter of the site and for aesthetic purposes;
- Building works for the funeral services building, and associated foundation works.

During the construction phase of the proposed development, construction noise is expected to have the potential of affecting surrounding receivers.

Construction noise is generally managed in NSW by the ICNG and the NGLG. The ICNG nominates noise management levels (NML) to assist with assessment and management of construction noise. The ICNG also acknowledges that such noise is temporary and not always feasible and reasonable to apply specific measures to meet numerical noise levels. The ICNG provides guidance for considering a range of work practices and management measures that can be applied to a project, where reasonable and feasible, with the aim of minimising construction noise impact.

Typical activities that are likely to pose a higher noise risk and likely to exceed the NMLs are earthworks, foundation works, concrete pours and construction of the building structural frame and envelope when cranes are involved. These however are likely to be concentrated over a discrete period rather that throughout the entire construction period. The temporary nature of such noise sources is therefore likely to cause limited noise impact on surrounding receivers.

In acknowledgement that temporary noise associated with construction of the proposed cemetery are likely to cause adverse noise impact, the following measures are recommended for consideration:

- Manage construction noise in accordance with guidance provided in ICNG and NGLG.
- Construction works to be scheduled within the standard hours nominated in the ICNG. These hours are Monday to Friday 7.00 am to 6.00 pm, Saturday 8.00 am to 1.00 pm. No works on Sunday or public holidays.
- Where feasible, consider setting of solid construction hoarding to act as a noise barrier.
- Notify the surrounding receivers of the proposed construction program and upcoming specifically noisy activities.
- Adopt construction practices that will result in a lower noise impact where feasible as well as general good practice with the view of minimising construction noise.
- Discourage construction personnel from engaging in anti-social behaviour and unnecessary noise-generating activities.

6 SUMMARY

Based on the noise assessment documented in this report, the following conclusions are made:

- Queanbeyan-Palerang Regional Council is proposing a new cemetery on land located at 1241 Old Cooma Road, Googong.
- Once operational, the cemetery is expected to accommodate 3 to 4 funerals per week.
- The typical hours of operation for the proposed cemetery would be 7.00 am to 4.00 pm Monday to Friday, with most services occurring after 9.00 am and the occasional service occurring on weekends or after 4.00 pm on a weekday.
- Unattended noise monitoring was undertaken on site for a period of >7 days per requirement of the NPfI and this informed the existing background noise levels, which in turn informed the noise assessment guideline levels.

Table 6.1 Summarised findings of noise assessment

ITEM	CRITERIA	FINDINGS	PROJECT RISK LEVEL	REQUIRED MITIGATION CONSIDERATION
Operational noise impact due to mobile machineries	Residential receivers 38 dB $L_{Aeq,\ 15min}$ Place of worship 50 dB $L_{Aeq,\ 15min}$	Exceed identified trigger levels by up to 3 dB at two locations	Low to medium	Not considered necessary as the level of exceedance is minor and based on a conservative assessment. Exceedance expected to occur only when mobile machineries are operated in a relatively small area of the entire site closest to receiver R04 and R05
Operational noise impact due to fixed plant and on site vehicles		Expected to be acceptable with appropriate review and assessment during detailed design	Low to medium	Where possible, position these noise sources strategically on the subject development block (e.g. furthest from all sensitive receivers). More detailed acoustic assessment should be undertaken as soon as more detail on the proposed site is available. Limit the speed of on-site vehicles. Avoid any discontinuities along the access road as well as car park areas. These include traffic calming devices, humps, joints, boom gates or the like. Signage to discourage noisy driving behaviour such as horning, excessive/unnecessary accelerating. Limit any truck's access to site to occur during the day and evening time periods only.
Road traffic noise due to additional road traffic		Any triggered road traffic noise increase as a result of the cemetery expected negligible	Low	None

ITEM	CRITERIA	FINDINGS	PROJECT RISK LEVEL	REQUIRED MITIGATION CONSIDERATION
Construction noise and vibration		Likely to cause noise disturbance	Medium	Manage construction noise in accordance with guidance provided in ICNG and NGLG. Construction works to be scheduled within the standard hours nominated in the ICNG. These hours are Monday to Friday 7.00 am to 6.00 pm, Saturday 8.00 am to 1.00 pm. No works on Sunday or public holidays. Where feasible, consider setting of solid construction hoarding to act as a noise barrier. Notify the surrounding receivers of the proposed construction program and upcoming specifically noisy activities. Adopt construction practices that will result in a lower noise impact where feasible as well as general good practice with the view of minimising construction noise. Discourage construction personnel from engaging in anti-social behaviour and unnecessary noise-generating activities.

QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2	PROPOSED QUEANBEYAN CEMETERY SITE
ATTACHMENT 6	SOCIAL IMPACT REPORT COFFEY 2018

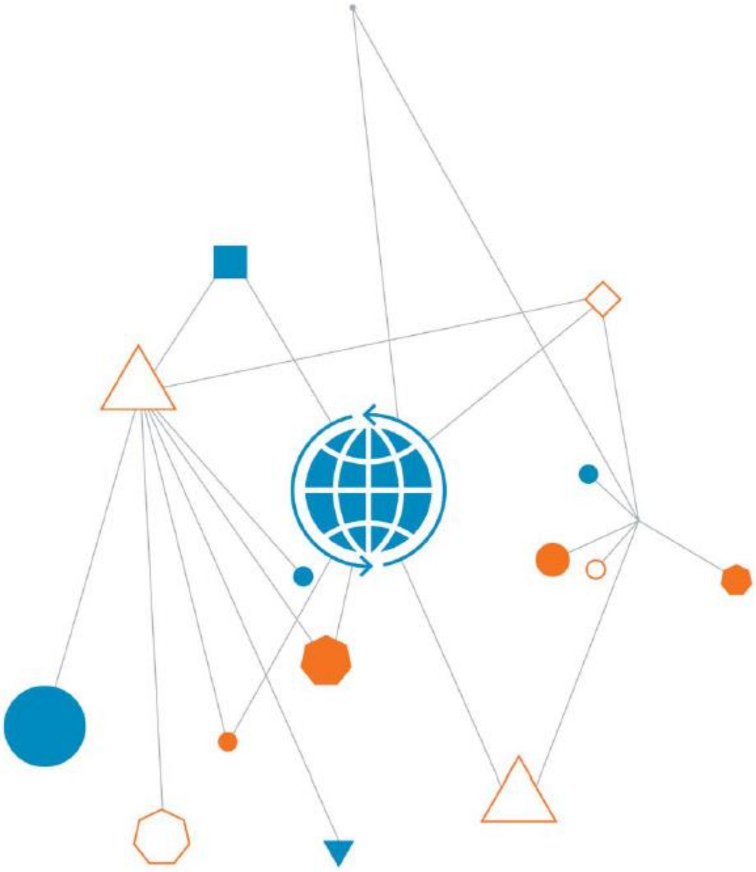
coffey
A TETRA TECH COMPANY

Queanbeyan-Palerang Regional Council

Proposed memorial park south of Queanbeyan

Social Report

June 2018



When you
think with a
global mind
problems
get smaller

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Proposed memorial park south of Queanbeyan

Prepared for
Queanbeyan-Palerang Regional Council

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June 2018

754-MELEN215472_SIA_v3

Quality information

Revision history

Revision	Description	Date	Originator	Reviewer	Approver
v1 draft	Draft Social Report	17/05/18	Tasha Latham	Emma Waterhouse	Emma Waterhouse
v2 draft	Draft Social Report	05/06/18	Tasha Latham	Emma Waterhouse	Emma Waterhouse
v3	Final Social Report	28/06/18	Tasha Latham	Emma Waterhouse	Emma Waterhouse

Distribution

Report Status	No. of copies	Format	Distributed to	Date
v1 draft	1	PDF	ELA	17/05/18
v2 draft	1	PDF	ELA	05/06/18
V3	1	PDF	ELA	28/06/18

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Executive Summary

Queanbeyan-Palerang Regional Council (QPRC) proposes to develop a memorial park on a parcel of land approximately 11 km south of Queanbeyan in New South Wales (NSW), south of the Googong township. The existing Lanyon Park cemetery in Queanbeyan is nearing capacity; in addition, the ACT's existing three cemeteries are expected to reach capacity within eight years. The QPRC has identified that an additional facility is required to accommodate the needs of a growing and ageing population.

QPRC has prepared a planning proposal in accordance with section 3.33 of the *Environmental Planning and Assessment Act 1979* to amend the *Queanbeyan Local Environmental Plan 2012* to enable the use of the proposed site as a cemetery, currently zoned E4 Environmental Living. The planning proposal identified the need for studies to assess and manage potential environmental and social impacts associated with use of the site as a cemetery.

This report provides a high-level review of the existing social characteristics of the site and surrounds and the likely social issues associated with its development.

Sensitive receptors in proximity to the proposed site include residential properties to the west on the Mount Campbell Estate, properties directly south of the proposed site and St Paul's Anglican Church.

During construction, minor short-term amenity impacts may be experienced at nearby sensitive receptors from air and noise emissions generated by machinery, heavy vehicles and equipment. Nearby sensitive receptors may also experience minor short-term changes to visual amenity and traffic due to the presence of construction works and vehicles.

During operations, two sensitive receptors have the potential to experience minor amenity impacts from noise emissions associated with mobile machinery operated on site. The site is likely to be visible from immediately adjacent locations, up to 1 km to the north-east and north-west and from up to 2 km south.

Residents near the proposed site may also be concerned about the potential for the development to increase the risk of injury or death from traffic accidents during construction and operation. Residents in proximity to the proposed site may also perceive that the proposed development could affect the value of their property.

Local businesses such as eating establishments may benefit from increased demand for goods and services during construction and operation of the memorial park.

This report suggests an approach for engaging with stakeholders on the development of the proposed site as a memorial park. The potential social issues identified in this report will need to be verified and revised once formal community engagement process occurs.

1. Introduction

Queanbeyan-Palerang Regional Council (QPRC) proposes to develop a memorial park on a parcel of land approximately 11 km south of Queanbeyan in New South Wales (NSW) (Figure 1). The site is currently used for grazing and other agricultural uses.

The existing Queanbeyan cemetery at Lanyon Drive, approximately 10 km north of the proposed site, is expected to reach capacity in approximately five years. The cemetery caters for all denominations and cultures and capacity issues will impact on its ability to service these various needs. The Riverside Cemetery in Queanbeyan approximately 13 km north of the proposed site is closed to new plot sales. Bungendore Cemetery, approximately 38 km north of the proposed site, in Bungendore NSW is also reaching capacity. The proposed memorial park south of Queanbeyan is required to accommodate the needs of a growing and ageing population.

QPRC has prepared a planning proposal in accordance with section 3.33 of the *Environmental Planning and Assessment Act 1979* to amend the *Queanbeyan Local Environmental Plan 2012* to enable the use of the proposed site as a cemetery, currently zoned E4 Environmental Living. The planning proposal identified the need for studies to assess and manage potential environmental and social impacts associated with use of the site as a cemetery. One such study identified was a social impact assessment (SIA).

This report provides a high-level review of the existing social characteristics of the site and surrounds and the likely social issues associated with its development. QPRC is yet to engage with the community on the use of this site as a cemetery and the potential social issues identified in this report will need to be verified and revised once this engagement occurs.

1.1. Project site and surrounds

The 36.4 ha triangular site is located 11 km south of Queanbeyan in the suburb of Googong on the eastern side of Old Cooma Road at the Burra Road intersection south of the Googong urban release area. It comprises Lot 2 DP 112382 and Lot 126 DP 754881 and is currently zoned as E4 Environmental Living.

The site is currently used for grazing and agriculture, with farming practices having taken place on the site since the 1800s. A cottage sits close to the centre of the site. Church Creek runs through the site in a north-west direction and other smaller tributaries drain into it.

Properties surrounding the proposed site are predominantly zoned as E4 Environmental Living. They consist of a mix of farming properties (mainly grazing), rural residential living lots and in the new urban release areas, smaller residential lots.

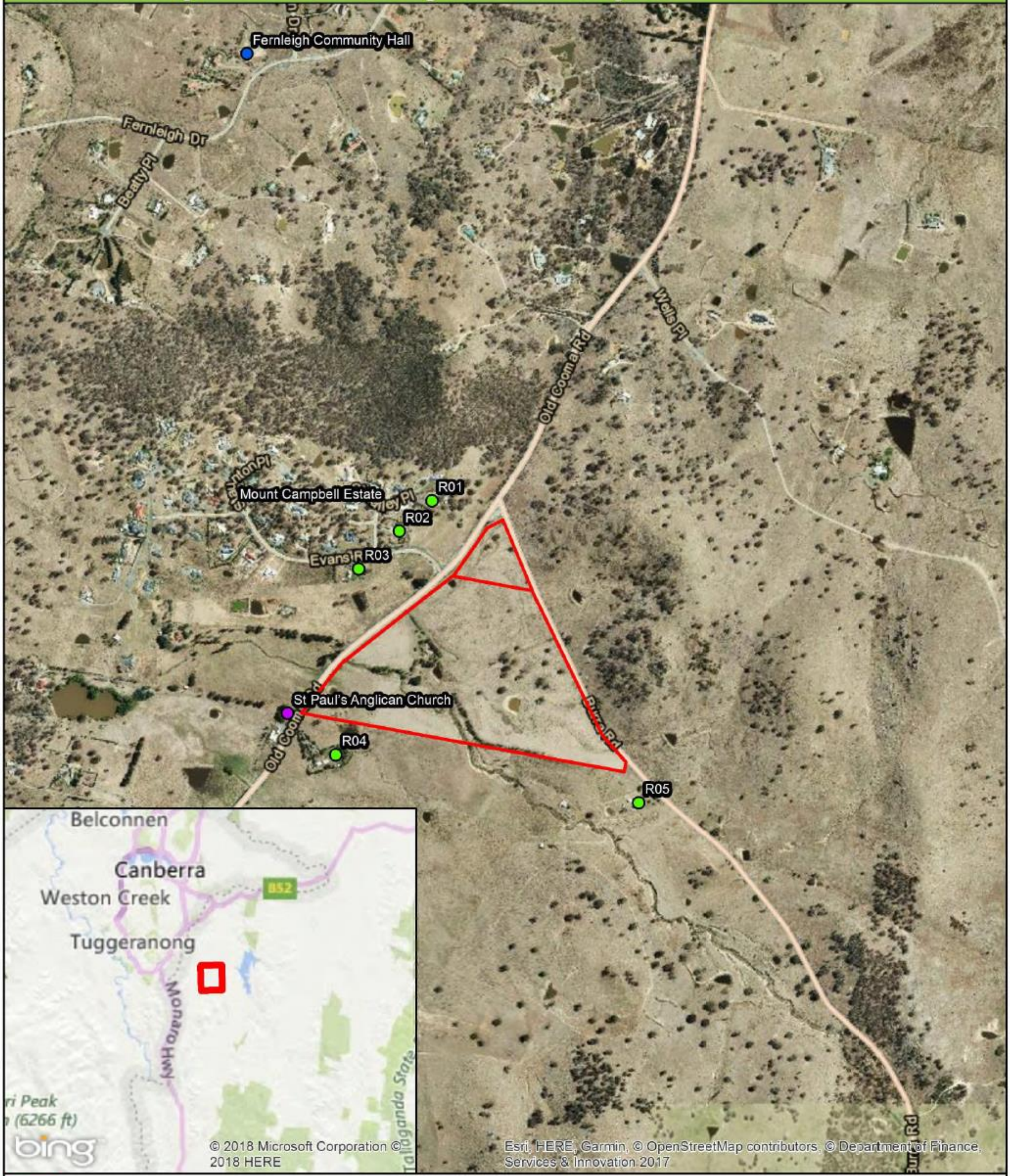
1.2. Project description

The proposed development of a memorial park is likely to involve construction of:

- Public amenities.
- Potential water features.
- Access roads and onsite parking.
- Service sheds.

Development of the memorial park will also involve extensive tree planting, including a minimum 20 m wide perimeter buffer of trees and the establishment of landscaped gardens.

Location of Proposed Site and Nearby Sensitive Receptors



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🟥 Study Area
● Place of Worship
● Residential Receiver
● Community Hall

0 150 300 600
Metres
Datum/Projection:
GDA 1994 MGA Zone 55

N

eco logical AUSTRALIA
www.ecoaus.com.au
Prepared by: EB Date: 1/06/2018

Approximately 16 ha of land will be disturbed for the construction of the memorial park. A 5 ha buffer will be established around the perimeter of the disturbed land, and an additional 6 ha dedicated to environmental restoration of biodiversity on site, including restoration of Church Creek and remnant vegetation within the site boundary.

Construction of the memorial park is anticipated to take three to six months. The existing farm house and buildings onsite are expected to act as offices.

Once the memorial park is developed, the following activities are predicted to occur on the site:

- An average of three to four burials per week. These will involve light excavation works to prepare the ground using equipment equivalent to a backhoe or farm tractor. Cars associated with a funeral procession will come in and out of the memorial park on the day of the service using the on-site car parking.
- Routine garden maintenance involving lawn mowers, whipper-snippers and other garden maintenance equipment will be carried out on site on a regular basis.
- Routine maintenance and funeral services with operating hours 7:00 a.m. – 4:00 p.m., Monday to Friday. There may be occasions where late or weekend services are carried out to meet religious or family needs.

A water management strategy will be implemented to use stormwater run-off and treat the site’s effluent.

The memorial park will employ three staff members during its operational life.

2. Method

This chapter outlines the method used to develop the social report.

2.1. Scoping

The first phase of work involved identifying potential social issues associated with the development of the proposed site as a memorial park. These issues were used to frame what needed to be investigated as a part of the baseline assessment.

2.2. Baseline assessment

A high-level baseline assessment was conducted to describe key social characteristics of the site and surrounding area. This involved a review of aerial imagery of the site and surrounds and information collected from a site visit by ELA (March 2018). This information was used to understand the land uses and potential sensitive receptors in proximity to the proposed site and any other notable features of the surrounding landscape.

Baseline information was collected on the suburb of Googong and the Queanbeyan-Palerang Regional Local Government Area from a range of secondary sources including Australian Bureau of Statistics (ABS) 2016 census, local policies and strategies and newspaper articles.

2.3. Refinement of potential social issues

This phase involved refining the list of potential social issues identified during the scoping phase based on a review of:

- Background information on the project.
- Findings of the social baseline assessment.
- Findings of other relevant technical studies being completed for the project including the Desktop Visual Assessment (ELA, 2018), Noise Impact Assessment (WSP, 2018a) and Transport Impact Assessment (WSP, 2018b).
- Media articles on the community's response to the proposed development of the site as a memorial park.

The focus of this phase of work was on identifying and describing potential social issues for QPRC to discuss and verify with the community at a later date.

2.4. Suggested approach to stakeholder engagement

The final phase of work involved developing a suggested approach to guide QPRC in engaging with government stakeholders and the local community on the use of the proposed site as a memorial park. The focus of this phase was to provide an approach to disseminating information to stakeholders on the development of the proposed site and to understand stakeholder values and concerns.

3. Existing social environment

3.1. Social context

New growth areas south of Queanbeyan include Googong, South Jerrabomberra and Royalla.

Googong, where the proposed memorial park would be located, is a master planned township located south-east of Queanbeyan. Residents first moved into the township in early 2014, and in 2016 there were close to 900 residences (ABS, 2018). Further development of the town is planned over the next 20 years to accommodate a projected population of 18,000 people in 6,200 residences (Googong Township Pty Ltd, 2018).

The town currently includes a school, childcare centre, recreation centre, playgrounds and sporting fields and a village centre incorporating a supermarket, café, health services, shops and a community centre. Further development of the town is projected to include construction of additional residential areas, shopping villages, recreational areas, a primary and secondary school, community centre and library.

3.1.1. Demographics

The population of Googong was 2,690 in 2016 and is projected to increase to 11,588 in 2031 according to the NSW Department of Planning and Environment (Department of Planning, 2016) (see Table 1). In 2016, Queanbeyan-Palerang Regional Local Government Area (LGA) had a population of 56,027 (ABS, 2017) and is predicted to increase by 42.6 % to 79,900 people in 2031).

Table 1 Population projections

Locality	2011	2016	2021/2022	2031/2032
Googong State Suburb	1,122[*]	2,690	5,344	11,588
Queanbeyan-Palerang Regional LGA	54,850[§]	56,027[†]	67,250[§]	79,900[§]
ACT	357,222[†]	397,397[†]	437,032[‡]	499,463[‡]
NSW	7,218,529[†]	7,480,231[†]	8,297,500[§]	9,386,850[§]

* ABS (2011).
† ABS (2017).
§ NSW Department of Planning and Environment.
‡ ACT Government Treasury.

The median age of people living in Googong was 32 in 2016 compared to 38 in the Queanbeyan-Palerang Regional LGA. Further details of age demographics within the region are provided in Table 2.The population of the Queanbeyan-Palerang Regional LGA of retirement age is expected to increase by 50.2% between 2016 and 2026.

The gender distribution within the Queanbeyan-Palerang Regional LGA is relatively even with slightly more men than women (50.2% male and 49.8% female), whereas in Googong, there are slightly more women (51.9 %) than men (48.1 %).

Table 3 outlines the household type and composition within Googong and the Queanbeyan-Palerang Regional LGA. The average number of people per household is 3.1 in Googong compared to 2.6 across the Queanbeyan-Palerang Regional LGA. Almost all the residents in Googong (99.6%) live in separate houses, whereas dwelling structures in Queanbeyan-Palerang Regional LGA are more diverse with 14.1 % semi-detached, row, terrace or townhouses and 11.9 % flats or apartments.

Most households in Googong and in the Queanbeyan-Palerang Regional LGA are classified as family households (91% and 71.8% respectively). Over 60% of families consist of a couple with children in Googong, while in Queanbeyan-Palerang Regional LGA this figure is below 50%.

Table 2 Age profile

Locality	Total	Dependent Children % (0 to 14)	Workforce Age % (15 to 64)	Seniors % (65+)	Median Age
Googong State Suburb	2,690	25.3%	68.6%	6%	32
Queanbeyan-Palerang Regional LGA	56,027	19.5%	68.4%	12.1%	38
ACT	397,397	18.7%	68.7%	12.6%	35
NSW	7,480,231	18.5%	65.1%	16.2%	38

Note: the sum of percentages for a given area do not all equal 100 % due to decimal rounding.
Source: ABS (2017)

Table 3 Household structure

	Dwellings	Ave. people/ house-hold	Dwelling structure				Household type			Family composition			
Locality			SH (%)	SD (%)	F/A (%)	OD (%)	Family (%)	Single person (%)	Group (%)	Couple without children (%)	Couple with children (%)	One parent (%)	Other (%)
Queanbeyan-Palerang Regional LGA	23,983	2.6	73.2	14.1	11.9	0.5	71.8	25.8	2.3	36.8	48.2	13.9	1.2
Googong State Suburb	897	3.1	99.6	0	0	0	91.0	7.9	1.0	32.5	59.6	7.4	0.4

SH: Separate house; SD: Semi-detached, row or terrace house, townhouse etc; F/A: Flat or apartment; OD: Other dwelling
Source: ABS (2017)

3.1.2. Income

The median personal, family and household incomes for residents in Googong are higher than those of Queanbeyan-Palerang Regional LGA, NSW and the ACT (see Table 4). The median weekly personal income within Googong is $1,234 per week, compared to $933 per week in Queanbeyan-Palerang Regional LGA, $998 in the ACT and $664 per week in NSW.

Table 4 Median personal, family and household income

Locality	Median weekly income		
	Personal	Family	Household
Googong State Suburb	$1,234	$2,816	$2,813
Queanbeyan-Palerang Regional LGA	$933	$2,303	$1,882
ACT	$998	$2,445	$2,070
NSW	$664	$1,780	$1,486

Source: ABS (2017)

3.1.3. Religious affiliations

Religious affiliations for Googong and Queanbeyan-Palerang Regional LGA residents vary. The top five religious affiliations are detailed in Table 5.

Table 5 Religious affiliations

Locality	Top five religious affiliations
Googong State Suburb	• Catholic: 31.5% • No affiliation (as stated): 25.6% • Anglican: 15.2% • Not stated: 10.5% • Christian (not further defined): 3.2%
Queanbeyan-Palerang Regional LGA	• No affiliation (as stated): 28.7% • Catholic: 26.9% • Anglican: 16.4% • Not stated: 9.9% • Uniting Church: 2.6%

Source: ABS (2017)

3.1.4. Property values

Median property prices within the Queanbeyan-Palerang Regional LGA for the June 2017 quarter range from $345,000 for strata properties to $618,000 for non-strata properties (Housing NSW, 2018). Non-metropolitan median property prices for the rest of NSW were $350,000 for strata properties and $415,000 for non-strata properties (see Table 6).

Table 6 Property values

Locality	June 2017 quarter (strata)	June 2017 quarter (non-strata)	June 2017 quarter (total)
Queanbeyan-Palerang Regional LGA	$345,000	$618,000	$495,000
Greater Metropolitan Region of NSW	$742,000	$895,000	$820,000
Rest of NSW	$350,000	$415,000	$400,000
NSW	$700,000	$700,000	$700,000

Source: Housing NSW, 2018 – website: https://www.housing.nsw.gov.au/about-us/reports-plans-and-papers/rent-and-sales-reports.

3.1.5. Traffic and access

The proposed site has frontages onto Old Cooma Road and Burra Road. Both are two-way roads with one traffic lane in each direction intersecting at a priority controlled intersection with Give Way control on Burra Road. The speed limit on each road is 100 km per hour.

The road network surrounding the proposed site does not currently accommodate walking and cycling facilities, or public transport services (WSP, 2018b).

Traffic data collected in 2017 indicates that Old Cooma Road carries approximately 2,540 vehicles per day. Weekday peak hour periods are between 8:00 a.m. and 9:00 a.m. and 5:00 p.m. and 6 p.m. during which there are approximate hourly volumes of 310 to 350 vehicles respectively. On weekends, traffic is generally consistent between 10:00 a.m. and 4:00 p.m., with up to 270 vehicles per hour.

Burra Road carries approximately 1,100 vehicles per day including a peak of hourly volume of 132 vehicles in the morning and 154 vehicles in the afternoon.

A school bus service (No. 66) runs past the site on Old Cooma Road. The service runs once in the morning and once in the afternoon. A bus stop is located adjacent to the site on the western side of Old Cooma Road, north of Evans Road.

3.1.6. Nearby sensitive receptors

One of the closest sensitive receptors is St Paul's Anglican Church, located approximately 40 m south-west of the proposed site on the western side of Old Cooma Road.

Other sensitive receptors close to the site include residential properties on 1291 Old Cooma Road and 102 Burra Road. Both properties share the southern boundary of the proposed site and appear to be used for grazing.

The driveway to 1291 Old Cooma Road exits onto Old Cooma Road, just south of the proposed site and the driveway to 102 Burra Road exits onto Burra Road, just south-east of the proposed site.

The Mount Campbell Estate is located immediately west of the proposed site. The estate can be accessed via Evans Road which runs off Old Cooma Road just south of the proposed site. Five properties to the east of the estate that can be accessed via O'Malley Place are closest to the proposed site (a minimum of approximately 170 m).

Other sensitive receptors close to the site include Ferleigh Park Community Hall, located approximately 1.6 km north-west of the proposed site on Swan Drive, and Avalanche Homestead (a sheep and cattle station that also operates as a farm stay and B&B and offers 4WD tours), located over 2 km south-east of the proposed site, on Burra Road.

Googong Foreshore is a recreational area located approximately 4 km east of the proposed site. The area is used for bushwalking, birdwatching, bike riding boating and fishing.

No known tourist attractions are located close to the site.

3.2. Community response

To date, no engagement has been conducted by QPRC with the community on the use of the proposed site as a cemetery. Given this, the community's response to the proposed development is unknown except for reports in the local media.

In May 2017 the Canberra Times reported that local residents were rallying against the council over the proposed development (The Canberra Times, 2017). The Queanbeyan Age reported (May 2017) that the proposed cemetery was unlikely to be supported by residents of the Mount Campbell Estate (The Queanbeyan Age, 2017).

The main issue raised by residents in these media articles is the lack of community consultation and transparency about the proposal by the council. Other community concerns reported in the local newspapers include the potential for stormwater flooding at the site and the negative impact on one resident's visual amenity of the area.

Local media also reported that up to 50 people attended a community meeting on the proposed development in May 2017, with some residents voicing their objection to the cemetery.

4. Potential social issues

Use of the proposed site as a cemetery has the potential to create a range of social issues and impacts for community members living, working and travelling close to the site.

Potential social issues are discussed below, and will require further refinement and verification once stakeholder engagement is conducted by QPRC to accurately understand community concerns.

4.1. Amenity

4.1.1. Air and noise emissions

Residents living close to the proposed site could experience a change in amenity associated with air and noise emissions from the proposed development.

Noise emissions will be generated during construction and operation of the proposed facility during the daytime only. During construction, noise emissions will be generated from machinery, heavy vehicles and equipment undertaking land clearing and earthworks, landscaping works, demolition, building works and vehicle movements. During operations, noise will be generated from light excavation equipment and vehicle movements, and routine maintenance activities involving ride-on lawn mowers, whipper-snippers and other garden equipment (WSP, 2018a).

Unattended noise monitoring was conducted at the proposed site and at the five nearest sensitive receivers over a 15-day period to establish existing ambient background noise levels (Figure 1). The background noise monitoring indicates that the local noise environment is dominated by traffic noise along Old Cooma Road and natural sounds such as birds and the wind in trees.

Using the background noise monitoring data, noise criteria were established for the construction and operation of the proposed Project, in accordance with the *Interim Construction Noise Guideline* (NSW) (ICNG) and the *NSW Noise Policy for Industry* (NPfI) respectively (Table 7). The criteria provide noise emission thresholds for the Project, that if exceeded, could result in noise impacts to nearby residents.

Table 7 Noise emission thresholds

	Noise emission threshold (dBA $L_{Aeq\ 15min}$)*		
Land use	Day	Evening	Night
	During construction†		
Residential	43	41	NA
	During operation§		
Residential	38	38	NA
Place of worship	50	50	NA

* Equivalent continuous sound level over 15 minutes.

† Criteria established in accordance with ICNG.

§ Criteria established in accordance with NPfI.

Day = 7am – 6pm, evening = 6pm – 10pm, night = 10pm – 7am.

The noise impact assessment (WSP, 2018a) found that some construction activities such as earthworks, foundation works, concrete pours and building construction (when a crane is in use), are likely to generate noise levels at nearby sensitive receptors that exceed the criteria and could cause noise disturbance. Impacts would be limited to the period of construction (i.e., across three to six months) and restricted to standard construction hours (7:00 a.m. to 6:00 p.m. Monday to Friday and 8:00 a.m. to 1:00 p.m. Saturday). In such circumstances, the ICNG provides guidance on measures that should be implemented to reduce noise emissions during construction. Such measures include notifying surrounding receivers of the proposed construction program (and the timing of potentially noisy activities) and adopting construction methods that are less noisy. Specific noise mitigation measures based on the recommendations of the noise impact assessment (WSP, 2018) will be confirmed during detailed design and implemented during the construction phase.

During operations, noise emissions from mobile machinery such as a small excavator, small tip truck, and ride on mower, are expected to exceed the nominated noise criteria at two sensitive receptors (R04 and R05) by up to 3 dB. This minor exceedance is only expected to occur where mobile machinery is operating in a relatively small area of the site, closest to R04 and R05 (WSP, 2018a) and specific mitigation measures were not recommended. Other noise emissions during operations (such as from light vehicles and buildings) are expected to be at or below the adopted noise thresholds. The noise impact assessment report (WSP, 2018) noted that these anticipated noise levels from the proposed developed should be verified during the detailed design phase.

Any change in noise emissions generated by increased vehicle movements to and from the site during construction and operations is expected to be negligible.

Air emissions will be generated during construction from vehicles, machinery and equipment and are expected to be negligible in the context of a site located near a main road. Dust could be generated during earthworks and would be controlled with standard mitigation measures. Emissions during operation will be restricted to light vehicles and excavators on site.

4.1.2. Visual amenity

Development of the proposed site as a memorial park has the potential to change the visual amenity experienced from properties and roads in proximity to the proposed site.

The proposed site is visible from immediately adjacent locations, up to 1 km to the north-east and north-west and from up to 2 km south (ELA, 2018). The site is likely to be visible from some residential properties on the Mount Campbell Estate to the west of Old Cooma Road, particularly those properties located close to Old Cooma Road. The site is also likely to be visible from residential properties situated to the north of Royalla and south of the site, as well as from St Paul’s Anglican Church. Properties north of the proposed site, in areas such as Googong, have minimal visibility of the site.

The site is also visible from higher slopes and ridges between 2 km and 5 km away, including sections of Old Cooma Road, to the south of Binowee Drive and discontinuous areas along Royalla Drive (ELA, 2018). People travelling on these road sections are likely to have views the site. Many of the slopes and ridges do not contain private residences or public recreation facilities and many are over 3 km away. Larger buildings only are likely to be discernible. Visual impacts are only likely to be an issue if the site is further developed (ELA, 2018). Existing trees could provide significant screening, particularly at distant locations (ELA, 2018).

During construction of the proposed memorial park, residents in the Mount Campbell Estate and directly south of the proposed site are likely to view construction works, as will people travelling on nearby roads. Once constructed, these residences and road users may experience views of some of the structures on site such as the public amenities. The minimum 20-m-wide perimeter buffer of trees is likely to screen some views of the site, particularly as the trees mature over time.

4.2. Traffic and access

Increased vehicle movements on local roads during construction and operation of the cemetery could change local access and increase travel times for people living, working or travelling in proximity to the site.

4.2.1. Traffic

Relatively small numbers of construction vehicle movements are expected in and out of the proposed site during the construction period (three to six months). Road closures are unlikely. Increased travel times are not expected due to the relatively small numbers of construction vehicle movements. While Nearby residents and other users of Old Cooma Road and Burra Road may experience minor traffic disruptions.

The transport impact assessment (WSP, 2018b) carried out for the proposed development estimated up to 150 vehicles will be generated during peak periods. Traffic generated is likely to fluctuate as people arrive for a funeral service in one hour and then leave in the next hour. Funerals are expected to generally occur outside of peak teams (i.e., after 9:00 a.m. on weekdays with the occasional service on weekends or after 4:00 p.m. on a weekday). Given this timing, WSP identified a low likelihood that peak traffic generated by development of the proposed site would overlap with that for Old Cooma Road (WSP, 2018b).

Indicative traffic modelling conducted by WSP (2018) indicates that the intersection of Old Cooma Road and Burra Road currently operates well with minimal queues or delays on all approaches. Old Cooma Road and Burra Road are expected to experience a 6% annual increase in traffic from future residential development nearby (WSP, 2018b). Allowing for this annual growth in traffic movement, and the expected growth associated with the proposed development of this site, the intersection of Old Cooma Road and Burra Road is expected to continue to operate well with minimal queues and delays on all approaches in the future (year 2031) (WSP, 2018b). Turn treatments (for example the use of traffic islands) have been proposed at the intersection of Old Cooma Road and Burra Road (on Old Cooma Road) to improve road safety conditions.

No on-street parking is available at the proposed site and 150 car parking spaces will be required on site to accommodate the anticipated peak demand for parking (WSP, 2018b).

4.2.2. Access

Access is expected be maintained at all times to properties located in proximity to the proposed site during construction including those with driveways on Old Cooma Road and Burra Road. Once constructed, access on Old Cooma Road and Burra Road will remain unchanged.

As there is currently no access to the site by public transport and no cycling or walking facilities are available, access will be limited to private vehicles and ride share vehicles unless these services are established.

Development of the proposed site will provide improved access to a cemetery facility for the growing population of Queanbeyan, particularly growth areas to the south of the city such as Googong. The demand for specific religious or cultural services is also likely to be met, which Lanyon Drive Cemetery is understood to experience.

4.3. Safety

Development of the proposed site has the potential to increase the risk of injury or death from traffic accidents during construction and operation from additional vehicle movements on nearby roads and increase community concern over road safety.

For instance, the community may be concerned over the safety of school students getting on and off the school bus at the bus stop located adjacent to the site on the western side of Old Cooma Road. A review of crash data from 2012 to 2017 for Old Cooma Road and Burra Road did not highlight any crash trends or significant road safety hazards (WSP, 2018b). Turn treatments at the intersection of Old Cooma Road and Burra Road (on Old Cooma Road) and a proposed reduction to the speed limit on Burra Road from 100 km per hour to 80 km per hour will assist in improving road safety conditions.

4.4. Economic

4.4.1. Property values

Residents living near the proposed site, such as people living on Mount Campbell Estate, could perceive that the value of their property will decline should it be developed as a memorial park. While the site is visible from some residential properties on the Mount Campbell Estate to the west of Old Cooma Road, the perimeter buffer of trees is expected to screen some views of the site.

4.4.2. Livelihoods

Development of the proposed site as a cemetery has the potential to affect the value of nearby businesses that are reliant on tourists such as short-term accommodation providers and eating establishments. Few such establishments are located close to the site, reflecting the rural residential nature of the area.

The closest known establishment is the Avalanche Homestead (located approximately 2 km south-east). The property is a working sheep and cattle station that also operates as a farm stay and B&B and offers 4WD tours. Development at the proposed site is unlikely to be visible from the Homestead (ELA, 2018). Other built elements in the landscape are of a similar scale and nature (such as churches and houses) and the proposed development is not expected to deter tourists from visiting the area.

Local businesses such as eating establishments may benefit from increased demand for goods and services during construction and operation of the memorial park. Potential employees will also benefit from employment during both construction and operations.

5. Suggested approach to community and stakeholder engagement

This chapter outlines an approach for engaging with stakeholders on the development of the proposed site as a cemetery.

QPRC should commence stakeholder engagement as early as possible in the planning process to provide stakeholders with the opportunity to provide input and minimise the potential for stakeholder concern. Importantly, engagement with stakeholders will also assist to understand any key constraints associated with the proposed site early in the planning process.

5.1. Community drop-in sessions (phase 1)

The first suggested step in engaging with community stakeholders is to hold community drop-in sessions. These informal gatherings could be held at Fernleigh Park Community Hall which is located approximately 1.6 km north-west of the proposed site. The sessions would provide an opportunity for interested members of the community to speak with Council planners and obtain information on:

- Why the proposed site was selected.
- What is proposed at the site (based on available information).
- Timing and process for development of the proposed site.
- Findings of the technical studies prepared to date.

The drop-in sessions would enable community members to discuss any concerns that they may have with the proposed development of the site for consideration by QPRC in planning.

A minimum of two sessions should be held on a weekday evening and/or Saturday morning to maximise the opportunity for attendance. Information could be presented on display boards including large (A2 or A1) maps showing the site and surrounding area and images of similar facilities. Feedback forms could be made available for people to record their views and any queries they may have.

5.2. Understanding stakeholder concerns and values

Community values are qualities of the social environment that are important to people and conducive to individual wellbeing. They form the basis of an assessment of how the community could be impacted by a development. Community values may relate to community connections, local places, access to infrastructure and services and aspects of a lifestyle that people enjoy.

A key step to understanding how the local community could be impacted by the proposed development of the site as a cemetery is to engage with them on what they value about their area, and what concerns they have with the proposal. This information could be gathered through feedback forms distributed at the drop-in session or a small workshop with a cross-section of community members.

Information gathered would need to be reviewed and collated to develop an understanding of community values and key areas of concern to inform an assessment of social impacts.

5.3. Community drop-in sessions (phase 2)

Should the planning proposal be approved and QPRC decide to proceed with an application for Development Approval (DA) for a cemetery at the proposed site, additional community drop-in sessions should be held to enable community members to view and comment on the draft design(s).

Council officers could provide an overview of the findings of the social impact assessment, how this information influenced decision making to proceed with the proposed development at this location, and the timing and nature of the proposed works.

Should QPRC determine not to proceed with a cemetery at the proposed site, Council should consider publishing information on their website on the key reasons not to proceed with the development of the site and next steps.

5.4. Engagement with government stakeholders

QPRC should engage with government stakeholders such as the NSW Office of Environment and Heritage, Rural Fire Service and NSW Police on the development of the proposed site as a cemetery.

Information could be sent to key government stakeholders on the proposed site, including on what is being proposed, timing of the proposed works, and potential environmental and social issues identified in the technical studies.

A follow-up letter could be sent to these same government stakeholders to outline and seek comment on the draft design(s) for the memorial park throughout the DA stage, when available.

6. Conclusion

QPRC has identified a proposed site approximately 11 km south of Queanbeyan to develop a cemetery facility. The proposed site is south of the Googong township, one of a number of new urban growth areas south of Queanbeyan.

The existing Lanyon Park cemetery in Queanbeyan is nearing capacity; in addition, the ACT's existing three cemeteries are expected to reach capacity within eight years. The QPRC has identified that an additional facility is required to accommodate the needs of a growing and ageing population.

Sensitive receptors in proximity to the proposed site include residential properties to the west on the Mount Campbell Estate, properties directly south of the proposed site and St Paul's Anglican Church. Further north-west and south-east of the site are Ferleigh Park Community Hall and Avalanche Homestead.

Potential social issues have been identified with the construction and operation of a cemetery at the proposed site. During construction, minor short-term amenity impacts may be experienced at nearby sensitive receptors from noise emissions generated by machinery, heavy vehicles and equipment. Nearby sensitive receptors may also experience minor short-term changes to visual amenity and traffic due to the presence of construction works and vehicles.

During operations, two sensitive receptors could experience minor amenity impacts from noise emissions associated with mobile machinery operated on site. The site is likely to be visible to sensitive receptors to the west of Old Cooma Road, to the north of Royalla (south of the site), at St Paul's Anglican Church, on higher slopes and ridges between 2 km and 5 km away and on certain roads in proximity to the site. Development of the proposed site will provide improved access to a cemetery facility for the growing population of Queanbeyan. Local businesses such as eating establishments may benefit from increased demand for goods and services during construction and operation of the memorial park.

Residents near the proposed site may also be concerned about the potential for development of the site to increase the risk of injury or death from increased traffic volumes on and potential for more frequent accidents to occur during construction and operation. Residents close to the site may also perceive that the proposed development could affect the value of their property.

The development of the proposed site as a cemetery, and the potential social issues identified in this report (and other concerns of stakeholders), will need to be refined and verified once a formal community engagement process occurs.

An approach has been proposed for engaging with stakeholders on the development of the proposed site as a memorial park. The focus of this engagement is on providing stakeholders with information on what is being proposed at this site to assist in informing QPRC's decision making. Stakeholder engagement is also required to understand stakeholder values and concerns and ensure that any key constraints associated with the proposed site are considered early in the planning process.

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WSP. 2018b. New Cemetery and Crematorium at 1241 Old Cooma Road, Googong: Transport Impact Assessment.

QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2	PROPOSED QUEANBEYAN CEMETERY SITE
ATTACHMENT 7	TRANSPORT IMPACT ASSESSMENT REPORT

QUEANBEYAN-PALERANG REGIONAL COUNCIL

MAY 2018

New Cemetery at 1241 Old Cooma Road, Googong

Transport Impact Assessment

Question today
Imagine tomorrow
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New Cemetery at 1241 Old Cooma Road, Googong
Transport Impact Assessment

Queanbeyan-Palerang Regional Council

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REV	DATE	DETAILS
A	01/05/18	Draft report for client review
B	10/05/2018	Final
C	31/05/2018	Removal of Crematorium element

	NAME	DATE	SIGNATURE
Prepared by:	Brigette Humphrey-Robinson	30/05/18	
Reviewed by:	Cindy Williams	31/05/18	
Approved by:	Cindy Williams	31/05/18	

PS107892-ITP-REP-001-RevC May 2018

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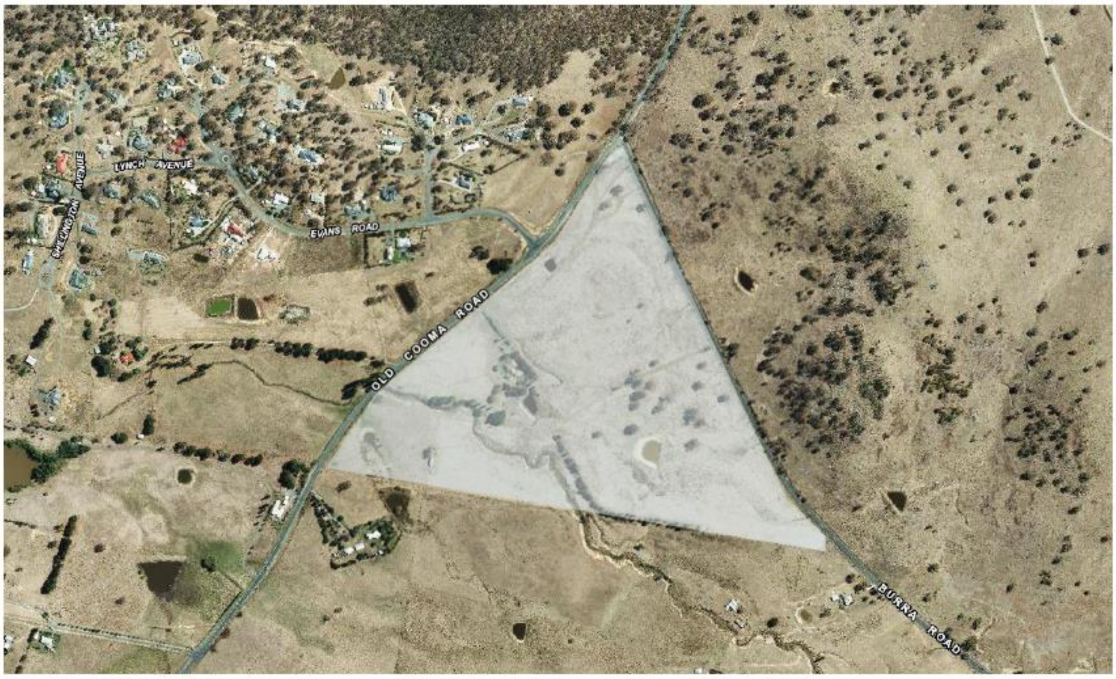
1 INTRODUCTION

1.1 BACKGROUND

Queanbeyan-Palerang Regional Council has prepared a planning proposal for a new cemetery on land located at 1241 Old Cooma Road, Googong, as indicatively shown in Figure 1.1. The site is located approximately 11 kilometres south of Queanbeyan and approximately four kilometres south of the Googong urban release area, on the eastern side of Old Cooma Road and the southern side of Burra Road.

The site is currently zoned as E4 – Environmental Living as part of the Queanbeyan Local Environmental Plan 2012.



Source: NSW Land & Property Information, https://maps.six.nsw.gov.au/, visited 19 April 2018

Figure 1.1 Site location

This report has been prepared to assess the impacts of the proposal on the adjacent road network, identify any constraints on the road network and determine if the existing road network can cater for the proposed land use.

1.2 DETAILS OF THE PROPOSAL

Once operational, the cemetery is expected to accommodate up to 4 funerals per week. This involves light excavation equipment equivalent to a farm tractor or backhoe, small truck and cars associated with a funeral procession. Routine maintenance will include ride on lawn mowers, whipper-snippers and other garden equipment.

The typical hours of operation would be 7.00 am to 4.00 pm Monday to Friday, with most services occurring after 9.00 am and the occasional service occurring on weekends or after 4.00 pm on a weekday.

1.3 REFERENCES

The following documents have been reviewed and referenced in the preparation of this report:

1 Australian Bureau of Statistics, Census of Population and Housing data from 2016

2 Australian Standards, AS/NZS 2890.1: 2004 Parking facilities Part 1: Off-street car parking

3 Australian Standards, AS/NZS 2890.6: 2009 Parking facilities Part 6: Off-street parking for people with disabilities

4 Austroads, Guide to Road Design Part 4 Intersections and Crossings: General, 2017

5 Queanbeyan – Palerang Regional Council, Queanbeyan Development Control Plan, 2012

6 Queanbeyan – Palerang Regional Council, Planning Proposal for Cemetery and Crematorium Lot 2 DP 112382 and Lot DP 754881 Old Cooma Road, Queanbeyan

7 Roads and Maritime Services, Traffic Modelling Guidelines, 2013

8 Roads and Maritime Services, Guide to Traffic Generating Developments, 2002

9 TDG, Queanbeyan City Council TRACKS Model South Jerrabomberra and Queanbeyan Traffic Analysis 2014, Part 2 – Selected Road Network Improvements Transportation Assessment Report, December 2014

10 Traffic count data conducted in June/July 2017 provided by Queanbeyan – Palerang Council.

2 TRANSPORT CONTEXT

2.1 LAND USE

The subject site is currently surrounded by rural residential development including the Little Burra Estate to the south of the site, as well as rural land grazing land.

North of the site, the Googong urban release area is expected to accommodate nearly 6,200 residential dwellings once complete, as well as a town centre and other community uses.

To the east of the site, approximately 45 rural residential dwellings are being planned for development and a further 50 dwellings are being planned to the south.

To the west of Old Cooma Road, Mount Campbell Estate includes approximately 50 residential dwellings.

2.2 EXISTING TRANSPORT NETWORK

The site has frontages to Old Cooma Road and Burra Road, which are both local roads with posted speed limits of 100 kilometres per hour. Along the site frontage, Burra Road has a straight alignment and Old Cooma Road has two horizontal curves.

Old Cooma Road and Burra Road are two-way roads configured with one traffic lane in each direction and intersecting at a priority controlled intersection with Give Way control on Burra Road.

The following on-site observations were made regarding the intersection of Old Cooma Road and Burra Road:

- Vehicles turning left from Old Cooma Road to Burra Road typically turn at relatively high vehicle speeds
- The Burra Road approach operates as two stand up lanes, with the potential for a right turn vehicle on Burra Road to block the sight lines for a left turn vehicle on Burra Road and vice versa
- Majority of vehicles entering and exiting Burra Road were travelling to/from the north on Old Cooma Road
- The intersection operates with no vehicle queues and minimal delays during the peak hours.

South of Burra Road, Old Cooma Road intersects with Evans Road, providing access to the Mount Campbell Estate. This intersection is located on the inside of a horizontal curve, with some sight line implications.

The surrounding road network does not currently accommodate walking and cycling facilities, or public transport services, with the exception of school bus routes and a school bus stop located on Old Cooma Road, approximately 65 metres north of Evans Road.

2.2.1 EXISTING TRAFFIC VOLUMES

2.2.1.1 OLD COOMA ROAD

Old Cooma Road connects Queanbeyan to the north with the Monaro Highway to the south, which in turn provides access to Cooma.

Traffic data collected in mid 2017 indicates that in the vicinity of the site, Old Cooma Road currently carries approximately 2,540 vehicles per day, with a heavy vehicle proportion of 8.6 per cent and weekday peak hourly volumes of approximately 310 to 350 vehicles in the AM and PM peak, respectively. Therefore, Old Cooma Road currently has a peak to daily traffic volume ratio of 12 to 14 per cent.

The weekday peak hours along Old Cooma road are 8.00 am to 9.00 am and 5.00 pm to 6.00 pm. On the weekend, traffic volumes were observed to be relatively consistent between 10.00 am to 4.00 pm (up to 270 vehicles per hour).

South of the site, Old Cooma Road carries approximately 1,700 vehicles per day.

2.2.1.2 BURRA ROAD

Burra Road primarily provides access to the suburb of Burra and also offers an alternative route to/from other nearby suburbs including Williamsdale and Urila.

Burra Road carries approximately 1,100 vehicles per day, with a heavy vehicle proportion of 4.6 per cent. Applying a 12 to 14 per cent peak to daily ratio to Burra Road results in estimated peak hourly traffic volumes of 132 vehicles and 154 vehicles in the AM and PM peak hours, respectively.

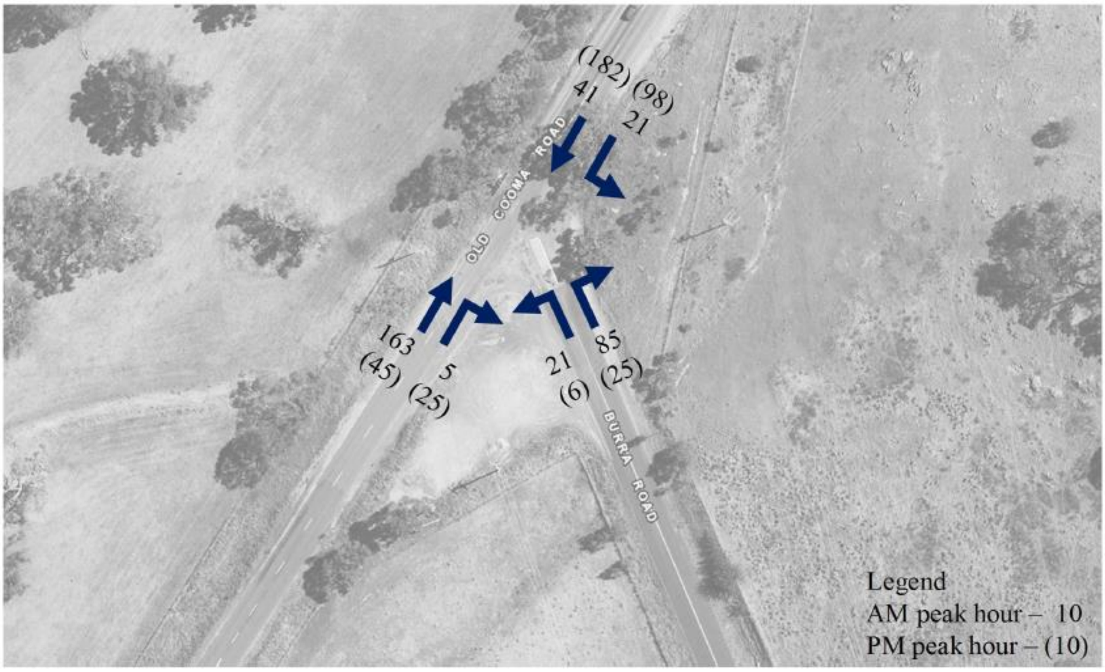
2.2.1.3 INTERSECTION OF OLD COOMA ROAD AND BURRA ROAD

With regards to the tube count data available for Old Cooma Road and Burra Road, the following directional assumptions have been made:

- AM peak hour – 80 per cent northbound, 20 per cent southbound
- PM peak hour – 20 per cent northbound, 80 per cent southbound.

In addition, it is estimated that nearly 80 per cent of vehicles using Burra Road would travel to/from the north via Old Cooma Road, with 20 per cent travelling to/from the south via Old Cooma Road.

On the above basis, the estimated AM and PM peak hourly traffic volumes at the intersection of Old Cooma Road and Burra Road are shown in Figure 2.1.



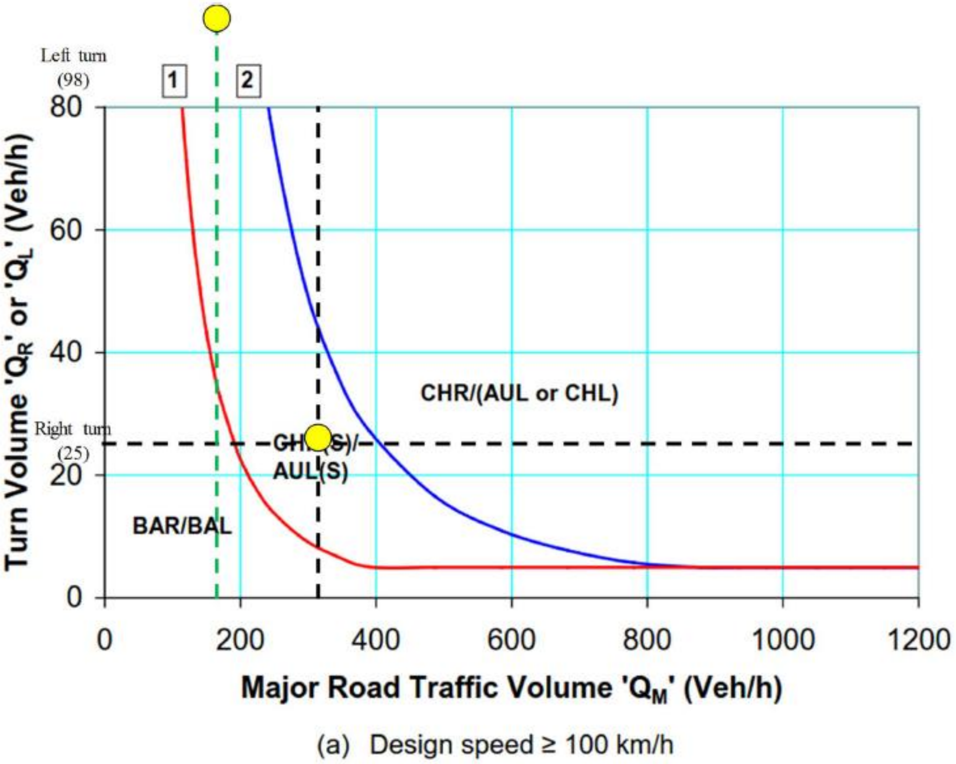
Source: NSW Land & Property Information, https://maps.six.nsw.gov.au/, visited 19 April 2018

Figure 2.1 Estimated existing peak hour traffic volumes

Adopting these estimated traffic volumes, an assessment of the warrants for basic, auxiliary and channelised turn treatments on the major road at rural priority controlled intersections, as presented in the Guide to Road Design Part 4: Intersections and Crossings – General (2017) has been completed for the Old Cooma Road and Burra Road intersection. On this basis, Figure 2.2 shows that the intersection of Old Cooma Road and Burra Road currently warrants the following turn treatments on Old Cooma Road:

- Channelised right turn treatment, with a short deceleration lane
- Auxiliary left turn treatment, with a short deceleration lane albeit noting that a channelised left turn treatment is preferred for road safety reasons.

In addition, the planned increase in residential dwellings with access via Burra Road and forecast traffic growth along Old Cooma Road would increase the need for the above treatments at the Old Cooma Road and Burra Road intersection to maintain safe intersection operation in the future.



Source: Basemap from Guide to Road Design Part 4 Intersections and Crossings: General, Austroads, 2017

Figure 2.2 Warrants assessment for turn treatments at the existing intersection of Old Cooma Road and Burra Road

The operation of the intersection of Old Cooma Road and Burra Road has been assessed using SIDRA Intersection modelling software, adopting the indicative peak hour traffic volumes shown in Figure 2.1.

The Traffic Modelling Guidelines (Roads and Maritime Services, 2013) specifies that intersection operation is generally measured by the following three elements:

- Degree of Saturation (DoS)
- Level of Service (LoS)
- 95th per centile base of queue distance.

SIDRA Intersection measures these elements, with the intersection LoS being a measure of the average delay at the intersection, as defined by the criteria set out in Table 2.1.

Table 2.1 SIDRA Intersection level of service criteria

Level of Service	Average Delay per vehicle (second per vehicle)	Criteria for traffic signals and roundabouts	Criteria for give way and stop signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good operation with acceptable delays and spare capacity	Good operation with acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays roundabouts require other control mode	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	At capacity, requires other control mode

Source: Adopted from Guide to Traffic Generating Developments (Roads and Maritime Services, 2002)

Table 2.2 presents a summary of the existing intersection operation of the Old Cooma Road and Burra Road intersection, with full results presented in Appendix A. It is noted that the critical movement for level of service at a priority controlled intersection is the movement with the worst delay.

Table 2.2 Existing intersection operation

Intersection	Peak	Leg	Degree of Saturation	Average Delay (seconds)	95th Percentile Queue (metres)	Level of Service
Old Cooma Road/ Burra Road	AM	South	0.10	8.5	3	A
	PM	South	0.03	8.8	1	A

Based on the above indicative traffic modelling, the intersection of Old Cooma Road and Burra Road currently operates well with minimal queues and delays on all approaches.

2.3 FUTURE TRANSPORT NETWORK

Stage 1 of the Old Cooma Road upgrade was completed in 2014 and included construction of 1.8 kilometres of straight road with three traffic lanes, including one travel lane in each direction and a southbound overtaking lane. The Stage 1 realignment provided a straighter section of the road near the existing quarry, to facilitate safer north-south access between Queanbeyan and Googong and further south.

Stage 2 of the Old Cooma Road upgrade is planned to commence in July 2018 and be completed by December 2019. Stage 2 will include two lanes in each direction between Edwin Land Parkway and Googong Road (approximately 4 kilometres north of Burra Road), as well as a 2.5-metre-wide shared path.

It is understood that there ae currently no plans to upgrade Old Cooma Road south of Googong Road and near the site.

Referencing traffic modelling conducted on behalf of Council (TRG, 2014), traffic volumes along Old Cooma Road south of Googong Road are estimated to be the following within 2031:

- AM peak – 550 vehicles including 450 vehicles travelling northbound and 100 vehicles travelling southbound
- PM peak – 550 vehicles including 150 vehicles travelling northbound and 410 vehicles travelling southbound.

These 2031 traffic forecasts indicate traffic growth of between 45 per cent to 85 per cent between 2017 and 2031. This equates to linear annual growth of up to 6 per cent per year.

It is also noted that the traffic forecasts adopt an 80:20 directional split, which is generally consistent with the assumptions made in this assessment, as discussed in section 2.2.1.3.

2.4 CRASH DATA REVIEW

Crash data provided by Council indicates that between the five-year period of 2012 to 2017 two crashes occurred at the intersection of Old Cooma Road and Burra Road, with the following characteristics:

- One rear end crash with a vehicle colliding with a stationary vehicle. Both vehicles were travelling northbound on Burra Road
- One crash involved a school bus performing a U-turn and colliding with a culvert.

No crashes occurred in this five-year period at the intersection of Old Cooma Road and Evans Road, which is located opposite the site.

In addition, three collisions occurred mid-block, within one kilometre from the intersection of Old Cooma Road and Burra Road. These crashes are summarised below:

- One crash occurred on Burra Road and two occurred on Old Cooma Road
- Two crashes were run-off road collisions and one crash involved a vehicle hitting a kangaroo.

This crash data does not highlight any obvious crash trends or any significant road safety hazards along Old Cooma Road and Burra Road, in the vicinity of the site.

3 PARKING IMPACT ASSESSMENT

3.1 CAR PARKING

No guidelines exist with regards to suitable car parking requirements for cemeteries and ancillary facilities. Therefore, car parking demand can be forecast using a first principles approach on the basis of anticipated visitor numbers and estimated vehicle occupancy.

It is estimated the number of attendees at most services is between 50 and 100. However, a large number of attendees, estimated to be up to 300 can occur occasionally. For the purpose of this parking assessment, the following three design scenarios have been assessed:

- Typical service – 50 attendees
- Large service – 150 attendees
- Very large service – 300 attendees.

Reference has been made to the Australian Bureau of Statistics, Census of Population and Housing data from 2016 (ABS data) to estimate the average number of people per vehicle that would attend a service at the proposed cemetery. The ABS data indicates that the average household size in the Queanbeyan-Palerang Local Government Area (LGA) is 2.6 people per household. Therefore, a conservative vehicle occupancy rate of two people per vehicle has been adopted for this assessment.

The parking demand for three design scenarios are summarised in Table 3.1.

Table 3.1 Parking demand scenarios

Design scenario	Number of attendees	Average Vehicle Occupancy Rate	Estimated Parking demand
Typical	50 people	2.6	25
Large	150 people		75
Very large	300 people		150

Based on the above, and noting that there is no on-street parking available in the vicinity of the site, it is recommended that the proposed cemetery should be designed to accommodate approximately 150 parking spaces.

Given that the peak parking demand of 150 spaces would occur occasionally, an on-site parking provision of 150 spaces would typically accommodate a combined visitor and staff parking demand.

3.2 ACCESSIBLE PARKING

Part 2 of Queanbeyan DCP 2012 specifies that for community uses, two to three per cent of the car parking provision should be accessible parking. Based on a parking provision of 150 spaces, five of these should be accessible spaces.

3.3 CAR PARK LAYOUT

Car parking should be dispersed across the site to enable easy and accessible access to various facilities and burials.

The on-site car parking should be designed in accordance with the Australian Standards, (AS/NZS 2890.1: 2004 and AS/NZS 2890.6). Referencing Table 1.1 of AS/NZS 2890.1: 2004, the proposed car parking spaces should be designed for user class 3 for short term city and town centre parking, with parking space dimensions of 2.6 metres wide and 5.4 metres long and aisle widths of 5.8 metres.

4 TRAFFIC IMPACT ASSESSMENT

4.1 VEHICLE ACCESS ARRANGEMENTS

Two alternatives are being investigated for vehicle access for the proposed development, as follows:

1 vehicle access via Old Cooma Road

2 vehicle access via Burra Road.

With consideration for the existing configuration of both roads, it is recommended that the site access be positioned along the straight section of Burra Road to avoid potential sight line issues associated with the placement of the site access on a horizontal curve along Old Cooma Road.

With consideration for the required sight distances along a 100 kilometres per hour sign posted rural road, ideally the site access would be located around 300 metres south of the intersection of Old Cooma Road and Burra Road. However, sight lines are partially restricted in this location due to horizontal and vertical road geometry. Therefore, it is recommended that consideration be made to reduce the speed limit of Burra Road at its northern end to 80 kilometres per hour, with the site access to be located approximately 240 metres to the south of the intersection of Old Cooma Road and Burra Road, where a minimum sight distance of 225 metres could be achieved in both directions.

A site access on Burra Road would result in increased traffic demand along Burra Road and increased turning movements at the intersection of Old Cooma Road and Burra Road.

4.2 TRAFFIC GENERATION

As discussed in section 3, a funeral service could generate between 25 and 150 vehicles, depending on the number of attendees. Given that the cemetery is expected accommodate up to 4 funeral services per week, it is unlikely that more than one service would occur at the same time.

Due to the nature of the proposed development, the traffic generation would be tidal, with all attendees expected to arrive in one hour and leave in another hour.

With consideration for the proposed hours of operation for the cemetery and the design scenarios discussed in section 3, the following conservative traffic scenarios have been considered as part of this assessment:

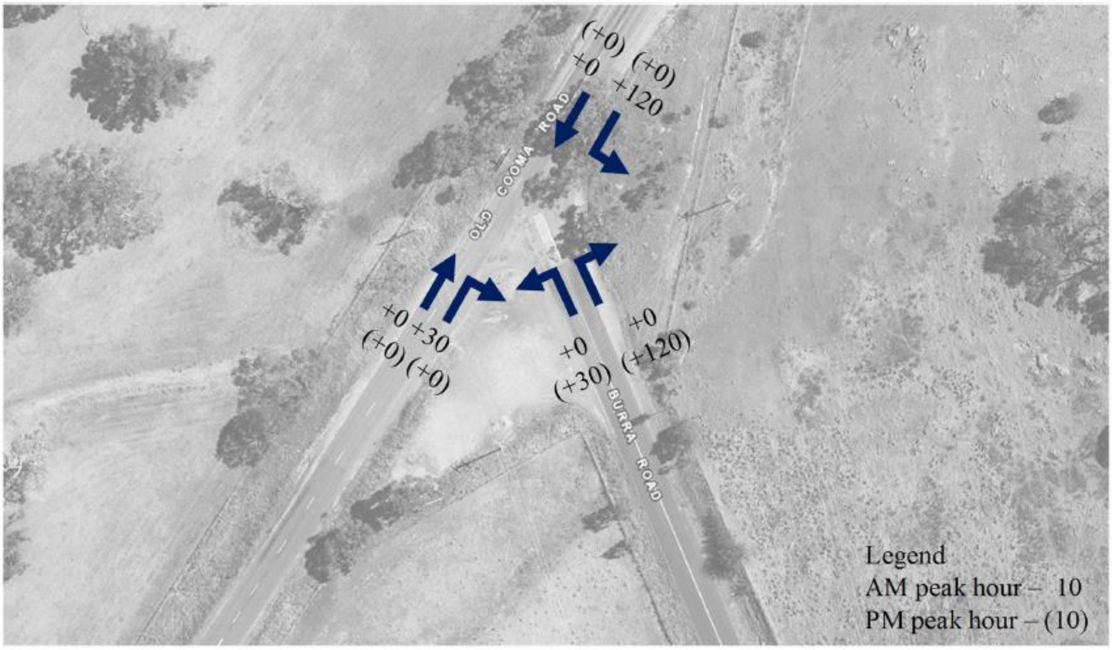
1 Weekday AM – up to 150 vehicles entering the site

2 Weekday PM - up to 150 vehicles exiting the site.

The following assumptions have been made with respect to the directional distribution of the traffic generated by the development:

- To/from the north via Old Cooma Road – 80 per cent
- To/from the south via Old Cooma Road -20 per cent.

On the above basis, the estimated traffic generation for the site is shown in Figure 4.1.



Source: NSW Land & Property Information, https://maps.six.nsw.gov.au/, visited 19 April 2018

Figure 4.1 Peak hour development traffic generation

4.3 INTERSECTION OPERATION

The future intersection operation in 2031, assuming traffic generation plus 6 per cent per annum linear growth of the estimated existing traffic volumes presented in Figure 2.1 has been assessed, as summarised in Table 2.2. The full results are included in Appendix A.

Table 4.1 Post-development 2031 intersection operation

Intersection	Peak	Leg	Degree of Saturation	Average Delay (seconds)	95th Percentile Queue (metres)	Level of Service
Old Cooma Road/ Burra Road	AM	South	0.12	9.4	3	A
	PM	South	0.23	9.5	7	A

Based on the above indicative traffic modelling, the intersection of Old Cooma Road and Burra Road would continue to operate well with minimal queues and delays on all approaches in 2031, with consideration for 6 per cent annual linear background growth.

Notwithstanding the above, the intersection of Old Cooma Road and Burra Road would warrant the following turn treatments to accommodate the development and expected background traffic growth:

- Channelised right turn treatment, with a full deceleration lane
- Channelised left turn treatment, with a full deceleration lane.

In addition to the above, a channelised right turn with a full deceleration would be warranted at the site entry on Burra Road to safely accommodate right turn movements into the site.

It is recommended that peak hourly intersection counts at the Old Cooma Road and Burra Road intersection be completed and used in any subsequent traffic assessments as part of the future development applications.

5 ADDITIONAL TRANSPORT PROVISIONS

As discussed in section 2.2, the site does not currently have access to public transport and/or walking and cycling facilities.

Given the surrounding road high speed road network and long distances to surrounding urban areas, walking and cycling provisions to/from the site would unlikely be well used by staff or visitors of the site. Internally, the site layout should be designed with a suitable footpath network that links car park areas to key locations across the site including provisions for mobility impaired visitors. This may include provision of a low speed shared zone road environment throughout the site.

Further, consideration should be made for future public transport services linking the site with Queanbeyan and surrounding urban areas and planned residential areas to improve accessibility of the site for all staff and visitors, particularly those that don't have access to a private vehicle. It is also recommended that set-down/pick-up areas and associated covered waiting areas be provided to be used for ride share vehicles including taxi's and any community transport services which may be available now or in the future.

6 SUMMARY

Based on the traffic and transport assessment documented in this report, the following conclusions are made:

- Queanbeyan-Palerang Regional Council is proposing a new cemetery on land located at 1241 Old Cooma Road, Googong.
- Once operational, the cemetery is expected to accommodate up to 4 funerals per week.
- The typical hours of operation for the proposed cemetery would be 7.00 am to 4.00 pm Monday to Friday, with most services occurring after 9.00 am and the occasional service occurring on weekends or after 4.00 pm on a weekday.
- Land surrounding the site, primarily consists of rural residential developments and rural grazing land with rural residential developments continually being planned nearby.
- The site has frontages to Old Cooma Road and Burra Road, which are both high speed rural roads carrying 2,500 vehicles and 1,100 vehicles per day, respectively.
- The intersection of Old Cooma Road and Burra Road is a priority controlled intersection which would likely warrant turn bays on Old Cooma Road under the existing traffic volumes. Notwithstanding this, the intersection currently operates well with minimal vehicle queues and delays on all legs.
- Old Cooma Road and Burra Road are expected to experience considerable growth in the future, approximately 6 per cent per annum (linear growth) as a result of nearby future residential areas.
- It is estimated that the site could generate a peak parking demand of 150 vehicles. Therefore, the site should be designed to accommodate approximately 150 spaces which would ideally be dispersed across the site.
- The car parking provisions would need to accommodate two to three per cent as accessible spaces.
- The site is estimated to generate a peak of 150 vehicles in the AM and PM peak hours. Albeit, the likelihood of the peak traffic generation of the site to overlap with the road network peak hours is considered very low.
- The intersection of Old Cooma Road and Burra Road would continue to operate with minimal queues and delays on all approaches in 2031, following completion of the development and with consideration for 6 per cent annual traffic growth on all movements.
- It is recommended that the site access be provided along Burra Road with the following provisions:
  - Positioned approximately 240 metres south of the intersection of Old Cooma Road and Burra Road
  - Include a right turn bay on Burra Road to accommodate the vehicle peak arrivals
  - Speed limit reduction on Burra Road from 100 kilometres per hour to 80 kilometres per hour.
- It is recommended that peak hourly intersection counts at the Old Cooma Road and Burra Road intersection be completed and used in any subsequent traffic assessments as part of the future development applications.
- Consideration for alternative transport modes including public transport and ride share services should be made to ensure access to the site for those that do not have access to a private vehicle.

APPENDIX A

SIDRA INTERSECTION RESULTS

MOVEMENT SUMMARY

▽ Site: 1v [Old Cooma Rd/Burra Rd-Ex-AM]

Three-way intersection with 2-lane major road (Stop control)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Burra Road											
1	L2	22	4.6	0.103	8.1	LOS A	0.4	2.6	0.19	0.66	72.0
3	R2	89	4.6	0.103	8.5	LOS A	0.4	2.6	0.19	0.66	71.6
Approach		112	4.6	0.103	8.4	LOS A	0.4	2.6	0.19	0.66	71.7
East: Old Cooma Road											
4	L2	22	4.6	0.036	8.0	LOS A	0.0	0.0	0.00	0.23	81.0
5	T1	43	8.6	0.036	0.0	LOS A	0.0	0.0	0.00	0.23	93.0
Approach		65	7.2	0.036	2.7	NA	0.0	0.0	0.00	0.23	88.6
West: Old Cooma Road											
11	T1	172	8.6	0.096	0.0	LOS A	0.0	0.3	0.01	0.02	99.2
12	R2	5	4.6	0.096	7.7	LOS A	0.0	0.3	0.01	0.02	85.0
Approach		177	8.5	0.096	0.2	NA	0.0	0.3	0.01	0.02	98.7
All Vehicles		354	7.0	0.103	3.3	NA	0.4	2.6	0.07	0.26	86.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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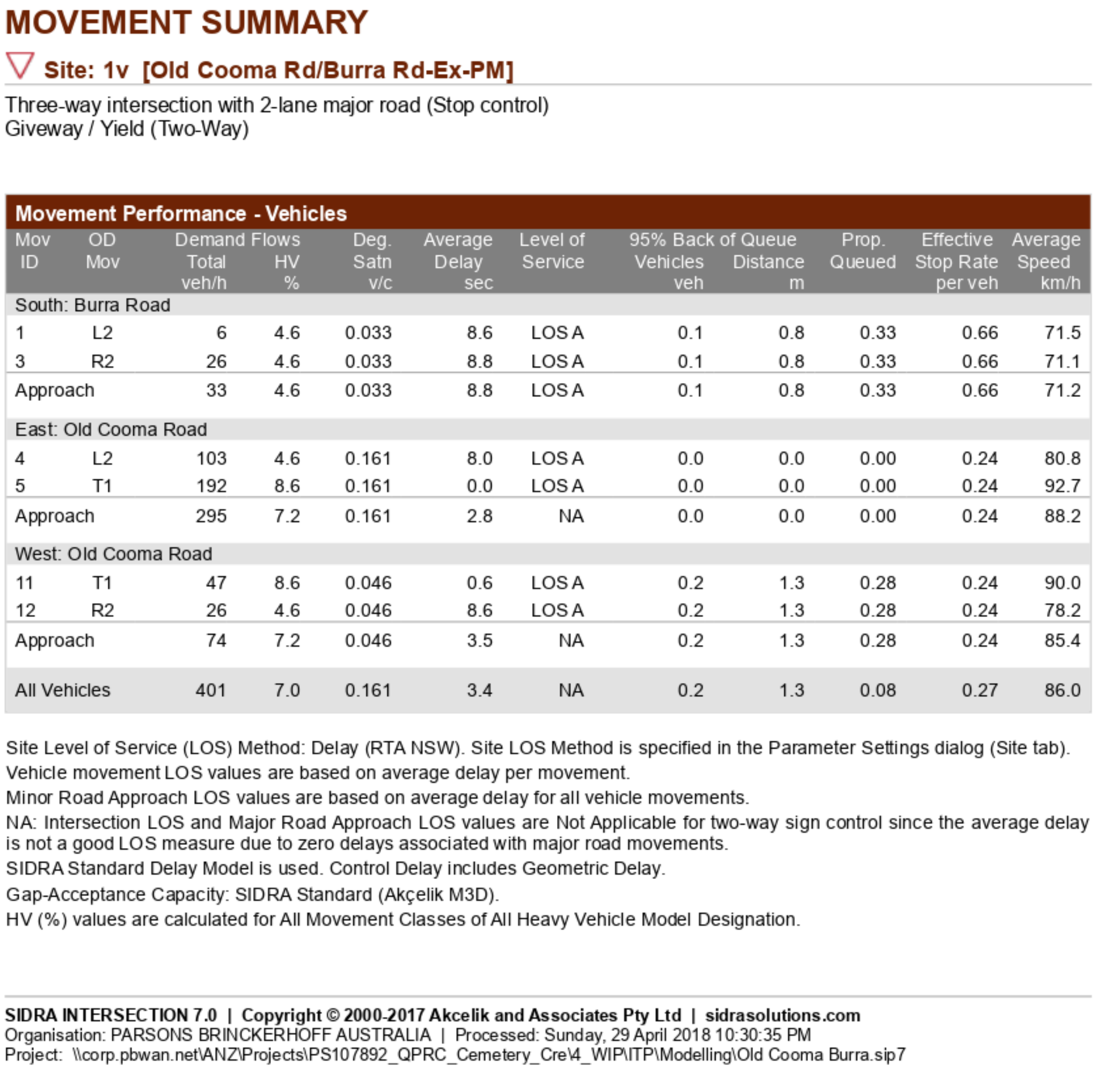

MOVEMENT SUMMARY

Site: 1v [Old Cooma Rd/Burra Rd-Ex-PM]

Three-way intersection with 2-lane major road (Stop control)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Burra Road											
1	L2	6	4.6	0.033	8.6	LOS A	0.1	0.8	0.33	0.66	71.5
3	R2	26	4.6	0.033	8.8	LOS A	0.1	0.8	0.33	0.66	71.1
Approach		33	4.6	0.033	8.8	LOS A	0.1	0.8	0.33	0.66	71.2
East: Old Cooma Road											
4	L2	103	4.6	0.161	8.0	LOS A	0.0	0.0	0.00	0.24	80.8
5	T1	192	8.6	0.161	0.0	LOS A	0.0	0.0	0.00	0.24	92.7
Approach		295	7.2	0.161	2.8	NA	0.0	0.0	0.00	0.24	88.2
West: Old Cooma Road											
11	T1	47	8.6	0.046	0.6	LOS A	0.2	1.3	0.28	0.24	90.0
12	R2	26	4.6	0.046	8.6	LOS A	0.2	1.3	0.28	0.24	78.2
Approach		74	7.2	0.046	3.5	NA	0.2	1.3	0.28	0.24	85.4
All Vehicles		401	7.0	0.161	3.4	NA	0.2	1.3	0.08	0.27	86.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 1v [Old Cooma Rd/Burra Rd-Ex-AM+Dev+Growth]

Three-way intersection with 2-lane major road (Stop control)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Burra Road											
1	L2	22	4.6	0.119	8.2	LOS A	0.4	3.0	0.29	0.69	71.0
3	R2	89	4.6	0.119	9.4	LOS A	0.4	3.0	0.29	0.69	70.6
Approach		112	4.6	0.119	9.2	LOS A	0.4	3.0	0.29	0.69	70.7
East: Old Cooma Road											
4	L2	167	4.6	0.136	8.0	LOS A	0.0	0.0	0.00	0.46	76.5
5	T1	79	8.6	0.136	0.0	LOS A	0.0	0.0	0.00	0.46	87.1
Approach		246	5.9	0.136	5.4	NA	0.0	0.0	0.00	0.46	79.6
West: Old Cooma Road											
11	T1	172	8.6	0.139	0.4	LOS A	0.5	3.5	0.22	0.18	92.1
12	R2	63	4.6	0.139	8.5	LOS A	0.5	3.5	0.22	0.18	79.8
Approach		235	7.5	0.139	2.6	NA	0.5	3.5	0.22	0.18	88.4
All Vehicles		593	6.3	0.139	5.0	NA	0.5	3.5	0.14	0.39	80.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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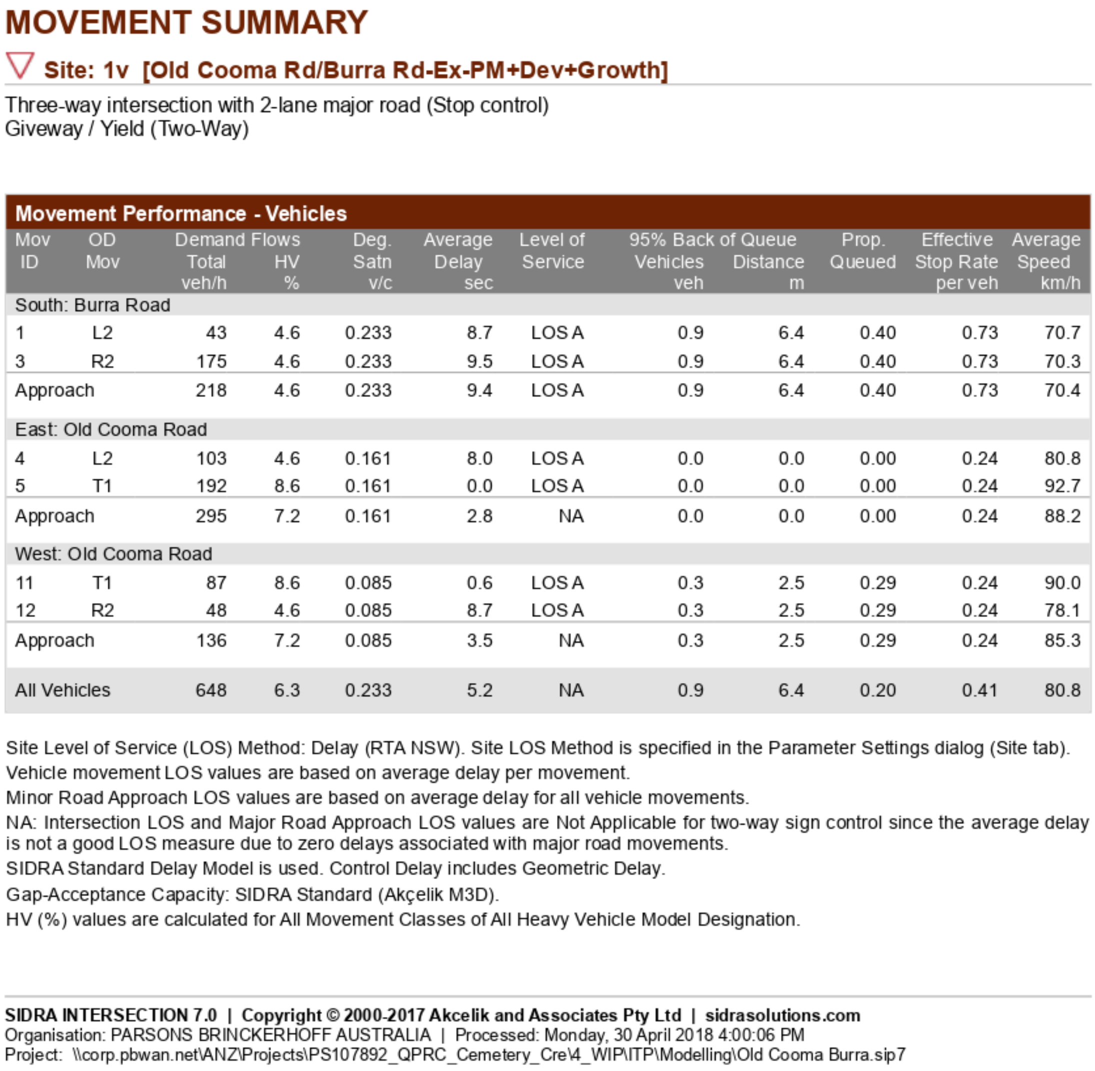

MOVEMENT SUMMARY

▽ Site: 1v [Old Cooma Rd/Burra Rd-Ex-PM+Dev+Growth]

Three-way intersection with 2-lane major road (Stop control)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Burra Road											
1	L2	43	4.6	0.233	8.7	LOS A	0.9	6.4	0.40	0.73	70.7
3	R2	175	4.6	0.233	9.5	LOS A	0.9	6.4	0.40	0.73	70.3
Approach		218	4.6	0.233	9.4	LOS A	0.9	6.4	0.40	0.73	70.4
East: Old Cooma Road											
4	L2	103	4.6	0.161	8.0	LOS A	0.0	0.0	0.00	0.24	80.8
5	T1	192	8.6	0.161	0.0	LOS A	0.0	0.0	0.00	0.24	92.7
Approach		295	7.2	0.161	2.8	NA	0.0	0.0	0.00	0.24	88.2
West: Old Cooma Road											
11	T1	87	8.6	0.085	0.6	LOS A	0.3	2.5	0.29	0.24	90.0
12	R2	48	4.6	0.085	8.7	LOS A	0.3	2.5	0.29	0.24	78.1
Approach		136	7.2	0.085	3.5	NA	0.3	2.5	0.29	0.24	85.3
All Vehicles		648	6.3	0.233	5.2	NA	0.9	6.4	0.20	0.41	80.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2	PROPOSED QUEANBEYAN CEMETERY SITE
ATTACHMENT 8	SOCIAL IMPACT ASSESSMENT REPORT ELTONS 2019

Social Impact Assessment

Planning Proposal for cemetery

Client: Queanbeyan-Palerang Regional Council
Date: 21 January 2019

A Veris Company

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Prepared by	Sonia Dalitz and Claire Adams
Reviewed by	Steve Rossiter
Date	21 January 2019
Version	Final 2.0

Disclaimer

This report has been prepared solely for Queanbeyan-Palerang Regional Council (the client) in accordance with the scope provided by the client for the purposes as set out throughout this report. Elton Consulting accepts no liability or responsibility for or in respect of the use or reliance upon this report and its supporting material by anyone other than the client.

Report title	Social Impact Assessment
Project name	Planning Proposal for cemetery at Lot DP 112382 and Lot 126 DP754881
Client name	Queanbeyan-Palerang Regional Council
Project number	18/8514
Date	21 January 2018
Version	Final Draft 02

Prepared by	**Reviewed by**
Sonia Dalitz	S. Rossiter
Sonia Dalitz, Project Manager MPPP, GradDipEd, BA	Steve Rossiter, Director, Social Sustainability MSc (Community & Regional Planning), GradDipEd, BA

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FIGURES

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APPENDICES

1 Executive summary

This Social Impact Assessment (SIA) has been prepared for Queanbeyan-Palerang Regional Council (QPRC) to inform a Planning Proposal for a cemetery at the intersection of Old Cooma Road and Burra Road, Googong. The SIA is also required by the Department of Planning and Environment (DPE) as part of the planning approvals process. Qualitative information available for this SIA included outcomes from targeted stakeholder engagement activities including telephone interviews, a telephone survey and a focus group.

The SIA found the key likely social impacts if the proposal is approved include:

- Decreased levels of community trust in the planning decision making process leading to potential negative impacts to levels of social wellbeing
- Cumulative risks to the ways people travel on a day to day basis due to perceptions that existing traffic congestion will be exacerbated leading to longer travel times and more stressful driving experiences
- Risks to community cohesion arising from potential changes to the rural character of the area, with associated negative health impacts including higher risks of social isolation
- Fear of potential decreased property values leading to speculative market behaviour and consequently higher risks of financial stress
- Risks to the community's ability to access cemetery services and facilities, with a potential shortfall of interment space if the proposal does not progress.

This SIA found that overwhelmingly, these potential negative social impacts are likely to be primarily and intensely felt among a relatively small number of people made up of predominantly existing residents who currently live in immediate geographical proximity to the site, and some people who are planning to move to the area surrounding the site in the near future (less than 2 years).

It is estimated that of affected households in the immediate geographic area, up to 60 households are potentially at high risk of experiencing the identified negative social impacts arising from the proposal if it is approved. It is assessed that the potential social impacts would cause primarily minor inconveniences and the majority of affected households would have the capacity to adapt over time with supportive mitigations relating to future cemetery facility design. The potential social impacts to these highly affected households need to be weighed carefully against the overarching social benefit to a much larger number of households across the LGA who would have increased potential local access to diverse and appropriate cemetery services and facilities if the proposal is approved.

The SIA found the proposal has a baseline social context of predictable and irreconcilable division between the amenity interests of people living in the area immediate to the site, and the wider public interest in maintaining a right to access interment infrastructure. There was a high degree of alignment found between the identified potential social impact issues for a cemetery on the site and social impact issues identified for other proposed cemeteries throughout NSW and the ACT. Overall, there was a high degree of consensus that a 15-minute travel distance to a rural location such as the site is appropriate for use as a cemetery, however affected people in the immediate geographic area were less likely to agree that the site constitutes the 'outskirts of town'.

If the proposal is approved, a key recommended mitigation is for QPRC to commence a robust, proactive and comprehensive communications and engagement strategy designed to ensure a high level of community awareness that the site would be developed as a cemetery. This would include provision of genuine opportunities for the community to collaborate with QPRC on future cemetery design.

If the proposal does not progress, a key recommendation is that QPRC should take necessary steps to allow the site to be developed for housing purposes in a timely way. Effective communications, including a Local Cemetery Strategy, should then be provided to reassure residents, businesses and visitors that alternatives are being pursued to meet medium to long term interment needs in the area.

From the full range of identified social impacts (outlined at **Appendix A**) the following key recommended mitigation and enhancement measures were identified:

Summary of likely social impacts and their recommended mitigation or enhancement measures

Description of likely social impact	Recommended mitigation or enhancement
Reduced social wellbeing arising from decreased levels of community trust in the planning decision making process arising from both actual and perceived shortfalls in the ability of QPRC to involve people in decisions that affect them through community consultation processes to date.	» Implementation of a comprehensive communications management plan (detailed at section 7.1)
Cumulative risks to the ways people travel on a day to day basis arising from likely increases in vehicle traffic to and from the site for cemetery operational activities, resulting in fear of longer travel times and more stressful driving experiences including accidents.	» Implementation of road improvements recommended in the Transport Impact Assessment » Implementation of a cemetery operational management plan that prevents conflict between cemetery service times and road network 'peak' traffic times » Advocate to Transport NSW for a reliable public transport route to the cemetery site » Consideration of additional significant improvements to the road route between Queanbeyan CBD and the site (detailed at section 7.2)
Risks to community cohesion arising from localised activism and fear of changes in character to the existing rural setting	» Implementation of a comprehensive communications management plan that includes the provision of community services information and referral options for counselling services » Provision of targeted opportunities for people to participate in future concept design of the cemetery » Provision of a program of community development activities or projects targeting Mount Campbell and Burrabella residents
Fear of potential decreased property values leading to speculative real estate market behaviour and consequently higher risks of financial stress	» Implementation of a comprehensive communications management plan that includes QPRC liaison with relevant local property developers or real estate agents to monitor property sales in the immediate site area » Provision of targeted opportunities to involve residents in the development of cemetery concept design drawings to ensure they can assist with suggestions that manage concerns that they perceive could impacts their property value.
Risks to the community's ability to access cemetery services and facilities, with a potential shortfall of interment space if the proposal does not progress.	» If the proposal is approved, > QPRC should commence exhibition of their Draft Cemetery Strategy > Detailed design of the cemetery should include considerations outlined at section 7.5. » If the proposal does not progress, QPRC should urgently pursue provision of an alternative cemetery site to prevent residents being socially disadvantaged in their ability access to interment services.

2 Introduction

Elton Consulting has been engaged by Queanbeyan-Palerang Regional Council (QPRC) to prepare a Social Impact Assessment (SIA) to inform a Planning Proposal for a cemetery at the intersection of Old Cooma Road and Burra Road, Googong.

2.1 What is social impact assessment?

SIA is the process through which efforts are made to estimate in advance the intended or unintended likely social consequences of a planning decision or action by a public or private entity.

The NSW Environmental Planning and Assessment Act (1979)[1] supports the requirement for SIA through:

- Its object to promote the social and economic welfare of the community[2]
- A requirement for the likely impacts of development, including social impacts in the locality, to be considered and addressed as part of the planning process[3].

Social impacts can be both positive and negative, tangible or intangible, direct or indirect, quantifiable or qualitative. In many cases the same social impact can be experienced differently: for example, some people may find visiting a cemetery a peaceful and contemplative experience, while others may find it a stressful and upsetting place to be.

2.2 Study scope

This SIA has been informed by:

- A review of relevant local and state policy and planning documents
- A targeted desktop literature review of research, social media and other related 'grey' data sources
- A review of existing social and demographic information previously prepared for the proposal (Social Report prepared by Coffey, June 2018).
- Semi structured phone interviews with representatives from:
    - QPRC Urban Landscapes
    - NSW Catholic Cemeteries and Crematoria
    - Mount Campbell Estate Residents
- A Computer Assisted Telephone Interview (CATI) survey of 143 residents within the Queanbeyan-Palerang LGA. There were 61 respondents from the suburb of Googong, 82 respondents from surrounding suburbs, with analysis between areas weighted 50:50.
- A Social Impact Assessment focus group with 14 attendees out of 25 invited affected persons.

This SIA is being prepared subsequent to the preparation of a Planning Proposal that was submitted by QPRC to the NSW Department of Planning and Environment (DPE) in August 2017. The submitted Planning Proposal (Section C) did not comprehensively address potential social effects however committed to a SIA being prepared if the Planning Proposal were to proceeded. This SIA therefore constitutes a DPE condition of final approval for the amendment to the Queanbeyan Local Environment Plan (LEP) 2012 to permit a cemetery on the site.

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[1] Environmental Planning and Assessment Amendment Act 2017
[2] Object (a) of the Act
[3] Section 4.15 (b) of the Act

Prior to the submission of this SIA to DPE, QPRC propose to implement a range of community and stakeholder engagement activities (estimated to be held late 2019). It is anticipated that this community consultation process will provide a further opportunity for people who may be affected by the Planning Proposal to have a say on the potential social impacts identified in this SIA. The preparation of this SIA assumes that QPRC will undertake additional consideration of any further identified social impacts once outcomes of this community and stakeholder engagement are known.

Social impact assessment guidelines

The NSW Department of Planning and Environment (DPE) have developed a *Social Impact Assessment Guideline* (September 2017)[4] to provide a framework for identifying and responding to social impacts of state significant mining, petroleum and extractive industry development. These guidelines have been referred to as the main methodological approach for preparation of this SIA.

Further details of the guidelines are provided at **Appendix A**.

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[4] NSW Department of Planning & Environment Social impact assessment guideline, Accessed 17 November 2018 from https://www.planning.nsw.gov.au/policy-and-legislation/under-review-and-new-policy-and-legislation/social-impact-assessment

3 Site context

3.1 Site location

The site of the proposed cemetery (the site) is located in the Queanbeyan-Palerang Regional Council LGA, east of the Australian Capital Territory (shown in **Figure 1**). The site is approximately 10km south of Queanbeyan, in the suburb of Googong (shown in **Figure 2**). The site is a triangular shape area of 36.4ha at the intersection of Old Cooma Road and Burra Road.

Figure 1 **Location of site within Queanbeyan- Palerang LGA boundary**

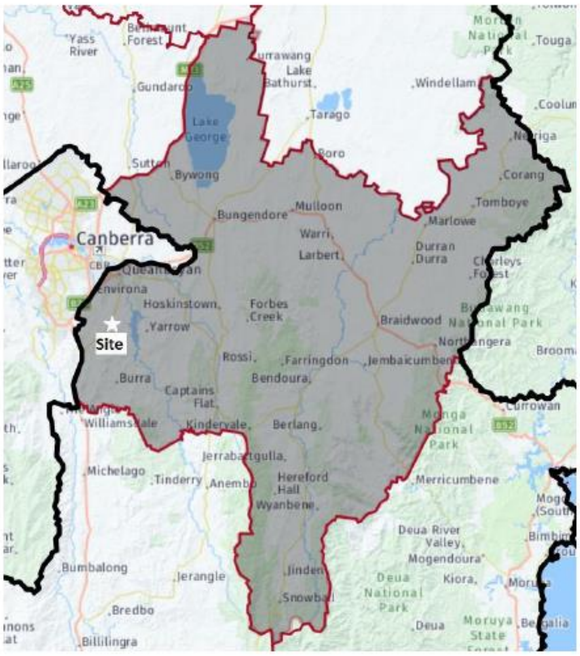

Figure 2 **Location of site within Googong suburb boundary**

Source: Profile .id https://profile.id.com.au/cbrjo/about?WebID=140, Nearmaps (2018)

The land surrounding the site includes a community title housing development known as 'Mount Campbell' to the west and a new community-scheme housing development, 'Burrabella' to the south, which shares a boundary with the site (see **Figure 3** overleaf).

Figure 3 Mount Campbell and Burrabella resident views to site

Source: Elton Consulting, December 2018.

In addition to residential dwellings in the immediate area, a number of other uses nearby the site are likely to be sensitive to any potential social impacts of the proposal, namely:

- St Paul's Anglican Church (opposite site)
- Fernleigh Park Community Hall (including small playground, 1.6km from site)
- Avalanche homestead (a Farm stay Bed and Breakfast, 2km from site)
- Access to Googong Foreshore for recreation (4km from site).

3.2 Site background

The site is currently zoned E4 Environmental living, which means planning for the land is intended for low impact residential development or development that is designed to recognise the bushland character of the locality[5].

Past use

The property has been farmed since the 1800's and is used for rural purposes such as grazing. There is an existing dwelling on the site that was used as a residence prior to the property being purchased by QPRC.

Current use

The site and its dwelling are currently being leased by QPRC for the continued purpose of residence and grazing.

Reasons for change

QPRC has been actively seeking a suitable site for provision of a new cemetery since 2009. This is based on concerns that capacity in the Queanbeyan Lawn (Lanyon Drive) Cemetery is limited and additional land will be required to provide interment services for the growing population of the LGA into the future.

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[5] Queanbeyan Local Environment Plan 2012
https://www.legislation.nsw.gov.au/#/view/EPI/2012/576/partlanduseta/include21

3.3 Overview of the current situation

To understand the potential social impacts of change caused by the proposal, it is important to understand the baseline condition of the existing situation. This 'before-development' description enables accurate future comparisons to be made.

Proposal background

In 2017 the site was identified as a suitable cemetery location and subsequently purchased by QPRC (see criteria at **Appendix B**). QPRC assert that it did not consult with the community prior to the purchase of the site due to a confidentiality agreement entered into with the property owner until contracts were exchanged.

The purchase of the site and its intended use was advised to approximately 130 nearby residents and land owners via letter dated 20 April 2017 and formally announced at Council meeting 10 May 2017. The letter sent by QPRC to residents outlines Council's position as follows:

» Queanbeyan-Palerang's population is set to grow from around 56,000 to more than 76,000 over the next 15 years. With this growth comes pressure on infrastructure and services that are provided to the community.

» One service that is nearing capacity is Queanbeyan cemetery. Queanbeyan currently utilises the Lanyon Drive cemetery, however that is expected to reach capacity within the next five years.

» Council has been aware of the need to expand these services and has been investigating potential sites across the region over the past four years.

» Council's plans are to construct a modern-style memorial park on a small portion of the property (the site).

» Residents are encouraged to access information about the proposal on the QPRC website and register at http://yourvoice.qprc.nsw.gov.au/ to ensure they are advised of upcoming project consultation.

Details of the proposal were also included in the QPRC Weekly eNewsletter dated 12 May 2017, which advised residents that:

» Council had purchased the land as a preferred site for a proposed memorial park

» Prior to a development application being lodged, a number of planning processes studies and investigations would be carried out, including applying for a Gateway determination

» Council is still exploring other potential cemetery sites in case the site is deemed unsuitable for the proposal.

Need for the proposal

In order to enable a future cemetery facility to be constructed on the site, QPRC need to make a change to the E4 Environmental Living zone for the site which does not currently describe a cemetery or crematoria as a permitted use for the land. To change the permitted use of the land, QPRC was required to submit a Planning Proposal to the NSW Department of Planning and Environment (DPE) for approval.

QPRC subsequently prepared and submitted a Planning Proposal to DPE Gateway in August 2017 that sought to make a change to the Queanbeyan LEP to allow a cemetery and crematoria on the site. The justification (Part 3) provided in the Planning Proposal includes that:

» Over the past 8 years, the former Queanbeyan City Council has been reviewing the need for a new cemetery to supplement the existing Queanbeyan Lawn (Lanyon Drive) Cemetery. Council has now identified the need for a new cemetery as the existing Queanbeyan Lawn (Lanyon Drive) Cemetery is nearing its capacity with approximately five years left remaining. This matter is included in Council's 2013 - 2017 Delivery Plan.

» The Community Strategic Plan 2013- 2023 sets out the key directions identified by the community. One such key direction is 4.1 Undertake planning to ensure infrastructure is prepared for future growth. The location of a site for a new cemetery is identified as a strategy to achieve this key direction.

» The Planning Proposal is considered to be the best manner to progress the intended use of the site.

Description of proposed change

Importantly, the Gateway determination process described above does not itself constitute approval for a cemetery facility to be constructed on the site. The proposed change in this case is to decide whether the proposal will allow future cemetery development assessment phases to proceed.

If approved, the change will make a cemetery development on the site permissible. A further development assessment process would then be entered into for the actual construction and operation of a cemetery.

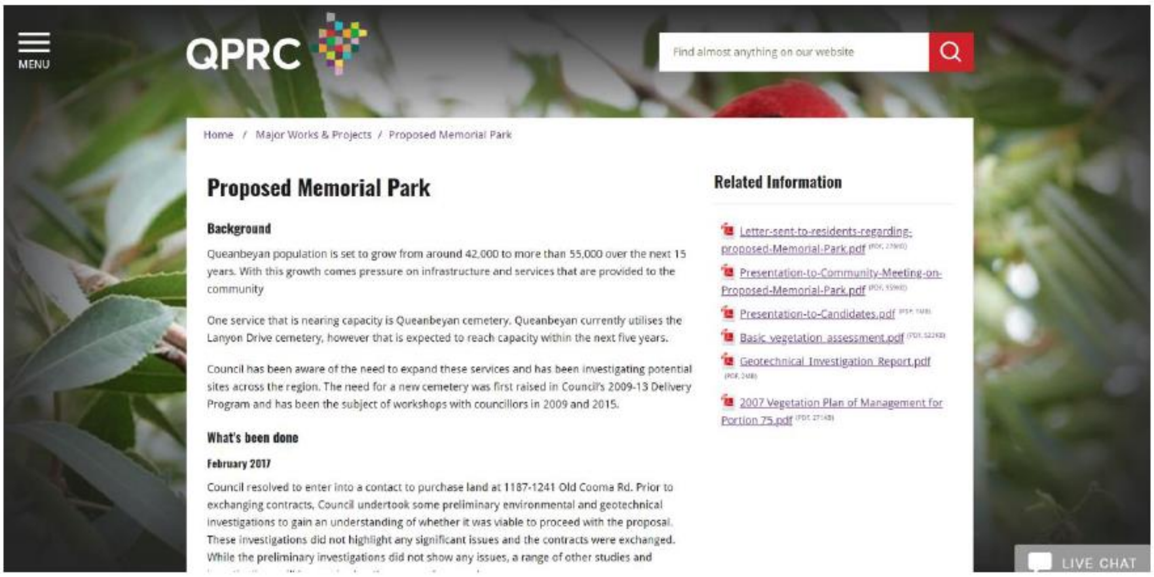
This means that at this stage of the Planning Proposal, any detailed description of a cemetery must be treated as hypothetical. QPRC have consistently communicated to the public that the intended cemetery would be in a modern 'memorial garden' style. For the purpose of this SIA however, it is assumed that the detailed design of any future cemetery cannot be considered certain. Similarly, it is assumed that the construction and operation of the proposed cemetery could theoretically be undertaken by an entity other than Council.

QPRC currently communicates information to the public about the proposed cemetery via a dedicated landing page on their website, shown in **Figure 4**.

The project website:

- Briefly outlines the need for a new cemetery in the region and what has been done on the project so far
- Provides links to relevant documents including the letter sent to residents, presentations to community meeting and candidates along with the initial vegetation and geotechnical investigation reports undertaken by Council prior to purchasing the site in February 2017.
- Outlines in timeline format next steps, which has been updated during the preparation of this SIA to reflect progress made
- Shows the location of the proposed cemetery
- Has a link to Council's Your Voice engagement hub[6].

Figure 4 Screenshot of QPRC website for the proposal



Home / Major Works & Projects / Proposed Memorial Park

Proposed Memorial Park

Background

Queanbeyan population is set to grow from around 42,000 to more than 55,000 over the next 15 years. With this growth comes pressure on infrastructure and services that are provided to the community

One service that is nearing capacity is Queanbeyan cemetery. Queanbeyan currently utilises the Lanyon Drive cemetery, however that is expected to reach capacity within the next five years.

Council has been aware of the need to expand these services and has been investigating potential sites across the region. The need for a new cemetery was first raised in Council's 2009-13 Delivery Program and has been the subject of workshops with councillors in 2009 and 2015.

What's been done

February 2017

Council resolved to enter into a contact to purchase land at 1187-1241 Old Cooma Rd. Prior to exchanging contracts, Council undertook some preliminary environmental and geotechnical investigations to gain an understanding of whether it was viable to proceed with the proposal. These investigations did not highlight any significant issues and the contracts were exchanged. While the preliminary investigations did not show any issues, a range of other studies and

Related Information

- Letter-sent-to-residents-regarding-proposed-Memorial-Park.pdf
- Presentation-to-Community-Meeting-on-Proposed-Memorial-Park.pdf
- Presentation-to-Candidates.pdf
- Basic vegetation assessment.pdf (PDF, 522KB)
- Geotechnical Investigation Report.pdf (PDF, 2MB)
- 2007 Vegetation Plan of Management for Portion 75.pdf (PDF, 271KB)

The Planning Proposal as originally submitted to DPE was to allow a cemetery and crematorium as an additional permitted use in Schedule 1 of the Queanbeyan Local Environmental Plan 2012 (QLEP) for the proposed site, Lot 2 DP 112382 and Lot 126 DP 754881 Old Cooma Road Queanbeyan. This proposed change would only apply to

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[6] Queanbeyan Palerang Regional Council 'Proposed Memorial Park' Major Works & Projects page https://www.qprc.nsw.gov.au/Major-Works-Projects/Proposed-Memorial-Park accessed 16/11/18

these lots and not to any other E4 Environmental Living zoned land within the LGA unless specifically mentioned in Schedule 1 of the QLEP 2012.

In response to a Council meeting resolution made on 9 May 2018, DPE altered the proposal on the 8 October 2018 to remove a crematorium as a proposed additional use, leaving a cemetery as the only proposed change.

Based on the existing operations of the Queanbeyan Lawn (Lanyon Drive) Cemetery and other recently constructed cemeteries in the area, if the current proposal is approved, a subsequent development application for a cemetery is likely to include:

» Facilities for staff

» Onsite parking for staff and visitors including amenities

» Facilities for funeral related services including service sheds

» Tree plantings

» Interment walls

» Extensive areas for burial with associated pathways and landscaping.

It is estimated construction of the cemetery could take up to six months.

While detailed design of a cemetery has not been undertaken, information provided by QPRC is that the proposed future cemetery is also likely to incorporate:

» A 20m buffer between the interment areas and the perimeter boundary. QPRC would plant trees in advance in these buffer areas. Resources have been budgeted for this 17/18 and 18/19 budget although no planting has yet begun

» Out of the whole 36ha site area it is likely that less than half (about 10 to 16ha) would be the constructed cemetery area. Around the perimeter fencing tree planting will take place with other areas (if not suitable for interment or with some biodiversity value) would be retained and restored.

» The cemetery is likely to require up to 3 staff members in the longer term (+10 years)

» The cemetery is likely to operate from 7am to 4pm on weekdays, with some infrequent Saturday services if needed to meet family or religious needs.

Responses to proposed change

Since QPRC announced the proposal, there has been a considerable level of community concern expressed in print and online media, as well as by individuals at formal Council meetings.

The proposal has been a regular topic on the agenda at biannual QPRC Community meetings.

A desktop analysis of responses was reviewed and are described at **Appendix C**. Relevant social concerns raised from this analysis have been included in the scoping of social impacts provided at **Appendix A.**

4 Policy and planning context

The site and its surrounds are influenced by an extensive number of policy and planning documents at both a local and state level. A selection of these are reviewed in this chapter to determine the relationship between the proposal and stated public policy goals. Identifying and assessing this broader, regional scale wellbeing and welfare is particularly important to this SIA as the provision of cemeteries is considered highly relevant to the wider public interest.

4.1 Local level planning documents

Community Strategic Plan 2018-2028, Queanbeyan-Palerang Regional Council (2017)

The Community Strategic Plan (CSP)[7] adopted in late 2017 sets out the community's vision and long term aspirations. One of the identified strategic priorities is "Land use planning that responds to local needs" (p13). The provision of a new cemetery in the LGA is considered by QPRC to fall under this priority. The provision of cemetery services also responds to the community vision statement "we are well connected to accessible services and facilities that provide our needs for living, work and leisure" (p14).

The CSP notes strong community appreciation of social and environmental connections traditionally associated with country and rural communities including a country lifestyle, natural beauty (landscape, bush and clean air) and peace and quiet (p13). This suggests that local communities may be particularly concerned about potential impacts or changes to a highly valued level of existing amenity in their lifestyle.

Community survey outcomes[8] (collected in 2017) indicate the following for the urban area of Queanbeyan-Jerrabomberra-Googong:

» A heavy emphasis on appreciating their proximity to employment and services in Canberra (p13)

» A 'issues' focus on poor public amenity; roads, traffic and transport problems (p21)

» A strong identification with trees, mountains, rivers and lakes in the landscape (p29)

» An expressed desire for better roads and public transport (p33).

It is worth noting that throughout the CSP, the lack of mention of any comments or issues around cemeteries suggests it is a relatively low level social issue when compared to other social infrastructure provision such as sport and recreation facilities, playgrounds and safety.

Planning Proposal for Cemetery and Crematorium (August 2017)

All documents relating to the Planning Proposal submitted to DPE can be found using the LEP's Online System[9]. A summary of relevant Planning Proposal documents is provided in **Table 1** below.

Table 1 Planning Proposal documents

Date	Title	Document purpose	Outcome
28 June 2017	QPRC: Council report minutes	Council (Administrator) endorsement to commence work on Planning Proposal	Resolved in favour

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[7] QPRC Website https://www.qprc.nsw.gov.au/Council/Council-business/Budgets-and-planning

[8] QPRC Website

[9] NSW Government Current LEP Proposals http://leptracking.planning.nsw.gov.au/currentproposal.php

Date	Title	Document purpose	Outcome
18 August 2017	QPRC: Planning Proposal	To amend the Queanbeyan LEP	Seeking Gateway determination
25 August 2017	DPE: Determination letter	To amend the Queanbeyan LEP to "permit a cemetery and crematorium" at the site	Permitted to proceed with conditions
5 June 2018	DPE: Alteration of Gateway determination	To change description of the Planning Proposal to "permit a cemetery" only at the site	Amendment approved
8 October 2018	DPE: Alteration of Gateway determination	To extend the timeframe to complete the planning proposal	Amendment approved

The Gateway Determination Report from DPE noted that the site appears to be suitably sized to accommodate a cemetery however additional studies would be needed to verify the suitability of the site (p2). It is noted in this report that residents of the Mount Campbell rural estate have raised concerns of adverse social impacts and that additional studies are needed to clarify these likely impacts.

4.2 State level planning documents

NSW South East and Tablelands Regional Plan (July 2017)

This Plan[10] guides the NSW Government's land use planning priorities and decisions over the long term (p4). Direction 21 of the Plan is to increase access to health and education services, including sufficient space for cemeteries and crematoria (p45).

Cemeteries and Crematoria NSW Strategic Plan 2015-2020 (October 2015)

Cemeteries and Crematoria NSW was established in response to NSW Government reforms in 2012 regarding the interment industry. The organisation's vision is that "All people in NSW have access to sustainable, innovative and culturally appropriate services provided by the interment industry in a consistent, transparent and accountable manner" (p20).

The Strategic Plan[11] describes cemeteries and crematoria as critical community infrastructure and essential service to the people of NSW (p10). The Plan is structured around four key priority areas including:

» All people in NSW have access to a range of interment services that preserve dignity and respect and support cultural diversity

» All people in NSW have access to affordable and sustainable interment options

» Sufficient and suitable land is available to meet future demand for interment services

» All cemetery and crematorium operators in NSW function in a consistent, transparent and accountable manner.

The Plan does not identify the QPRC LGA as facing a critical short term shortage of cemetery space when compared to the Greater Sydney metropolitan area. The plan does however focus on the need to ensure viable cemetery proposals are being progressed to ensure additional cemetery capacity is available in the long term.

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[10] NSW Planning & Environment website, Plans for your area, Regional Plans, South East and Tablelands https://www.planning.nsw.gov.au/~/media/Files/DPE/Plans-and-policies/south-east-and-tableland-regional-plan-2017-07.ashx

[11] NSW Department of Industry website, What we do. https://www.industry.nsw.gov.au/lands/what-we-do/crown-land/cemeteries-crematoria/reporting

5 Social context

A baseline community profile study aims to describe what the social context of the site is like now, and to identify any social issues or problems that may be already present in the area. A *Social Report* was compiled for QPRC by Coffey Services Australia (June 2018). This report provides a high level review of the existing social characteristics of the site and its surrounds. It includes a demographic description of the suburb of Googong and compares it with that of the Queanbeyan-Palerang LGA. This was combined with qualitative data gathered during the focus group.

Population growth

The population of the area is increasing over time, with projected continued growth as the township of Googong expands over the next 20 years. This supports Council's assertion that demand for cemetery space in the locality will continue to increase over time. People living in the area expressed experiences of additional pressure on local infrastructure arising from ongoing urban growth activities, especially roads, traffic and transport.

Age and household type

The age and household profile of the area is broadly consistent with the general population, suggesting social impacts will likely be felt by a wide variety of individual and family types.

It is noted that the Googong age and household characteristics suggest a community orientated towards young families. It is likely that these households may hold particular concerns for any social impacts that relate to children living in the area, such as their access to schools or recreational activities.

A large number of households in Googong have only recently moved to the area, suggesting social cohesion in the suburb is still in a forming stage. Many attachments to neighbours and place are likely to be newly formed, and due to the degree of new construction in their neighbourhood, residents may be sensitive to social impacts related to unanticipated changes to their environment.

It was found that Googong residents have a strong attachment to their place and neighbourhood, with perceptions of the suburb as a friendly and quiet suburb. There is an active Googong Residents Association who advocate to QPRC about local issues. Overall, residents are likely to have varying levels of awareness about what social services and facilities are currently available in the area, including those offered by QPRC.

Both trust in QPRC and risks to social cohesion were identified as major potential social impact issues and are discussed in detail at section 7.1 and 7.3.

Income

Higher median household incomes for Googong are likely to reflect a high proportion of dual income households with or without children, higher household levels of education and employment in managerial or professional industries. This profile suggests people may be sensitive to social impacts that potentially impact their commute to work or access to out of hours care services for children

Religious affiliation

The religious affiliation of the area is dominated by people who identify with a number of Christian faiths. Non-Christian faiths collectively make up less than 5% of responses, being Hindu, Buddhism, Sikhism and Islam. This suggests that there is some need for cemetery provision to respond to cultural diversity in the area.

While the social report did not look explicitly at cultural background, it is noted that Googong has higher proportions of people who were born in India or the Philippines. This suggests that these residents may be sensitive to any social impacts relating to different cultural practices around death and burial.

Property values

The social report states June 2017 property values. This data is included to suggest that people may be sensitive to social impacts relating to changes to property values arising from the proposal. Risk to property values was identified as a major potential social impact and is discussed in detail at section 7.4.

Traffic and access

The social report states local traffic volumes and peak times. This data is included to suggest that people may be sensitive to social impacts relating to changes to the way they travel or the time it takes them to travel to access daily needs. A school bus stop nearby to the site suggests people will be sensitive to social impacts on the operation of this route. Risk of traffic congestion was identified as a major potential social impact and is discussed in detail at section 7.2.

6 Literature review

Making an assessment about the likely future social impacts of the cemetery proposal requires knowledge about what research literature reports about cemeteries in other places. This section provides a review of what other sources say about nearby cemeteries as well as similar proposals which can indicate an understanding of likely impacts.

Management of ACT cemeteries (2017)

This report[12] sets out the outcomes of an inquiry into the management of cemeteries in the ACT. Given the proximity of the ACT to Queanbeyan, it is highly relevant to consider matters raised in this inquiry particularly in relation to burial and cremation trends, land management and identification of potential future sites. Eleven submissions were received by the committee in addition to five days of public hearings held during October 2017.

Relevant findings within the report are:

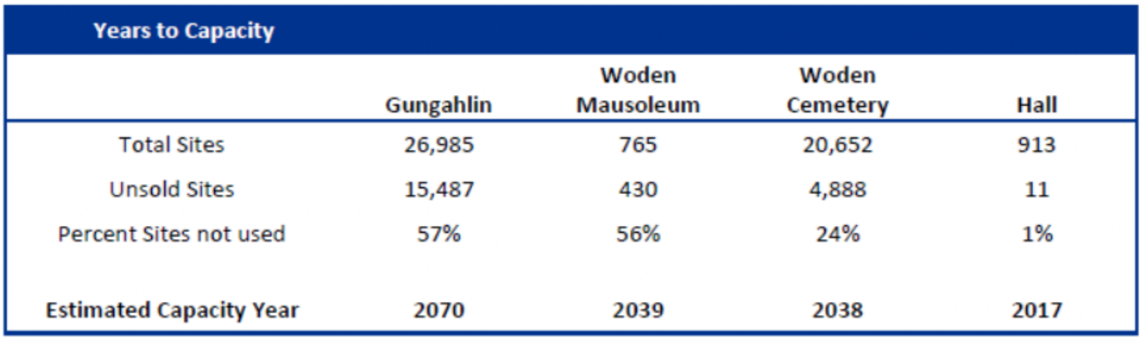
» Existing burial and cremation services provide for the burial traditions and rituals of 17 religious dominations including non-religious burial and cremation practices (p5)

» There is a need to provide a variety of interment options and opportunities (p7)

» Consistent evidence of a trend away from burial towards cremation (p8)

» Study of existing cemetery capacity (p19) (see **Figure 5** below)

Figure 5 Current estimated capacity of cemeteries in the ACT



Years to Capacity

	Gungahlin	Woden Mausoleum	Woden Cemetery	Hall
Total Sites	26,985	765	20,652	913
Unsold Sites	15,487	430	4,888	11
Percent Sites not used	57%	56%	24%	1%
Estimated Capacity Year	**2070**	**2039**	**2038**	**2017**

» Community concern about cemetery access issues that result in considerable travel requirements for families and friends of a deceased (p21) including need for public transport options (p25)

» Cemeteries are scary place at night (p22)

» Preference for cemeteries to not result in loss of public green (park) space.

Recommendations of the report included:

» The development and construction of a second crematorium in Canberra be considered a high priority (3.24)

» There be re-consideration of the planned expansion of Woden cemetery (5.24)

» The ACT Cemeteries Authority proceed with plans for a Southern Memorial Park as a matter of urgent priority (5.32), proposed to be a 70ha site near Hume.

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[12] ACT Legislative assembly, Management of ACT cemeteries- Report 4, November 2017 https://www.parliament.act.gov.au/in-committees/standing-committees-current-assembly/standing-committee-on-environment-and-transport-and-city-services/inquiry-into-the-management-of-act-cemeteries

A review of submissions made by non-government individuals and groups raised the following additional social impact related concerns:

- Preference for sites close to public transport and hotel accommodation for interstate relatives and friends
- Need for cemeteries to be tranquil places for people to reflect
- Changing attitudes to death with opportunities for the urban design of cemeteries to incorporate memorials and graves in multi-use spaces with parks and reception facilities
- Preference for two lane roads to accommodate funeral processions to reduce the risk of accidents.

Urban cemetery planning and the conflicting role of local and regional interest (2015)

This research paper[13] examines past and present issues that have informed new cemetery planning in Sydney's rural-urban fringe and uses four case studies to trace tensions within the development assessment process (p450). It notes that community engagement around strategic and statutory planning for cemeteries is often fraught with opposition, with division between the interests of the local community in terms of their immediate amenity, and the longer-term interment needs of broader society (p451).

Relevant social issues and concerns relating to the studied cemetery proposals (p454-455) were:

- Potential impacts of flooding
- Small size of block (less than 10ha)
- Inadequacy of supporting drawings and expert reports accompanying the applications
- Need for adequate screening from adjacent properties
- Concern about cumulative impact of cemetery 'proliferation' (i.e. numerous cemeteries within close proximity to each other)

Relevant court findings on the studied cemetery proposals (p454-455) were:

- The public interest, concern and unknown long term impacts upon groundwater, traffic and onsite operation aspects of the cemetery and its financial viability outweigh any proposed mitigation measures (finding overturned on appeal)
- Green burial practices are supportive of a rural landscape character, which relates to openness of land and its scenic quality rather than strictly its agricultural capacity
- A numerical standard for cemetery sizes should not necessarily be prescriptive
- Given predictions of regional burial capacity shortages the cemetery was in the public interest.

Discussion on the case study findings highlighted the following:

- The importance of having an independent assessment panels/ objective authority as the decision maker with the capacity to move beyond the local interest perspective (p455)
- General lack of reliable data on supply and demand for burial plots, and lack of detail on spatial locations or temporal demand in strategic planning documents (p456)
- The growing importance of cemeteries in anchoring culturally diverse communities within existing social structures, assisting immigrant communities with integration.
- In relation to concerns about property value impacts (p457), noting a suggested positive effect of cemeteries as a 'relatively benign neighbour' in terms of physical nuisance if compared to some other rural activities (e.g. poultry farms, fertilised market gardens, noisy trail bike riders).

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[13] Urban cemetery planning and the conflicting role of local and regional interests, Bennett, G. and Davies, P.J. Land Use Policy 42 (2015) p 450-459.

The paper concludes by noting there is a lack of research available to understand where communities would want cemeteries and related facilities to be located. It highlights that local opposition to new cemeteries is inevitable irrespective of demand, with local community priorities seeming to be "vested in the status quo".

The paper recommends better understanding how cemeteries are valued by society to provide a foundation for their future planning, along with early consultation with local and regional communities about long term need for cemetery land uses (p457).

Data on demand for cemeteries

There are three key factors that influence the demand for cemetery land:

- Number of people who die (death rate) requiring burial or cremation
- Rate of cremation
- For burials, grave occupancy rate (which allows projection of the use of new grave plots as opposed to second or subsequent interment in an existing grave).

According to the ABS[14], the following trend for QPRC is identified:

- A relatively stable number of deaths per year ranging between 258 and 293 people over the past seven years
- A declining standardised death rate from 6.2 in 2011 to 5.4 in 2017

According to data provided by Cemeteries & Crematoria NSW[15], the following trends for QPRC can be inferred:

- A comparatively low cremation rate in the South East and Tablelands region (50.9%)
- An average grave occupancy rate of 1.56 for Rural and Regional NSW.

QPRC report they are in the process of developing a draft Cemeteries Strategy which is likely to include additional analysis on local demand for cemetery services and facilities.

Research for this SIA (see **Appendix D-2**) suggests that the majority of residents would prefer to be within a 15 minute drive of a cemetery facility (approximately 10km). **Figure 6** (overleaf) shows a map of the proposed cemetery in relation to existing cemeteries in the area. As Riverside Cemetery (number 6) has no capacity to accept new burials, when Queanbeyan Lawn (Lanyon Drive Cemetery (number 5) reaches capacity, the only other existing cemetery that may meet these criteria is Woden cemetery (number 7) located in the ACT.

Other key points about existing cemeteries in the area are:

- There is only one crematoria available in the wider region (ACT) which is privately owned and operates with an effective monopoly on local cremation services
- All cemeteries within QPRC and the ACT are run by publicly owned entities
- Gungahlin cemetery (ACT) is the largest existing cemetery (approximately 38ha) with all other existing cemeteries having site areas less than 15ha.

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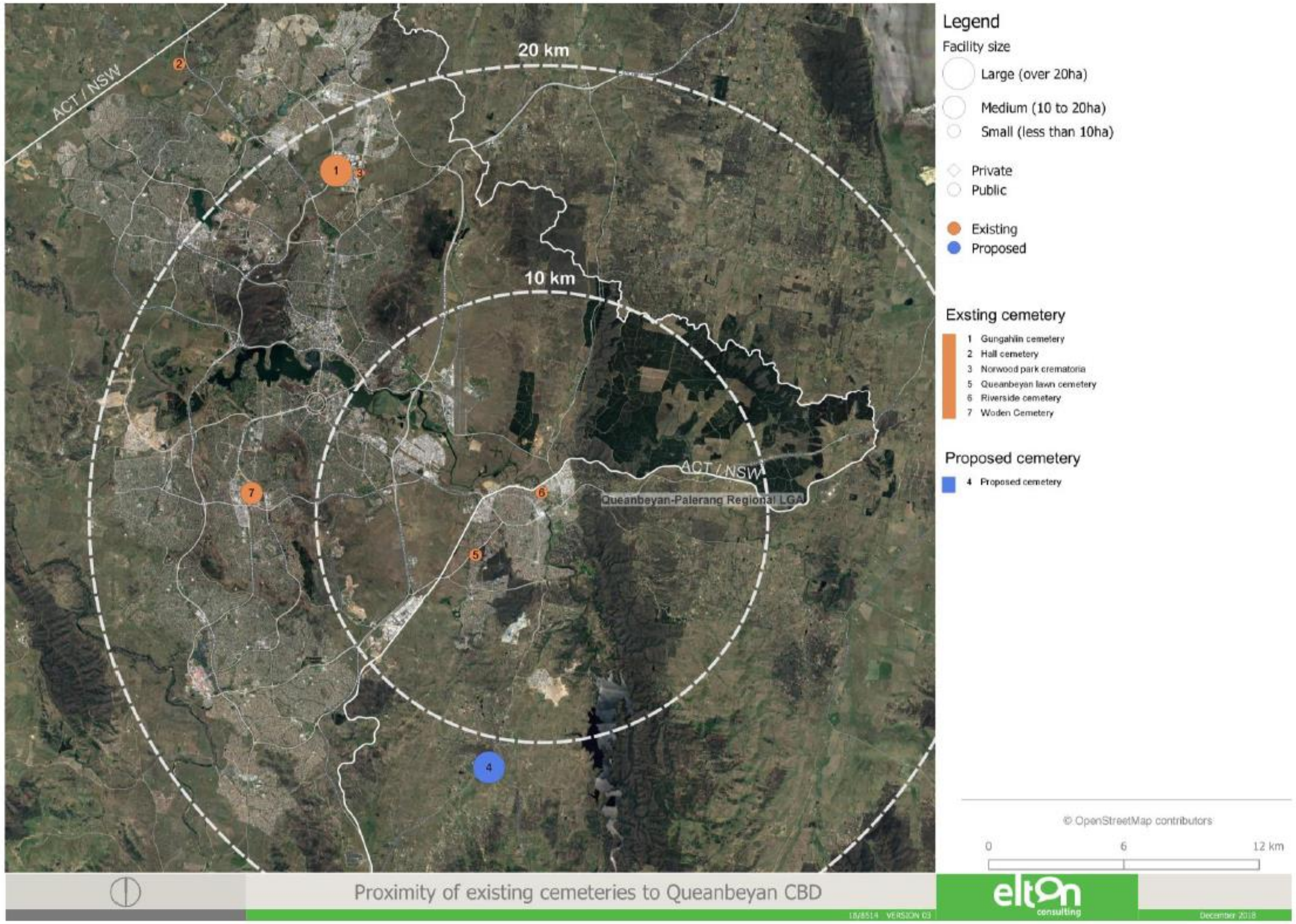
[14] Australian Bureau of Statistics 3302.0 Deaths, Australia, 2017 released 26 September 2018
http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3302.02017?OpenDocument

[15] NSW Cemeteries and Crematoria website
https://www.industry.nsw.gov.au/__data/assets/pdf_file/0005/175406/CCNSW-activity-report-2016-17.pdf

Figure 6 Map of proposed cemetery in relation to existing cemeteries



7 Likely social impacts

This chapter of the SIA incorporates targeted stakeholder engagement outcomes from public involvement in the formation of the assessment of the likelihood and severity of identified social impacts. Details of engagement activities undertaken are provided at **Appendix D**.

From the full range of identified social impacts (outlined at **Appendix A**) the following likely and major impacts were identified:

1. Decreased levels of community trust in the planning decision making process arising from both actual and perceived shortfalls in the ability of QPRC to involve people in decisions that affect them through community consultation processes to date
2. Cumulative risks to the ways people travel on a day to day basis arising from likely increases in vehicle traffic to and from the site for cemetery operational activities
3. Risks to community cohesion arising from localised activism and fear of changes in character to the existing rural setting
4. Fear of potential decreased property values leading to speculative real estate market behaviour
5. Risks to/or increases in access to cemetery services and facilities.

7.1 Levels of trust in political systems

The extent to which people are able to participate in decisions that affect their lives is key to their level of social wellbeing. From both QPRC and the community's perspective, the flow of information regarding the site purchase and announcement of the intent to provide a cemetery could have been managed better. This has led to the proposal already resulting in some affected people experiencing negative impacts to their social wellbeing arising from decreased levels of trust in political systems designed to represent them.

The main source of information about the proposal at the time of site acquisition was via word of mouth, social media and subsequent local newspaper articles rather than via formal QPRC marketing channels such as letters to residents, newspaper advertisements and Council meetings. The unofficial access to proposal information has led to QPRC being constrained in their ability to address potential misinformation and address perceptions of underhand decision making.

There is a strong perception among some affected people that the context of QPRC being under the control of an administrator at the time of the site being acquired may have influenced the level of democratisation in the decision making process. This distrust extends to the source of funds for the site purchase and its possible impact on rate levies or the ability of QPRC to fund alternate social infrastructure projects. Similarly, there are mixed views as to the role that legal confidentiality requirements played in the ability for QPRC to consult with communities about the site. Some people are understanding that the prior property owner wanted this information protected, while others view it as an excuse for lack of transparency.

Overall, the sentiment was expressed that QPRC had a public obligation to be more open about the specific geographical areas it was investigating as potential cemetery sites, even if they did not reveal a particular site address.

Countering concerns about QPRC communications for the site, this SIA found there is a high level of general community awareness that cemetery space in the LGA is running out. The objective of the proposal, namely that QPRC is looking at options for a cemetery site in the southern portion of the LGA, was found to be largely undisputed. It is likely that the problem of needing additional interment options has had time to filter through to the community as local knowledge over a longer period of time, while the site acquisition and proposal for a cemetery is perceived as a comparably abrupt announcement.

It is also important to note that for residents who are actively campaigning against the cemetery, the removal from the proposal of the option for a crematorium on the site is viewed as a positive democratic outcome. This indicates that there is preparedness from elected Councillors to respond to community views, although it is difficult to fully assess to what degree this democratisation reflects the views of other LGA residents.

Although intangible, the negative impacts to social wellbeing arising from decreased levels of community trust in the planning decision making process impact poses a real risk of cumulative impacts being experienced if the proposal is approved. For example, if QPRC are unable to deliver a memorial park style cemetery there would likely be further deterioration in the community's confidence in Council. This is particularly important as negative views of QPRC's capacity to consult with their communities is likely to be exacerbated by broader societal wide declines in trust in levels of government, politicians and democracy[16].

Mitigating this social impact will require QPRC to proactively rebuild levels of community trust in its decision making processes through a commitment to full transparency about details of the proposal as it progresses through the planning approvals process.

Recommended mitigation and enhancement measures

- Implementation of a comprehensive communications management plan that includes a 'feedback loop' of information so that the community understands how their involvement has impacted decision making. The communications management plan should:
  - Keep the community informed of the planning proposal process and outline points of engagement opportunities available to them at each stage. This should be undertaken using Plain English and occur via a variety of means:
    - Project landing page on QPRC website that is prominently displayed and easy to search
    - Letter box/ mail drops that provide a clear link to project landing page
    - Social media including Facebook
    - Email updates/ e-news
    - Community meetings/ briefings to local community associations
    - Local newspaper
  - Provide further information to the community on cemetery proposal including:
    - Outline of the history and rationale for the site selection
    - Outline of timeline for decision making and associated consultation opportunities
    - Funding details for the cemetery (including any impact on rates)
    - Operational plans (i.e. who will be responsible for maintenance)
    - Any expected/projected long term (10+year) impacts
  - Provide opportunities for affected communities to give targeted input at each stage of the proposal, including face to face consultation opportunities for Mount Campbell, Burrabella and Googong residents and their community associations. These should be held at or near the site, e.g. Fernleigh Community Hall, Royalla Hall and Googong Community Centre.
  - Provide cemetery concept design drawings that assist the community to visualise the proposal options to ease concerns
    - Involve the community in suggesting terms of reference for the design brief for concept designs
    - Consider allowing the community to participate in co-design of cemetery (e.g. children's art, suggestions box, workshop with landscape architect, community voting on design options).

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[16] Australian Election Study, 2018 https://www.australianelectionstudy.org/trends.html

- Provide affected people with community services information and referral options for counselling services (discussed further at section 7.3)
- Provide for liaison with relevant local developers and real estate agents to monitor potential impacts on property values (discussed further at section 7.4).

7.2 Cumulative risks to ways of travel

There is a strong perception in the community that the proposal will result in actual increases in traffic that could lead to longer travel times and more stressful daily driving experiences.

The existing roads in the broader geographical area around the site are currently rural in nature and lack wide verges where people could safely pull over. Vehicles travel at high speeds (80km+) and the roads can be hilly, limiting visibility.

With the existing and future planned urban growth in the Googong area, there are baseline experiences of communities currently already suffering negative social impacts arising from localised traffic congestion. Several road projects are already underway to address this existing congestion, as well as funded plans to duplicate Old Cooma Road to Googong Road, due for completion in 2020[17]. Affected people are therefore highly concerned about the potential for any cumulative impacts of traffic movements from future operation of the proposed cemetery.

The main traffic concerns that affected people perceive a cemetery facility will exacerbate are:

- Slow motor vehicle funeral processions causing it to take longer for people to commute to work, get their kids to school or other day to day destinations
- Longer term increases in cemetery visitation traffic creating a higher risk of car accidents and 'prangs' resulting in financial burdens (repairs) and/or physical injury.
- Inability of vulnerable people (e.g. the elderly) to access the site for visitation via reliable and frequent public transport or other active transport options.

The Transport Impact Assessment (TIA) prepared for the proposal contains further information on projected actual traffic movements associated with the development of a cemetery on the site. It finds that with an average of four funerals per week, the likelihood of peak traffic generation of the site overlapping with the road network peak hours is very low.

While the actual risks to ways of travel is therefore minor, the expressed perceived levels of concern about major cumulative consequences of cemetery development is considered high. If the proposal is approved, it is likely to be difficult to distinguish between the cumulative risks to ways of travel arising from the site and that arising from ongoing urban expansion. It is acknowledged that several of the following mitigations therefore relate strongly to addressing social impacts from existing risks to ways of travel in the area that contribute to some affected people's perceptions that the site is not suitable to provide for cemetery operations.

Recommended mitigation and enhancement measures

- Implementation of recommended road improvement mitigations from the Transport Impact Assessment prior to any cemetery operation, including ongoing monitoring of peak hour intersection counts at the intersection of Old Cooma Road and Burra Road to assess the future need for signalisation
- Implementation of a cemetery operational management plan that prevents conflict between cemetery service times and 'peak' traffic times, particularly relating to funeral processions and visitation on special occasion days such as Mother's Day/ Christmas

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[17] Details available at QPRC web site https://www.qprc.nsw.gov.au/Major-Works-Projects/Old-Cooma-Road

- Advocate to Transport NSW for a reliable public transport route to be provided to the cemetery site which is available as a realistic and convenient return trip on all days of the week. Alternatively, a community bus service could be required as a condition for the future cemetery operation
- Consideration of additional significant improvements to the road route between Queanbeyan CBD and the site prior to its development as a cemetery. Suggested road improvements (subject to feasibility) include:
  - Construction of generous entrance/exit to the site with good visibility and line markings/signage
  - Widen existing roads that access the site
  - Implement improved intersection controls
  - Cycling/bike path along Old Cooma Road
  - Pedestrian path between Googong and the cemetery site
  - Tree plantings along cemetery boundary to help absorb traffic noise
  - Duplication of Old Cooma Road between Googong and the cemetery site (Burra Road turnoff)/ Dual carriageway provision
  - Upgrade to Old Cooma Road south of Googong Road with overtaking lanes
  - Provide fencing along existing roads (to prevent risk of collision with Kangaroos).

7.3 Community cohesion and/or character

The proposal has resulted in a small number of significantly affected people taking active steps to oppose the cemetery (outlined in **Appendix C**). These people are primarily residents in the immediate geographic area of the site for who the proposal has already had major impacts on their way of life including negative health impacts arising from mental stress. A primary concern of these residents is fundamental changes in their amenity, especially the visual character of the bush nature of their surroundings. This has led to secondary social impacts being experienced by other residents in the immediate and surrounding geographical area who either share this concern, or are concerned on behalf of the affected residents. This includes prospective future residents of the Burrabella development.

This identified social impact is similar to that described in section 7.1 (levels of trust in political systems) in that it relates to people's social wellbeing relating to their ability to have a say in decisions that affect them, however focuses on peer to peer influences rather than decision makers in positions of power. It is also similar in that this social impact is already being experienced in affected communities since the proposal announcement.

Even though the proposal has not yet been approved, there is sufficient anecdotal evidence to suggest the perception of negative social impacts has led to some people who live near the site making real, life-changing decisions on the basis of speculation about the proposal. This includes people moving home, changing their mind about a property purchase, or planning to move/sell should the proposal be approved.

To project the potential number of people that could be affected by this impact, the level of opposition to the proposal from Googong residents (38%) was applied to the number of households in the immediate geographic area (150 households), resulting in an estimated 57 households, or 170 people, being at risk[18]. For these households, social consequences may result in:

- Major life-changing decisions to move away from an area they feel strong attachments to and have formed neighbourly relationships within. For these households, the impacts are likely to be impossible to reverse or compensate for.

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[18] Based on 38% of surveyed Googong residents being opposed to the proposal (see Appendix D-1)

- Moderate life disruptions arising from decisions to sell property or move away from an area they aspired to make their home with possible associated negative financial consequences. For these households, the impacts are likely to be recovered from over time with a degree of community support.

While emphasising these consequences would likely only affect a comparatively small number of people, it has already created a 'ripple' effect of disquiet in the wider geographical area. The social cohesion concerns held by affected people primarily revolve around the expression of residents anger towards the proposal through social media campaigning, petitioning, letter box drops and vandalism of protest signage. The general sentiment expressed is that this sort of behaviour is passive aggressive in nature, and has led to a dichotomy forming between people who support and oppose the proposal. Use of emotive language such as referring to the cemetery as a 'graveyard' has resulted in similar scepticism as that expressed towards QPRC's references to the cemetery as a 'Memorial Park'. As detailed designs of the cemetery are not available at this stage of the planning process, this social impact has contributed to general community confusion about the potential size, scale and function of the cemetery.

Overall, in the immediate and surrounding geographical areas there are indications of 'us' and 'them' attitudes developing between people depending on their level of support for the proposal. The risk of this identified social impact is potential declines in levels of trust between neighbours that could lead to individuals experiencing a decreased sense of belonging in their community. These individuals are then placed at higher risk of social isolation which is associated with health impacts including depression and anxiety. Relating to this, for residents who highly value their existing bush views and rural setting, the construction of a cemetery is also likely to lead to increased risk of negative health impacts arising from grief and loss of changes to their physical surroundings.

On a smaller scale, those people engaged in anti-cemetery activism directed at QPRC have indicated some positive social impacts arising from a sense of common purpose and achievement, particularly related to the removal of the option of a crematorium from the proposal.

The proposal is also viewed by a number of people as providing positive potential intergenerational impacts by providing future generations with cemetery services, particularly as a place of reflection with opportunities to visit loved ones. Suggestions were that the future cemetery could provide recreational and leisure opportunities such as a parkland, public art areas and picnic spots. These potential social benefits are discussed further below at section 7.5.

Recommended mitigation and enhancement measures

- Implementation of a comprehensive communications management plan so that the community is accurately informed about the nature of the cemetery proposal (described in detail at section 7.1). The plan should also include provision of community services information and referral options for counselling services to any identified directly impacted residents
- Provision of targeted opportunities for people in the immediate geographic area to participate in future concept designs for the cemetery to provide reassurance and ease concerns about impacts to their visual amenity
- Provision of a program of community development activities or projects targeting Mount Campbell and Burrabella residents over the short to medium term to bolster levels of community cohesion. This could include meet and greets, pop up events or art installations, markets or community days. These activities and projects do not necessarily need to be held near the site, but could take place in Googong or the Queanbeyan CBD, and explicitly encourage affected residents to take part via the aforementioned communications management plan (see section 7.1).

7.4 Fear of decreased property values

This SIA identified that while cemeteries are generally accepted as essential social infrastructure, they are widely perceived by property owners as undesirable neighbouring social infrastructure facilities with the potential to diminish the value of what is often their primary asset. While addressing such anticipatory behavioural psychology is difficult, the social consequences are potentially major as many life decisions are made by people based on their property value which often has cumulative impacts on related decisions such as savings, retirement and mortgage payments.

As described in section 7.3 above, there was anecdotal evidence to suggest that existing speculation about the possibility of the cemetery proposal being approved has already led to a small number of households modifying decisions about the sale or purchase of their properties in the immediate geographical area around the site.

Also related to section 7.1, there is a sentiment that these decisions may have been different had people had a higher level of awareness about the proposal prior to their property related decision making.

It is important to note that for this impact, there are baseline experiences of ordinary property market fluctuations in values arising from existing and future planned growth in the Googong area, and wider economic conditions. While it is beyond the scope of this SIA to provide property market analysis that distinguishes this impact from other cumulative property value impacts, it is considered possible that anticipated decreases in property values arising from knowledge of the cemetery proposal may have resulted in financial hardship being experienced by some residents in the immediate geographic area comparative to a baseline situation of no cemetery being proposed. By extension, it is therefore also possible that this perceived impact could lead to further localised property speculation if the proposal is approved.

Recommended mitigation and enhancement measures

» Proactive implementation of a comprehensive communications management plan (described at section 7.1) so property owners in the immediate site area are kept up to date about details of the proposal as it progresses through the planning approvals process. This should include mechanisms for a two-way flow of information between QPRC and relevant local property developers and real estate agents to monitor property sales in the immediate site area to identify potential baseline data that can be used at future planning stages to better understand any potential localised impacts on property values.

» Provision of targeted opportunities to involve residents in the immediate geographic area to participate in the development of cemetery concept design drawings to ensure they can assist with suggestions for its future operation that manage concerns they perceive could impacts their property value. Suggested enhancements could include:

  > Ensuring the cemetery entrance is off Burra Road (away from the Mount Campbell entrance)

  > Screening of properties through mature tree plantings, ideally native species

  > Improvements to local utility access, such as internet services.

7.5 Access to cemetery services and facilities

The proposals ability to provide an additional local cemetery was strongly supported as a positive social impact. Benefits of an additional local cemetery that were identified are:

» Provision of a local interment alternative to the Queanbeyan Lawn (Lanyon Drive) cemetery

» Increased opportunity to be buried near to where people live/want to visit loved ones

» A new recreation space/ place to walk that would become historically/culturally interesting over time (e.g. genealogy/ famous persons)

It is noted that these findings are likely to apply generally to the public interest of cemetery facility provision and could also be potentially applicable to any alternate sites identified by QPRC.

For the proposed site, there are mixed views on the appropriateness of the cemetery location. These views are closely related to perceptions of travel distance convenience. While there was clear consensus that the 'outskirts of town' is an appropriate location for a cemetery site, a key finding of the SIA is that there are highly subjective differences in what the 'outskirts' is considered to be. Research undertaken for the SIA (see **Appendix D-1**) found that the more proximate to the proposed cemetery site people are, the more likely they were to consider a more rural site as appropriate. Finding a suitable balance between a cemetery being easy to access and convenient, while also being away from existing or planned residential dwellings is likely to be an irreconcilable tension.

This impact also expanded on the described fear of limited public transport, cycling and walking transport options to the site (see also section 7.2). Concern was expressed that people who would want to visit the cemetery, particularly older people who may not own a vehicle, will have limited transport options and effectively suffer a consequence of social isolation from their right to access cemetery services.

For people highly affected by this social impact, the only acceptable mitigation is viewed as a decision by QPRC to find a more isolated site for provision of a cemetery.

Recommended mitigation and enhancement measures

If the proposal is approved:

- QPRC to exhibit Draft Cemetery Strategy to the community that outlines actions to improve data collection on local cemetery capacity and monitor demand over time
- The design of the cemetery should be undertaken in a contemporary, best practice landscaped style including:
  - A capacity level that can accommodate interment needs over the very long term, for example 50 to 100 years lifespan.
  - Mature tree screening, preferably with native species, should be achieved prior to cemetery operation
  - Limited size of cemetery development footprint within the site, with remaining area to include portions dedicated for environmental restoration of biodiversity
  - Appropriate location of car parking and buildings, with sufficient onsite parking to accommodate large funeral services
  - Appropriate location of interment areas
  - Inclusion of community bus and taxi set down/pick up area
  - Internal network of pedestrian pathways and shaded rest areas, as well as links to external pedestrian network
  - Inclusion of options that cater for a wide variety of burial practices including green burials
  - Visual compatibility with St Paul's Anglican Church
  - CPTED assessment of design undertaken at DA stage
- As part of any future cemetery Development Assessment, the following should be required:
  - A construction management plan
  - An operational management plan, including identification of intended organisation to operate facility
  - An onsite water management plan that addresses any potential impacts on surrounding properties

If the proposal does not proceed:

- QPRC should urgently pursue provision of an alternative cemetery site to prevent residents being socially disadvantaged in their ability access to interment services.

7.6 Likely social impacts if proposal does not proceed

If the proposal does not proceed, QPRC have indicated that they will sell the land for development, likely to be large block residential dwellings in similar character to those planned at Burrabella.

It is highly likely that QPRC would continue looking for alternative suitable cemetery sites with renewed urgency.

Based on existing projections of cemetery capacity, it is likely that there would be shortages in the availability of local interment space within the next 5 years. If this occurs, residents who wish to access cemetery services in the local area would be substantially inconvenienced. As discussed in Chapter 6, it is likely the only existing alternative would be Woden cemetery in the ACT which is also experiencing pressure for expansion of services.

A secondary impact is the reduced potential for social benefits arising from the development of a cemetery, such as additional tree plantings and supplementary local road improvements, may not occur or be delayed into the long term until sufficient urban growth expansion warranted similar improvements.

Recommended mitigation and enhancement measures

» If the proposal does not progress, it is considered imperative that QPRC adhere to its stated commitment of reselling the land for alternate development purposes permitted under the current zoning. The decision should be clearly communicated to the community in a timely way.

8 Conclusion

This SIA found substantiated justification of the need for a new cemetery in the southern region of the QPRC LGA. Provision of a new cemetery is likely to be in the wider public interest as an important social infrastructure facility that will provide improved options for local interment services.

The proposal does not address a similar identified need for crematoria facilities and services. It is noted however that the decision of Council to remove the option for a crematorium from the proposal has already accomplished effective mitigation of some negative social impacts currently being experienced by residents in the immediate geographical area.

For other affected households in the immediate geographic area, there is substantial risk of minor inconveniences to residents arising from future development of a cemetery facility affecting their current way of life and the value they attach to their home's rural setting. These households are likely to have the capacity to adapt over time with careful cemetery design and adequate landscaped screening.

This SIA found that all the identified social impacts (described in **Appendix A**) are broadly consistent with those experienced by communities affected by cemetery development applications in comparable regional areas and are unlikely to arise directly from the suitability of the proposals specific site location. Rather, the social impacts described by affected people in this assessment are characteristic of general societal discomfort with the placement of cemetery facilities close to residential properties.

If the proposal is approved, a key recommendation is that QPRC should implement a comprehensive communications management strategy to ensure it is well known among the community that the site is intended for development as a cemetery. This is crucial to resident's current and future ability to make informed decisions about their choice of where to live and go about their daily lives within the LGA. Effective communications, including a Local Cemetery Strategy, will also benefit businesses such as funeral operators, and visitors who live outside the LGA but are planning for future interment services for themselves or their loved ones.

If the proposal does not progress, it is recommended QPRC also implement a communications strategy that ensures it is well known among the community that the site will not be developed as a cemetery. QPRC should then take necessary steps to allow the site to be developed for alternate purposes. In this circumstance, QPRC should also provide reassurance to residents, businesses and visitors that alternatives for provision of additional local cemetery services are being pursued to meet medium to long term interment needs.

Appendices

A Social impact identification

The NSW Department of Planning and Environment (DPE) *Social Impact Assessment Guideline* (September 2017)[19] outline the following categories of social impacts for consideration:

Table 2 Social Impact Assessment categories

SIA Category	Description
Way of life	How people live, for example how they get around, access employment and recreation activities, how people interact with each other on a daily basis.
Community	Including its composition, cohesion, character and sense of place.
Access to and use of infrastructure, services and facilities	Whether provided by local, state or federal governments, for profit, not for profit or volunteer groups.
Culture	Including shared beliefs, customs, values and stories, connections to land.
Health and wellbeing	Including physical and mental health.
Surroundings	Including access to and use of ecosystem services, public safety and security, the aesthetic value and or amenity of the natural and built environment
Personal and property rights	Including if people's economic livelihoods are affected, whether they experience personal disadvantage or have their civil liberties affected.
Decision making systems	Particularly the extent to which people have a say in decisions that affect the, and have access to complaint remedy and grievance mechanisms.
Fears and aspirations	Related to one or a combination of the above, or about the future of their community.

The likelihood of each identified social impact matter occurring is rated as being likely if there is a real chance or possibility that the adverse impact will occur.

For all identified likely social impacts, an assessment of their effects and consequence is made based on the professional judgement and expertise of the SIA preparers, with qualifications noted at the SIA inside cover (page 2) of this report. The assessment includes consideration of impact:

- Extent (geographical area affected, number of people)
    - Immediate geographical area, covering Mount Campbell and Burrabella housing developments. Estimated to be currently around 150 households and a population of 450 people (ABS statistical area SA1 1101120), forecast to grow by 100+ people within the next 5 years
    - Wider geographical area, including the suburb of Googong. Estimated to be currently around 900 households and a population of 2,700 people (ABS statistical area SSC11704)[20], forecast to grow by 2,500+ people within the next 5 years and 12,000+ people in the longer term

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[19] NSW Department of Planning & Environment Social impact assessment guideline, Accessed 17 November 2018 from https://www.planning.nsw.gov.au/policy-and-legislation/under-review-and-new-policy-and-legislation/social-impact-assessment

[20] Data provided by QPRC indicates that the population of Googong is now likely to be around 3,300 people with 1,178 occupied dwellings as at November 2018.

  - Whole LGA. Estimated to be currently around 24,000 households and a population of 56,000 people, forecast to grow by 3,700+ people in the next 5 years, and 20,000+ people in the longer term.
- Duration (timeframe):
  - Short term: 1 to 2 years, or until a cemetery development application is approved
  - Medium term: 2 to 5 years, or until a cemetery is constructed
  - Long term: More than 5 years, or arising from operation of a cemetery.
- Severity (scale or degree of change)
  - Minor: an impact likely to be controlled by normal best practice cemetery development at later stages of the planning process
  - Moderate: an impact likely to require monitoring of mitigation measures as conditions of approval by decision makers
  - Major: an impact that should be considered in detail with effective mitigation measures to be conditions of proposal approval by decision makers.
- Sensitivity (Susceptibility or vulnerability or people, receivers or receiving environments).

Table 3 Social impacts matrix

Matters	Impact	Social impact category	Nature of potential impact without mitigation	Likelihood and severity	Duration	Extent/ Sensitivity	Mitigation or enhancement
Amenity	Acoustic (noise and vibration)	Way of life Health and wellbeing	» Stress and/or irritation caused by construction phase noise from the building of access roads, onsite buildings, landscaping works	Likely, Moderate	Medium term	Immediate geographical area (Addressed in Noise Impact Assessment)	» Implement a construction management plan » Limit size of cemetery development footprint within site
	Noise impacts	Health and wellbeing	» Stress and/or anxiety caused by operational nuisance noise such as light excavation machines, music during graveside ceremonies, maintenance equipment such as lawn mowers.	Likely, Minor	Long term Intermittent	Immediate geographical area (Addressed in Noise Impact Assessment)	» Implement a cemetery operational management plan (hours of operation) » Limit size of cemetery development footprint within site
			» Stress and/or irritation caused by increased noise of road traffic from cemetery visitors in light vehicles	Unlikely, Minor	Long term	Immediate geographical area Possible cumulative impacts to wider geographical region (Addressed in Noise Impact Assessment)	» Limit size of cemetery development footprint within site » Appropriate location of car parking and buildings at design stages » Implement a cemetery operational management plan (onsite vehicle behaviour/speed)

Matters	Impact	Social impact category	Nature of potential impact without mitigation	Likelihood and severity	Duration	Extent/ Sensitivity	Mitigation or enhancement
			» Stress for mourners/cemetery visitors caused by nuisance noise arising from existing residents/dwellings e.g. dirt bikes, lawn mowing, backyard get togethers.	Possible, Moderate	Long term Intermittent	Within site boundary	» Limit size of cemetery development footprint within site » Appropriate location of interment areas at design stages
	Odour	Health and wellbeing	» Stress and/or anxiety caused by the perception the facility will include a crematoria (fear of potential odour)	Unlikely, Minor	Short term	Immediate and surrounding geographical area	» Communications management plan providing clear community messaging that the proposal does not include a crematorium
	Vista	Culture (valuing rural setting)	» Stress and/or depression caused by loss of existing views	Possible, Moderate	Medium to long term	Immediate geographical area, particularly existing residents/ those who have recently bought property	» Limit size of cemetery development footprint within site » Require mature tree screening of burial areas to be achieved prior to cemetery operation approval » Implement best practice requirements for landscaping at the design stage ensuring it is sympathetic to the rural character of the area
		Health and wellbeing (mental and spiritual wellbeing)	» Stress and/or depression caused by view of cemetery (seeing mourners/ reminder of mortality)	Possible, Moderate	Long term Intermittent	Immediate geographical area with view of site (Addressed in Visual Impact Assessment)	» Limit size of cemetery development footprint within site » Require mature tree screening of burial areas to be achieved prior to cemetery operation approval

Matters	Impact	Social impact category	Nature of potential impact without mitigation	Likelihood and severity	Duration	Extent/ Sensitivity	Mitigation or enhancement
			» Stress for mourners/cemetery visitors caused by views of existing residents/dwellings	Possible, Minor	Long term Intermittent	Within site boundary	» Limit size of cemetery development footprint within site » Require mature tree screening of burial areas to be achieved prior to cemetery operation approval
	Air (particulate matter)	Health and wellbeing (physical) Environment	» Health conditions arising (e.g. asthma) from construction phase dust caused from building works	Possible, Moderate	Medium term	Immediate geographical area, particularly those with pre-existing health conditions	» Limit size of cemetery development footprint within site » Implement a construction management plan
			» Health conditions (e.g. asthma) arising operation phase dust from digging of graves	Unlikely, Moderate	Long term Intermittent	Immediate geographical area, particularly those with pre-existing health conditions	» Limit size of cemetery development footprint within site » Implement a cemetery operations management plan (maintenance hours)
		Health and wellbeing (mental)	» Stress and/or anxiety caused by the perception the facility will include a crematoria (fear of potential smoke)	Unlikely, Minor	Short term	Immediate and surrounding geographical area	» Implement a communications management plan providing clear community messaging that the proposal does not include a crematoria

Matters	Impact	Social impact category	Nature of potential impact without mitigation	Likelihood and severity	Duration	Extent/ Sensitivity	Mitigation or enhancement
Access	Road network	Way of life	» Traffic delays caused by funeral processions » Traffic congestion on special occasion (high visitation) days » Traffic congestion at the junction of Old Cooma and Burra Road	Possible, Moderate	Long term Intermittent	Wider geographical region (Addressed in Traffic Impact Assessment)	» Improve the local road network prior to cemetery operation as described in section 7.2 of this SIA » Implement recommendations of the TIA including: > Improve Old Cooma Road and Burra Road condition/ lane markings/turn bays » Implement a cemetery operations management plan (staggering of interment services)
	Parking (offsite)	Way of life Access to infrastructure	» Traffic congestion on special occasion (high visitation) days	Likely, Moderate	Long Term Intermittent	Wider geographical region	» Cemetery design to accommodate onsite parking facilities for traffic projections associated with large funeral services
	Transport Accessibility (active transport	Way of life Access to and use of infrastructure, services and facilities	» Lack of public transport services to site » Lack of pedestrian and cycle ways to site	Likely, Moderate	Short to medium term	Wider geographical region/LGA People who are transport disadvantaged, including older people	» Cemetery design to include set down/pick up areas for community busses and taxi services » Site to provide links to external pedestrian networks and provide active transport network within site

Matters	Impact	Social impact category	Nature of potential impact without mitigation	Likelihood and severity	Duration	Extent/ Sensitivity	Mitigation or enhancement
Built setting	Public domain and infrastructure	Access to and use of infrastructure, services and facilities	» Level of local access to interment services	Likely, Major	Medium to Long term	Wider geographical region	» Council to exhibit Draft Cemetery Strategy to the community as a matter of priority, including an outline of actions to improve data collection on local cemetery capacity and a commitment to monitoring demand over time » If the proposal does not progress, QPRC to pursue alternative cemetery sites as a matter of urgency » Cemetery design to include burial options to cater for a wide range of cultural practices including green burial.
Heritage	Aboriginal	Culture (heritage values)	» Loss of onsite Aboriginal archaeological sites	Addressed in Aboriginal Due Diligence assessment	Addressed in Aboriginal Due Diligence assessment	Within site boundary People who identify as Aboriginal	» Undertake further assessment of identified Aboriginal archaeological sites via Aboriginal Cultural Heritage Assessment including consultation with Aboriginal stakeholders
	Cultural	Culture (shared beliefs and customs)	» Reduction in local burial options for people (e.g. from diverse cultural backgrounds, including ‘green’ burials)	Likely, Major	Medium to long term	Wider geographical region/ LGA	» Cemetery design to include burial options to cater for a wide range of cultural practices including green burial.

Matters	Impact	Social impact category	Nature of potential impact without mitigation	Likelihood and severity	Duration	Extent/ Sensitivity	Mitigation or enhancement
		Culture (heritage values)	» Reduction in opportunities to increase visitation to St Paul's Anglican Church (Heritage listed)	Possible, Minor	Short to medium term	Immediate geographical area	» Implement cemetery management plan that commits to investigating opportunities for church to be used for funeral related activities » Cemetery is considered visually compatible with the church (addressed in Heritage Assessment)
Social	Health	Health and wellbeing Fears and aspirations	» Stress and/or depression and distress caused by cemetery triggering reminders of death/ fear of death	Possible, Major	Short term	Individuals, most likely living in the immediate geographical area	» If the proposal does not progress, this impact will be avoided » QPRC providing information on referral options to counselling services
		Health and wellbeing Fears and aspirations	» Stress and/or anxiety arising from fear local interment options will not be available and/or reduce local ability to visit interred loved ones	Possible, Moderate	Short term	Wider geographical region/ LGA	» Council to exhibit Draft Cemetery Strategy to the community as a matter of priority, including an outline of actions to improve data collection on local cemetery capacity and a commitment to monitoring demand over time » If the proposal does not progress, QPRC to pursue alternative cemetery sites as a matter of urgency

Matters	Impact	Social impact category	Nature of potential impact without mitigation	Likelihood and severity	Duration	Extent/ Sensitivity	Mitigation or enhancement
	Safety	Health and wellbeing Fears and aspirations Surroundings	» Risk of headstone/ site vandalism and/or loitering on site arising from relative isolation from urban areas	Possible, Minor	Short to medium term	Immediate geographical area	» Implement a cemetery operations management plan (security systems) » Design of cemetery site to reconcile crime prevention through environmental design principles with recommended visual screening requirements
	Housing availability	Way of life	» Reduced land availability for environmental living (E3) housing	Possible, Minor	Long term	Immediate geographical area	» If the proposal does not progress, QPRC to resell the land in a timely manner for the purpose of housing development »
	Social cohesion, social capital and resilience		» Decreased levels of trust between neighbours and higher levels of social isolation » Higher risk of mental health conditions	Likely, Major	Short term Ongoing	Immediate geographical area Wider geographical region/ LGA	» Implement detailed recommendations described in section 7.4 of this SIA
	Decision making systems	Decision making systems	» Deteriorating levels of trust in QPRC and planning processes	Likely, Major	Short term Ongoing	Wider geographical region/ LGA	» Implement a comprehensive communications management plan as described in chapter 7.1 of this SIA
Economic	Livelihood	Way of life	» Reduction in property values leading to financial hardship	Possible, Major	Short term	Immediate geographical area Small proportion of affected households	» Implement communications management plan

Matters	Impact	Social impact category	Nature of potential impact without mitigation	Likelihood and severity	Duration	Extent/ Sensitivity	Mitigation or enhancement
			» Increased local employment opportunities > Short term construction works > Ongoing operations	Likely, Minor	Medium to Long term	Wider geographical region/ LGA	N/A
		Access to and use of infrastructure, services and facilities	» Improved financial viability of QPRC arising from potential profitability of cemetery operations	Likely, Minor	Medium to long term	Wider geographical region/ LGA	» Cemetery development application to include information on intended facility operator (public or private) » If cemetery is to be run by Council, economic business case findings should be made available to the public.
Bio-diversity	Native vegetation or fauna	Surroundings	» Loss of flora or fauna	Addressed in Flora and Fauna assessment report	Medium term	N/A	» Site to include portions dedicated for environmental restoration of biodiversity on site as part of cemetery design
Water	Ground and surface water quality	Health	» Concern about leeching of pollution from decomposing bodies into the creek and/or bore water used by locals for watering/irrigation/ fire fighting	Possible (subject to findings of current hydro-geology studies)	Long term	Immediate area and wider geographical region	» Implement communications management plan that makes clear reference to relevant study findings » Implement any recommended mitigations of study when complete

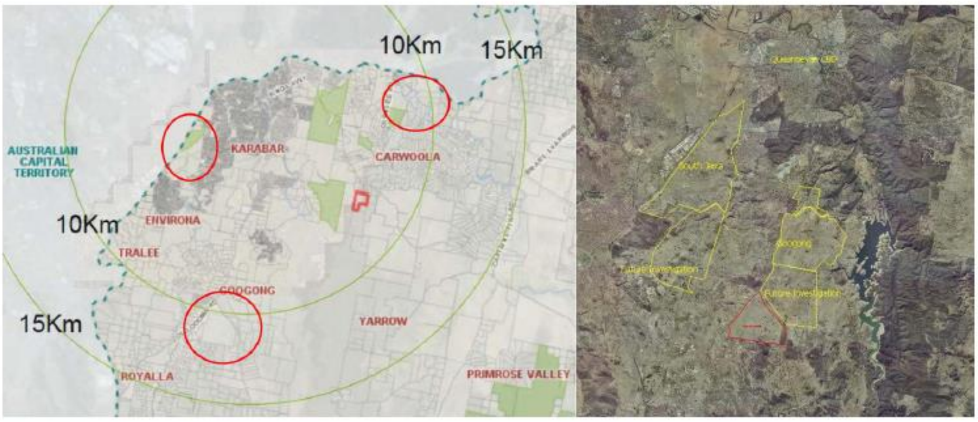
Matters	Impact	Social impact category	Nature of potential impact without mitigation	Likelihood and severity	Duration	Extent/ Sensitivity	Mitigation or enhancement
		Surroundings	» Concern about QPRC ability to maintain site to a high standard due to watering requirements	Possible, Moderate	Long term	Immediate geographical area, particularly landholdings reliant on bore or creek water	» Cemetery design to include onsite water management plan that addresses any impacts on surrounding properties
Risks	Flooding	Fears	» Stress and/or anxiety about human remains being exposed during flood events (linked to localised memories of 1974 flooding of Riverside cemetery)	Unlikely, Major	Long term Intermittent	Immediate geographical area, particularly people aged over 50 years	» Implement communications management plan that makes clear reference to relevant hydrological study findings

B Cemetery site selection criteria

The following site selection criteria (presentation to Council candidates 10 May 2017) was used to identify land within the QPRC LGA which may be suitable for a new cemetery:

- Proximity to city and urban areas, 10-15km radius
- Allow for future urban growth
- Proximity to main roads
- Able to accommodate separated exit and entrance
- Minimum site of 35 hectares of memorial park, including buffer zones, access roads and facilities.
- Topography predominately flat to slight undulation
- Consistent subsoil depths to 3.5m deep
- Outside 100-year flood zone preferred
- Low water tables desirable, ideally minimum 3.5 metres
- Access to services, irrigation water in dams, electricity and potentially gas
- Avoid significant environmental constraints, e.g. Googong Dam, Eastern escarpment, E1 & E2 Lands.

Figure 7 QPRC site search area



Six sites were identified and assessed across eastern, western and southern search areas of the LGA:

Eastern search area:

- Carwoola site 1, Crown Land, failed initial vegetation assessment, drains to Molonglo River and subject to land claim
- Carwoola site 2, passed initial veg assessment, unable to assess for Geotech as access consent not provided by property management.

Western Search Area:

- Hoover Road site 1 failed on Geotechnical assessment, former land fill site, unstable cannot excavate
- Site 2 private land failed vegetation due to high conservation value habitats and visible hard rock.

Southern search area: Two Sites assessed. QPRC concurrently negotiated to acquire options over two properties:

- Site 1 Showed potential but was declined by owners, details commercial in confidence
- Site 2 Passed initial vegetation and geotechnical assessment, owners agreed to the option per Council resolution
    - Due to changes to Federal legislation, the land owner requested Council accept outright purchase prior to 30th June 2017.

C Community responses to proposal

Newspaper articles

Newspaper report (May 2017) [21] that up to 50 people attended a Council meeting to voice their concerns including residents from Mount Campbell Estate. Issues raised were:

- Lack of community consultation
- Lack of transparency from Council to the public
- Potential for flooding on the site
- Lack of clarity as to why the site was selected.

Newspaper report (June 2017) [22] that Council had decided to submit a planning proposal to vary the land's zoning to allow a cemetery and crematorium on the site. The article notes that Council have not committed to a crematorium but are keeping the option open. The article reiterates concerns from Mount Campbell estate residents who attended the 10 May 2017 Council meeting in opposition to the project

- A lack of consultation in choosing the potential location.
- Because the land has been purchased, it presents to community as a foregone conclusion that the cemetery will proceed.

Newspaper report (August 2017) [23] that the proposed cemetery site is subject to flooding and referenced fears that the 1974 floods that washed out the Queanbeyan cemetery could be repeated if the cemetery goes ahead.

- Mount Campbell residents believe the land to be unsuitable due to flooding
- Nearby residents oppose the location on a range of issues including flooding.

The Canberra Times reported vandalism of a sign opposing the proposed cemetery in an article on 5 September 2017. The article outlines the following community concerns:

- Criticism of administration of the project and purchase of the property without notifying residents
- Fears the cemetery will ruin the local environment, bring down property prices and be vulnerable to flooding
- Preference for alternative locations of additional land near existing cemetery, or development of crown land
- Thought zoning protected them from development but now "a cemetery or a crematorium could be dumped in our backyard"
- Perception of being misled by previous descriptions of cemetery site being at nearby Royalla[24]

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[21] The Queanbeyan Age Chronicle, 11 May 2017, "Lively Council meeting over cemetery proposal" (James Hall). Accessed 8 November 2018 from https://www.queanbeyanagechronicle.com.au/story/4655247/lively-council-meeting-over-cemetery-proposal/

[22] The Queanbeyan Age Chronicle, 30 June 2017 "QPRC moving forward with plans for new Queanbeyan cemetery" (Elliot Williams). Accessed 16 November 2018 from https://www.queanbeyanagechronicle.com.au/story/4763006/controversial-cemetery-moving-forward/

[23] The Queanbeyan Age Chronicle, 10 August 2017 "Residents opposed to new Queanbeyan cemetery say it's a flood risk (Elliot Williams). Accessed 16 November 2018 from https://www.queanbeyanagechronicle.com.au/story/4844906/new-cemetery-raises-flood-concerns/

[24] The Canberra Times, 5 September 2017 " Sign opposed to controversial cemetery vandalised ahead of NSW council vote" (Tom McIlroy) accessed 16 November 2018 from https://www.canberratimes.com.au/national/act/sign-opposed-to-controversial-cemetery-vandalised-ahead-of-nsw-council-vote-20170905-gyaxlp.html

It was reported that the removal of the possibility of a crematorium at the site was a win for residents in an article dated 12 May 2018. Council voted to remove the crematorium from the proposed Schedule 1 (QLEP 2012) amendment in response to concerns from the community. The article also notes:

- A crematorium would have required a gas pipeline to be constructed at extra expense
- Residents now "feel confident the whole cemetery won't be going ahead" and submitted a petition opposing the cemetery with almost 400 signatures to the Council meeting on 9 May 2018
- Local councillor considers a cemetery between Queanbeyan and Bungendore would better serve the community's needs[25].

Council meetings

At Council Community Meeting held 3 May 2018, an update on the proposal was provided. At this meeting community members were provided the opportunity to ask questions, with key issues raised including:

- Stop the investigation and look for another site closer to Queanbeyan
- Frustration that 'bushland cemetery' site (portion 75) not going ahead (E2 land, high ecological value)
- Distrust in processes and lack of transparency around purchase of Old Cooma Rd site
- Deep concern and opposition to a crematorium on the site, frustration that Council won't decide/disclose either way - Burrabella in particular want guarantee of no crematorium
- Burrabella buyers feel misled/deceived that this project was unknown at time of purchase
- Alleged errors in Gateway submission – want these rectified
- How can a social impact assessment be done prior to community consultation? Impact on Mount Campbell Estate and Burrabella as closest residential communities – we haven't been asked so how can they know?

Other related concerns were:

- Availability of water to maintain memorial park gardens and impact on nearby residential bores (Mount Campbell and Burrabella)
- Cost to taxpayers – interest to hold block, investment if it can't even be used
- Errors/omissions on Council websites, and difficulty navigating/finding relevant documents – distrust in Council abilities/accuracy
- Consultation – will Burrabella future residents be directly notified? How to find out when the public hearing and consultation period will be.
- Which steps in the planning process there is consultation on – wanted social impact and community consultation input to Gateway which has concluded.

At its meeting of 9 May 2018, Council resolved (PLA052/18) to submit an amended planning proposal for the memorial park at Old Cooma Road to remove the use of a crematorium from the proposed additional uses of the site in response to community concerns. Council received a revised Gateway determination on 5 June 2018 and has been progressing the planning proposal.

Public Facebook 'No cemetery on Old Cooma & Burra Road' page:

- Created 23 April 2018
- 49 members as at 12/12/2018

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[25] The Sydney Morning Herald, 12 May 2018 " Win for residents as Googong crematorium idea scrapped" (Elliot Williams) accessed 16 November 2018 from https://www.smh.com.au/national/nsw/win-for-residents-as-googong-crematorium-idea-scrapped-20180512-p4zew6.html

Petition to QPRC:

- " We the undersigned vehemently oppose the development of a cemetery and crematorium as proposed by Tim Overall during his time as the sole administrator of the Queanbeyan and Palerang Regional Council (QPRC).

  The proposal, if supported by the QPRC, will see the development of a cemetery and crematorium directly across the road from 47 Lot Owners in an area zoned as Environmental Living."
- 420 signatures (mix of local residents and people outside of QPRC LGA).
- Submitted to Council on 9 May 2018/ tabled at the Planning and Strategy Committee of the Whole Council meeting.

D Targeted stakeholder engagement outcomes

D-1 Computer assisted telephone interview (CATI) survey

A short, 5 minute telephone (mobile and landline) survey was undertaken as part of this SIA. The survey was conducted in late November 2018 over 2 evenings by a professional research company with 140 survey responses collected for analysis. This sample size has a sampling error of +/-9.6%. Surveys were conducted on a purely random basis with responses post-weighted to reflect a mix of age and gender comparable with the demographics of the QPRC LGA. Half of respondents were from the suburb of Googong, and half from other surrounding suburbs including Queanbeyan, Jerrabomberra, Bungedore, Karabar, Crestwood and Royalla. All respondents were over the age of 18 years and did not include people who work for or are elected members of QPRC.

The survey questions asked were designed to investigate:

- Awareness of the planning proposal and support or opposition towards a cemetery at the site
- Perception of the positive and/or negative impacts if a cemetery were to be built at the site
- Perception of reasonable travel distance to access local cemetery facilities
- Demographic questions.

Results of the survey are described below:

A slight majority (51%) of all respondents were not aware of the planning proposal, while 49% were aware. Of these:

- Respondents from Googong had a higher level of awareness (65%)
- Respondents aged over 60 years had a higher level of awareness (57%)
- Respondents aged 40 to 49 years had the lowest level of awareness (41%)

Based on respondent's knowledge of the planning proposal, 52% were in support, 22% were opposed, and 26% were unsure. Of these:

- Googong respondents had a higher level of opposition (39%) followed by support (34%) and unsure (26%)
- There were slightly higher levels of support in the 40 to 59 year respondent age bracket (55%)
- There were slightly higher levels of opposition in the 60+ respondent age bracket (26%)

Respondents reasons for support for a cemetery were that it is in an appropriate location (24%) and it would be good to have another cemetery in the local area (18%) or there is a need for another cemetery in the local area (8.5%)

- Respondents from other suburbs were much more likely to say the cemetery would be an appropriate location (41.5%) compared with Googong residents (24.5%).
- Respondents from other suburbs were much more likely to say it would be good to have a local (34%) compared with Googong residents (13%).

Respondents reasons for opposition to a cemetery were that it is not in an appropriate location (13%) or is too far away (3.5%), and there is a lack of community consultation (5%).

- Respondents from Googong were much more likely to say the cemetery was not an appropriate location (24.5%) compare with respondents from other suburbs (13.5%).

- Respondents who did not provide an answer for their support or opposition or were unsure was 14%. Other responses made up 9.5%
    - Respondents from Googong were more likely to list an 'other' impact (23%) compared with other suburbs (6%).
- Respondents aged over 60 years were slightly more likely to state it is an appropriate location (36%) as well as that it is not an appropriate location (21%).
- Respondents aged 18 to 30 years were less likely to state it would be good to have a local cemetery (17%) and more likely to not answer or be unsure (21%).

Regarding potential impacts of the proposed cemetery:

- A significant percentage of respondents did not think it would have an impact (31.5%)
- Other primary impacts identified related to increased road traffic (20.5%) followed by concern it would upset neighbouring residents (20%) or reduce their property values (9.5%).
- Respondents from Googong were most likely to cite traffic impacts (29%) compared with respondents from other suburbs (19%)
- Respondents from Googong were most likely to cite concern it would upset neighbouring residents (27.5%) compared with respondents from other suburbs (19%)
- Respondents from other suburbs were much more likely to cite no impacts (45%) than respondents from Googong (24%)

Most respondents (53%) stated that it was quite or very important for a cemetery to be within a 15 minute drive of local residents in their area while 44% stated it was not at all or not very important.

- Response to this question was strongly tied to location, with 56% of respondents from Googong reporting it was not at all or not very important compared with 35.5% of respondents from other suburbs.
- Conversely, 63.5% of respondents from suburbs other than Googong stated it was quite or very important compared with 38% of respondents from Googong.

D-2 Social impact assessment focus group

A 2 hour focus group was held on a weeknight in early December 2018 at the Googong Community Centre to further investigate impacts identified in the telephone survey (described above at Appendix C-1). The focus group was facilitated by this report's authors, with two QPRC staff members attending as observers. There were 25 invitees to the focus group identified between QPRC and the report authors based on the following criteria:

- Residential proximity to site (randomised selection)
- Representatives of relevant identified business or community based organisations.

14 of the invitees accepted and attended the focus group in a voluntary capacity.

The questions asked during the focus group were designed to investigate:

- Understandings of the project and who might be impacted
- Identifying any relevant history, trends or existing social issues in the local area
- Perceptions of what a cemetery could look like at the site
- Understandings of the likely responses to primary identified social impacts
- Perceptions of impact significance
- Contributions to the design of project alternatives and mitigation suggestions.

Outcomes of the focus group have been integrated into the body of this report.

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QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2	PROPOSED QUEANBEYAN CEMETERY SITE
ATTACHMENT 9	HYDROLOGY ASSESSMENT REPORT NOVEMBER 2018

eco logical AUSTRALIA

Proposed cemetery site, Old Cooma Road

Hydrological assessment

Prepared for
Queanbeyan-Palerang Regional Council

15 November 2018

DOCUMENT TRACKING

Item	Detail
Project Name	QPRC Cemetery Background Studies
Project Number	9096
Project Manager	Kalya Abbey
Prepared by	Rizwana Rumman, Krey Price
Reviewed by	Andrew Herron
Approved by	Richard Cresswell
Status	Draft
Version Number	1
Last saved on	15 November 2018
Cover photo	Church Creek in the study area (Photo credit: Sarah Dickson-Hoyle)

This report should be cited as 'Eco Logical Australia (2018). *Proposed cemetery site, Old Cooma Road – Hydrological assessment*. Prepared for Queanbeyan – Palerang Regional Council (QPRC).'

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Template 29/9/2015

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Abbreviations, acronyms and initialisms

Abbreviation	Description
AEP	Annual Exceedance Probability
AIP	Aquifer Interference Policy
ARI	Annual Recurrence Interval
BoM	Bureau of Meteorology
ELA	Eco Logical Australia Pty Ltd
GDE	Groundwater Dependent Ecosystems
HEC-RAS	Hydrologic Engineering Centre's River Analysis System
IFD	Intensity-Frequency-Duration
MDB	Murray Darling Basin
NOW	NSW Office of Water (now DPI Water)
QPRC	Queanbeyan-Palerang Regional Council
RFFE	Regional Flood Frequency Estimation
WSP	Water Sharing Plan

Executive summary

Eco Logical Australia (ELA) has been engaged by the Queanbeyan-Palerang Regional Council (QPRC) to undertake a hydrogeological and hydrological review and constraints assessment for the proposed development and use of a cemetery site located within Lot 2 (DP112382) and Lot 126 (DP754881) of Old Cooma Road, Queanbeyan.

The assessment was undertaken to identify any potential hydrological and hydrogeological impacts and impacted areas to assess the suitability of the site for the proposed activity. In addition to a desktop review and data search, drainage and flood modelling was undertaken to assess potential flood constraints for the project.

The project area is located within the Murrumbidgee River catchment. The proposed development Site contains a section of Church Creek, a creek line that drains local farmland and a new housing development currently under development. There are no other major creek lines within the study area. Overland flow paths, however, exist from culverts that drain the roads surrounding the site.

Sheet flow from surface water run-off during large rainfall events may potentially cause impacts in isolated areas. These are unlikely to pose a risk to the site with appropriate stormwater management. Aside from the potential for overland flow downstream of the road culverts, the Site is not expected to be significantly affected by flooding; hydrological and hydraulic modelling indicates that with the exception of the area immediately adjacent to Old Cooma Road, flows in the creek are likely to be retained within the existing banks up to at least the 1% Annual Exceedance Probability design event.

Whilst no groundwater level or quality data is reported from a high-level assessment of available national databases, numerous (38) registered local stock and domestic bores do exist, though all tap deep (>20m) groundwaters in the underlying fractured rock systems. Ten shallow auger holes, drilled to a depth of 3.5 m below ground surface within the study area during a recent geotechnical investigation, did not encounter groundwater (ACT Geotechnical Engineers, 2017) and risk to and from local groundwater resources is not predicted to occur, based on a qualitative assessment.

No potentially significant aquatic or terrestrial groundwater dependent ecosystems were identified within a 2 km buffer of the study area and the project is determined to pose minimal risk as defined by the NSW Aquifer Interference Policy.

1 Introduction

Eco Logical Australia (ELA) has been engaged by the Queanbeyan-Palerang Regional Council (QPRC) to undertake a hydrogeological and hydrological review and constraints assessment for the proposed development and use of a cemetery site located within Lot 2 (DP112382) and Lot 126 (DP754881) of Old Cooma Road, Queanbeyan (**Figure 1-1**).

The assessment was undertaken to identify any potential hydrological and hydrogeological impacts and impacted areas to assess the suitability of the site for the proposed activity.

1.1 Project Background

The Queanbeyan Lanyon Drive Cemetery currently services the Queanbeyan region and is expected to reach capacity during the next five years, based on a forecasted population growth of approximately 36% by 2031 (QPRC, 2017). The Queanbeyan region includes the main growth centres of Googong, Tralee/South Jerrabomberra and infill units in Queanbeyan (QPRC, 2017).

To meet the future cemeterial needs of the region, the Queanbeyan-Palerang Regional Council (QPRC) has been engaged in a process of strategic planning to identify a new cemetery site, as well as undertaking works to prolong the serviceability of the existing Lanyon Drive Cemetery. As part of the planning proposal for the new cemetery site, QPRC is required by the New South Wales Department of Planning and Environment (DPE) to undertake background studies to characterise the existing environment at the site and identify potential areas that may impact upon the proposed development.

1.2 Study Area

The study area is approximately 36.4 hectares and is located approximately 11 kilometres south-west of Queanbeyan, and approximately 5 km west of the Queanbeyan River (**Figure 1-1**). The site is triangular in shape and bounded by Old Cooma Road to the west and Burra Road to the east. The Burra Road – Old Cooma Road intersection is located at the northern point of the site.

The site is currently used for grazing and agricultural purposes and has been farmed since the 1800's (QPRC, 2017). An existing dwelling is located near the centre of the site. Outside the site, the surrounding area comprises land that is zoned for environmental living purposes with the Mount Campbell community title development located to the west of the site, containing dwellings on smaller rural lots (QPRC, 2017).

1.3 Objectives of the assessment

The objectives of this assessment are to identify any potential hydrological and hydrogeological constraints with the proposed site use and provide advice on the assessment and management of such issues. Issues identified through this assessment are documented with:

- A clear description of the potential issue or impact.
- Presentation of the potential issue or impact (as needed).
- Assessment of the potential issue or impact
- Identification of options to address / mitigate the potential issue or impact.
- Suggestion of aspects that need to be considered in the final design to avoid the potential issue or impact.
- At the completion of the study, a final recommendation on the suitability of the site for the proposed use.

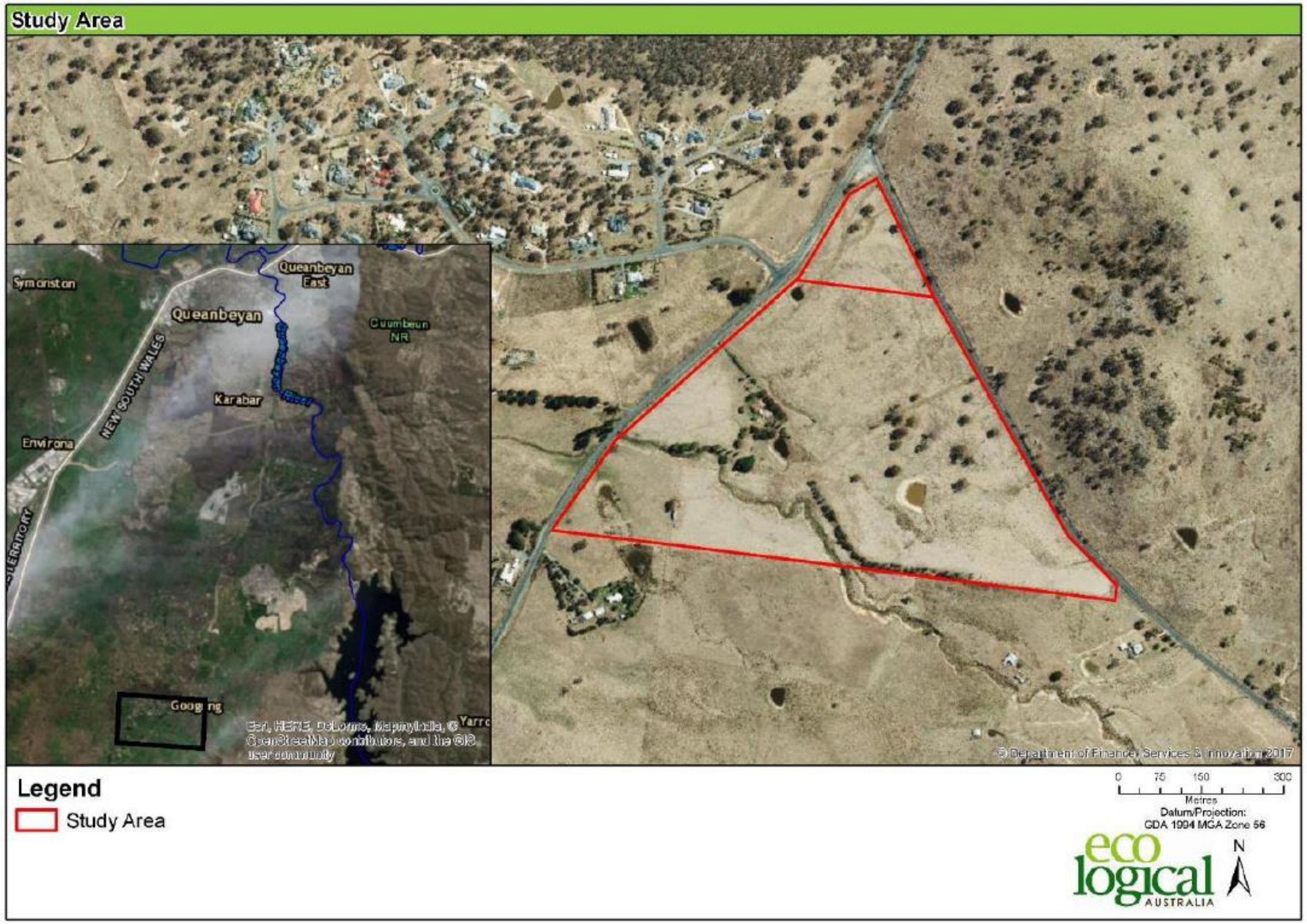

Figure 1-1: Study Area (the line across the top shows two lots associated with this site)

2 Statutory requirements

The following sections detail the relative State legislative requirements for the Project, applied to hydrological and hydrogeological aspects.

2.1 *Environmental Planning and Assessment Act 1979* (EP&A Act)

The EP&A Act is the principal planning legislation for NSW, providing a framework for the overall environmental planning and assessment of development proposals. A variety of other legislation and environmental planning instruments, such as the *Water Management Act 2000* are integrated with the EP&A Act.

Section 9.1 (formerly S117) Direction 4.3 Flood Prone Land provides that a draft Local Environmental Plan (LEP) shall not rezone land within flood planning areas from Special Area, Recreation, Rural or Environmental Protection Zones to a Residential, Business, Industrial or Special Area Zone, unless the relevant planning authority can satisfy the Director General that the planning proposal is in accordance with a floodplain risk management plan, or the provisions of the planning proposal that are inconsistent are of minor significance.

2.2 *Water Management Act 2000* (WM Act)

The main objective of the WM Act is to manage NSW water in a sustainable and integrated manner that will benefit current generations without compromising future generations' ability to meet their needs. The WM Act is administered by DPI Water and establishes an approval regime for development on waterfront land, defined as the land 40 m from the highest bank of a river, lake or estuary.

Section 91E of the Act creates an offence for carrying out a controlled activity within waterfront land without approval. According to Section 38 of the *Water Management (General) Regulations 2011*, a public authority is exempt from Section 91E of the Act. Therefore, if works are undertaken under Part 5 of the EP&A Act then a Controlled Activity Approval (CAA) will not be required. If works are undertaken under Part 4 of the EP&A Act however, then development within 40 m will require a CAA and DPI Water may also require a Vegetation Management Plan (VMP) to be prepared.

The Act also recognises the need to allocate and provide water for the environmental health of the State's rivers and groundwater systems, whilst also providing licence holders with more secure access to water and greater opportunities to trade water through the separation of water licences from land. The main tools within the Act for managing the State's water resources are Water Sharing Plans (WSPs), which establish rules for sharing water between different water uses such as town supply, rural domestic supply, stock watering, industry and irrigation and ensures that water is provided for the health of the system.

The following WSPs (Murrumbidgee Water Management Area) have been identified as relevant to surface water and groundwater environments within the subject lots:

- Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources (2011) and
- Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources (2012, current version January 2017 to date)

The Queanbeyan Water Source in *Unregulated Murrumbidgee Above Burrinjuck Dam Extraction Management Unit* forms part of the NSW Murrumbidgee Unregulated and Alluvial Water Sources WSP.

The Queanbeyan River is a major river system in this area and one of the seven surface water sources within the WSP area identified as having high instream values, i.e. likelihood of presence of known and expected threatened species. Some of these threatened species are highly sensitive to low flow extraction, whilst other threatened species, such as plants that occur in the riparian zone, are less sensitive. The shallow alluvial aquifer associated with surface water drainage lines within the site area can also be identified as potentially being impacted in relation to impacts on groundwater level and quality due to the possibility of excavations intercepting the water table (construction dewatering if required, contaminants from construction equipment etc.) during construction works.

The Murrumbidgee Unregulated River WSP also includes rules on the location of new works and extraction from existing works to protect high priority groundwater dependent ecosystems (GDE), high priority karst systems and other environmentally sensitive areas and provides conditions on works undertaken in the vicinity of GDEs.

The Aquifer Interference Policy (AIP) was established to define the assessment process for development applications in terms of their potential impacts on aquifers, to clarify the requirements for obtaining water licenses for aquifer interference activities, and to define the considerations for assessing potential impacts on key water-dependent assets. The policy focuses on activities that remove water from aquifers for non-water supply purposes.

The WM Act defines an aquifer interference activity as that which involves any of the following:

- The penetration of an aquifer.
- The interference with water in an aquifer.
- The obstruction of the flow of water in an aquifer.
- The taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.
- The disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

The AIP clarifies water licensing requirements and details how these potential interference activities will be assessed under relevant planning and approvals processes. The policy provides ‘minimal impact considerations’ to evaluate potential impacts on groundwater levels, pressures, and quality for different categories of groundwater sources. The policy also includes provisions for water take from a source following the cessation of the aquifer interference activity.

According to the AIP, a water licence is required under the WM Act (unless an exemption applies, or water is being taken under a basic landholder right) where any act by a person carrying out an aquifer interference activity causes:

- the removal of water from a water source; or
- the movement of water from one part of an aquifer to another part of an aquifer; or
- the movement of water from one water source to another water source, such as:
    - from an aquifer to an adjacent aquifer; or
    - from an aquifer to a river/lake; or
    - from a river/lake to an aquifer.

According to the AIP, the assessment of impacts on surface water sources, groundwater and GDEs is based on the project proponents’ ability to demonstrate:

1. The capacity to obtain the necessary licences to account for the take of water from a given source, or if licences are unavailable, that the Project has been designed to prevent the take of water;
2. That adequate arrangements will be in place to meet the 'minimal impact considerations' defined in the policy; and
3. Proposed remedial actions for impacts greater than those that were predicted as part of the relevant approval.

The 'minimal impact considerations' provided in the AIP have been developed for impacts on groundwater sources, connected water sources, and their dependent ecosystems, culturally significant sites and water users. These considerations are defined for 'highly productive' and 'less productive' groundwater sources, both of which are further grouped into categories according to aquifer type (e.g. alluvial, coastal sands, fractured rock, etc.). Two levels of 'minimal impact considerations' are provided, and if the predicted impacts are less than the Level 1 impact considerations, the impacts from the project would then be considered acceptable. If the predicted impacts are greater than the Level 1 considerations, studies would be required to fully assess these impacts.

For the purposes of this study, a desk-top assessment of the potential impact of the proposed works on the Lachlan Fold Belt MDB Groundwater Source (which forms part of the Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources, 2011) and Alluvial Water Sources (Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources, 2012) has been undertaken based on the criteria described in the AIP and re-produced in **Table 2-1**.

Table 2-1: Minimal Impact Considerations for Aquifer Interference Activities (Level 1)

Aquifer	Water table	Water pressure	Water quality
Alluvial Water Sources	Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" [1] variations, 40m from any high priority groundwater dependent ecosystem or high priority culturally significant site listed in the schedule of the relevant water sharing plan; or A maximum of a **2 m** decline cumulatively at any water supply work.	A cumulative pressure head decline of not more than 40% of the post-water sharing plan" pressure head above the base of the water source to a maximum of a **2 m** decline, at any water supply work.	(a) Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity; and (b) No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. Redesign of a highly connected[2] surface water source that is defined as a "reliable water supply" [3] is not an appropriate mitigation measure to meet considerations (a) and (b) above.
Lachlan Fold Belt MDB Groundwater Source		A cumulative pressure head decline of not more than 40% of the "post-water sharing plan" pressure head above the top of the relevant aquifer[4] to a maximum of a **3 m** decline, at any water supply work.	

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1 "post-water sharing plan" – refers to the period after the commencement of the first water sharing plan in the water source, including the highest pressure head (allowing for typical climatic variations) within the first year after commencement of the first water sharing plan;

2 "Highly connected" surface water sources are identified in the Regulations and will be based those determined during the water sharing planning process;

3 "Reliable water supply" is as defined in the SRLUP

4 "relevant aquifer" in relation to alluvial water sources is defined in the relevant WSP and relates to that part of the aquifer that can be utilised for productive purposes.

2.3 ***Fisheries Management Act 1995*** **(FM Act)**

The FM Act provides for the protection, conservation, and recovery of threatened species defined under the Act. It also makes provision for the management of threats to threatened species, populations, and ecological communities defined under the Act, as well as the protection of fish and fish habitat in general. In particular, the FM Act has mechanisms for the protection of mangroves, seagrasses and seaweeds on public water, land and foreshores. It is an offence to harm marine vegetation without a permit from NSW Department of Industry and Investment (Fisheries).

None of these protected matters are present onsite are therefore do not represent constraints to development, however, DPI Water have mapped Church Creek within the site as Key Fish Habitat. Where possible, future works should avoid disturbances to the creek bed and bank including riparian vegetation to protect Key Fish Habitat. Any future works under Part 4 of the EP&A Act involving the dredging of the creek bed, land reclamation, excavations to the bed or bank or obstruction of fish passage may require a Part 7 Permit under the FM Act and consultation with DPI Water. For works under Part 5 of the EP&A Act clauses 199 and 200 of the Act apply depending on whether dredging or reclamation works are being undertaken by or on behalf of a council or a pubic authority other than a council. Clauses 199 and 200 specify where a permit is required and where notification to the Minister is required.

2.4 **NSW Government Flood Prone Land Policy**

The primary objective of the NSW Government Flood Prone Land Policy is to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible.

The Policy devolves the management of flood prone land, primarily, to local government. The Floodplain Development Manual 2005 has been prepared by the government to guide councils in the implementation of the Policy. In addition, the NSW Department of Planning and Environment has a lead role in the development of regional strategies and plans under the EP&A Act and therefore Councils need to be cognisant of regional strategies and plans, when determining standards and implementation arrangements for flood prone land in their service areas.

The flood modelling described in this report confirms flood extents and allow the placement of proposed development features that need to be clear of surface water flows.

2.5 **Queanbeyan Local Environmental Plan 2012**

The Queanbeyan LEP (2012) makes local environmental planning provisions for land in the Queanbeyan-Palerang Regional Local Government Area (LGA) in accordance with the relevant standard environmental planning instrument under section 3.20 of the EP&A Act.

The subject lots are located on land which is currently zoned as E4 Environmental Living. Council has prepared a planning proposal to allow for a cemetery on the subject land. This requires the definition of ‘cemetery’ to be added to Schedule 1 Additional Permitted Uses as this land use is otherwise prohibited in the E4 Environmental Living zone. This will be done as an amendment to the Queanbeyan Local Environmental Plan 2012.

Pursuant to clause 7.2 the objectives of the LEP with regards to flood planning include minimising the flood risk to life and property associated with the use of land, allowing development on land that is compatible with the land’s flood hazard and taking into account climate change and avoiding significant adverse impacts on flood behaviour and the environment. The clause applies to land at or below the flood planning level. For the purposes of the LEP, “land at or below the flood planning level” means the level of a 1:100 ARI (Average Recurrence Interval) flood event plus 0.5 metres freeboard as described in the modelling results, including flood planning levels, described in this report.

Pursuant to clause 7.4 the objective of the LEP with regards to riparian land and watercourses includes protecting and maintaining water quality within water courses, stability of bed and banks, aquatic and riparian habitats and ecological processes. This clause applies to land identified as “Watercourse” on the Riparian Lands and Water Courses Map and all land within 40 m of the top of the bank of each watercourse on that land. Before determining a development application, council must consider all potential adverse impacts to riparian and watercourses, whether the development is likely to increase water extraction and any appropriate measures to avoid minimise and mitigate impacts of the development. Church Creek which flows through the Site is also marked on the LEP Riparian and Watercourses Map.

3 Methodology

This hydrology and hydrogeology assessment was undertaken using the steps outlined in the sections below covering:

- Data collation and review;
- Site conceptualisation;
- Hydrological and hydraulic modelling; and,
- Environmental constraints assessment.

3.1 Data collation and review

Data was collated from several online sources, including spatial databases, the Bureau of Meteorology (BoM) and government legislative sites. Data was categorised as:

- General information;
- Groundwater information; or,
- Surface water information.

The general information included spatial datasets, climate data and any relevant reports or associated project data.

Groundwater information consisted of the current NSW legislation data sets and any previous hydrogeological studies in the area. Online databases were also accessed to identify existing groundwater use in the area and the locations of any significant/registered groundwater dependent ecosystems (GDEs). Surface water information included any relevant previous studies and collated hydrological data, such as contour information and watercourses.

The following data sources were interrogated during this assessment:

- Previous studies, including but not limited to:
  - Groundwater Report on Beatty Hill, Old Cooma Road Development Application, 2001, Hyrdroilex Geological Consultants
  - Geotechnical Investigation Report, 1241 Old Cooma Road, Googong, NSW, ACT Geotechnical Engineers, 2017, Geotechnical Engineers Pty Ltd,
  - Flood analysis and concept culvert design, Rural Residential Subdivision, Burra Road, Mount Pleasant, 2015, CIC Australia P/L.
- Intensity-Frequency-Duration (IFD) information, Bureau of Meteorology
- NSW Office of Water (NOW) PINNEENA Groundwater database;
- Bureau of Meteorology (BoM) Groundwater Explorer database; and
- BoM GDE Atlas.
- Local contour maps

The above information was synthesised to aid in the development of the site conceptualisation and environmental constraints assessment. The outcomes are discussed in **Section 4**.

3.2 Site conceptualisation

A conceptual understanding of the site was developed as part of the desktop study. The conceptualisation incorporated hydrological systems, hydrogeological systems and any existing human or environmental receptors (determined through the data collation and review stage). The outcome of this conceptualisation is discussed in **Section 4.1**

3.3 Hydrological and hydraulic modelling

To categorise the existing design flood conditions from Church Creek at the site, the use of regionalised flood models was required as no appropriate water level or flow information exists in or near the catchment of interest. The flood volumes and levels were determined using a combination of models that build on each other. Thus, the Regional Flood Frequency Estimation (RFFE) model (University of Western Sydney) provides representative runoff rates to calibrate the RORB model in the absence of local gauged data. The RORB model generates likely flow conditions for designated drainage lines which are fed in to the HEC-RAS model together with local site information (e.g. land cover) to calculate water level conditions and hence potential for flooding as defined by over-banking under specific rainfall conditions.

3.4 Environmental constraints assessment

The environmental constraints assessment utilised the site conceptual model as well as various other data sources to identify potential areas of concern or limitations to be considered. Constraints that were examined included water quality, water quantity, groundwater flows and flood behaviour. Constraints were categorised according to risk and gaps in the available data requiring further investigation were identified.

4 Existing environment

4.1 Site conceptualisation

Church Creek is a third order watercourse within the Project Site marked on the LEP Riparian and Watercourses Map, that crosses the site from the south to the west (**Figure 4-2**). The creek receives discharge from several smaller tributaries, and the flow direction is to the north-west. There are a number of other smaller non-defined overland flow paths that cross the site from culverts under the roads that border the site.

Two other unnamed first and second order water courses have also been mapped from the local contour maps as feeding into Church Creek (shown in **Figure C-1** in Appendix C) however it is unclear if these watercourses actually exist or if they meet the definition of a river under the WM Act. Further site survey and Top of Bank mapping would be required to confirm which watercourses within the subject lots meet the definition of a river under the Act.

The Guidelines for Riparian Corridors on Waterfront Land (DPI Water) recommends Vegetated Riparian Zones (VRZs) have a width based on watercourse order as classified under the Strahler System. The width of the VRZ should be measured from the top of highest bank on both sides of the water course. **Table 4-1** below lists DPI Water recommended riparian corridor (RC) widths based on Strahler Stream Order.

Table 4-1: Recommended riparian corridor (RC) widths

Watercourse type	VRZ width	Total RC width
1st order	10 metres	20 m + channel width
2nd order	20 metres	40 m + channel width
3rd order	30 metres	60 m + channel width
4th order and greater	40 metres	80 m + channel width

A review of the NSW Office of Water (NOW) surface water database identified no registered stream flow monitoring gauges near the site, with the closest stream gauge (# 410770) located on the Queanbeyan River at the ACT border (approximately 12.5 km north of the Project site).

Groundwater flow dynamics in the study area are also not fully delineated as no active monitoring bores could be identified in or around the study area to allow for monitoring of groundwater levels. However, there is an old well located on the site that may have been used as a water source in the past.

Aspects of this conceptualisation are discussed in greater detail in the sections below.

4.1.1 Climate

Rainfall and temperature data was obtained from the Bureau of Meteorology (BoM) online climate database for the Tuggeranong (Isabella Plains) AWS (BoM site 070339) located approximately 10.2 km west of the study area. The regional climate is categorised as cool temperate, with year-round rainfall (average annual rainfall 631.3 mm) with a seasonal distribution showing greater rainfall in the summer months (**Figure 4-1**). Mean maximum temperatures range from 11.8 °C in July to 29 °C in January (**Figure 4-1**).

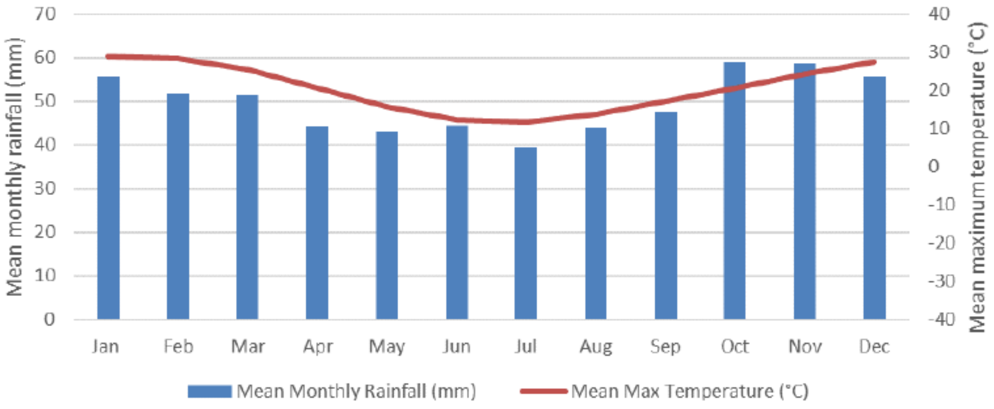

Figure 4-1: Monthly rainfall and temperature near the study area

4.1.2 Hydrology

The study area falls within the Murrumbidgee catchment (**Figure 4-2**). The Church Creek passes through the southern portion of the site in a south-east to north-west direction that drains local farmland (and a soon to be constructed housing development (**Figure 4-2**).

Sheet flow from surface water run off during rainfall events may potentially cause impacts in isolated areas and may enhance local recharge to any perched water tables.

4.1.1 Regional geology

The regional geological setting of the property is shown in **Figure 4-3**. The study area is located within a complex structural corridor within rock sequences of Silurian age, regionally described as the Canberra Graben. This structural feature is bounded to the west by the Murrumbidgee Batholith, comprised of granodioritic intrusives, and to the east by the Cullarin Horst, a complex geological province represented by deformed Ordovician-aged sediments intruded by granites (HGC, 2001).

The 1:100,000 Canberra Geology map indicates that the site is located mostly on the Colinton Volcanics bedrock, with a small part south of the study area located on the Williamsdale Volcanics. Two faults separate the Colinton Volcanics from the Deakins Volcanics approximately 3.5 km west and from Cappanana formation approximately 4 km east of the study area.

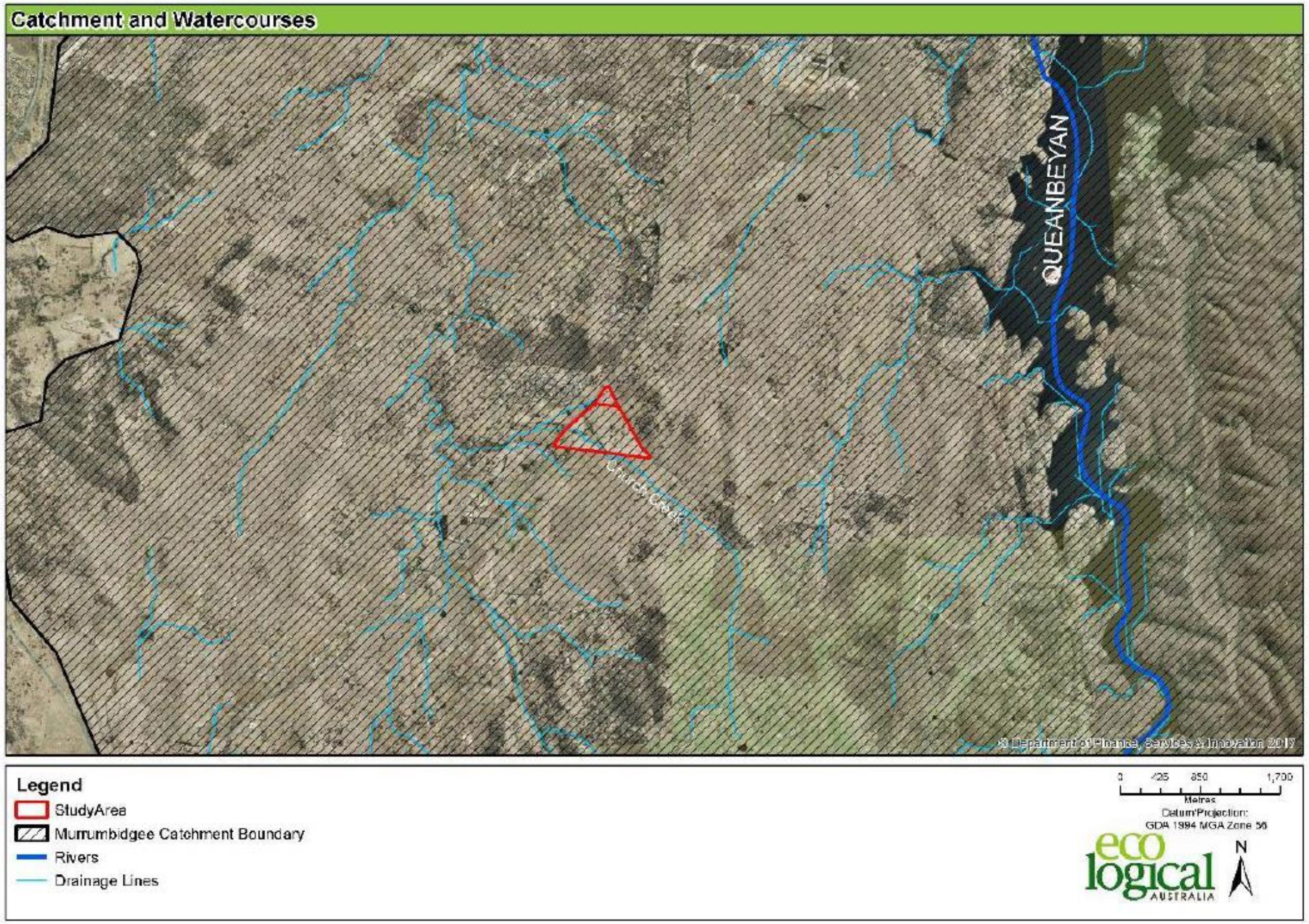

Figure 4-2:Catchment and watercourses in the study area

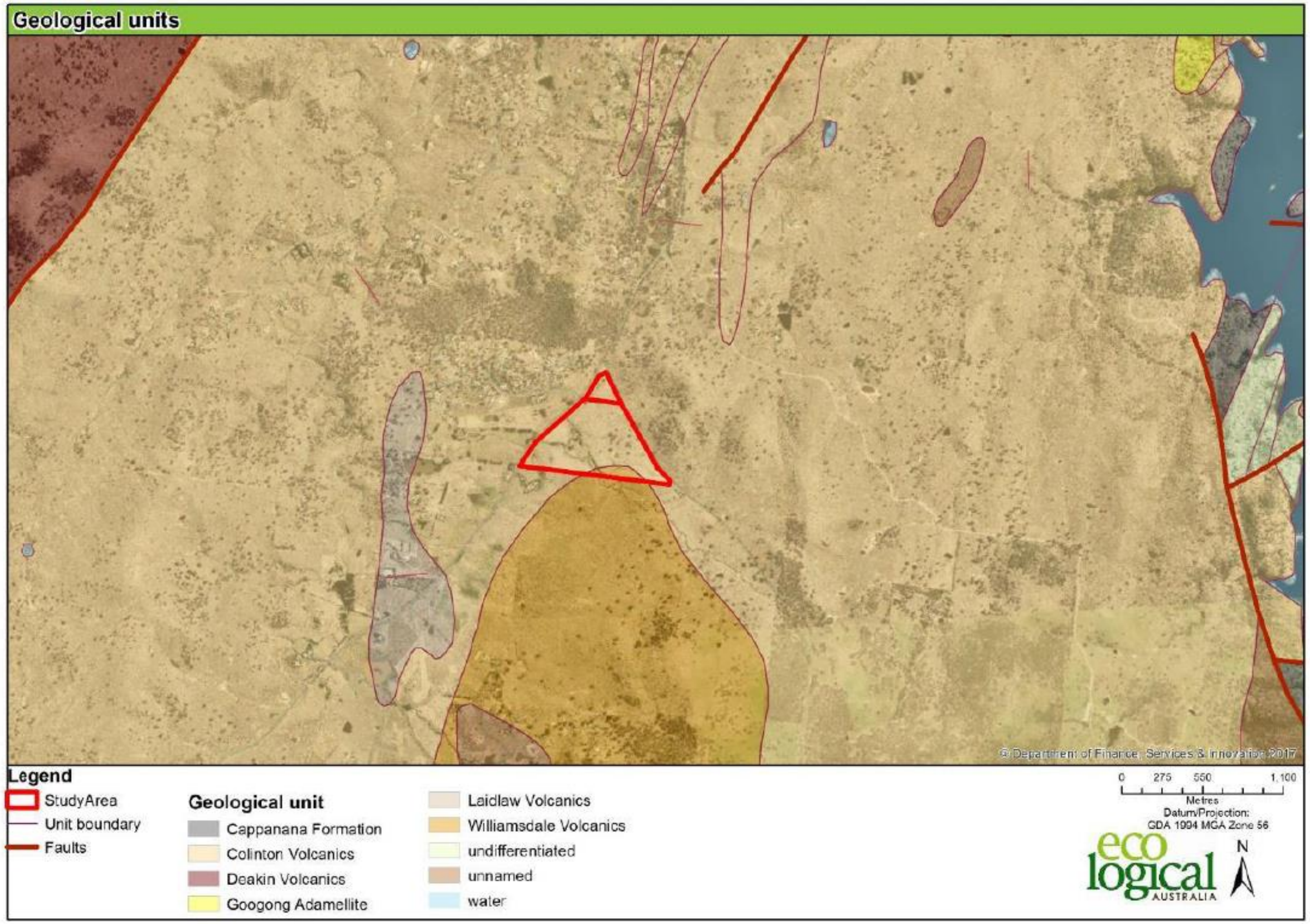

Figure 4-3: Geological units

4.1.2 Subsurface soil profile

The subsurface conditions near the study site was investigated via ten auger holes (ACT Geotechnical Engineers, 2017) and is summarized in **Table 4-2**, below.

Table 4-2: Generalised soil and sub-soil conditions at the site (ACT Geotechnical Engineers, 2017)

Geological profile	Typical Depth Interval	Description
Topsoil	0 m to between 0.1m and 0.2m	SILTY SAND; fine to coarse sand, low plasticity silt, brown, some grass roots, dry to moist, loose.
Slopewash	Between 0.1m and 0.2m to between 0.4m and 0.6m	SILTY SAND; fine to medium sand, low plasticity silt, pale grey-brown, dry to moist, medium dense.
Alluvial/ Residual Soil	Between 0.1mto 0.6 m to between 0.3m and >3.5m	SILTY SANDY CLAY, SILTY CLAYEY SAND, & SANDY CLAY; fine to coarse sand, low to medium and some medium to high plasticity clay, red-brown, orange-brown, brown, grey, dry to moist and moist, stiff to very stiff and dense.
Bedrock	Typically, from 0.2 to 1 m and below	DACITE; fine to coarse grained, orange brown, grey, highly weathered (HW) and weak rock grading to moderately weathered (MW) and medium strong rock.

4.1.3 Hydrogeology

Interrogation of the NOW online groundwater database and the BoM Groundwater Explorer database identified 38 registered groundwater bores within approximately 2 km of the project area, with only two of the 38 bores located within the project area as shown in **Figure 4-4**. No water level/quality data for these bores were available in the NOW PINNEENA database. The five registered bores within (or within 200m of) the project boundary were all drilled in the 1950s and are unlikely to be functioning today. All other bores were drilled since 1986 for stock and domestic use (29 for household use; two for stock use and two of unknown use). As such, there is no requirement for these bores to monitor or report level or quality information, though property owners may have this information.

A summary of registration details for these bores is provided in **Appendix A.** Thirty-four of the 38 bores were drilled to about 20 m or deeper, giving good evidence that local groundwaters are deep and in the fractured rock aquifers. The lithology of two of the shallow bores is not provided and these likely represent perched lenses in the weathered regolith as the other two shallow bores are reportedly completed in clay.

Groundwater in the area is expected to be associated with fractures within bedrock and contained within joints, fractures, faults and fissures in the rock mass (HGC, 2001). The closest fault observed was approximately 1.5 km north of the study area (**Figure 4-3**). A recent geotechnical investigation at this site (ACT Geotechnical Engineers, 2017) augered ten holes to a maximum depth of 3.5 m within the project area (**Figure 4-5**). No groundwater was encountered in any of the augered holes, with the soils mostly dry to moist. Temporary, perched seepages might be expected following rainfall within the more pervious soils in the southern area, with shallow hard rock encountered in the north (**Figure 4-5**).

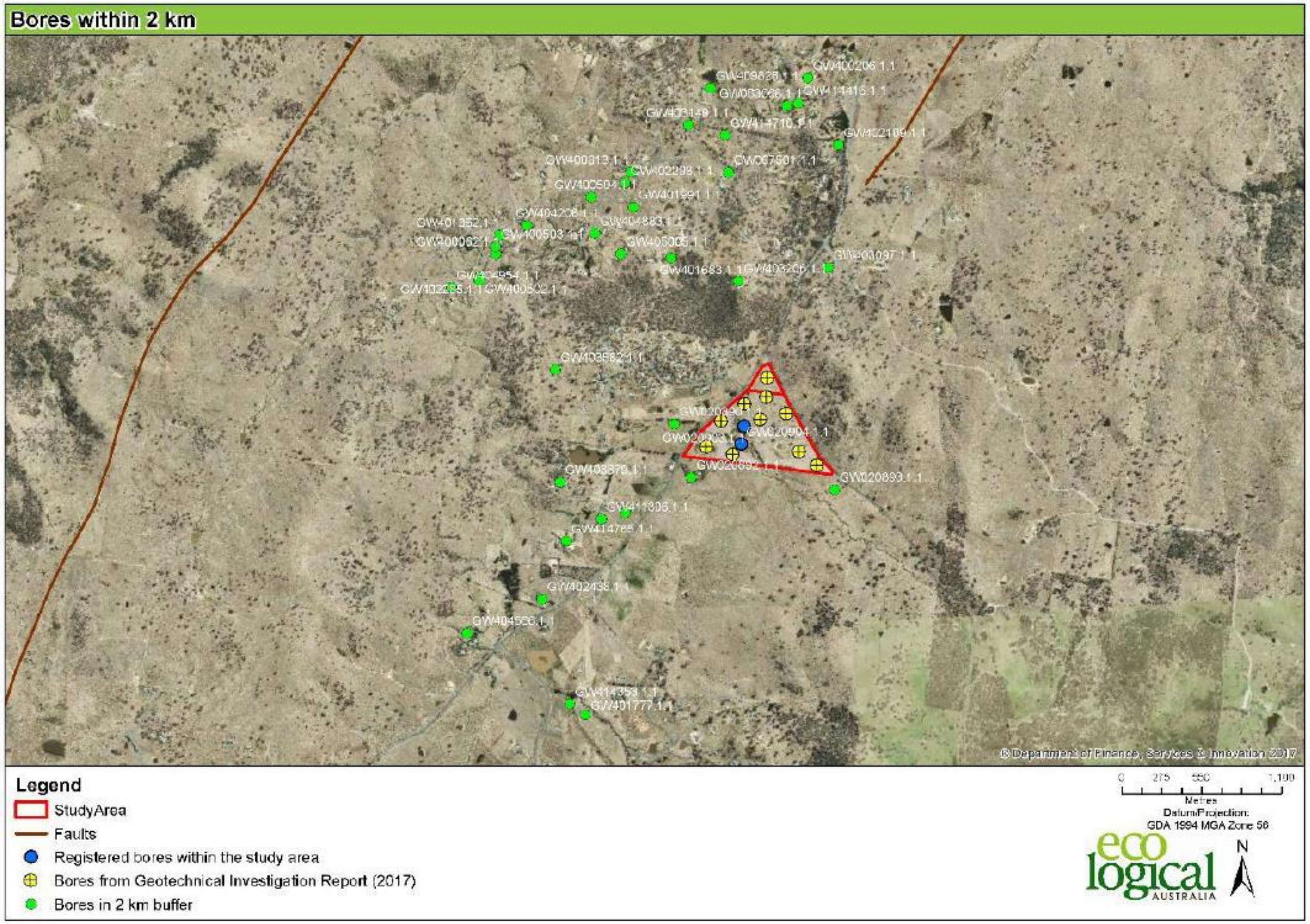

Figure 4-4: Groundwater bores around the study area

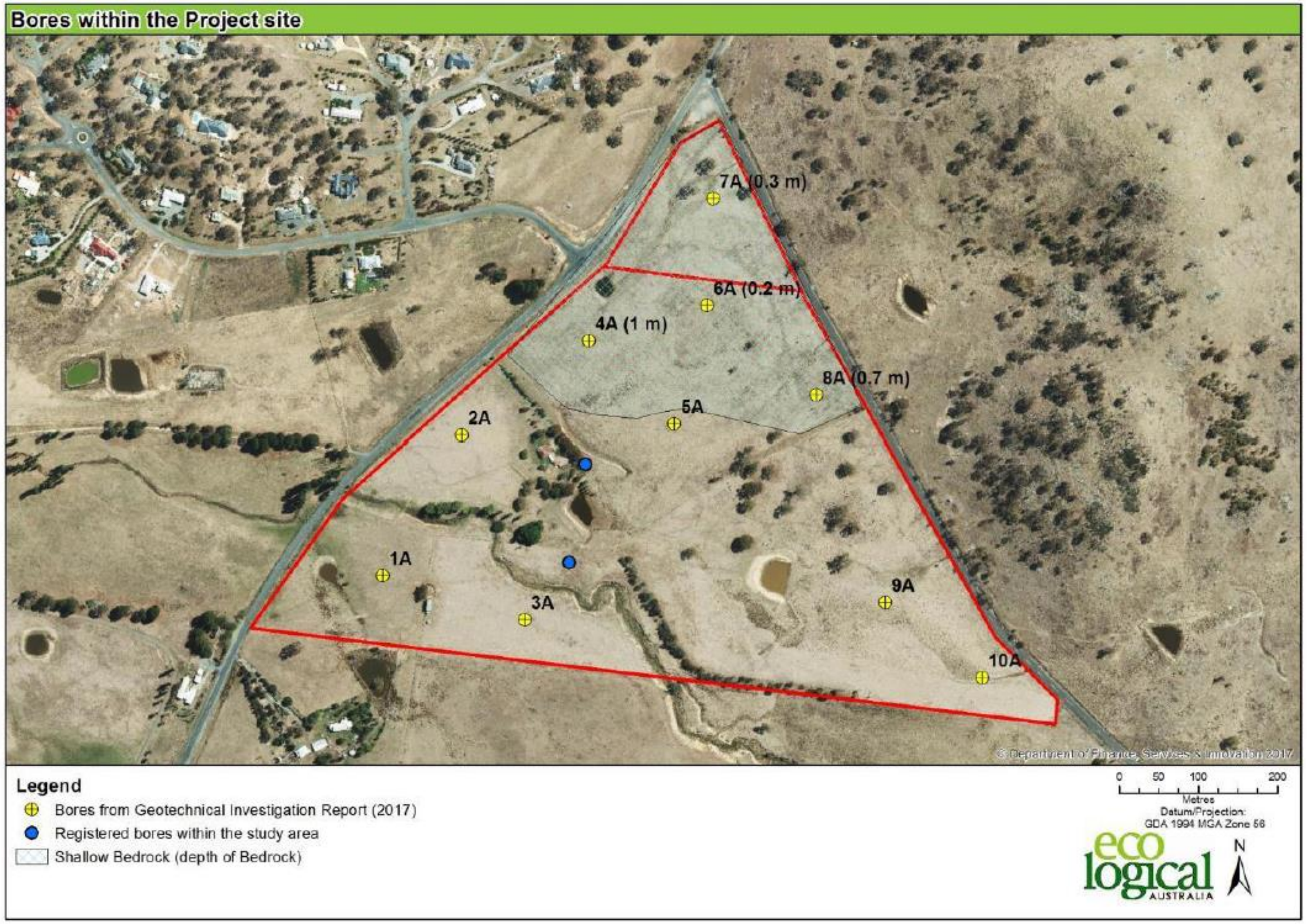

Figure 4-5: Groundwater bores within the project area.

Table 4-3: Summary information for geotechnical holes within the project area (*after* ACT Geotechnical Engineers, 2017)

Bore ID	Logging Date	Soil Type	Moisture status	Excavation depth (m)	Water encountered	Geological profile (at 3.5 m)
1A	6/04/2017	Silty sand/silty sandy clay/ clayey sand	dry to moist at 2 m depth below ground, moist at 3 m below ground	3.5	No	Alluvium
2A	6/04/2017	Silty sand/silty sandy clay/ silty clayey sand	dry to moist at 1 m depth below ground, moist at 1.4 m below ground	3.5	No	Alluvium
3A	6/04/2017	Silty sand/ sandy clay	dry to moist at 1 m depth below ground, moist at 2.5 m below ground	3.5	No	Alluvium
4A	6/04/2017	Silty sand/ sandy clay	dry	Excavation terminated at 1.5 m (medium strong rock)	No	Bedrock
5A	6/04/2017	Silty sand/ sandy clay/ silty sandy clay	dry at 0.4 m depth below ground, dry to moist at 3-3.5 m	3.5	No	Alluvium
6A	6/04/2017	Silty sand	dry	Excavation terminated at 0.3 m (medium strong rock)	No	Bedrock
7A	6/04/2017	Silty sand/ silty sandy clay	dry	Excavation terminated at 0.6 m (medium strong rock)	No	Bedrock
8A	6/04/2017	Silty sand/ sandy clay	dry	Excavation terminated at 1.3 m (medium strong rock)	No	Bedrock
9A	6/04/2017	Silty sand/silty sandy clay/ sandy clay/ clayey sand	dry to moist at 1-2 m below ground, moist to wet at 2-3.5 m below ground	3.5	No	Alluvium
10A	6/04/2017	Silty sand/clayey sand/silty sandy clay/ sandy clay	dry to moist at 1.5-22 m below ground, moist at 2-3.5 m below ground	3.5	No	Alluvium

4.1.4 Water chemistry

No salinity data was recorded from the 38 registered bores located within 2 km distance of the study area. A previous study at Old Cooma Road (HGC, 2001), located approximately 3 km south-west of the project area, reported that the likely total salinity is expected to be in the range of 500-800 mg/L, with elevated bicarbonate and total hardness in the range of 300-500 mg/L. The significant number of local stock and domestic bores suggests that deeper, fractured rock, aquifers provide water of reasonable quality.

4.1.5 Groundwater Dependent Ecosystems (GDEs)

No potentially significant GDEs could be identified within a 2 km buffer around the site based on a high level, desk-top assessment of available data (**Figure 4-6**).

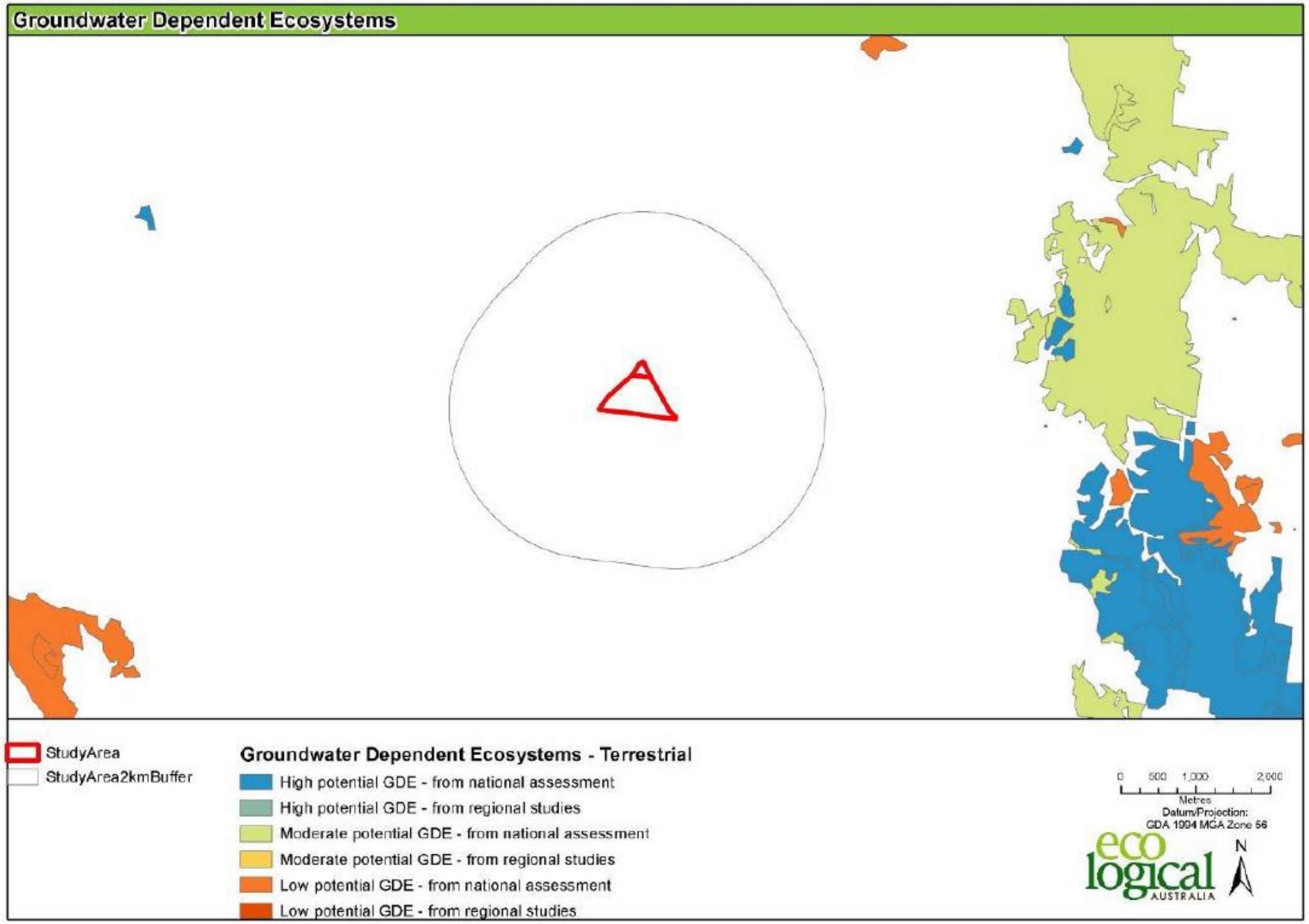

Figure 4-6: Groundwater Dependent Ecosystem map

5 Hydrological and Hydraulic modelling

5.1 Flooding assessment

For the purposes of identifying the flood conditions for the site, only catchments that drained to the defined Church Creek waterway were modelled. Catchments were delineated using available terrain mapping with resolutions ranging from 1-metre to 5-metres.

To categorise the existing design flood conditions from Church Creek at the site, the use of regionalised flood models was required as no appropriate water level or flow information exists in or near the catchment of interest. The flood volumes and levels were determined by the Regional Flood Frequency Estimation (RFFE) model (University of Western Sydney), RORB (Monash University and Hydrology and Risk Consulting) and Hydrologic Engineering Centre's River Analysis System (HEC-RAS) (U.S. Army Corps of Engineers) programs, which calculate flow and water level conditions.

The RFFE model was parameterised using GIS datasets. The model was used to determine representative runoff rates to calibrate the RORB model in the absence of local gauged data. The RORB model was parameterised using GIS datasets, Bureau of Meteorology's Intensity-Frequency-Duration (IFD) information, the Australian Rainfall and Runoff (2016) data hub and the RFFE outputs. The HEC-RAS model was parameterised using GIS datasets, RORB model outputs and local site information (e.g. land cover).

Event durations from 10 minutes to 7 days were run through the RORB model to determine the critical flood duration and volume for the 10% Annual Exceedance Probability (AEP), 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and 0.1% AEP events. AEP is defined as the likelihood (e.g. 1%) each year that a flood of a particular magnitude will be exceeded. The AEP may be directly compared to the Average Recurrence Interval (ARI) which reports the probability (e.g. 1 in 100 year) that a flood of a particular magnitude will be exceeded. The AEP and ARI are two ways of expressing the same information (i.e. the 1% AEP is essentially equivalent to the 1 in 100 ARI) and they are approximately the inverse of each other (1/100-year ARI ≈ 1% AEP). As it is statistically feasible to have multiple ARI events within the designated interval, the ARI has fallen out of favour in deference to reporting the AEP for a given location.

As the AEP numbers become smaller the magnitude of the flows increases to a maximum flow which designates the probable maximum flood (PMF). The PMF is generally only used as a design criterium for dam construction and structures that should not get flooded (e.g. electrical sub stations) with a risk level based on a specific AEP (generally 1% – or an ARI equivalent of 1 in 100 years) is commonly used for flood assessment purposes.

The critical event duration (the event with the highest peak flow) for the study catchment was 6 or 12 hours, depending on the AEP event examined. The peak flows from these events are outlined in at the downstream end of the RORB model (as shown in **Figure B-3** in Appendix B). Please note that unless a specific catchment (relating to the RORB model) or chainage (reported in the HEC-RAS model) location is specified, all table results in this document refer to the downstream end of these catchments.

Table 5-1: Peak flows for existing conditions

AEP (%)	Catchment Peak flow (m^3/s)

10%	7.064
5%	10.722
2%	15.407
1%	18.879
0.5%	22.081
0.2%	27.069
0.1%	32.230

The flows for the relevant sub-catchments were used as inputs to the HEC-RAS model. The water levels within Church Creek adjacent to the existing dwelling for selected peak flow events are shown in **Table 5-2**. The depths are the depth of water from the surface to the lowest point in the cross section.

Table 5-2: Peak water levels for existing conditions

AEP (%)	Catchment Water Depths (m)
5%	1.34
2%	1.46
1%	1.53
0.1%	1.75

The results show that it is likely that with the exception of the area immediately upstream of Old Cooma Road, flow events up to the 1% AEP event would be contained within the banks; for some sections, larger events up to the 0.1% AEP would be contained.

It should also be noted that the RORB and HEC-RAS modelling relies on the accuracy of the existing DEM and any available stream bathymetry of the mapped creeks shown in **Figure B-3** in Appendix B).

Figure 5-1 to Error! Reference source not found. show the inundation extents for indicated AEP (labelled as corresponding ARIs in the model).

5.1.1 Implications of results for the Proposed Development

Modelling results indicate that flooding from Church Creek is unlikely to expand widely across the property and is therefore likely to have a limited to no impact on the use of the property as a cemetery.

It is recommended that monitoring of future flood levels is conducted to allow calibration of predicted rainfall-runoff relationships and flood levels.

Figure 5-1: Maximum flood extents for the 5% AEP event

Figure 5-2: Maximum flood extents for the 2% AEP event

Figure 5-3: Maximum flood extents for the 1% AEP event

Figure 5-4: Maximum flood extents for the 0.1% AEP event

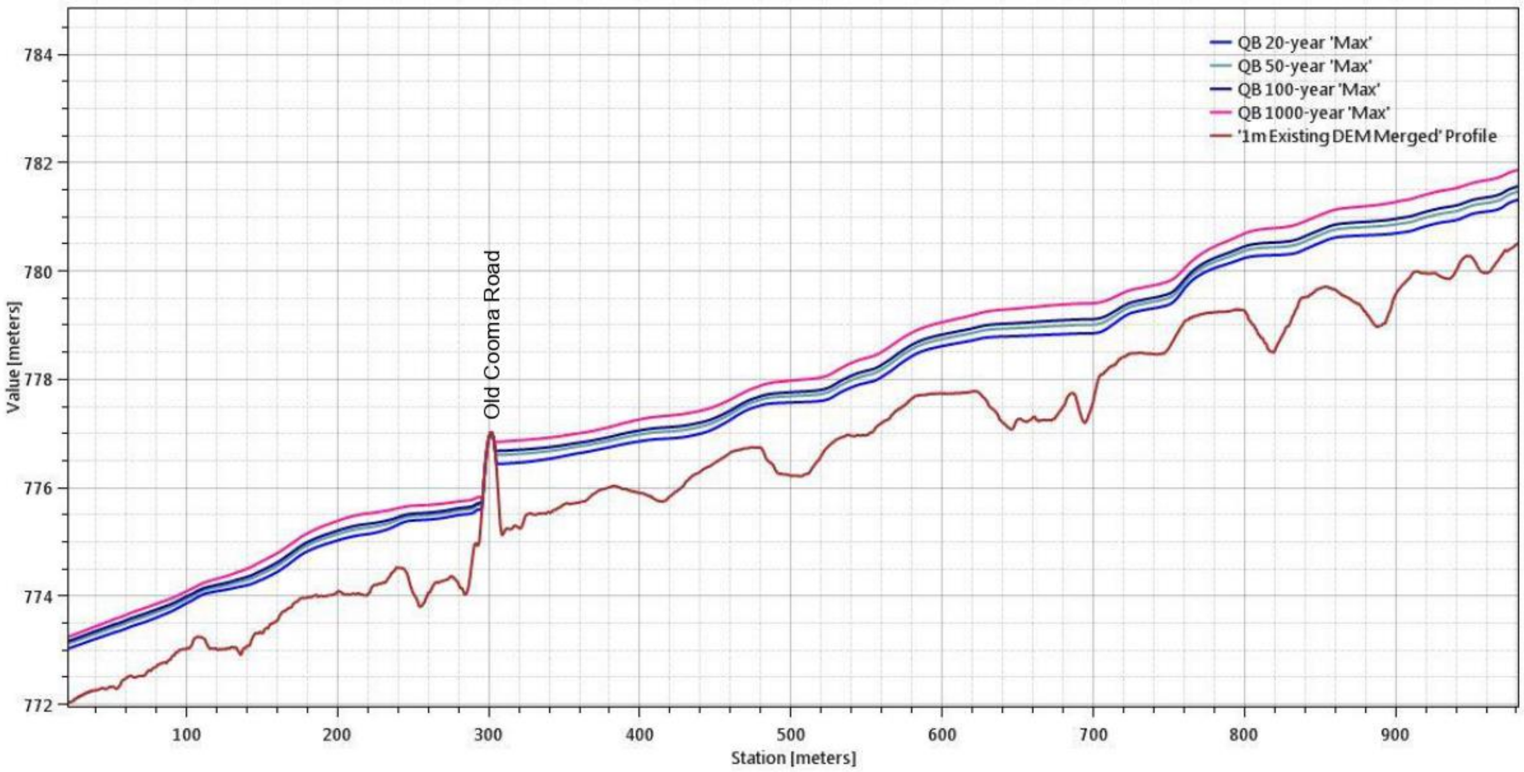

Figure 5-5: Water surface elevation profile for the 5%, 2%, 1% and 0.1% events

6 Constraints assessment

6.1 Hydrology

The hydrology constraints assessment assesses whether the proposed development has the potential to alter existing surface water flow patterns, affect drainage capacity and modify the existing flood regime. Any alteration of surface permeability has the potential to increase peak surface water flows, sheet flow and runoff volumes.

Table 6-1: Hydrology Constraint 1

Item	**Description**
Issue	*Flooding from Church Creek* Flood waters from the Church Creek have the potential to inundate the site. This would only occur during high flow events.
Map/Figure	**Figure 5-1** to Error! Reference source not found.
Assessment of Issue	**Figure 5-4** to Error! Reference source not found. show cross-sections f rom HEC-RAS models with potential water levels above the banks at the downstream end. Potential flooding under extreme (<1% AEP) events may occur downstream of cross section 7. Provided key infrastructure is set back from the creek this should not cause an issue.
Mitigation option(s)	Once modelling has occurred with detailed survey data, some mitigation options may need to be considered, though would be expected to be minor in nature (e.g. earthworks to form levees).
Final design consideration	To be confirmed based on revised modelling.

Table 6-2: Hydrology Constraint 2

Item	**Description**
Issue	*Drainage through site* The alteration of the land use of the site will require existing culvert drainage onto the property to be controlled and diverted through the site. This would be combined with the drainage within the site that would need to be managed and controlled through to Church Creek.
Map/Figure	Figure B-3 in Appendix B
Assessment of Issue	It is expected that adequate surface drainage features would be constructed to manage surface water.

Mitigation option(s)	Appropriately designed stormwater infrastructure
Final design consideration	As above.

Table 6-3: Hydrology Constraint 3

Item	Description
Issue	*Water quality / Erosion* The potential for surface water flows to interact with the proposed construction of the cemetery along with its operational activities poses a potential risk that water quality through increased erosion or pollution from chemicals including hydrocarbons. Church Creek is also an erosive stream that over time may change its course due to erosion from flows down the channel.
Map/Figure	Examples of erosion within Church Creek are presented in **Figure 6-1** and **Figure 6-2**.
Assessment of Issue	It is expected that drainage and diversion infrastructure within the site would capture, store and/or discharge surface water appropriately to minimise its impact on Church Creek. The banks within Church Creek may need to be armoured to protect the surrounding site from encroachment from the Creek. Any alterations within the creek would need to manage any impact to existing (or potential) Aboriginal artefacts within and on the banks of the creek.
Mitigation option(s)	Appropriately designed stormwater infrastructure and armouring of creek banks.
Final design consideration	As above.

Figure 6-1: Example 1 of erosion within Church Creek

Figure 6-2: Example 2 of erosion within Church Creek

6.2 **Hydrogeology**

The hydrogeology constraints assessment assesses whether the proposed development has the potential to impact groundwater in the area. Potential hydrogeological constraints are identified in the following tables and these are followed by an assessment against the minimal impact criteria of the NSW Aquifer Interference Policy.

Table 6-4: Hydrogeology Constraint 1

Item	**Description**
Issue	*Absence of groundwater quality data* An investigation on the NOW PINNEENA online groundwater database and the BoM Groundwater Explorer database showed no available groundwater level and quality data for the thirty-eight registered bores identified within 2 km distance of the study area.
Map/Figure	**Figure 4-4**
Assessment of Issue	A high level / qualified assessment of available online databases could not identify water quality/ water level data from the registered bores within the study area. Available information on bore construction, however, indicates that groundwater levels are deep (>20m) and unlikely to impact on the site. Shallow auger holes (to 3.5m) did not encounter groundwater, indicating dry conditions at least to this depth.
Mitigation option(s)	Conduct sampling rounds for water quality assessments/ water level measurements to validate information cited from previous studies in this area (e.g., HCG, 2001, ACT Geotechnical Engineers, 2017.)
Final design consideration	N/A

Table 6-5: Hydrogeology Constraint 2

Item	**Description**
Issue	*Potential groundwater contamination due to increased recharge* Potential groundwater contamination due to water entering the water table from the grave sites.
Map/Figure	N/A
Assessment of Issue	Surface water flow or sheet flow during a high rainfall event can increase recharge to shallow perched groundwater sources. Increased recharge is likely to result in localised water-level rise and has the potential to enter grave sites which can create potential groundwater contamination issues.

Item	Description
	Existing information suggests this not to be an issue, but it is recommended to undertake groundwater monitoring at the site to monitor local conditions.
Mitigation option(s)	Appropriately designed stormwater infrastructure and groundwater monitoring bores.
Final design consideration	N/A

Table 6-6: Hydrogeology Constraint 3

Item	Description
Issue	*Reduction of groundwater quantity to impact Groundwater Dependent Ecosystems (GDEs).* Lowering of the groundwater table, and/or disruption of groundwater flow to GDEs if groundwater dewatering is required at any excavated areas (including grave sites), could have the potential to impact on ecosystems. Areas of high groundwater risk may indicate areas of high environmental sensitivity.
Map/Figure	N/A
Assessment of Issue	A high level / qualified assessment of potential GDE occurrence has been made using data from the BoM GDE Atlas (2017). Data suggests that there are no likely aquatic/ terrestrial GDEs present within the study area. There are no water level data observed in the registered bores within the study area to assess the potential for any possible terrestrial vegetation species to be accessing groundwater. A recent study did not encounter groundwater to 3.5 m deep in bores dug in different locations within the study area and the soils were mostly dry to moist (ACT Geotechnical Engineers, 2017). It may be considered that the terrestrial vegetation in the Site is unlikely to be dependent on groundwater to maintain ecosystem health.
Mitigation option(s)	Establish regional baseline groundwater level dataset that includes seasonal variation to confirm depths to groundwater, and whether dewatering is likely to be necessary.
Final design consideration	N/A

Table 6-7: Hydrogeology Constraint 4

Item	Description
Issue	<u>*Salinisation/contamination of groundwater*</u> Impediment of shallow groundwater flow may result in elevation of groundwater tables and transport of salt to the soil zone, inducing salinisation and scalding at the surface. Construction activities (including grave excavations) and interaction of groundwater with the occupied grave sites may result in deterioration of groundwater quality and areas with high environmental sensitivity.
Map/Figure	N/A
Assessment of Issue	The proposed interments will be to a maximum depth of 3.5 m (quadruple occupation). Since groundwater was not encountered within 3.5 m of the local ground surface, the impacts on groundwater of these activities are likely to be minimal.
Mitigation option(s)	Install two monitoring bores to establish baseline groundwater level or quality dataset that includes seasonal variation to confirm depths to groundwater, flow directions and water quality. Minimise interaction with groundwater during construction activities.
Final design consideration	N/A

6.2.1 Aquifer Interference Policy

A preliminary assessment of the proposed activities against the 'minimal impact considerations' outlined in the AIP suggests the local groundwater level (>3.5 metres below ground level) is unlikely to be significantly impacted during construction and operational activities and hence no impacts to groundwater level or quality are anticipated. No impacts are therefore expected under the Water Management Act 2000 to existing groundwater users, including groundwater dependent ecosystems.

Our assessment therefore conservatively considers potential impacts to the Lachlan Fold Belt MDB Groundwater Source falls within the Level 1 impact considerations as defined in **Table 2-1**.

As minimal hydrogeological data (specifically groundwater level and quality) is available for the site and the surrounding area, these findings are indicative only and require on-ground assessment and validation through hydrogeological and geotechnical studies at the site and within the regional area to better assess the potential threats to groundwater. As a minimum, the assessments should consist of an updated survey of groundwater levels and sampling at the existing bores identified within the study area (**Figure 4-4**) to establish a baseline dataset. Collection of the monitoring data should be undertaken to capture changes due to seasonal variation.

7 Recommendations

The following recommendations are made in relation to hydrology, hydrogeology, water quality, and flooding, to better inform the project:

- Hydraulic modelling should be updated based on future observations of flood levels
- A climate change assessment of the hydrological aspects in the project area might be undertaken based on Australian Rainfall and Runoff guidelines
- Further data and information on groundwater and potential GDEs in the study area should be collected through a census of the groundwater bores, installation of shallow piezometers (if data from the census suggests groundwater levels may be an issue) and a site-specific survey to verify the presence of any terrestrial GDEs.

8 References

ACT Geotechnical Engineers. 2017. *Geotechnical Investigation Report,* ACT Geotechnical Engineers Pty Ltd.

HGC 2001. *Groundwater investigation, Proposed Beatty Hill subdivision, Old Cooma Road, Williamsdale area.* Hydroilex Geotechnical Consultants.

QPRC 2012. *Planning Proposal for Cemetery and Crematorium, Lot 2 DP 112382 and Lot 126 DP 754881.* Queanbeyan-Palerang Regional Council.

SRLE, 2015. *Rural Residential Subdivision, Burra Road, Mount Pleasant: Flood Analysis and Concept Culvert Design*, Southern Region Land Engineering.

WSP 2012. *Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources.*

Appendix A Registered groundwater bore details

Hydro Code	Latitude	Longitude	Easting	Northing	Ref Elevation (mAHD)	Bore Depth (m)	Drilled Depth (m)	Drilled Date	Major Lithology	Lithological description	Function Type
GW400062.1.1	-35.442476	149.189309	698713	6075684	756	90	90	4/02/1992	DCIT	Dacite	Household Use
GW020893.1.1	-35.457886	149.214262	700940	6073924	793.14	0	13.7	1/10/1952	CLAY	Clay yellow	Unknown
GW020903.1.1	-35.453719	149.207595	700345	6074400	782.08	0	7.9	1/01/1953	CLAY	Clay yellow some sand	Stock water
GW020890.1.1	-35.453442	149.202317	699866	6074441	776.15	19.8	19.8	1/10/1952	PRPR	Porphyry water supply	Unknown
GW067501.1.1	-35.437996	149.207135	700342	6076145	789.09	42	42	12/10/1989	GRNT	Black granite	Household Use
GW400206.1.1	-35.43233	149.213428	700927	6076761	778.12	39.6	39.6	28/04/1997	None	Soft shale.	Household Use
GW401352.1.1	-35.441325	149.189609	698743	6075811	756.63	78	78	31/12/1991	SLTE	Slate, soft	Household Use
GW401068.1.1	-35.458808	149.198345	699493	6073854	775.49	36	36	21/10/1999	BRKN	Broken brown shale	Household Use
GW400503.1.1	-35.442026	149.189296	698713	6075734	758.72	60.8	60.8	28/11/1994	None	Topsoil	Unknown
GW400504.1.1	-35.439188	149.196655	699388	6076034	735.8	60.8	60.8	5/12/1994	DCIT	Dacite	Household Use
GW400813.1.1	-35.437753	149.199745	699672	6076187	759.01	54	54	22/04/1998	HDBD	Hard grey black granite	Household Use
GW401683.1.1	-35.443137	149.202545	699913	6075584	788.92	121	121	23/05/2001	GRNT	Granite, broken	Household Use
GW401777.1.1	-35.471224	149.194716	699133	6072484	784.25	84	84	20/08/2001	SHLE	Shale, highly weathered yellow	Household Use
GW402438.1.1	-35.463971	149.19178	698884	6073295	776.22	75	75	26/05/2003	TPSL	Topsoil, and clay	Household Use
GW402285.1.1	-35.443879	149.188005	698591	6075531	738.38	66	66	18/12/2002	DCIT	Dacite	Household Use
GW020904.1.1	-35.45483	149.207317	700317	6074277	780.21	19.8	19.8	1/02/1953	PRPR	Porphyry decomposed	Stock water
GW402298.1.1	-35.438405	149.199269	699627	6076116	752.54	85	85	24/03/2003	SHLE	Shale, soft yellow	Household Use
GW401991.1.1	-35.439906	149.199848	699676	6075948	753.75	48	48	5/02/1992	DCIT	Dacite	Stock water
GW063668.1.1	-35.433997	149.211761	700772	6076579	773.01	22.9	22.9	1/09/1986	GRNT	Granite soft bands water supply	Household Use
GW020892.1.1	-35.456775	149.203428	699959	6074069	780.38	20.4	20.4	1/11/1952	CLAY	Clay yellow	Unknown
GW402109.1.1	-35.436553	149.215528	701108	6076288	789.63	23	23	2/12/2002	SHLE	Shale, weathered soft yellow	Household Use
GW400502.1.1	-35.444078	149.187975	698588	6075509	736.75	38	38	23/11/1994	None	Volcanics	Household Use

Hydro Code	Latitude	Longitude	Easting	Northing	Ref Elevation (mAHD)	Bore Depth (m)	Drilled Depth (m)	Drilled Date	Major Lithology	Lithological description	Function Type
GW403097.1.1	-35.444116	149.214394	700986	6075451	808.53	100	100	22/04/2001	TPSL	Topsoil	Household Use
GW403206.1.1	-35.44473	149.207586	700366	6075397	850.52	156	156	13/01/2004	CLAY	Clay	Household Use
GW403582.1.1	-35.449801	149.193442	699070	6074863	756.62	42	42	30/10/2002	SFBD	Soft volcanics	Unknown
GW403149.1.1	-35.43495	149.204271	700090	6076489	773.08	42	42	1/07/2005	SHLE	Shale, brown	Household Use
GW403879.1.1	-35.45677	149.193501	699058	6074090	781.55	71	71	30/10/2006	CLAY	Clay/shale - fine	Household Use
GW404208.1.1	-35.440783	149.191723	698936	6075867	743.04	82	0	7/02/2003	n/a	n/a	Household Use
GW405005.1.1	-35.442774	149.198739	699568	6075632	757.28	66	66	22/09/2008	TPSL	Topsoil	Household Use
GW404566.1.1	-35.465893	149.186025	698357	6073093	775.42	42	0	28/06/1999	n/a	n/a	Household Use
GW404883.1.1	-35.441447	149.196842	699399	6075783	743.22	10	0	1/11/1991	n/a	n/a	Household Use
GW404954.1.1	-35.444451	149.185841	698393	6075472	755.25	102	102	11/12/2008	BSLT	Basalt	Household Use
GW411306.1.1	-35.459158	149.196508	699325	6073819	775.11	36	36	22/04/2010	CLAY	Clay - brown	Stock water
GW409828.1.1	-35.432707	149.206032	700255	6076734	751.92	45	45	20/12/2009	TPSL	Topsoil	Household Use
GW414710.1.1	-35.435691	149.206984	700334	6076401	765.88	60	0	26/11/2002	n/a	n/a	Household Use
GW414353.1.1	-35.470525	149.193577	699031	6072564	783	114	114	11/05/2010	GRNT	Granite, blue	Household Use
GW414415.1.1	-35.433867	149.212607	700849	6076592	778.35	23.5	0	10/09/2010	n/a	n/a	Household Use
GW414765.1.1	-35.460443	149.193788	699075	6073682	775.22	5	0	15/09/2011	n/a	n/a	Household Use

Green shaded bores occur within the project area; orange shaded bores occur within 200 m of the project boundary

Appendix B Technical Hydrological Modelling Details

Water Volume Modelling

This section outlines the flow volume modelling that was undertaken to determine flows into Church Creek that formed the basis for determining water levels from flooding of Church Creek.

Regional Analysis

To provide an estimate of the likely design flow volumes from the catchment the Regional Flood Frequency Estimation (RFFE) model (http://rffe.arr-software.org/) was used. It uses information from nearby similar catchments to provide an estimation of their 6-hour peak durations. The details required for this are:

- Catchment outlet location (latitude and longitude);
- Catchment centroid location (latitude and longitude); and,
- Catchment area.

The results of RFFE model the catchment is shown in **Figure B-1**.

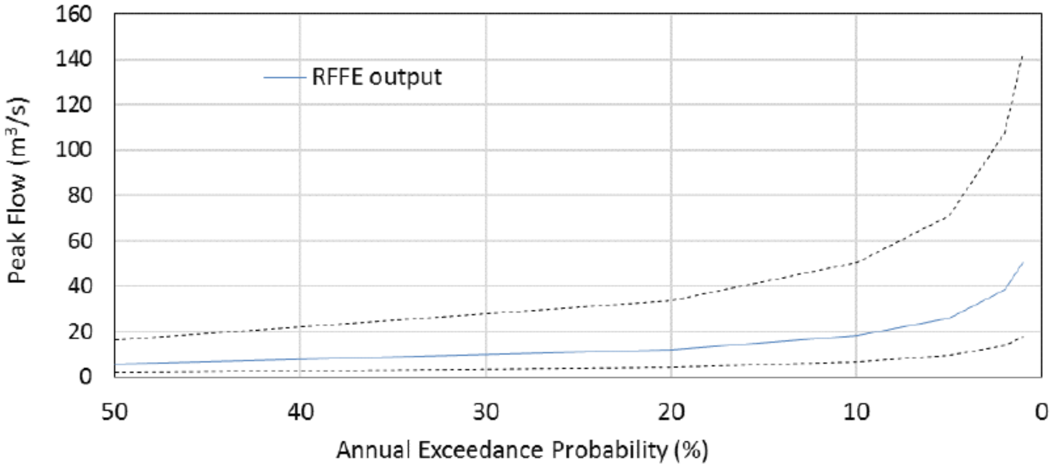

Figure B-1: RFFE 6-hour estimates for the study Catchment (dashed lines representing 5% and 95% confidence intervals).

Sub-catchment delineation

Figure B-2 shows the proposed site and the catchment determined based on the available DEM. The analysis of the proposed site and the DEM determined that the project boundary fell within one watershed region.

For the purposes of RORB modelling the modelled catchment was divided up into 12 sub-catchments. The catchment and link details for the existing that are applied to the RORB catchment file, shown in **Figure B-3**. The catchment characteristics and link parameters for the modelled catchment are shown in **Appendix C**.

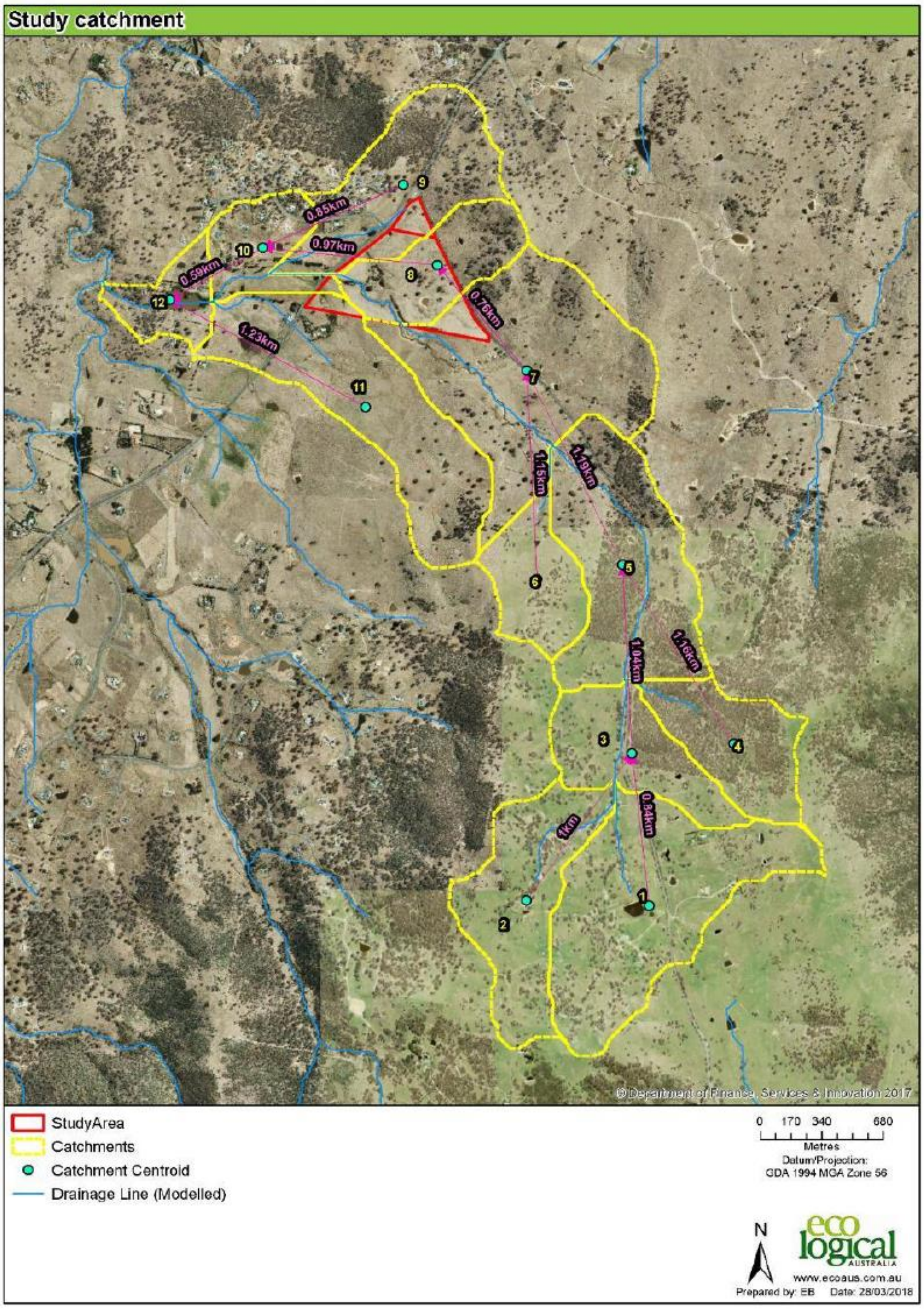

Figure B-2: Study catchments

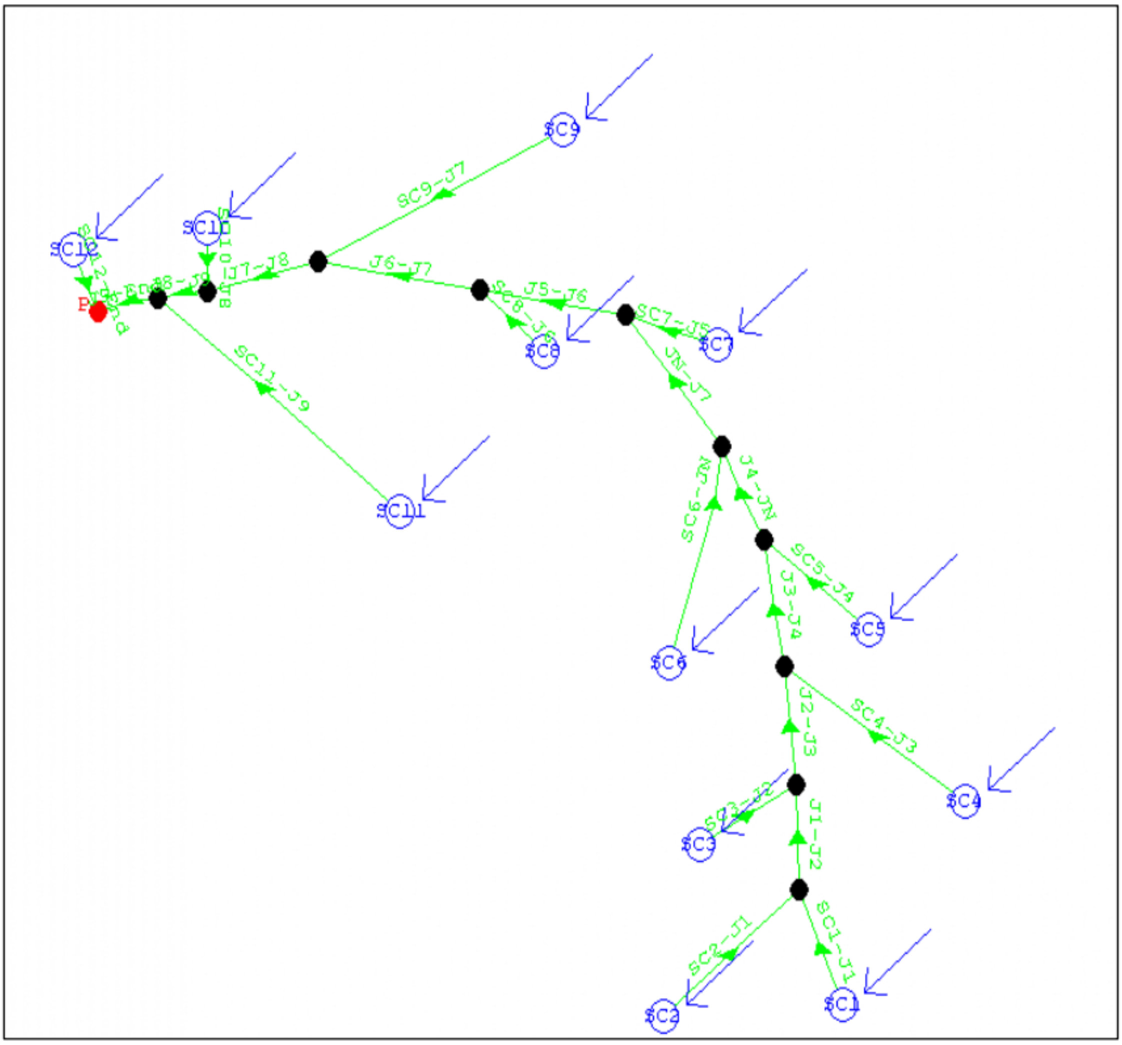

Figure B-3: RORB sub-catchment relationships for the study catchment

Intensity-Frequency-Duration (IFD) Information

The IFD information was sourced for the Site from the 2016 Bureau of Meteorology IFD curves on March 12, 2018 for coordinate 35.453985°S and 149.202299°E and is outlined in Table B-1. Exceedances rarer than the 1% AEP less than 24 hours in duration were not available on the BoM website and were infilled based on a logarithmic regression.

The temporal pattern used for this was sourced from Australian Rainfall and Runoff 2016 and is discussed in the following section, *Australian Rainfall and Runoff Information*.

Table B-1: IFD information for the Project site

Duration	Annual Exceedance Probability Rainfall Depths (mm)										
	63.2%	**50%**	**20%**	**10%**	**5%**	**2%**	**1%**	**0.5%**	**0.2%**	**0.1%**	**0.05%**
1 min	1.61	1.82	2.51	3.02	3.54	4.28	4.88	5.37	6.09	6.63	7.16
2 min	2.74	3.09	4.19	4.94	5.69	6.66	7.4	8.22	9.24	10.01	10.79
3 min	3.75	4.22	5.75	6.81	7.88	9.31	10.4	11.53	12.99	14.09	15.19
4 min	4.63	5.22	7.13	8.5	9.88	11.8	13.3	14.69	16.59	18.02	19.45
5 min	5.4	6.09	8.36	9.99	11.7	14	15.9	17.53	19.82	21.55	23.28
10 min	8.21	9.27	12.8	15.5	18.3	22.2	25.5	28.01	31.78	34.62	37.47
15 min	10.1	11.4	15.8	19.1	22.5	27.4	31.4	34.52	39.16	42.67	46.18
30 min	13.6	15.3	21.2	25.4	29.8	35.8	40.7	44.9	50.82	55.29	59.77
1 hour	17.6	19.8	27	32.1	37.2	44.2	49.7	54.95	61.96	67.27	72.58
2 hour	22.5	25.2	33.8	39.8	45.9	54.1	60.7	66.93	75.26	81.57	87.87
3 hour	26	29	38.6	45.4	52.2	61.8	69.4	76.31	85.77	92.93	100.09
6 hour	33.2	36.8	48.7	57.4	66.5	79.5	90.2	98.57	110.97	120.35	129.73
12 hour	42.1	46.5	61.8	73.5	86.1	104	120	130.3	147.2	159.97	172.75
24 hour	51.6	57.3	77.1	92.8	110	134	154	154	177	210	238
48 hour	60.6	67.8	92.9	113	134	162	185	185	207	240	267
72 hour	65.4	73.5	101	123	146	175	198	198	222	255	282
96 hour	68.8	77.5	107	129	153	183	206	206	232	267	295
120 hour	71.8	80.7	111	134	158	189	213	213	241	278	307
144 hour	74.6	83.7	115	138	162	194	220	220	248	289	321
168 hour	77.4	86.6	118	141	166	200	228	228	255	299	335

Australian Rainfall and Runoff Information

The other information required for setting up the RORB model was sourced from the Australian Rainfall and Runoff (2016) data hub (http://data.arr-software.org) for the same location as for the IFD information. The key information obtained were the temporal patterns and the losses. The division that these parameters are sourced from is the Murray-Darling Basin with the river region being Murrumbidgee River, SE Coast.

For this river region, the initial loss is 22.0 mm and the continuing loss is 5.2 mm/hr. For each temporal pattern duration, 30 patterns were available to be used by RORB. Patterns available for the durations are outlined in **Table B-2**. The shaded durations are durations where IFD information is not available (and therefore were not used in the modelling).

The temporal pattern information was used to provide inputs to the Monte Carlo model run in RORB.

Table B-2: Temporal Pattern Durations from Australian Rainfall and Runoff

Durations			
10 minute	1 hour	9 hour	48 hour
15 minute	1.5 hour	12 hour	72 hour
20 minute	2 hour	18 hour	96 hour
25 minute	3 hour	24 hour	120 hour
30 minute	4.5 hour	30 hour	144 hour
45 minute	6 hour	36 hour	168 hour

Parameter Files

As there are no observed flow data for this catchment, the RORB parameter file was set-up using the "Separate catchment and generated design storm(s)" option. The model operates using a single set of routing parameters for the whole model and an initial loss / continuing loss model. The design rainfall specification used is:

- A user defined IFD (detailed above in **Table B-1**);
- Monte Carlo simulation from 10 minute to 168 hour durations;
- Default time increments of 70;
- Uniform areal pattern; and,
- Constant losses.

The parameter specification is:

- main routing parameter for the overall catchment, k_c of 6.64 to calibrate to RFFE analysis (results shown below);
- dimensionless exponent for non-linear routing, m of 0.8; and,
- Initial loss and continuing loss based on the Australian Rainfall and Runoff values discussed above.

The Monte Carlo simulation details are:

- Number of rainfall divisions: 50 (default);
- Number of samples per division: 20 (default);
- Temporal patterns as described above;
- No pattern censoring; and
- Fixed initial loss.

Calibration Results

The RORB model was calibrated to the RFFE analysis to fit within the confidence limits of the results. This calibration targeted obtaining the best possible fit to the 1% AEP result (closet to best estimate) and be in line with a flood study undertaken for the upstream property (SRLE, 2015). The outcome of this is shown in **Figure B-4** which shows that the 1%, 2%, 5% and 20% AEP results fall within the confidence limits using the recommended k_c value (6.64). Adjusting the k_c value to fit the median RFFE output resulted in too much flow through the system.

The peak flow results from the RORB model for the existing conditions at the Site are shown in **Figure B-5**. **Figure B-6** shows the peak design flow (for existing conditions).

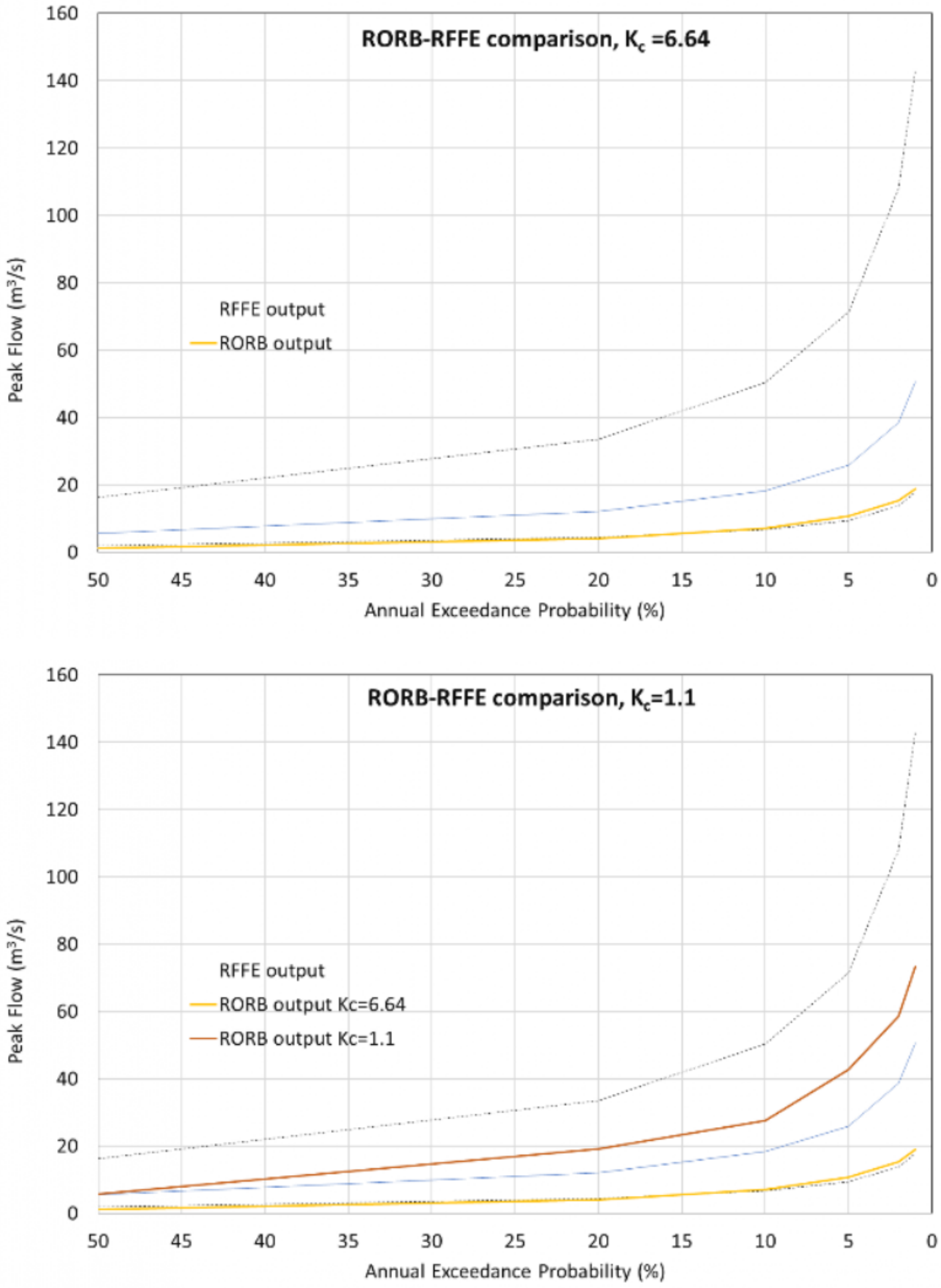

Figure B-4: RFFE – RORB calibration for the study catchment (Top panel, K_c = 6.64 and bottom panel, K_c = 1.1)

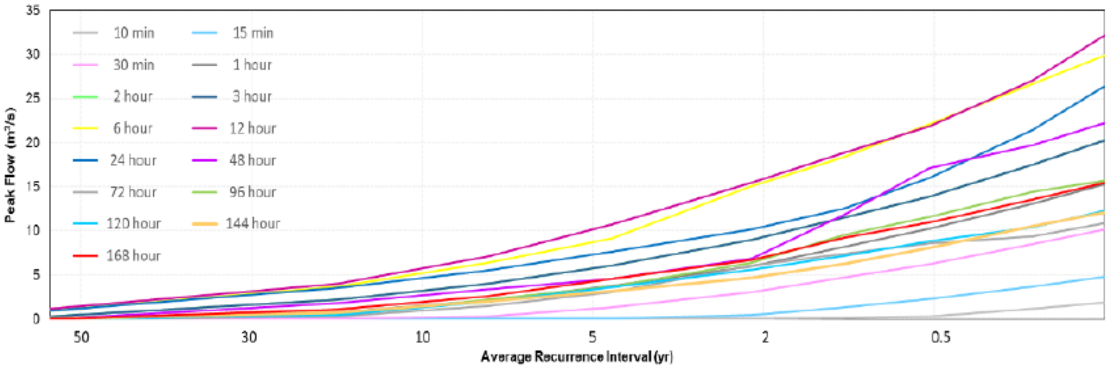

Figure B-5: RORB model results for existing conditions

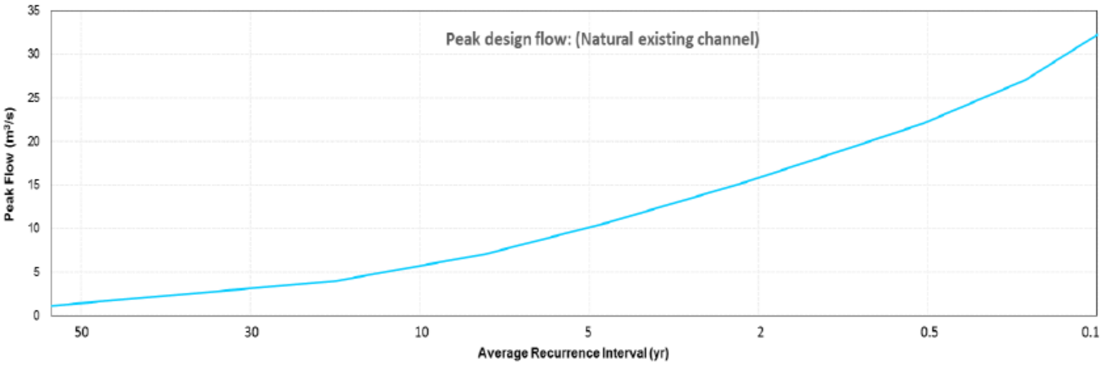

Figure B-6: Peak Design Flows

Technical Detail of Water Level Modelling

To model the water levels that correspond to the design flows produced by the RORB modelling a HEC-RAS model was developed to investigate the potential water levels from Church Creek.

Model Geometry

To set up the model required a number of GIS-based input sets and these were produced using the HEC-GeoRAS add-in to ArcMap. The key spatial datasets required were:

- The drainage centre line;
- Bank lines;
- Old Cooma Road centreline; and,
- The drainage cross sections.

A two-dimensional model grid was set up for the project using a 2-metre grid resolution. The features listed above were applied as breaklines with a 1-metre resolution. The culverts under Old Cooma Road were entered as a triple-barrel, 2-metre span by 1.5-metre rise concrete box culvert. A uniform Manning's roughness coefficient of 0.045 was applied to the modelled area, with sensitivities applied across a range from 0.03 to 0.06.

As a conservative measure, peak inflows from concentration points downstream of Old Cooma Road were introduced at the upstream boundary condition as pseudo-steady flows (filling all available storage areas). In addition to the Church Creek flood model, a localised rain-on-grid or direct rainfall model was applied to model overland flow. Intensity-Frequency-Duration (IFD) data were compiled across the catchment area from the Bureau of Meteorology (BoM) using the 2016 data set. The highest rainfall values were conservatively selected without areal reduction factors to compile a nested frequency storm for each site with an initial loss of 22 mm and a continuing loss of 5.2 mm/hour removed from the precipitation hyetograph based on values taken from the Australian Rainfall and Runoff (ARR) data hub (http://data.arr-software.org/, Ball et al., 2016). Rainfall excess was applied across the 2D flow area as an inflow boundary condition. Preliminary model runs were developed to determine the catchment response time, leading to the adoption of a 1-hour synthetic storm. A centrally loaded, nested frequency storm was applied across the entire catchment in HEC-RAS as unsteady flow boundary, with Church Creek receiving direct inflow as a time series hydrograph.

The downstream outlet was set to a normal depth boundary condition, using the uniform bed slope of 0.9% as the estimated energy gradient. A computational time step of 1 second was applied with a simulation window of 2 hours.

As shown in the velocity plots below, peak velocities in some sections of the channel exceed the typical 2 m/s threshold for requiring scour protection rock according to Austroads guidelines. Some erosion would be expected under the modelled scenarios.

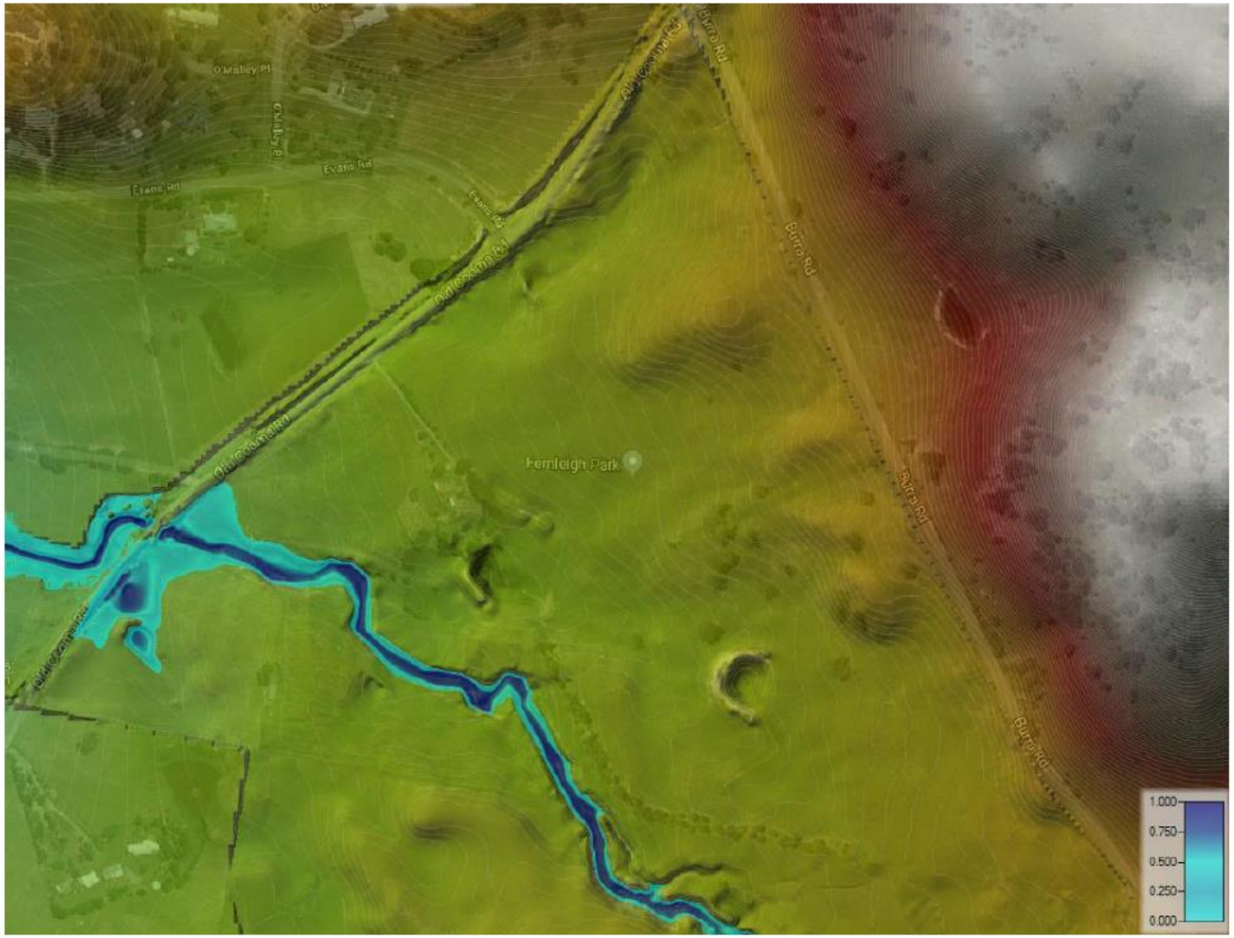

Figure B-7: Peak 100-year flow depths in Church Creek

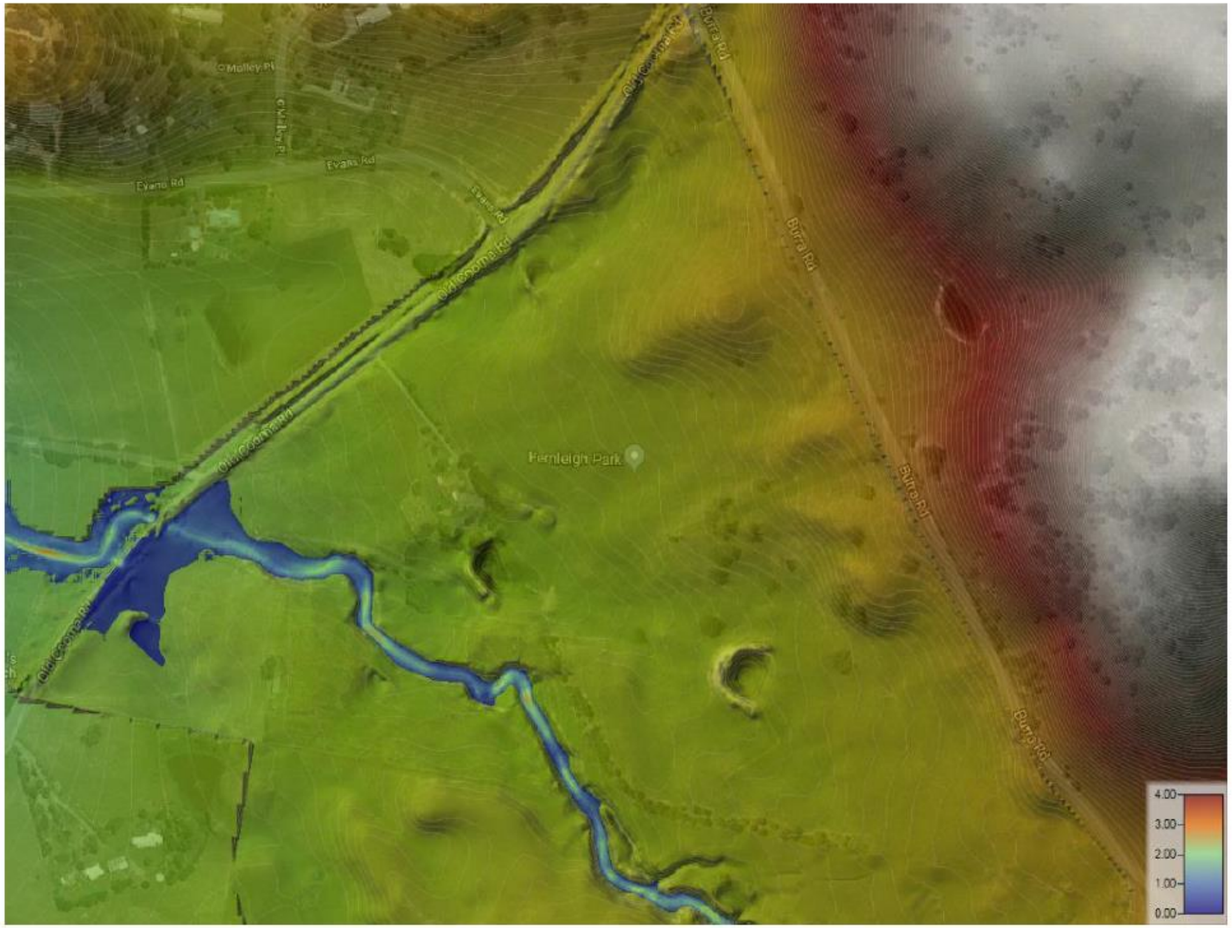

Figure B-7: Peak 100-year flow velocities in Church Creek

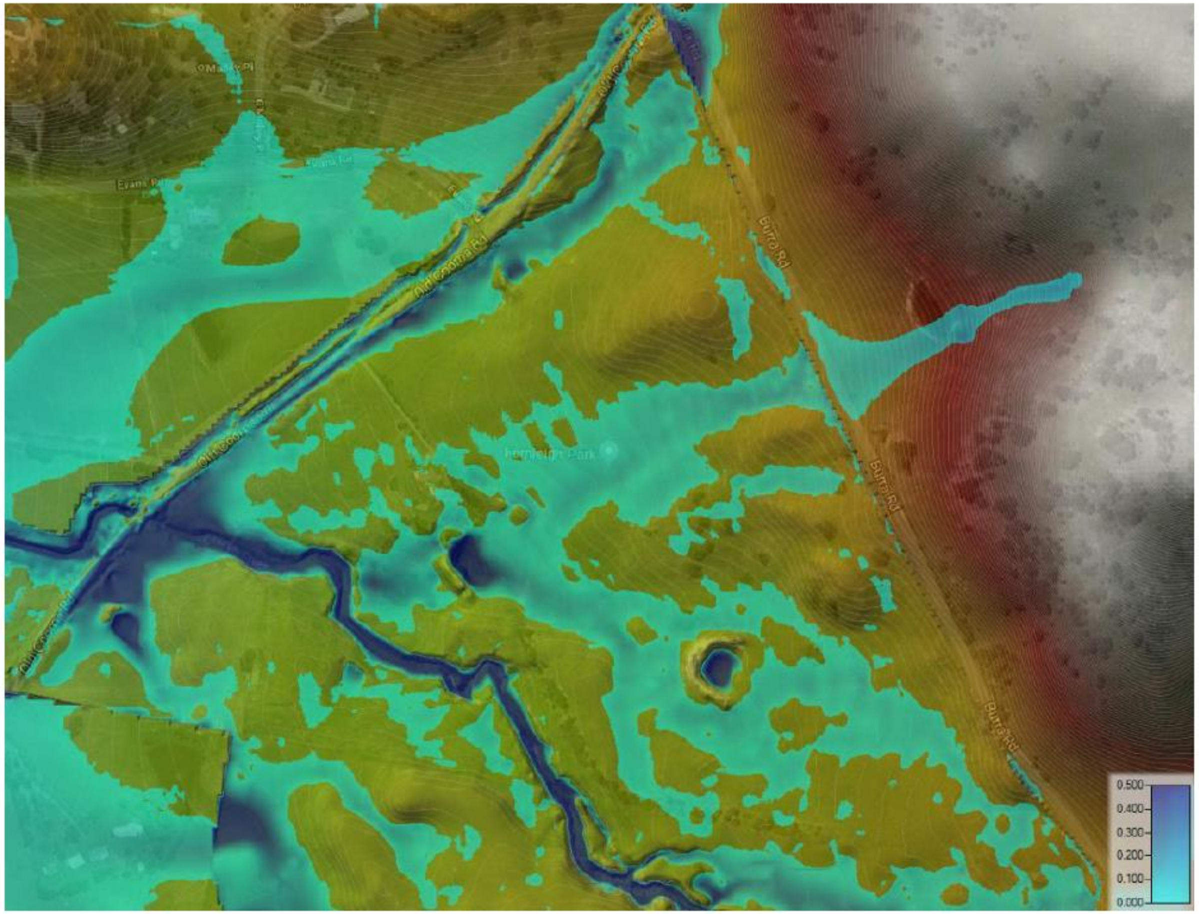

Figure B-7: Peak 100-year flow depths for overland flow

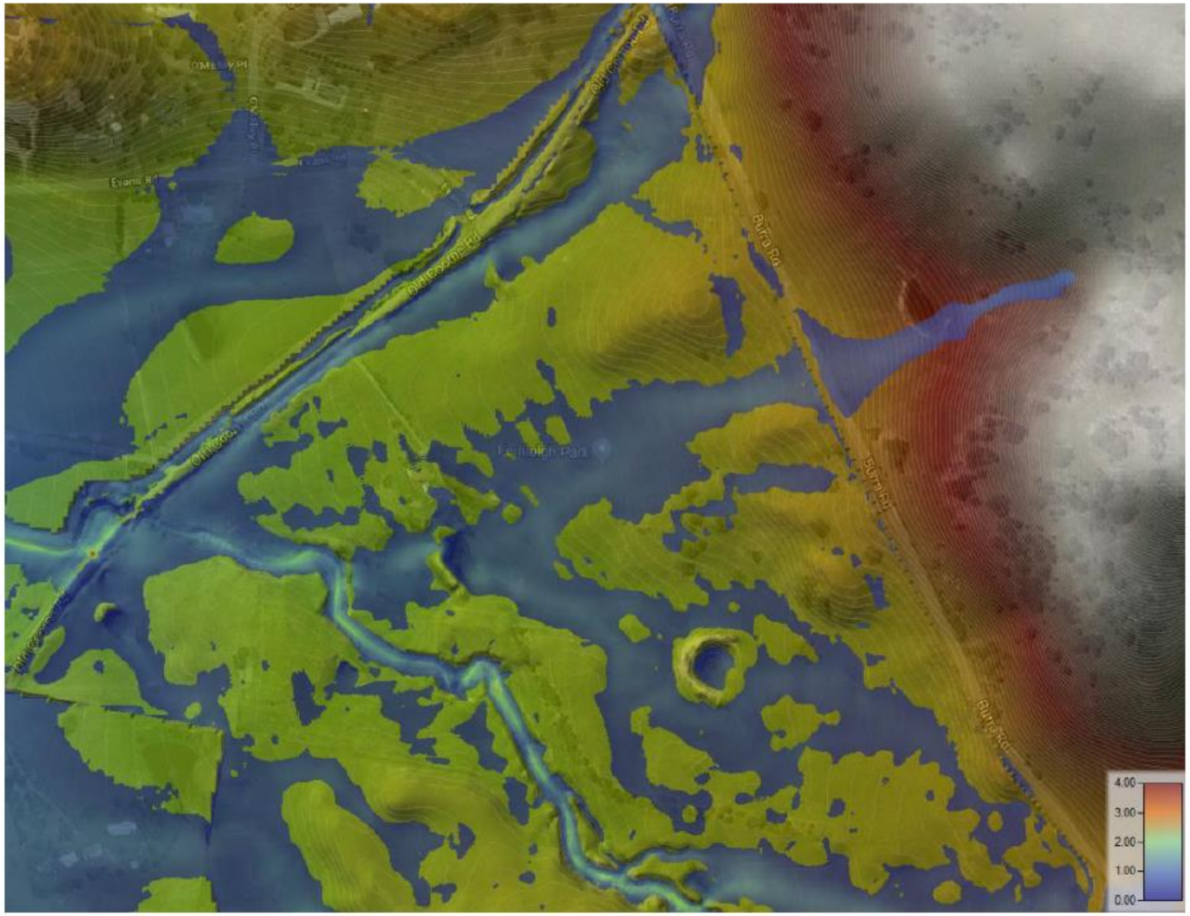

Figure B-7: Peak 100-year flow velocities for overland flow

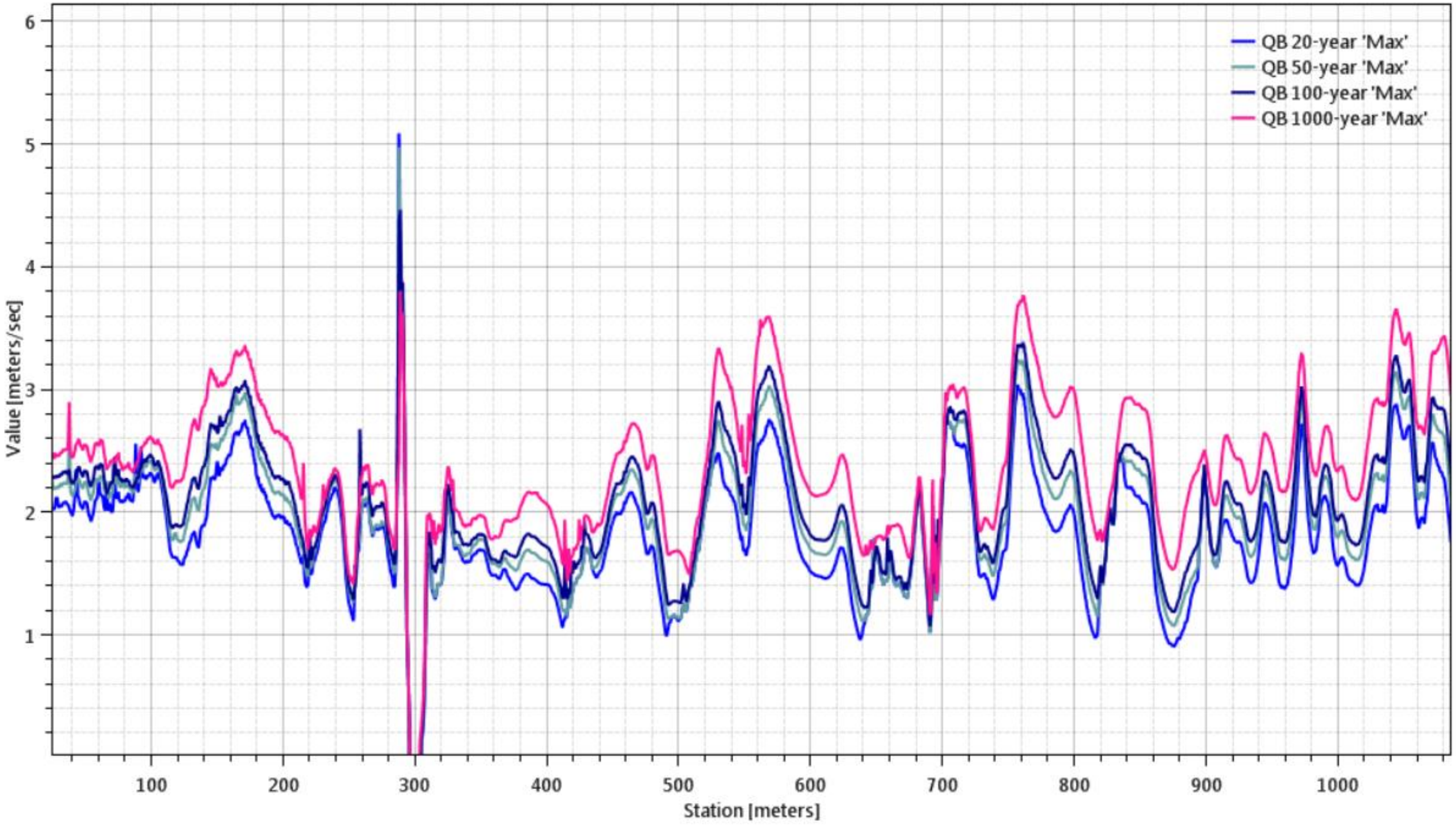

Figure B-7: Peak 100-year velocity profile

Appendix C Catchment Characteristics

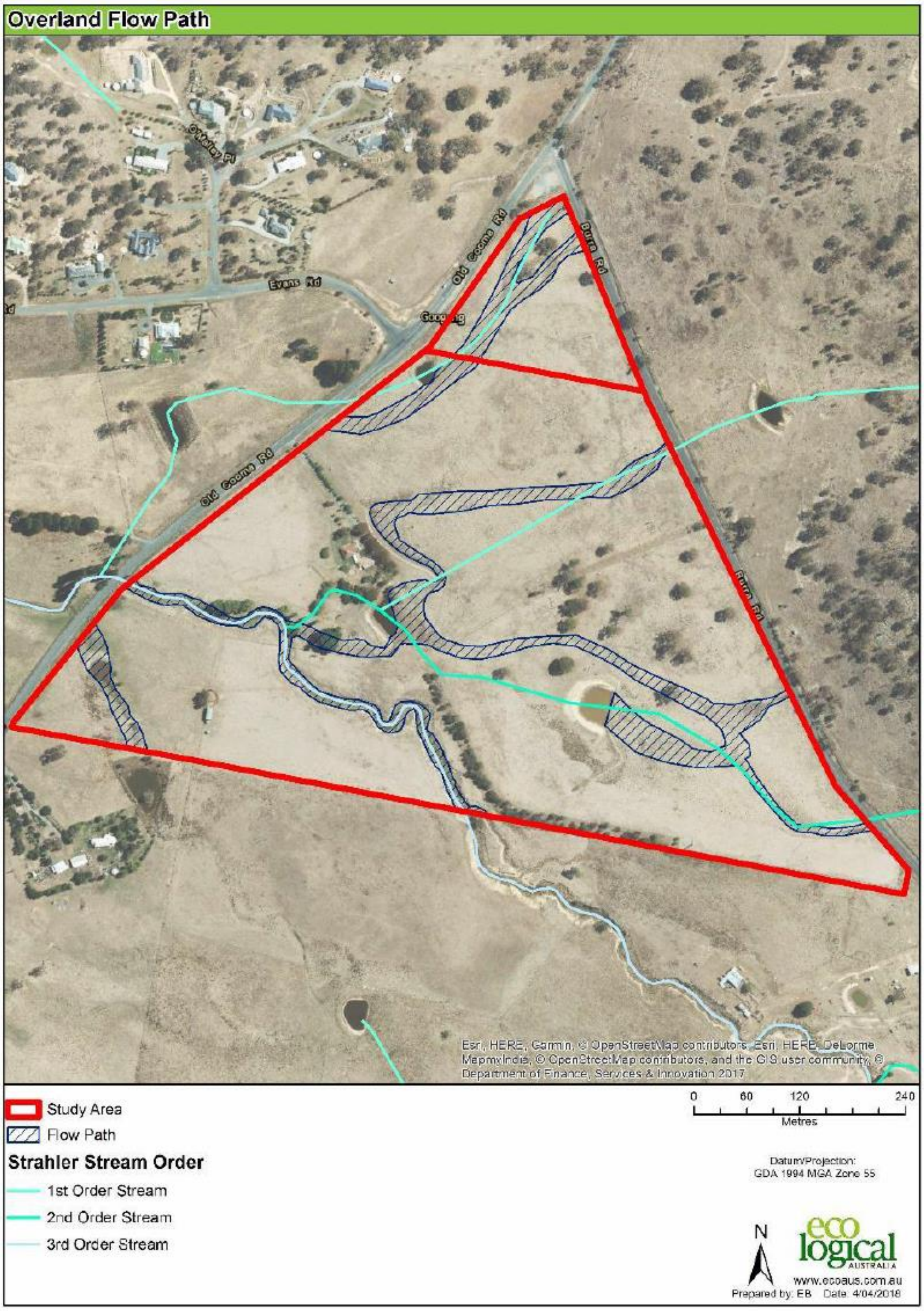

Figure C-1: Overland flow paths

Table C-1: Catchment characteristics

Node No	Sub Area	Area (km^2)
1	SC2	0.637
2	SC1	1.084
5	SC3	0.445
6	SC4	0.425
9	SC5	0.892
10	SC6	0.343
12	SC7	1.587
14	SC8	1.587
16	SC9	0.671
18	SC10	0.281
20	SC11	0.936
21	SC12	0.208

Table C-2: Link parameters

Reach No	Reach Name	Length (m)	Reach Type
1	SC1-J1	0.84	Natural
2	SC2-J1	1	
3	J1-J2	0.26	
4	SC4-J3	1.16	
5	SC3-J2	0.26	
6	J2-J3	0.26	
7	J3-J4	0.26	
8	SC5-J4	0.397	
9	SC6-JN	1.15	
10	J4-JN	0.397	
11	JN-J7	0.397	
12	SC7-J5	0.38	
13	J5-J6	0.38	
14	SC8-J6	0.485	
15	J6-J7	0.485	
16	SC9-J7	0.85	
17	J7-J8	0.197	
18	SC10-J8	0.197	
19	J8-J9	0.197	
20	SC11-J9	1.23	
21	SC12-End	0.5	
22	J9-End	0.5	

Table C-3: Flow calculation for HEC-RAS Model

RORB Location	HEC-RAS cross section river station (m)	10% AEP flow (m³/s)	1% AEP flow (m³/s)	0.5% AEP flow (m³/s)	0.2% AEP flow (m³/s)	0.1% AEP flow (m³/s)
J5-J6	602.9097	4.5	12.2	14.4	17.4	20.6
0	293.1794	5.3	14	16.7	20	23.6
J6-J7	1.486383	6.1	15.8	19	22.7	26.6

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QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2 PROPOSED QUEANBEYAN CEMETERY SITE

ATTACHMENT 10 DRAFT HYDROLOGY AND GROUNDWATER REPORT 2020

Proposed cemetery site, Old Cooma Road, Googong: Hydrogeological Assessment

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Queanbeyan-Palerang Regional Council

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DOCUMENT TRACKING

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Template 2.8.1

Contents

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List of Tables

Abbreviations, initialisms and acronyms

Abbreviation	Description
ARI	Annual Recurrence Interval
BoM	Bureau of Meteorology
ELA	Eco Logical Australia Pty Ltd
GDE	Groundwater Dependent Ecosystems
IFD	Intensity-Frequency-Duration
AHD	Australian Height Datum
DEM	Digital Elevation Model
MDB	Murray Darling Basin
QPRC	Queanbeyan-Palerang Regional Council

Executive Summary

Previous water studies (Eco Logical Australia, 2018) were submitted to NSW Natural Resources Access Regulator (NRAR) for consideration and NRAR provided comment on 22 October, 2018 (Appendix A) on the proposed development and has outlined specific requirements pertaining to groundwater conditions at the site and recommendations that need to be fulfilled prior to commencement of burials. This report responds to those recommendations and provides data and interpretation in support of amendment to the Queanbeyan Local Environmental Plan (LEP) 2012 to add the term 'cemetery' to Schedule 1 of the LEP to make this use permissible with consent within Lot 2 DP 112382 and Lot 126 DP754881.

NRAR provided a number of specific recommendations that are required to be addressed prior to finalising the proposed amendment to the LEP.

NRAR Recommendation #1

"Further investigation of the baseline groundwater levels and groundwater quality for a minimum 12 month period is undertaken prior to any further action to ensure there is sufficient depth to the water table."

Response

A network of five new monitoring bores (at three locations) have been installed across the Site, with nested sites in the east and west and a shallow bore to the south. Continuous logger monitoring of water levels has been undertaken over the past 15 months and manual spot readings have confirmed the accuracy of the loggers.

NRAR Recommendation #2

"Assessment of the cover-type material and depth to bedrock across the entire site to ensure that natural formations offer protection."

Response

Compilation of all geotechnical reports has provided a comprehensive picture of shallow ground materials allowing a distinction between shallow and deep unconsolidated profiles and demarking a zone with insufficient depth for gravesite development.

NRAR Recommendation #3

"Conduct a hydrogeological assessment of present and future risks should groundwater levels be less than 3 m below the ground surface … and:

a) Establish recommendations concerning appropriate management and treatment of leachates

b) Establish recommendations in order to prevent migration of decomposition products into the substrate and groundwater."

Response

Comparison of water levels with recent rainfall records allows an assessment of response to future events. Water levels respond to definable rainfall events and can be related to past rainfall trends. Rapid response to external stimuli (either addition through indirect rainfall recharge, or extraction through pumping) affords an opportunity to maintain deeper water levels, particularly in the western part of the Site where current water tables are close to 3 m below ground level.

The most appropriate course of management is to prevent water tables rising to depths less than 3 m below ground level through the use of monitoring and pumping as necessary.

a) Maintenance of the existing clay aquitard between the shallow and deep aquifers will restrict migration of any potential contaminants. No gravesites should be dug that penetrate this layer.

b) Shallow aquifer water naturally uses the existing surficial drainage network and this system should be monitored and bunding and sedimentation ponds could be considered. The existing flow is currently impeded by the road to the west (Eco Logical Australia, 2018) and a suitable containment structure could be established at this location.

NRAR Recommendation #4

"Allowance for climatic effects should be considered."

Response

Current climate predictions for this region suggest a continued drying, punctuated by more severe storm events. Whilst the drying will maintain low water levels, it is likely that extreme events (>100 mm) could induce water level rise in excess of 0.5 m, based on current records. Mitigation actions, such as pumping can effectively reduce this potential and should be coupled with on-going monitoring to continue to build a full understanding of the dynamics of the aquifer systems.

Consolidated response to NRAR generic recommendations

NRAR also noted five relevant (hydrogeological) general recommendations for any new cemetery site (Section 1.2). Based on the studies undertaken to date, the proposed development can satisfy these recommendations through an on-going program of groundwater monitoring and continued awareness of rainfall patterns and the corresponding potential impacts on the water tables. Judicial use of local groundwater pumping can help lower water tables as required, with a natural watercourse providing a suitable discharge pathway. Water quality in the groundwaters is good and would not pose any environmental stress to the surface system.

Groundwater could therefore be maintained at greater than 3 m below the ground surface (general recommendation 1) and gravesites can be excavated a minimum of 1.5 m above the water table for a large portion of the Site as dictated by the depth to competent rock (general recommendation 5).

Depth to unaltered or unweathered bedrock is in excess of 6 m for much of the Site. Areas where bedrock is within 3 m of the land surface have been identified and can be avoided (general recommendation 6).

The floodplain adjacent to the creek lines has been determined through examination of digital elevation models and through flood modelling (Eco Logical Australia, 2018) and these zones should be avoided as gravesites (General recommendation 7).

Zonation of the Site allows distinction of areas where there is a high risk of impact from gravesites. Gravesites would be excluded from zones where water tables are consistently shallow; zones which are adjacent to the creek and where the shallow substrate is very permeable (general recommendation 8).

.

1. Introduction

Eco Logical Australia (ELA) has been engaged by the Queanbeyan-Palerang Regional Council (QPRC) to undertake a hydrogeological and hydrological review and constraints assessment for the proposed development and use of a cemetery site located within Lot 2 (DP112382) and Lot 126 (DP754881) situated at 1241 Old Cooma Road, Googong (the Site – **Figure 1-1**).

The assessment was undertaken to identify any potential hydrological and hydrogeological impacts and impacted areas to assess the suitability of the site for the proposed activity.

1.1 Project Background

The Queanbeyan Lanyon Drive Cemetery currently services the Queanbeyan region and is expected to reach capacity during the next five years, based on a forecasted population growth of approximately 36% by 2031 (QPRC, 2017). The Queanbeyan region includes the main growth centres of Googong, Tralee/South Jerrabomberra and infill units in Queanbeyan (QPRC, 2017).

To meet the future cemeterial needs of the region, the Queanbeyan-Palerang Regional Council (QPRC) has been engaged in a process of strategic planning to identify a new cemetery site, as well as undertaking works to prolong the serviceability of the existing Lanyon Drive Cemetery. As part of the planning proposal for the new cemetery site, QPRC is required by the New South Wales Department of Planning and Environment (DPE) to undertake background studies to characterise the existing environment at the site and identify potential areas that may impact upon the proposed development.

Previous background studies included a hydrological assessment (Eco Logical Australia, 2018) which included a preliminary hydrogeological assessment based on available literature from previous studies as well as data from State databases. Specifically, the following data sources were interrogated during that assessment:

- Previous studies, including but not limited to:
    - Groundwater Report on Beatty Hill, Old Cooma Road Development Application, 2001, Hyrdroilex Geological Consultants
    - Geotechnical Investigation Report, 1241 Old Cooma Road, Googong, NSW, ACT Geotechnical Engineers, 2017, Geotechnical Engineers Pty Ltd
    - Flood analysis and concept culvert design, Rural Residential Subdivision, Burra Road, Mount Pleasant, 2015, CIC Australia P/L.
- NSW Office of Water (NOW) PINNEENA Groundwater database.
- Bureau of Meteorology (BoM) Groundwater Explorer database.
- BoM GDE Atlas.
- Local contour maps.

1.2 Recommendations from the Natural Resources Access Regulator (NRAR)

The NSW Natural Resources Access Regulator (NRAR) is the independent, transparent and effective regulator with total carriage of the compliance and enforcement of water management legislation in NSW. NRAR undertakes these functions that previously were split between the Department of Industry and WaterNSW. NRAR is thus responsible for water access licensing and approvals that are sought by government agencies (amongst others) that may impact on water resources.

Previous water studies (Eco Logical Australia, 2018) were submitted to NRAR for consideration and NRAR provided comment on 22 October, 2018 (Appendix A) on the proposed development and has outlined specific requirements pertaining to groundwater conditions at the site and recommendations that need to be fulfilled prior to commencement of burials.

Specifically, NRAR recommended:

1. Further investigation of the baseline groundwater levels and groundwater quality for a minimum 12 month period is undertaken prior to any further action to ensure there is sufficient depth to the water table.
2. Assessment of the cover-type material and depth to bedrock across the entire site to ensure that natural formations offer protection.
3. Conduct a hydrogeological assessment of present and future risks should groundwater levels be less than 3 m below the ground surface … and:
    a. Establish recommendations concerning appropriate management and treatment of leachates
    b. Establish recommendations in order to prevent migration of decomposition products into the substrate and groundwater.
4. Allowance for climatic effects should be considered.

NRAR also noted the following relevant (hydrogeological) general recommendations for any new cemetery site:

1. **The site should not have groundwater closer than 3m below ground level.**
2. *… (not groundwater related)*
3. *… (not groundwater related)*
4. *… (not groundwater related)*
5. **Burials should at least 1.5 metre clearance between the base of the grave and the top of the maximum groundwater level — burial sites should not have any standing water in them when dug**.
6. **Burial sites should not be dug in unaltered or unweathered bedrock (i.e. bedrock areas are recommended to be excluded from all burials)**
7. **Burial sites should not be dug in areas susceptible to groundwater flooding** (e.g. decomposed — weathered bedrock zones may be noteworthy groundwater sources, buried alluvial sand - gravel deposits along watercourse lines are highly susceptible to groundwater flooding).
8. Cemeteries are not recommended to be located in areas where:
    a. The groundwater level is shallow
    b. Seasonal or ephemeral floods occur
    c. The substrate is very permeable (e.g., sands and gravels, fractured rocks, karst structures)

1.3 Objective of this assessment

The objective of this assessment are to address the recommendations specified by NRAR (above) and provide evidence on the hydrogeological conditions prevailing across the site.

This report has been prepared to provide documented evidence of studies undertaken to address the specific recommendations of NRAR for the Site and provide context for the next phase of proposed development as a cemetery and crematorium.

1.4 Works undertaken

Eco Logical Australia (ELA) commissioned Coffey Services Australia Pty Ltd (Coffey) to install groundwater monitoring wells at three locations on the Site, collect representative groundwater samples, provide lithological logs at the locations of the bores and undertake continuous water level monitoring for a period of at least 12 months. Two sites were chosen to have both a shallow and deep monitoring bore, with the shallow bore sampling waters I the alluvium or colluvium and the deep bores tapping the underlying fractured bedrock aquifer.

In addition to water quality for groundwater at each location, loggers were installed at the three shallow bores to provide continuous water level monitoring. Approximately monthly manual water level readings have been taken since February 2019, coinciding with download of the logger data at the three shallow bores.

Data has been compiled and evaluated and used to produce a reasonable understanding of the groundwater conditions at the Site and an appreciation of the expected groundwater response to changing climatic conditions.

1.5 Study Area

The study area is approximately 36.4 hectares and is located approximately 11 kilometres south-west of Queanbeyan, and approximately 5 km west of the Queanbeyan River (**Figure 1-1**). The Site is triangular in shape and bounded by Old Cooma Road to the west and Burra Road to the east. The Burra Road – Old Cooma Road intersection is located at the northern point of the site.

The Site is currently used for grazing and agricultural purposes and has been farmed since the 1800's (QPRC, 2017). An existing dwelling is located near the centre of the site. Outside the Site, the surrounding area comprises land that is zoned for environmental living purposes with the Mount Campbell community title development located to the west of the site, containing dwellings on smaller rural lots (QPRC, 2017).

Figure 1-1: Study Area (the line across the top shows two lots associated with this site)

2. Existing environment

2.1 Site characterisation

The Site slopes gradually from north-east to south-west, developing a floodplain to the south of Church Creek, which is a third order watercourse within the Project Site, marked on the LEP Riparian and Watercourses Map, that crosses the site from the south to the west (Figure 2-1). The creek receives discharge from several smaller tributaries, with the regional flow direction to the north-west. There are a number of other smaller non-defined overland flow paths that cross the Site created via culverts under the roads that border the site.

Two other unnamed first and second order water courses have also been mapped from the local contour maps as feeding into Church Creek (shown in Figure 2-1). It is unclear, however, whether these watercourses would meet the definition of a river under the WM Act. Flood modelling undertaken previously (Eco Logical Australia, 2018) confirmed the likelihood that these water courses could flow under extreme rainfall conditions (Figure 2-2), though most flow remained concentrated in the main channel of Church Creek.

A review of the NSW Office of Water (NOW) surface water database identified no registered stream flow monitoring gauges near the site, with the closest stream gauge (# 410770) located on the Queanbeyan River at the ACT border (approximately 12.5 km north of the Project site).

Groundwater flow dynamics in the study area were not delineated previously as no active monitoring bores could be identified in or around the study area to allow for monitoring of groundwater levels. An old well located on the site may have been used as a water source in the past. Groundwater was assumed to flow from north-east to south-west, from higher to lower ground, with the creek acting as a drain for shallow groundwaters. From the single bore (GW0209031), a water level of 2.04 m below ground level (mbgl) was recorded on 7th July 2018. The shallow water table at this location prompted the further investigations and recommendations from NRAR, particularly as previous shallow bores (to 3.5 mbgl) did not intercept groundwater anywhere across the Site.

2.1.1 Climate

Rainfall and temperature data was obtained from the Bureau of Meteorology (BoM) online climate database for the Tuggeranong (Isabella Plains) AWS (BoM site 070339) located approximately 10.2 km west of the study area. The regional climate is categorised as cool temperate, with year-round rainfall (average annual rainfall 631.3 mm) with a seasonal distribution showing greater rainfall in the summer months (Figure 2-3). Mean maximum temperatures range from 11.8 °C in July to 29 °C in January.

Monthly and daily rainfall data for the last 23 years was retrieved from the BoM Weather Station Directory (http://www.bom.gov.au/climate/data/stations/). From the daily data a cumulative deviation from the mean daily rainfall (CDMDR) provides an overview on climactic changes, highlighting wetter periods as increasing trends and dry periods as decreasing trends (Figure 2-4). This gives a good indicator as to whether the area is suffering the effects of drought or if the current precipitation level is on/above average for the region. Of note, the strong downward trend due to the Millennium Drought is clearly seen as a prolonged deficit in the CDMDR in Figure 2-4.

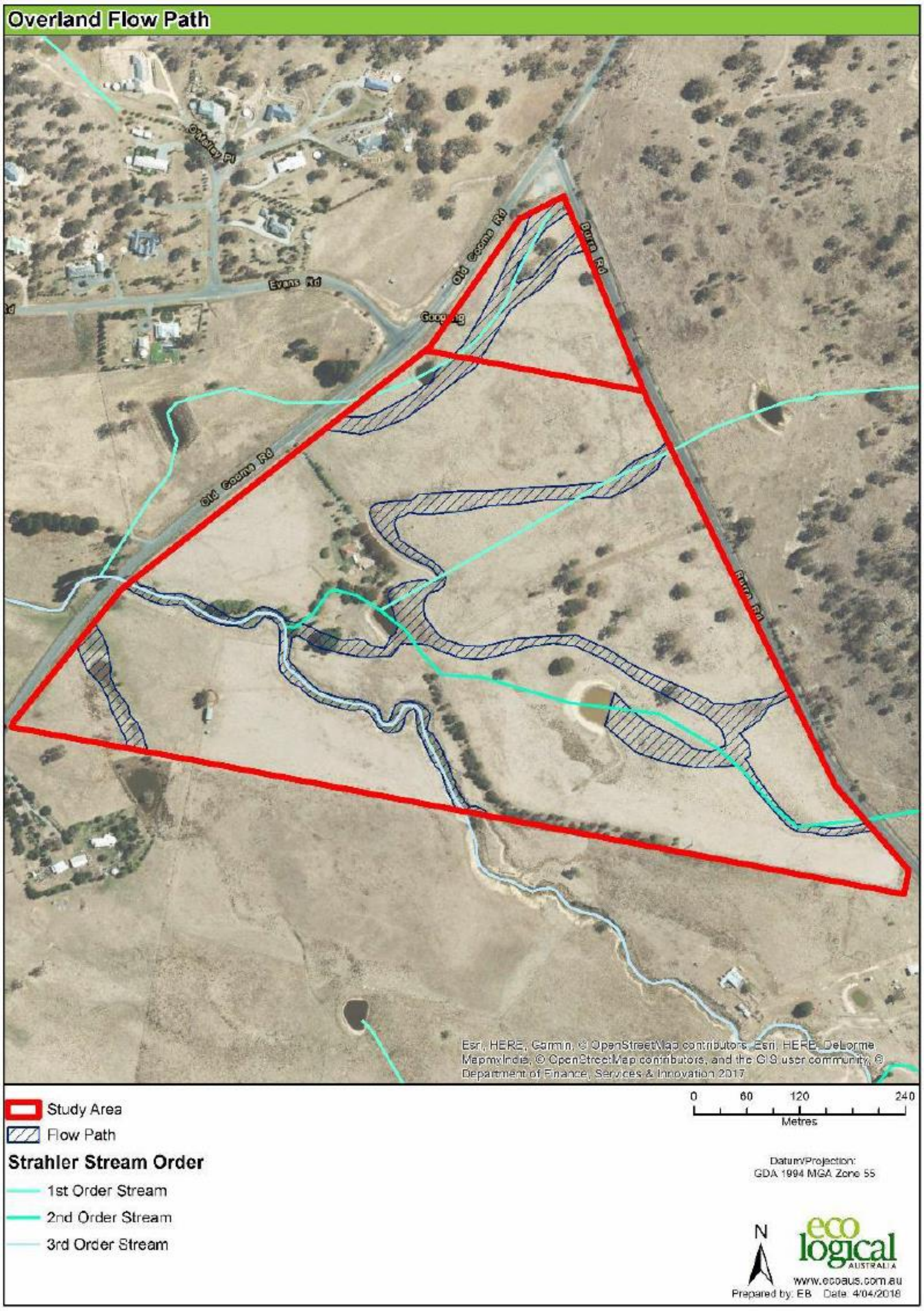

Figure 2-1: Overland flow paths across the Site. Church Creek runs from the central south boundary across to exit the Site to the west. Flow paths indicate expected flow based on the DEM. Strahler stream orders indicated for cadastral watercourses

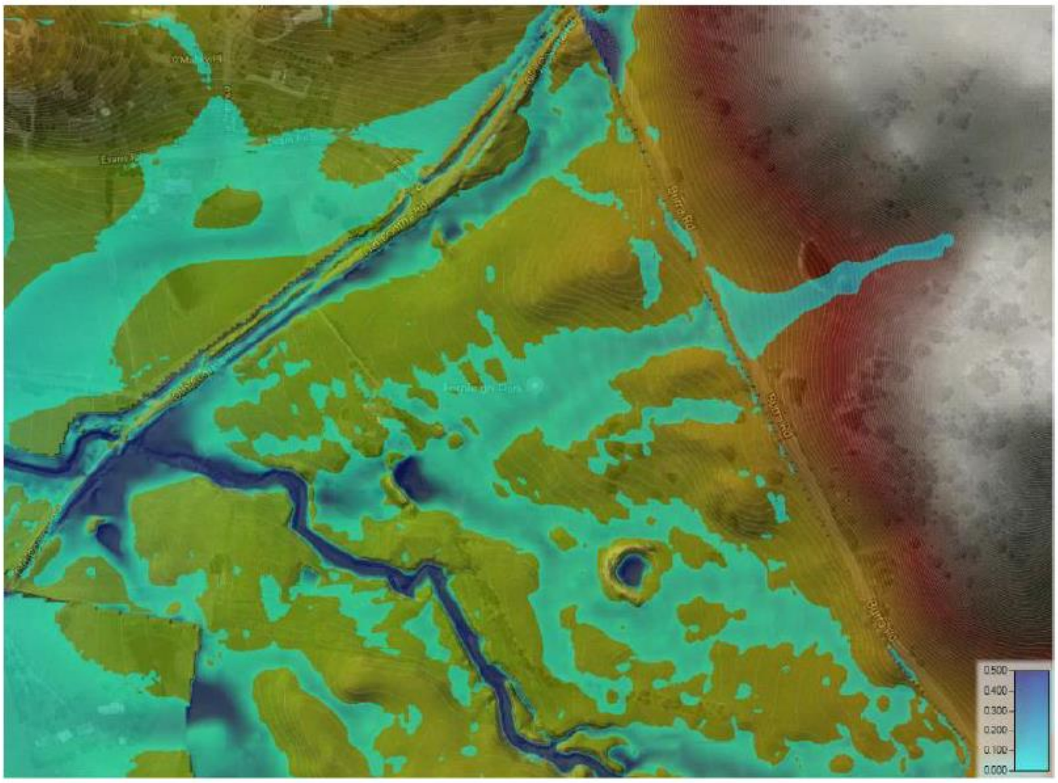

Figure 2-2: Modelled flood extents across the Site under the 1% AEP (1 in 100 year ARI conditions)(Eco Logical Australia, 2018)

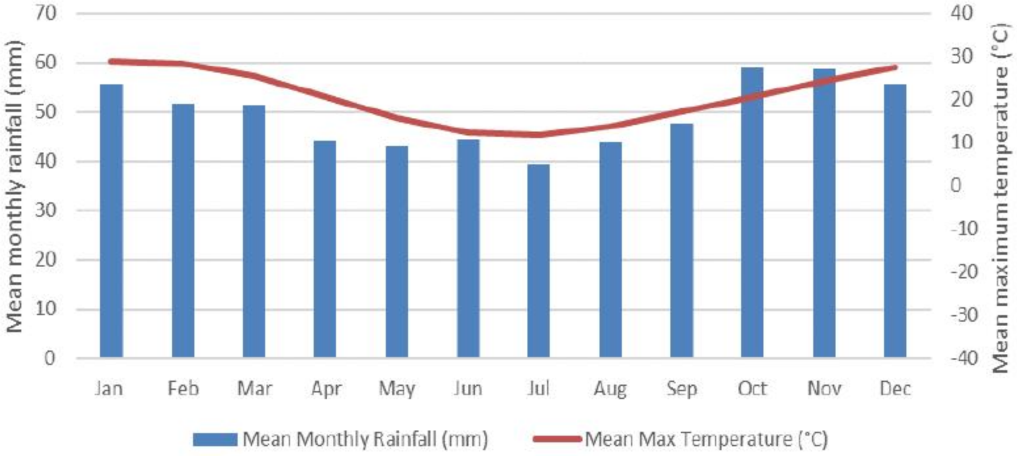

Figure 2-3: Monthly average rainfall and evaporation recorded at Tuggeranong (BoM 70339), 10.2 km west of the Site

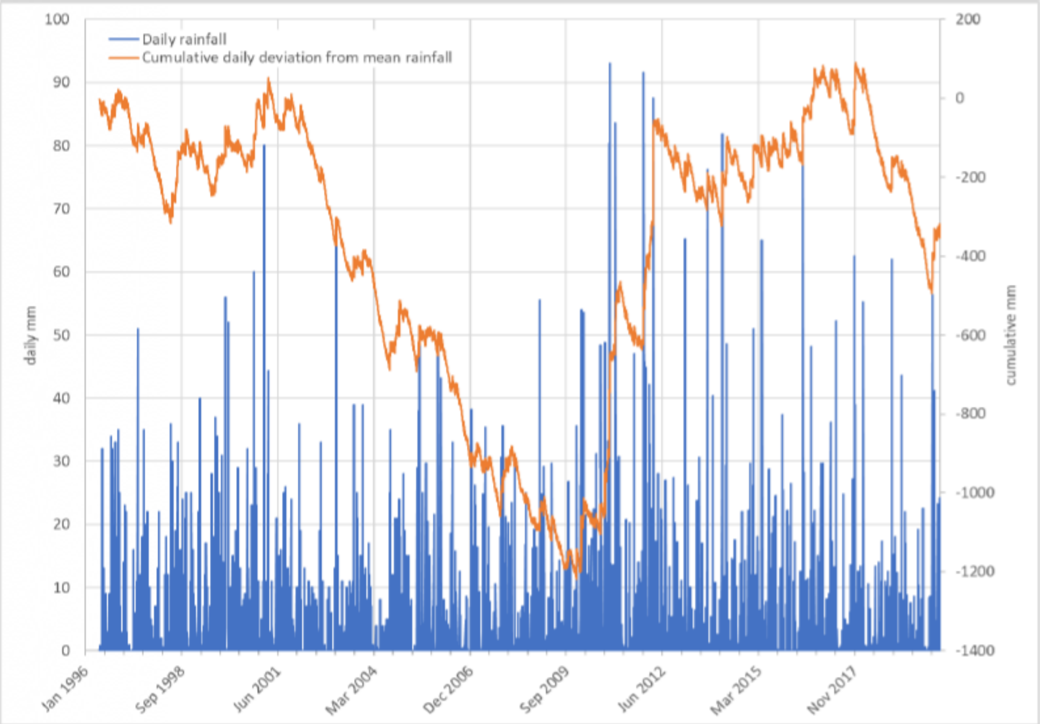

Figure 2-4: Rainfall recorded at Tuggeranong (Isabella Plains) Automated Weather Station (BoM 70339) and equivalent cumulative deviation from the mean daily rainfall

Based on rainfall data from last 23 years, the region on whole has recovered from the Millennium Drought, recovering to pre-drought conditions between 2010 and 2012, then has exhibited long-term average conditions (flat trend in the CDMDR) through to 2018, with the last two years being drier than average, though with significant rainfall in February and March of this year (Figure 2-5).

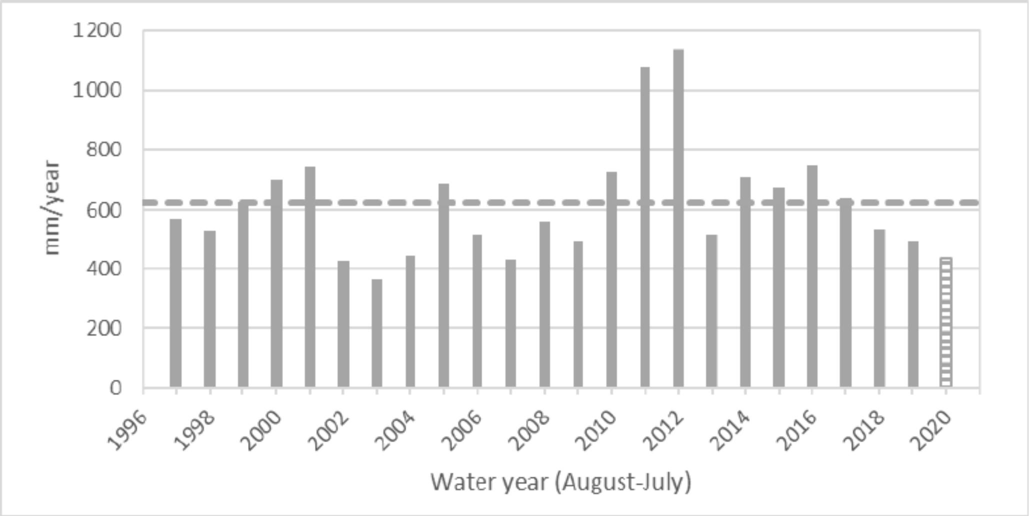

Figure 2-5: Annual rainfall for water years (August to July) at Tuggeranong (Isabella Plains) Automated Weather Station (BoM 70339). Mean rainfall for the period 1996 to 2020 of 624 mm also shown. (2020 only though to April)

2.1.2 Regional geology

The regional geological setting of the property is shown in Figure 2-6. The study area is located within a complex structural corridor within rock sequences of Silurian age, regionally described as the Canberra Graben. This structural feature is bounded to the west by the Murrumbidgee Batholith, comprised of granodioritic intrusives, and to the east by the Cullarin Horst, a complex geological province represented by deformed Ordovician-aged sediments intruded by granites (HGC, 2001).

The 1:100,000 Canberra Geology map indicates that the site is located mostly on the Colinton Volcanics bedrock, with a small part south of the study area located on the Williamsdale Volcanics. Two faults separate the Colinton Volcanics from the Deakins Volcanics approximately 3.5 km west and from Cappanana Formation approximately 4 km east of the study area.

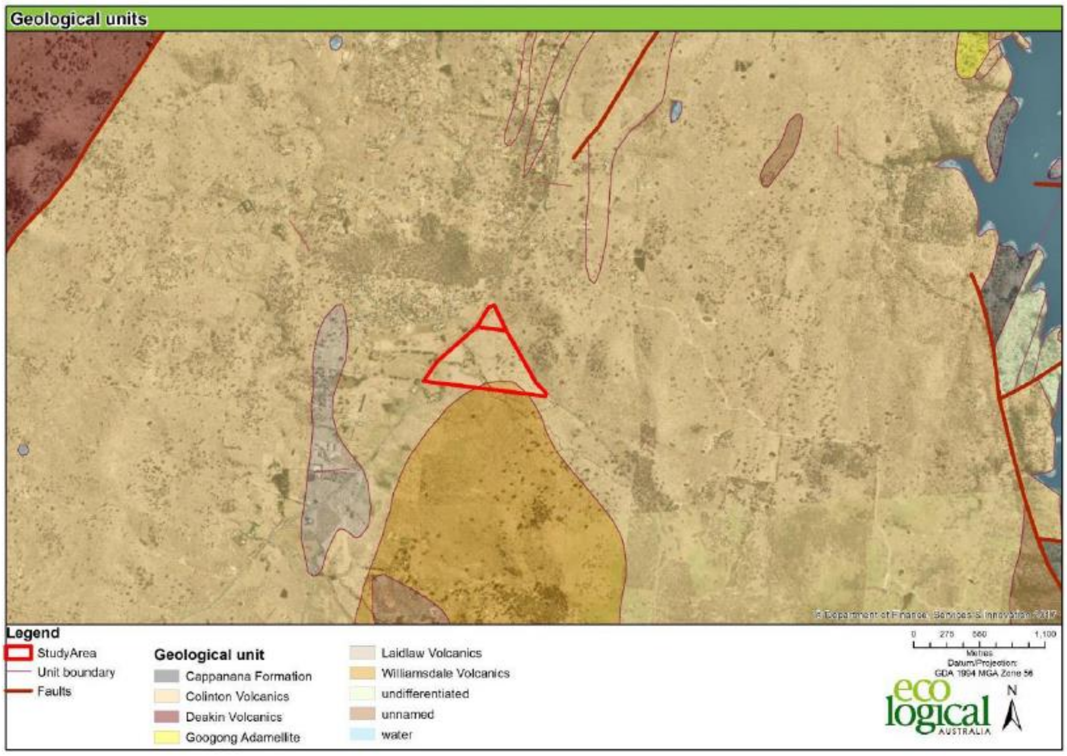

Figure 2-6: Surface Geological units across the region

2.1.3 Subsurface soil profile

The subsurface conditions near the study site was investigated in 2017 via ten auger holes (ACT Geotechnical Engineers, 2017) and is summarized in **Table 2-1**, below.

Table 2-1: Generalised soil and sub-soil conditions at the site (ACT Geotechnical Engineers, 2017)

Geological profile	Typical Depth Interval	Description
Topsoil	0 m to between 0.1m and 0.2m	SILTY SAND; fine to coarse sand, low plasticity silt, brown, some grass roots, dry to moist, loose.
Slope wash	Between 0.1m and 0.2m to between 0.4m and 0.6m	SILTY SAND; fine to medium sand, low plasticity silt, pale grey-brown, dry to moist, medium dense.
Alluvial/ Residual Soil	Between 0.1mto 0.6 m to between 0.3m and >3.5m	SILTY SANDY CLAY, SILTY CLAYEY SAND, & SANDY CLAY; fine to coarse sand, low to medium and some medium to high plasticity clay, red-brown, orange-brown, brown, grey, dry to moist and moist, stiff to very stiff and dense.
Bedrock	Typically, from 0.2 to 1 m and below	DACITE; fine to coarse grained, orange brown, grey, highly weathered (HW) and weak rock grading to moderately weathered (MW) and medium strong rock.

During bore development for this project, Coffey recorded ground conditions across the Site (Table 2-2 and Appendix B) in January 2019. Conditions confirmed those recorded by ACT Geotechnical Engineers (2017), namely the high clay content of the floodplain deposits. Of note, geotechnical bores on the slopes recorded thin soils with higher sand and silt content.

Table 2-2: Summary of ground conditions encountered during monitoring bore drilling, January, 2019

Material	Description	Depth to top of unit (m)	Range of thickness of unit (m)
Topsoil	Silty CLAY, low plasticity, brown, with rootlets and organic fines	0	0.05 to 0.2
Alluvium	Silty CLAY to clayey SAND, low to medium plasticity clay, brown to pale brown, fine to coarse-grained sand with traces of fine to medium-grained gravel	0.05 to 0.2	1.0 to 4.0
Residual soil	Clayey SAND, fine to medium-grained, pale brown, medium plasticity clay, very dense	1.0 to 4.0	0.75 to 1.5
Dacite bedrock	Extremely and highly weathered, very low to low strength	3.1 to 7.6	0.2 to 2.3
	Moderately to slightly weathered, generally low to medium strength	6.9 to 7.6	unproven

2.1.4 Registered and previously reported bores

Interrogation of the NOW online groundwater database and the BoM Groundwater Explorer database identified 38 registered groundwater bores within approximately 2 km of the project area, with only two of the 38 bores located within the project area as shown in **Figure 2-7**. No water level/quality data for these bores were available in the NOW PINNEENA database. The five registered bores within (or within 200m of) the project boundary were all drilled in the 1950s and are unlikely to be functioning today. All other bores were drilled since 1986 for stock and domestic use (29 for household use; two for stock use and two of unknown use). As such, there is no requirement for these bores to monitor or report level or quality information, though property owners may have this information.

A summary of registration details for these bores is provided in Appendix C. Thirty-four of the 38 bores were drilled to about 20 m or deeper, giving good evidence that local groundwaters are deep and in the fractured rock aquifers. The lithology of two of the shallow bores is not provided and these likely represent perched lenses in the weathered regolith as the other two shallow bores are reportedly completed in clay.

Groundwater in the area is expected to be associated with fractures within bedrock and contained within joints, fractures, faults and fissures in the rock mass (HGC, 2001). The closest fault observed was approximately 1.5 km north of the study area (Figure 2-6). The geotechnical investigation at this site (ACT Geotechnical Engineers, 2017) augered ten holes to a maximum depth of 3.5 m within the project area (). No groundwater was encountered in any of the augered holes, with the soils mostly dry to moist. Temporary, perched seepages might be expected following rainfall within the more pervious soils in the southern area, with shallow hard rock encountered in the north ().

Of six bores reported in the immediate vicinity of the Site (Figure 2-9), only one (GW0209031.1) could be accessed recently to measure water level. A depth to water was recorded as 2.04 mbgl. If representative of the Site water table, insufficient free-board would be available to justify a cemetery at this location.

2.1.5 Water chemistry

No salinity data was recorded from the 38 registered bores located within 2 km distance of the study area. A previous study at Old Cooma Road (HGC, 2001), located approximately 3 km south-west of the project area, reported that the likely total salinity is expected to be in the range of 500-800 mg/L, with elevated bicarbonate and total hardness in the range of 300-500 mg/L. The significant number of local stock and domestic bores suggests that deeper, fractured rock, aquifers provide water of reasonable quality.

2.1.6 Groundwater Dependent Ecosystems (GDEs)

As reported previously, no potentially significant GDEs could be identified within a 2 km buffer around the site based on a high level, desk-top assessment of available data (Eco Logical Australia, 2018).

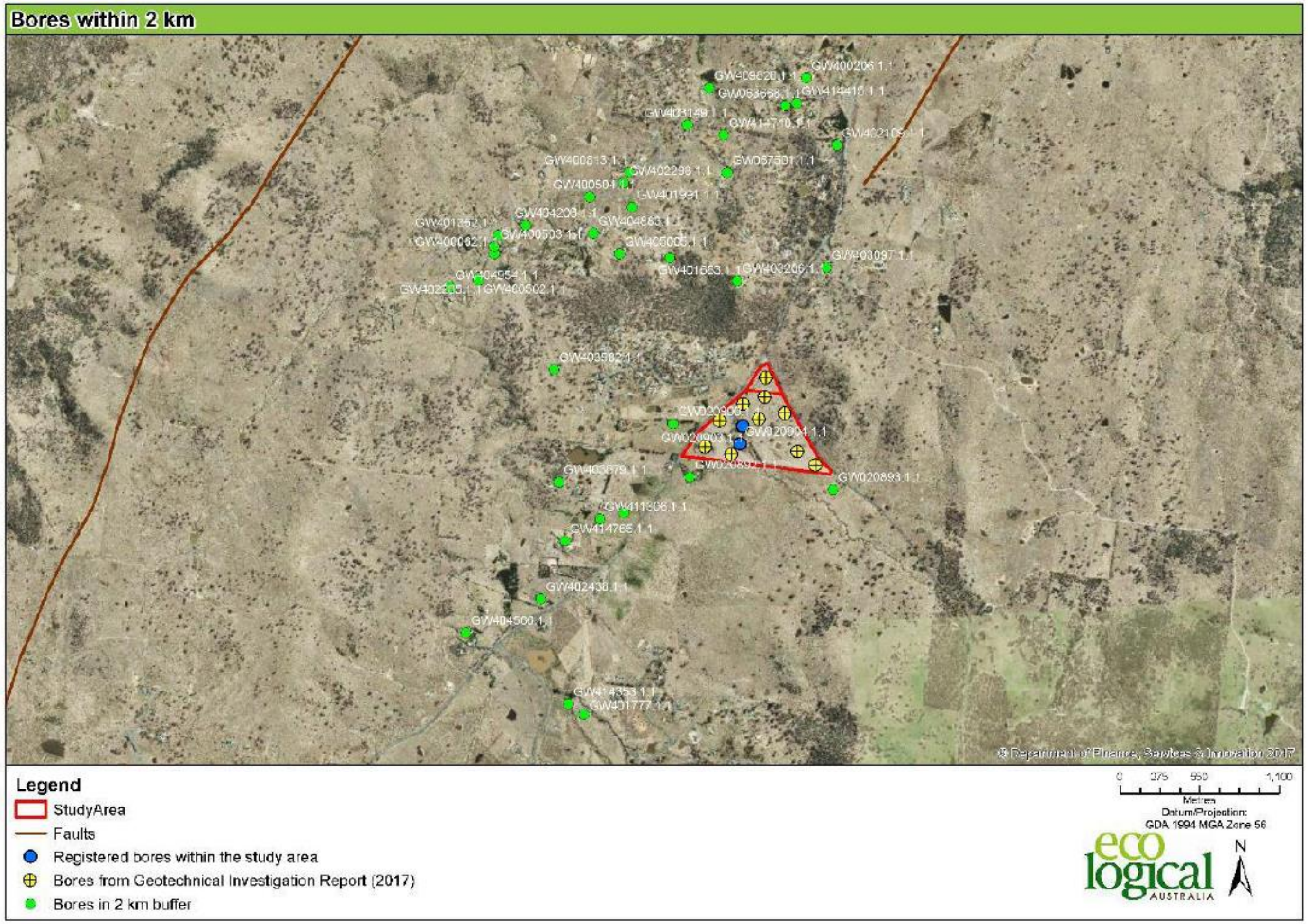

Figure 2-7: Registered and reported groundwater bores around the study area

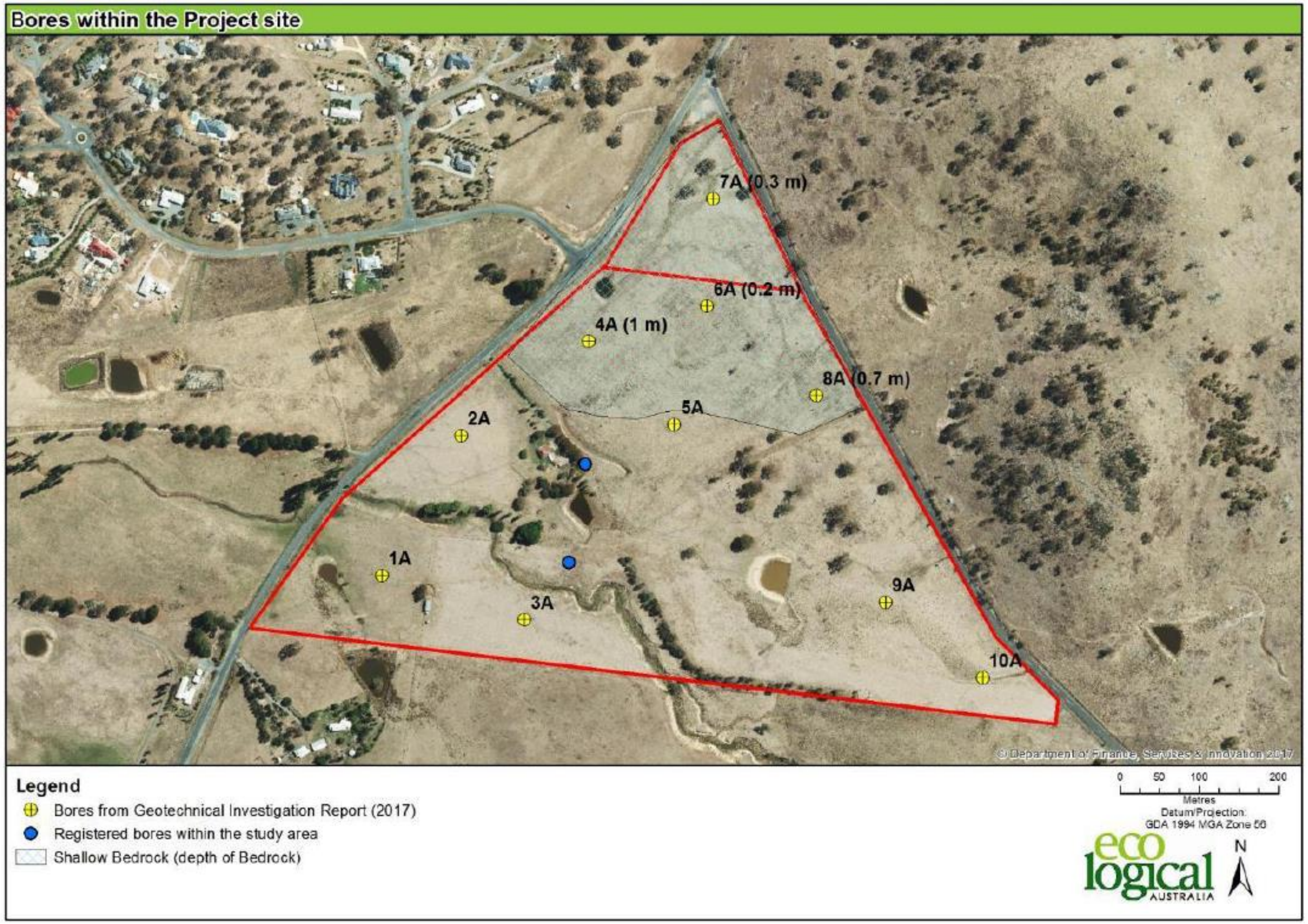

Figure 2-8: Reported bores within the project area prior to this study.

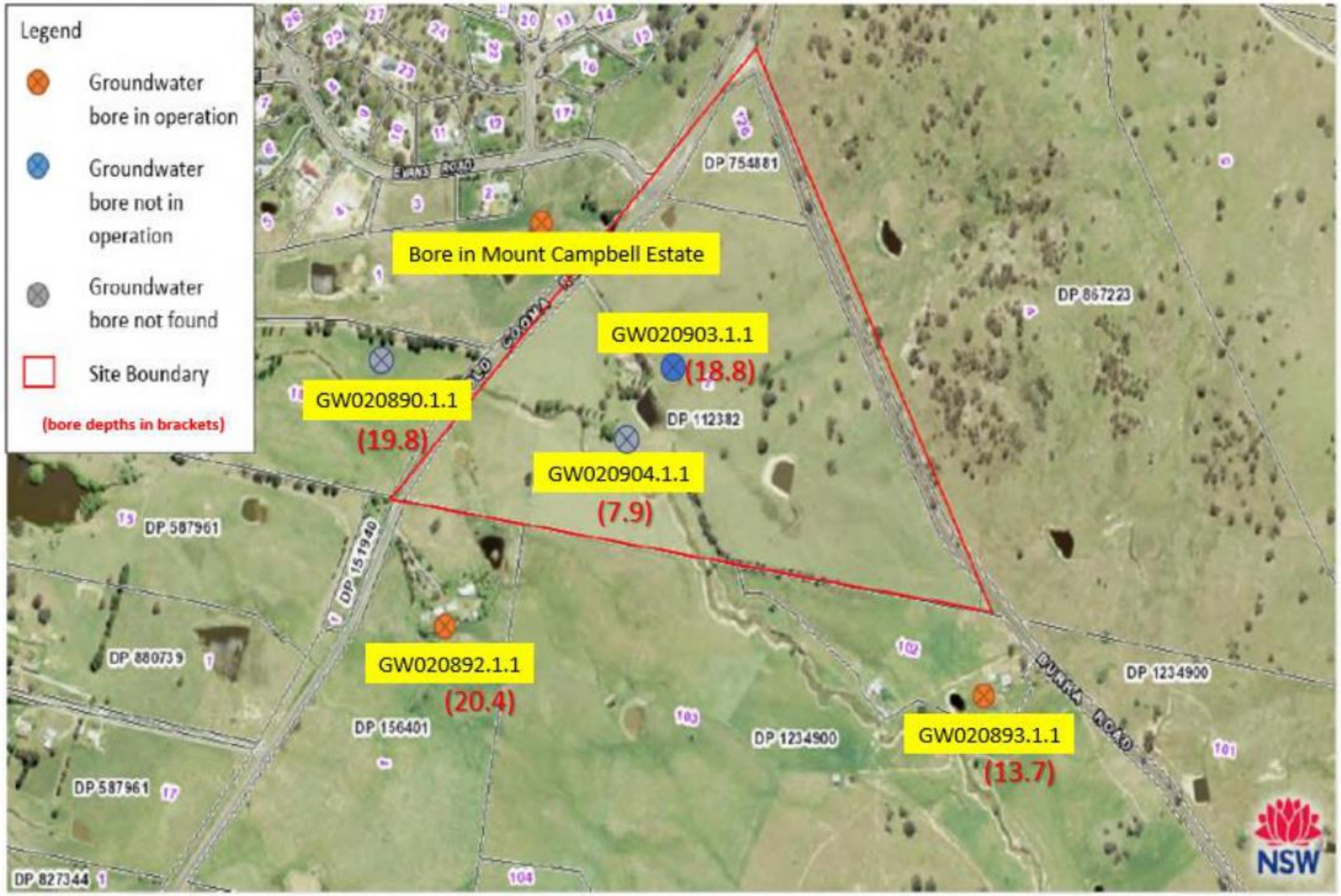

Figure 2-9: Registered groundwater bores around the Site. Construction depth indicated in brackets.

Table 2-3: Summary information for geotechnical holes within the project area (*after* ACT Geotechnical Engineers, 2017)

Bore ID	Logging Date	Soil Type	Moisture status	Excavation depth (m)	Water encountered	Geological profile (at 3.5 m)
1A	6/04/2017	Silty sand/silty sandy clay/ clayey sand	dry to moist at 2 m depth below ground, moist at 3 m below ground	3.5	No	Alluvium
2A	6/04/2017	Silty sand/silty sandy clay/ silty clayey sand	dry to moist at 1 m depth below ground, moist at 1.4 m below ground	3.5	No	Alluvium
3A	6/04/2017	Silty sand/ sandy clay	dry to moist at 1 m depth below ground, moist at 2.5 m below ground	3.5	No	Alluvium
4A	6/04/2017	Silty sand/ sandy clay	dry	Excavation terminated at 1.5 m (medium strong rock)	No	Bedrock
5A	6/04/2017	Silty sand/ sandy clay/ silty sandy clay	dry at 0.4 m depth below ground, dry to moist at 3-3.5 m	3.5	No	Alluvium
6A	6/04/2017	Silty sand	dry	Excavation terminated at 0.3 m (medium strong rock)	No	Bedrock
7A	6/04/2017	Silty sand/ silty sandy clay	dry	Excavation terminated at 0.6 m (medium strong rock)	No	Bedrock
8A	6/04/2017	Silty sand/ sandy clay	dry	Excavation terminated at 1.3 m (medium strong rock)	No	Bedrock
9A	6/04/2017	Silty sand/silty sandy clay/ sandy clay/ clayey sand	dry to moist at 1-2 m below ground, moist to wet at 2-3.5 m below ground	3.5	No	Alluvium
10A	6/04/2017	Silty sand/clayey sand/silty sandy clay/ sandy clay	dry to moist at 1.5-22 m below ground, moist at 2-3.5 m below ground	3.5	No	Alluvium

3. New monitoring bores

Five (5) new bores across 3 locations have been installed on behalf of QPRC to provide groundwater information for the Site (). Details of bore installation and initial sampling are provided in Appendix B (Coffey, 2019). These bores were installed in January 2019 and were located to coincide with three of the previously bored geotechnical holes: 1A, 2A and 9A.

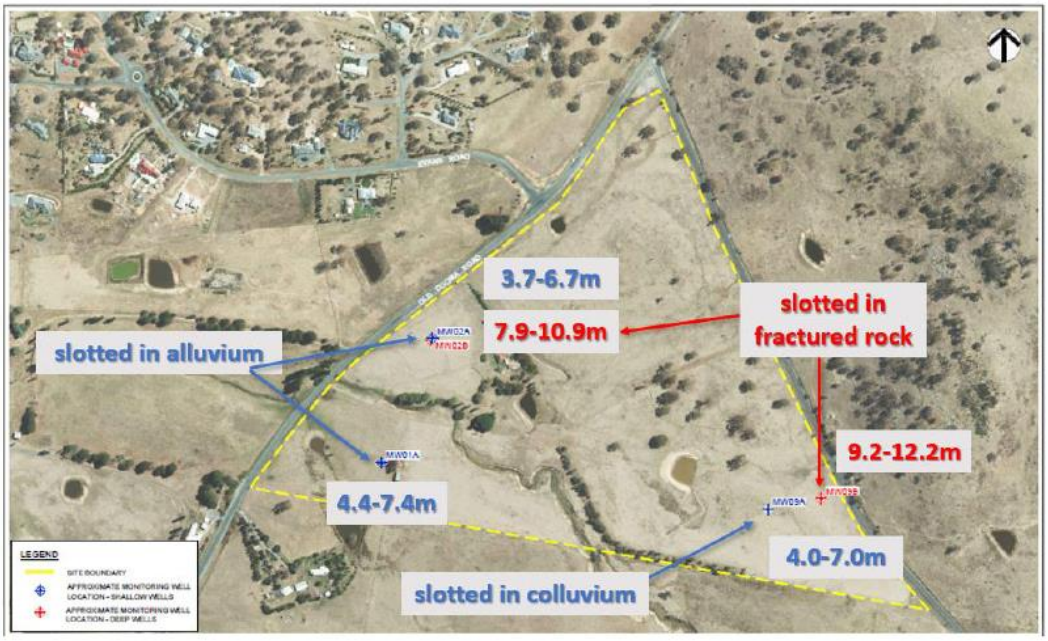

Figure 3-1: Locations of the five new monitoring bores on the Site showing slotted intervals for each bore

Based on the drilling records, the three shallow bores (1A, 2A and 9A) are constructed within clayey sand-sandy clay alluvium/colluvium with the remaining two deep bores (2B and 9B) constructed to monitor groundwater in the dacite (weathered and fractured) bedrock.

In-Situ Rugged Troll 100 data loggers were installed at each of the three (3) shallow bores (MW01A, MW02A and MW09A) on 13th February 2019, and an In-Situ Rugged BaroTroll data logger was installed at the top of the MW02A bore to monitor barometric pressure. Data is collected every fifteen (15) minutes, with each logger checked, data down-loaded and reinstalled approximately each month. Latest data were retrieved on 21st April, 2020.

Manual water level measurements were taken at all 5 bores during each data collection event to validate the collected logger data. Loggers have not proven to be completely reliable, however, with some data lost, notably at bore MW01A, with all loggers malfunctioning following heavy rains in February this year. This has resulted in some recent data gaps at all sites. All loggers were replaced on 31st March, 2020. The replacement bore at MW01A also malfunctioned and re-set, losing the data. This logger was replaced on 21st April, 2020.

4. Addressing the NRAR recommendations

4.1 Baseline groundwater and water quality

Time series for all collected data is presented in Figure 4-1. Water level data has now been collected over 15 months (January 2019 to April 2020) and continues with 3 data loggers in the shallow monitoring bores (in the alluvium of Bores MW01A and MW02A and the colluvium of MW09A) and on-going manual dipping on a roughly monthly basis.

Distinct trends can be determined at each site (and each bore) providing information on groundwater recharge and movement and connectivity between shallow and deep aquifers. Comparison to the rainfall record illustrates the differing response at each location (Figure 4-1).

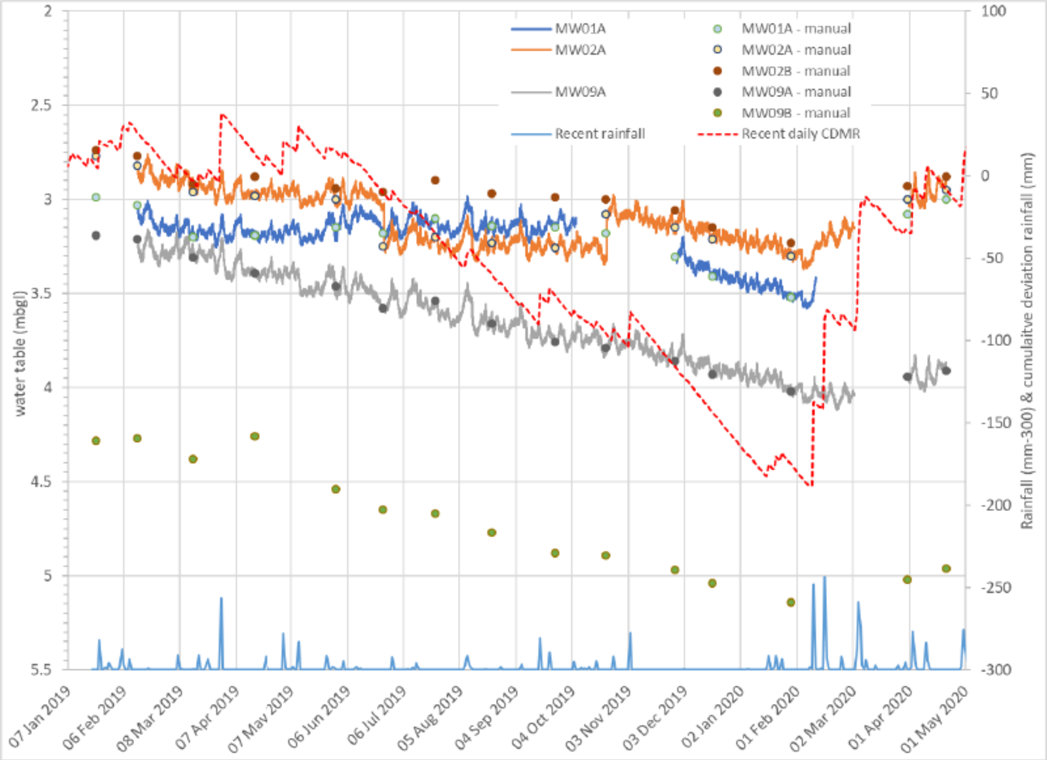

Figure 4-1: Summary chart of data retrieved from the five new monitoring bores at 1241 Cooma Road, Googong.

4.1.1 Site 1A – south of Church Creek

Throughout 2019, the shallow bore at site 1A remained steady (Figure 4-2), despite the regional rainfall deficit, until early October when water level dropped quickly until mid-December, then began to rise, despite minimal rain in the district through November and December (less than the 10th percentiles across the recorded record). Unfortunately, the logger failed in December and the replacement logger also re-set and deleted the data. Manual measurements indicate that the water level returned to previous heights following the rains in early 2020.

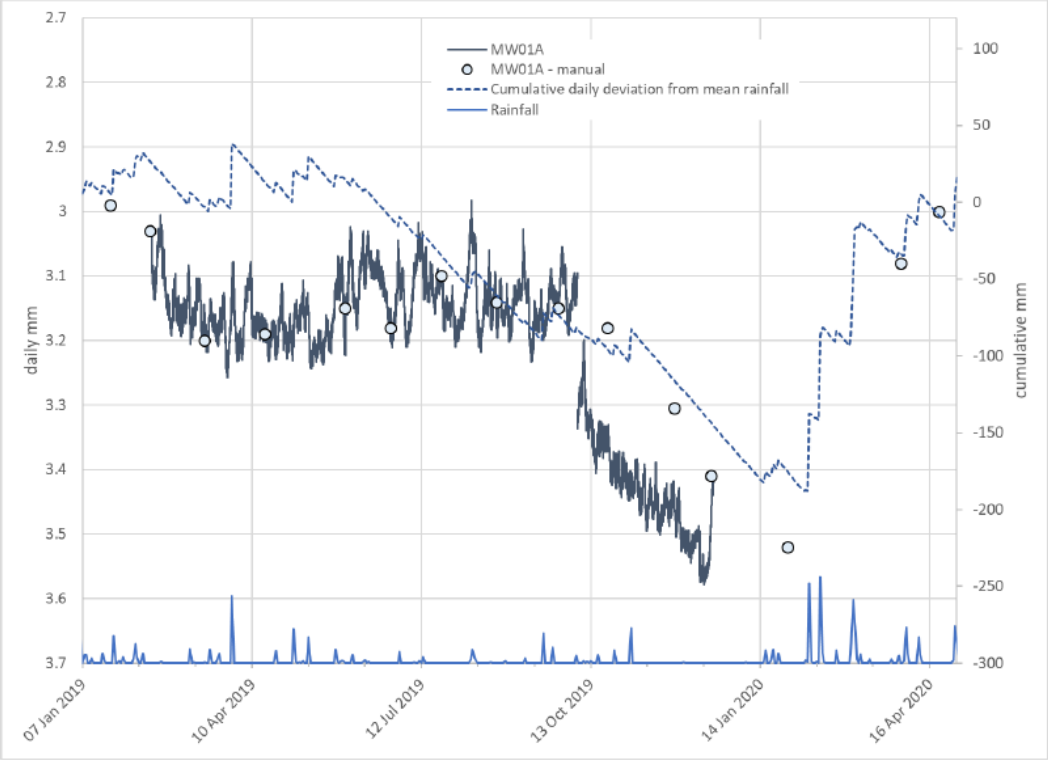

Figure 4-2: Water level at site 1A since January 2019

The significant drop occurred late in the prolonged dry trend in rainfall, following lower-than-average rainfall for October and November (23.4 and 23 mm, respectively, recorded at the Tuggeranong Weather Station – BoM #70339). It is feasible that the drop in water level was driven by external pumping. An active bore (likely stock and domestic use) to the south (GW020892) may have been used during this time. No records have been requested from the owners of this bore to date.

Significant drops are also observed following rainfall events. For example, the water table at MW01A dropped 150 mm during the period between rains from 15th July to 7th August 2019. This amounts to a drop of 6.5 mm/day. This rapid drop suggest a highly transmissive unit with low storage capacity. This would explain why an external stimulus, such as local pumping could have a significant impact.

Of note, manual measurements through October and November are higher than the corrected logger record and this may reflect the unstable nature of this logger which has now been retired from use.

4.1.2 Site 2 – north of Church Creek; west of homestead

The time series for site 2 (Figure 4-1) shows what appears to be the effects of pumping on the shallow bore at site 2A. The congruence between the logger and manual measurements confirm that this is not an instrumentation malfunction. It is likely that this reflects the impacts from pumping at the groundwater bore at Mount Campbell Estate (Figure 2-9) during a period of very low rainfall between June and November 2019 (Figure 4-3). No impacts are seen on the deep bore (2B *see* Figure 4-1) suggesting the two aquifers are isolated from each other.

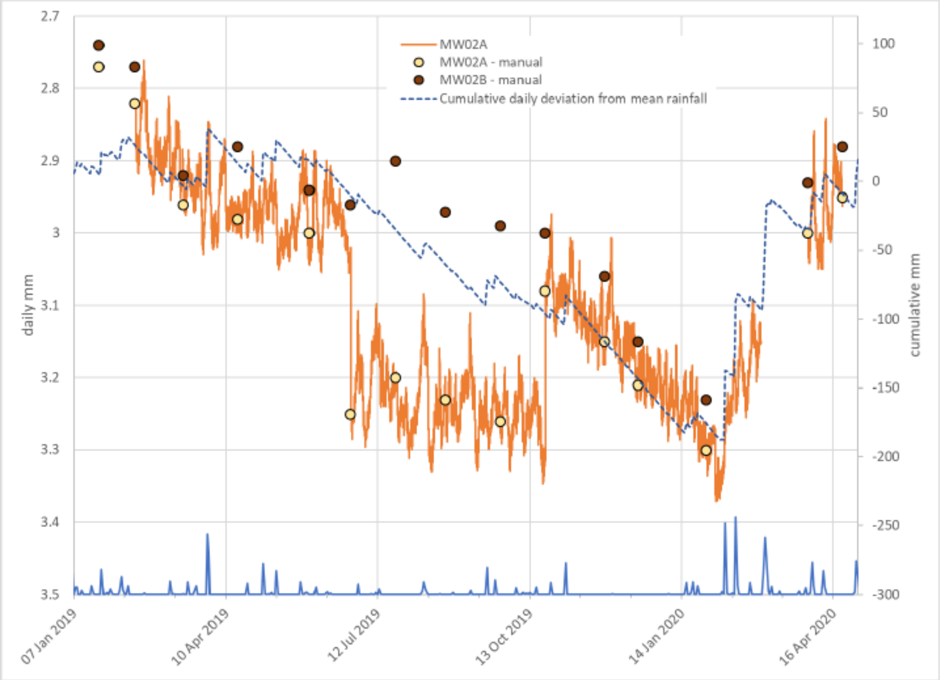

Figure 4-3: Local rainfall (Tuggeranong) compared to water levels at site 2A since January 2019

The deep bore constructed at this site (MW02B) targeted groundwater in the underlying dacite country rock at 7.9 to 10.9 metres below ground. Water levels in this pipe were consistently higher than MW02A indicating an upward pressure and separation between the two aquifers. This was emphasised when the shallow bore recorded a significant drop in June 2019, with the reduction in overlying pressure resulting in a rise in the water level in the underlying aquifer that then gradually receded over time until the shallow aquifer returned to normal levels in late October and water levels in the deep bore dropped to a comparable pressure difference to that prior to the change in level at MW02A. Both bores have tracked in parallel since that time, suggesting a common recharge source, but separation of the aquifers in the vertical sense by a confining unit.

The response of MW02A suggests impact from nearby pumping of the aquifer. The active bore to the west on Mount Campbell's Estate may therefore be tapping the shallow groundwater, but not the deeper, bedrock aquifer and could be invoked as the source of the drawdown. The estate bore was not monitored during this time and construction details are not available.

Of note, the apparent response to external pumping occurs at a different time to that observed at MW01A, suggesting the formations on either side of Church Creek behave independently, suggesting that the creek acts as a boundary feature for the shallow groundwater system.

4.1.3 Site 9 – south-west corner of the Site

Water levels at the south-eastern bore location show a more subdued response to rainfall and do not respond rapidly to significant rainfall events (Figure 4-4).

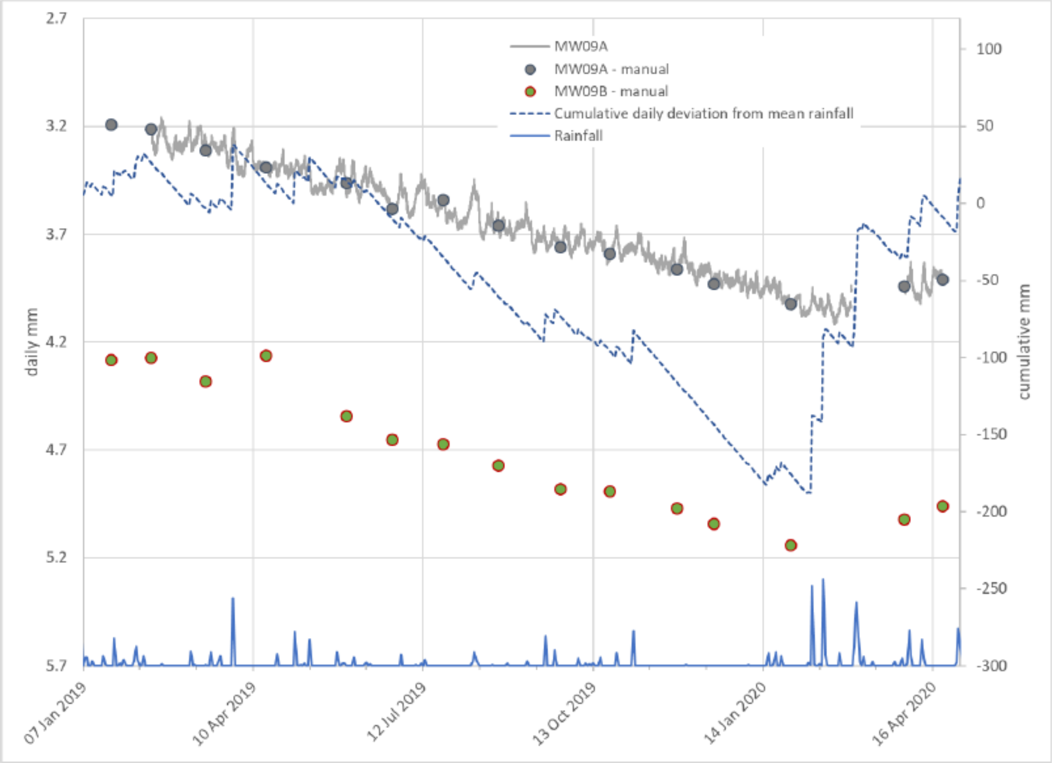

Figure 4-4: Water levels recorded at site 9 since January 2019 compared to regional rainfall.

Significant rainfall events at the beginning of this year (two events greater than 50 mm in February and a four-day event in March precipitating 83 mm) realised a reversal in the downward trend for the previous year, though not a significant rise.

Water levels for both aquifers follow similar trends, with a consistent metre separation over time. As the water levels in bore MW09B are higher than the base of the slots in bore MW09A (7 m), it can be assumed that an intervening confining layer separate the two aquifers.

4.1.4 Water tables and groundwater flow

Comparison of water levels across the Site show a fall in level from east to west; from high ground in the east down to uniform heights across the Church Creek floodplain (Figure 4-5: Groundwater flow (white arrows) overlain on modelled stream-flow. Maximum height of groundwater (mAHD) indicated for the shallow water tableFigure 4-5). Indicative flow lines suggest that the creek acts as a drainage feature and boundary influence on groundwater flow. Discordant response to external stimuli (presumed to be pumping from different bores) at locations 1 and 2 support the compartmentalisation of groundwater sources north and south of the creek. The observed opposite level response for bores 2A and 2B at the same location strongly suggest the shallow alluvium and colluvium aquifer is separated from the deeper bedrock aquifer by a confining layer, likely the clayey-sand in the weathered zone above the dacite.

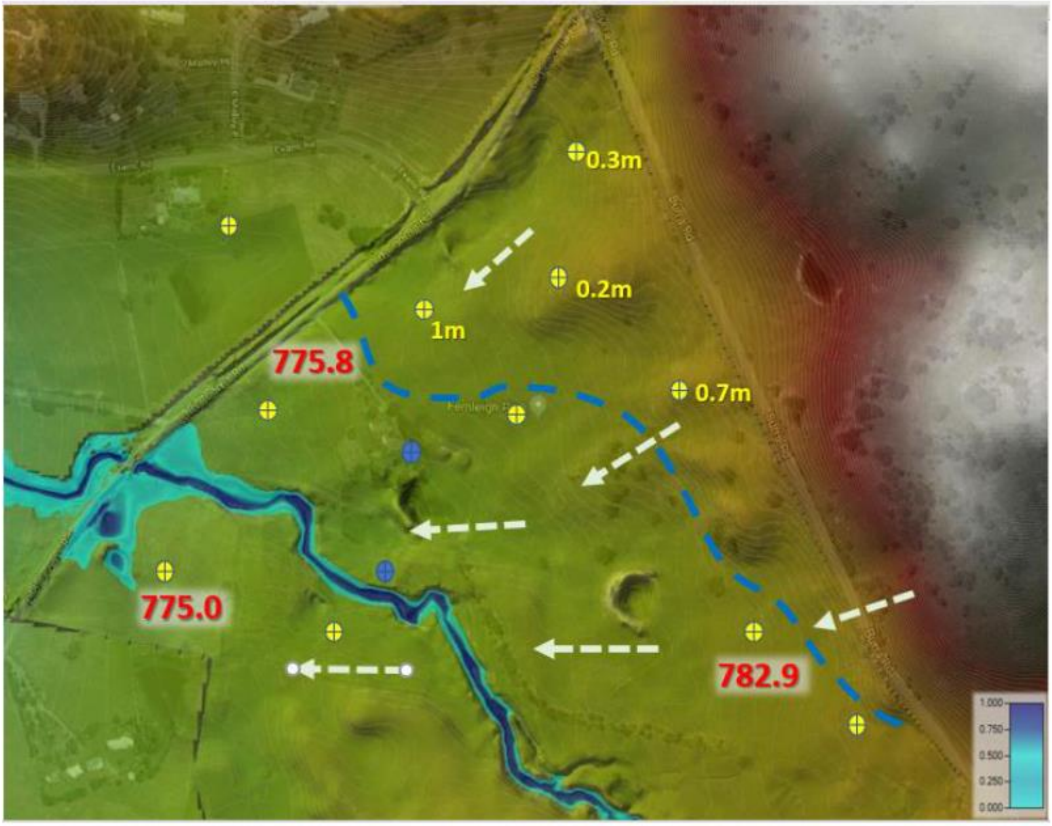

Figure 4-5: Groundwater flow (white arrows) overlain on modelled stream-flow. Maximum height of groundwater (mAHD) indicated for the shallow water table. Zone of very shallow soil/weathered zone indicated by the dashed line.

Groundwater heights, however, are comparable under normal conditions, for both aquifers (~775 mAHD at site 2 and ~783 mAHD at site 9), reflecting the common recharge source and flow directions.

4.1.5 Water quality

Following development of the monitoring bores (purging each well by a minimum of 3 bore casings, or until water quality readings stabilised), water quality measurements were taken using the field calibrated TPS 90FL-T water quality meter, measuring electrical conductivity (EC), pH, dissolved oxygen (DO), redox potential (Eh), temperature and turbidity. A photoionisation detector was then used to determine the presence of volatile organic compounds in the wells. Results are presented in Table 4-1.

All samples had moderate salinity (just above drinking guidelines) and were slightly acidic, reflecting both a short path from rainfall recharge to groundwater and flow through clay-rich sediments. The close proximity to the surface, combined with the short recharge distance has resulted in relatively high oxygen contents (about half saturation) and positive redox, as expected with relatively high oxygen levels. Temperatures are cooler than local minimum temperatures for that time of year and likely represent residual temperatures from the previous winter. Whilst generally cloudy (reflecting the clayey nature of the host rocks), no significant volatiles were recorded indicating no contamination from surficial sources.

Table 4-1: Water quality measurements on five monitoring bores taken on January 22nd, 2019

Bore ID	Total well depth (mbtoc)	Water level (mbtoc)	Purge volume (L)	EC (µS/cm)	pH	DO (ppm)	Eh (mV)	T (°C)	Volatiles (PID)	Turbidity (NTU)
MW01A	7.4	2.99	70	821	6.69	4.36	137	15.5	No odour nor sheen	Turbid (580)
MW02A	7.2	2.77	35	1594	6.51	3.87	72	15.5	No odour nor sheen	Cloudy (486)
MW02B	11.4	2.74	70	1315	6.36	3.05	87	13.5	No odour nor sheen	Slightly cloudy (17)
MW09A	7.0	3.19	30	690	6.61	2.27	101	13.7	No odour nor sheen (3.9 pm)	Very cloudy (755)
MW09B	12.2	4.28	55	1464	6.4	1.22	68	10.0	No odour nor sheen	Slightly cloudy (32)

Notes:
mbtoc = metres below top of casing
L = litres
µS/cm = micro Siemens per centimetre
ppm = parts per million, or milligrams per litre (~8 ppm DO = 100% saturated water)
mV = millivolts
NTU = nephelometric turbidity units

4.2 Assessment of cover and depth to bedrock

The additional bore logs generated through installation of the new monitoring bore network provide further ground material information to assess the capability of the Site to host grave sites. Specifically, depth to competent rock can now be estimated for much of the Site and this defines a zone where depth to hard rock is less than 3 m and therefore not suitable for grave sites (Figure 4-6).

Figure 4-6: Depth to competent bedrock. Shaded area marked where bedrock is less than 3 m below ground. Numbers in brackets inferred from bore construction records.

All locations investigated to the south of the shallow soil zone had suitable materials for soft excavation. Topsoil and alluvium ranges up to 4 m where logged, increasing to the south and west. Beneath this, incompetent weathered material extends up to 7 m on site and likely deeper to the south and west. Lower horizons tend to be clay-rich and form confining layers above the fractured dacite bedrock.

Further, the bore logs reveal that most sediments are clay-rich and the presence of highly permeable sediments is restricted to thin layers and not pervasive across the Site (Appendix B).

4.3 Hydrogeological assessment of present and future risks

The recent time series of water levels can be directly compared to the rainfall record and relative response estimated. Thus, water levels at site 1 (MW01A – Figure 4-2), show an initial response to rainfall events, but rapidly dissipate to an equilibrium level at about 3.15 m below ground level. At site 2 (MW02A – Figure 4-3) the water table also responds immediately to all rainfall events, but only events greater than 30 mm appear to result in any significant departure from equilibrium. No rainfall results in a fall in water table of 2 mm/day. Rainfall of 250 mm over two months in summer led to a water table rise of 300 mm.

The bores to the south-east (MW9a and MW9B) show a subdued response to rainfall, with an apparent 2 week lag when sufficient rain falls (>100 mm) to cause a water table response (Figure 4-4).

To explain the previously measured high water table in June 2018 the monitored data can be plotted against the long-term rainfall record (Figure 4-7). The rainfall record shows that the current phase of drying follows a significantly wetter period through 2016 and 2017. The spot read in 2018 was taken following the wetting period. Specifically, a steep rising trend in cumulative rainfall followed a sequence of high rainfall events late in 2017. That sequence is comparable, but lower, in volume (183 mm) to that recently observed in February this year (219 mm) that produced a similar cumulative increase in the rainfall record.

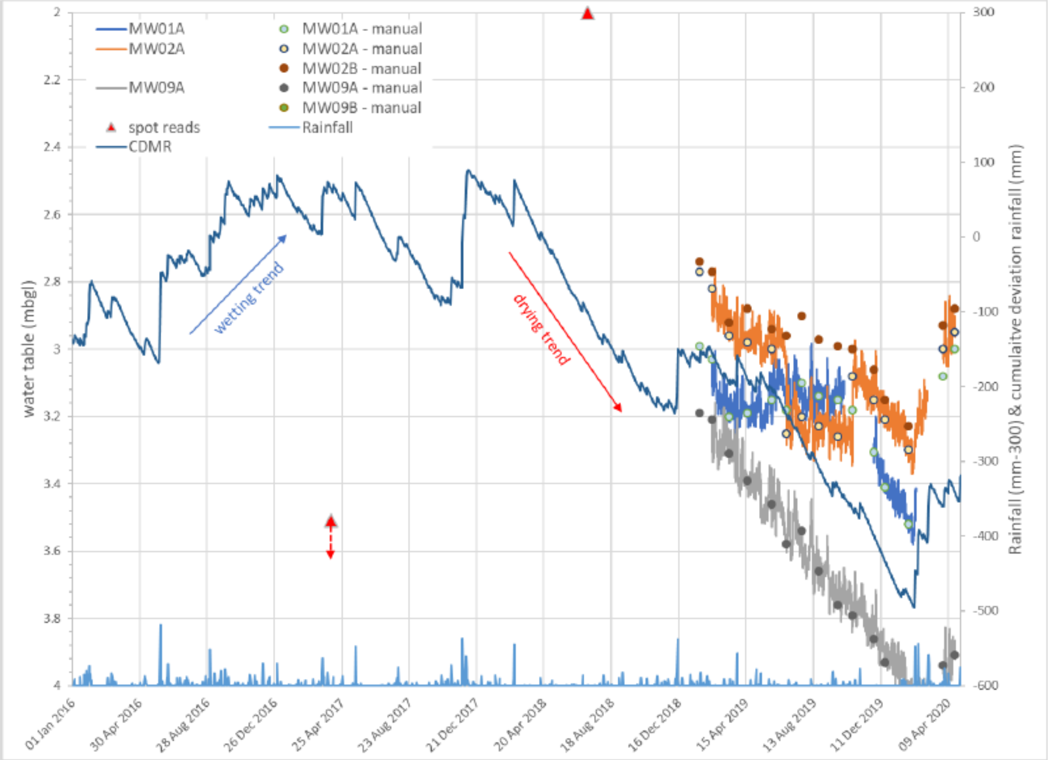

Figure 4-7: Longer term rainfall record and previous water level measurements on Site

Whilst the trends in rainfall are indicative of water table trends, longer records are required to estimate quantitative relationships. Thus, no geotechnical bores developed in April 2017 recorded groundwater, which must have been at a depth of greater than 3.5 m across the Site, despite being during a climatically wetter period (Figure 4-7). Reference is made to the longer term rainfall record (Figure 2-4), whereby the recent drying trend is small in comparison to that realised through the Millennium Drought.

The rapid response of the water tables (within a day) to significant rainfall events (>30 mm) and rapid return to ambient conditions when events are less than 30 mm, or rapid fall when rainfall events are indicative of low storage potential and/or highly transmissive aquifers. The high clay content of most sediments encountered in bores suggests profile transmissivity would be low, though traces of gravel and some sand layers are indicated in the bore logs (). The indication is that storativity is low, hence responses to water addition (recharge) or removal (pumping) is locally amplified across the western side of the Site. The muted response observed at Site 9 is indicative of greater storage potential and hence less response to changes in water supply and demand.

4.3.1 Site zonation

Consideration of water levels across the Site, combined with understanding of ground conditions and with regard to previous studies on hydrology (Eco Logical Australia, 2019), geotechnical surveys (ACT Geotechnical Engineers, 2017) and regional groundwater surveys (HGC, 2001) allows an assessment of distinct zones across the Site and their applicability for gravesite development (Figure 4-8).

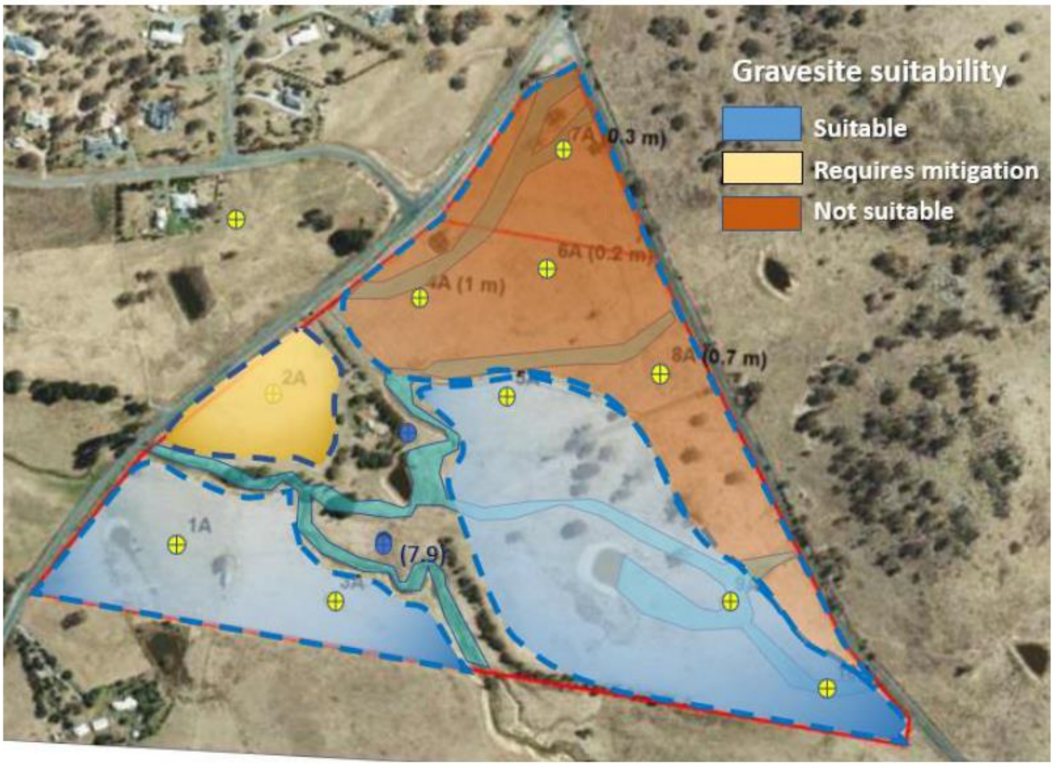

Figure 4-8: Site zonation for gravesite suitability

4.3.1.1 Suitable area

Suitable area across the Site has the combination of adequate depth (>3 m) of unconsolidated material, overlying a clay base aquitard over the competent bedrock and has water tables that are consistently equal or greater than 3 m below ground surface. Deeper groundwater is physically separated from the shallow system in the unconsolidated material and can be protected through preservation of the intervening clay-rich aquitard.

This zone covers the southern half of the Site and extends from the south-east corner, along the southern boundary to the south-west corner. Excluded areas include the shallow soils to the north and east and the immediate floodplain of Church Creek.

4.3.1.2 Area requiring further testing and monitoring and may require mitigation

An area norther of Church Creek on the eastern boundary appears to maintain groundwater levels around 3 m below ground level, but is susceptible to rapid rises and falls in water levels in response to rainfall patterns. The area appears to respond rapidly to pumping from a bore to the west (Mount Campbell Estate bore) and this may provide a suitable mitigation measure when water tables rise shallower than 3 m below ground surface. Continued monitoring is advised and particularly following rainfall events greater than 30 mm.

4.3.1.3 Area not suitable for gravesites

The area to the north of the Site has shallow soils and competent rock within 3 m of the ground surface making this region unsuitable for gravesites.

The riparian zone within 40 m of the high bank of the creek, as defined through flood modelling (Eco Logical Australia, 2018) should be avoided due to the potential for flooding and rapidly elevating water tables in the alluvium of the creek bed.

5. Consolidated response to NRAR specific recommendations

NRAR provided a number of specific recommendations to be addressed prior to finalising the proposed amendment to the LEP:

5.1 NRAR Recommendation #1

"Further investigation of the baseline groundwater levels and groundwater quality for a minimum 12 month period is undertaken prior to any further action to ensure there is sufficient depth to the water table."

5.1.1 Response

A network of five new monitoring bores (at three locations) have been installed across the Site, with nested sites in the east and west and a shallow bore to the south. Continuous logger monitoring of water levels has been undertaken over the past 15 months and manual spot readings have confirmed the accuracy of the loggers.

5.2 NRAR Recommendation #2

"Assessment of the cover-type material and depth to bedrock across the entire site to ensure that natural formations offer protection."

5.2.1 Response

Compilation of all geotechnical reports has provided a comprehensive picture of shallow ground materials allowing a distinction between shallow and deep unconsolidated profiles and demarking a zone with insufficient depth for gravesite development.

5.3 NRAR Recommendation #3

"Conduct a hydrogeological assessment of present and future risks should groundwater levels be less than 3 m below the ground surface … and:

a) Establish recommendations concerning appropriate management and treatment of leachates

b) Establish recommendations in order to prevent migration of decomposition products into the substrate and groundwater."

5.3.1 Response

Comparison of water levels with recent rainfall records allows an assessment of response to future events. Water levels respond to definable rainfall events and can be related to past rainfall trends. Rapid response to external stimuli (either addition through indirect rainfall recharge, or extraction through pumping) affords an opportunity to maintain deeper water levels, particularly in the western part of the Site where current water tables are close to 3 m below ground level.

The most appropriate course of management is to prevent water tables rising to depths less than 3 m below ground level through the use of monitoring and pumping as necessary.

a) Maintenance of the existing clay aquitard between the shallow and deep aquifers will restrict migration of any potential contaminants. No gravesites should be dug that penetrate this layer.

b) Shallow aquifer water naturally uses the existing surficial drainage network and this system should be monitored and bunding and sedimentation ponds could be considered. The existing flow is currently impeded by the road to the west (Eco Logical Australia, 2018) and a suitable containment structure could be established at this location.

5.4 NRAR Recommendation #4

"Allowance for climatic effects should be considered."

5.4.1 Response

Current climate predictions for this region suggest a continued drying, punctuated by more severe storm events. Whilst the drying will maintain low water levels, it is likely that extreme events (>100 mm) could induce water level rise in excess of 0.5 m, based on current records. Mitigation actions, such as pumping can effectively reduce this potential and should be coupled with on-going monitoring to continue to build a full understanding of the dynamics of the aquifer systems.

5.5 Consolidated response to NRAR generic recommendations

NRAR also noted five relevant (hydrogeological) general recommendations for any new cemetery site (Section 1.2). Based on the studies undertaken to date, the proposed development can satisfy these recommendations through an on-going program of groundwater monitoring and continued awareness of rainfall patterns and the corresponding potential impacts on the water tables. Judicial use of local groundwater pumping can help lower water tables as required, with a natural watercourse providing a suitable discharge pathway. Water quality in the groundwaters is good and would not pose any environmental stress to the surface system.

Groundwater could therefore be maintained at greater than 3 m below the ground surface (general recommendation 1) and gravesites can be excavated a minimum of 1.5 m above the water table for a large portion of the Site as dictated by the depth to competent rock (general recommendation 5).

Depth to unaltered or unweathered bedrock is in excess of 6 m for much of the Site. Areas where bedrock is within 3 m of the land surface have been identified and can be avoided (general recommendation 6).

The floodplain adjacent to the creek lines has been determined through examination of digital elevation models and through flood modelling (Eco Logical Australia, 2018) and these zones should be avoided as gravesites (General recommendation 7).

Zonation of the Site allows distinction of areas where there is a high risk of impact from gravesites. Gravesites would be excluded from zones where water tables are consistently shallow; zones which are adjacent to the creek and where the shallow substrate is very permeable (general recommendation 8).

6. References

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Eco Logical Australia 2018. Proposed cemetery site, Old Cooma Road – Hydrological Assessment. Report prepared for Queanbeyan-Palerang Regional Council (QPRC)

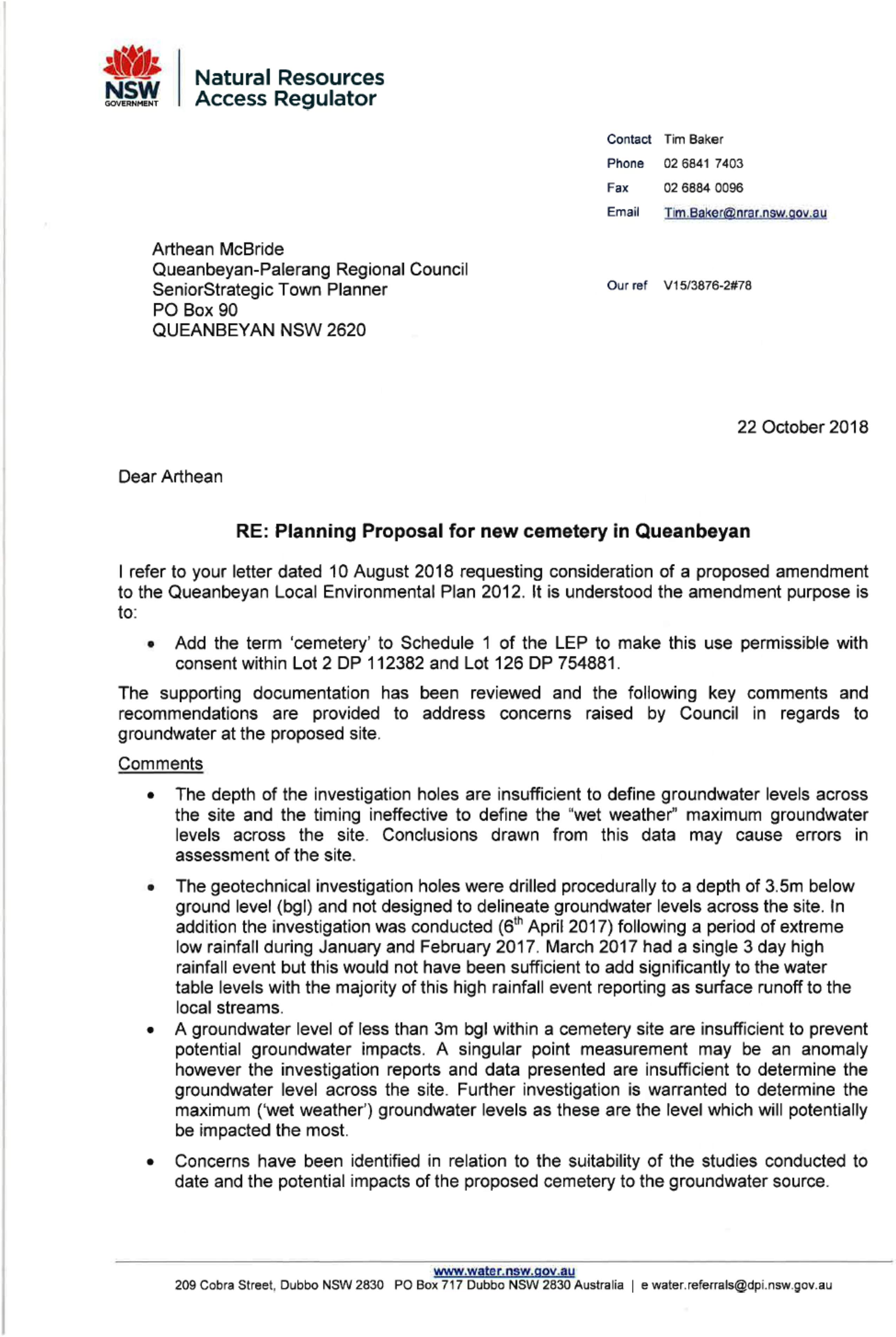
HGC 2001. *Groundwater investigation, Proposed Beatty Hill subdivision, Old Cooma Road, Williamsdale area.* Hydroilex Geotechnical Consultants.

QPRC 2012. *Planning Proposal for Cemetery and Crematorium, Lot 2 DP 112382 and Lot 126 DP 754881*. Queanbeyan-Palerang Regional Council.

SRLE, 2015*. Rural Residential Subdivision, Burra Road, Mount Pleasant: Flood Analysis and Concept Culvert Design*, Southern Region Land Engineering.

WSP 2012. *Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources.*

Appendix A NRAR response to initial documentation (2 October, 2018)



NSW GOVERNMENT
Natural Resources
Access Regulator

Contact Tim Baker
Phone 02 6841 7403
Fax 02 6884 0096
Email Tim.Baker@nrar.nsw.gov.au

Arthean McBride
Queanbeyan-Palerang Regional Council
SeniorStrategic Town Planner
PO Box 90
QUEANBEYAN NSW 2620

Our ref V15/3876-2#78

22 October 2018

Dear Arthean

RE: Planning Proposal for new cemetery in Queanbeyan

I refer to your letter dated 10 August 2018 requesting consideration of a proposed amendment to the Queanbeyan Local Environmental Plan 2012. It is understood the amendment purpose is to:

- Add the term 'cemetery' to Schedule 1 of the LEP to make this use permissible with consent within Lot 2 DP 112382 and Lot 126 DP 754881.

The supporting documentation has been reviewed and the following key comments and recommendations are provided to address concerns raised by Council in regards to groundwater at the proposed site.

Comments

- The depth of the investigation holes are insufficient to define groundwater levels across the site and the timing ineffective to define the "wet weather" maximum groundwater levels across the site. Conclusions drawn from this data may cause errors in assessment of the site.
- The geotechnical investigation holes were drilled procedurally to a depth of 3.5m below ground level (bgl) and not designed to delineate groundwater levels across the site. In addition the investigation was conducted (6th April 2017) following a period of extreme low rainfall during January and February 2017. March 2017 had a single 3 day high rainfall event but this would not have been sufficient to add significantly to the water table levels with the majority of this high rainfall event reporting as surface runoff to the local streams.
- A groundwater level of less than 3m bgl within a cemetery site are insufficient to prevent potential groundwater impacts. A singular point measurement may be an anomaly however the investigation reports and data presented are insufficient to determine the groundwater level across the site. Further investigation is warranted to determine the maximum ('wet weather') groundwater levels as these are the level which will potentially be impacted the most.
- Concerns have been identified in relation to the suitability of the studies conducted to date and the potential impacts of the proposed cemetery to the groundwater source.

Recommendations prior to finalising the proposed amendment

1. Further investigation of the baseline groundwater levels and groundwater quality for a minimum 12 month period is undertaken prior to any further action to ensure there is sufficient depth to the water table. This should be performed by the installation of three monitoring bores to basement in a way to allow for determination of groundwater flow direction, i.e. not aligned), soil characterisation (logging during drilling) and water quality characterisation. The more significant information to obtain is the depth and variation of water levels. This can be obtained through the use of automated water level loggers placed in bores for the recommended 12 month period.
2. The further investigation is to include an assessment of the cover material type and depth to bedrock across the entire site to ensure that natural formations offer protection.
3. Using the data obtained under recommendation 1 and 2, conduct a hydrogeological assessment of present and future risks should groundwater levels be less than 3 m below the ground surface or occurs at, or less than, 1.5 m below the burial level; and
    a. establish recommendations concerning appropriate management and treatment of leachates;
    b. establish recommendations in order to prevent migration of decomposition products into the substrate and groundwater;
4. Allowance for potential rise in the water table, including climatic (drought versus non-drought), seasonal variations and extreme rainfall must be included in any further assessment.

Recommendation should the amendment be approved

- Before commencement of burials, best practices would require a minimum of three (3) groundwater monitoring bores are installed; constructed into bedrock to enable sufficient monitoring of groundwater levels, groundwater flow across the site and groundwater quality. These bores can be the same bores as those installed prior to determination. The risk assessment will inform the level of effort and frequency of monitoring requirements.

General Recommendations for any new cemetery site

1. The site should not have groundwater closer than 3m below ground level.
2. Burials should be at least 250 metres from any well, borehole or spring supplying water for human consumption or used in food production – for example at dairy farms, commercial vegetable gardens/farms, etc.
3. Burials should be at least 30 metres from any spring or watercourse not used for human consumption or not used in food production.
4. Burials should be at least 10 metres from any field drain, including dry ditches.
5. Burials should at least 1.5 metre clearance between the base of the grave and the top of the maximum groundwater level – burial sites should not have any standing water in them when dug.
6. Burial sites should not be dug in unaltered or unweathered bedrock (i.e. bedrock areas are recommended to be excluded from all burials)
7. Burial sites should not be dug in areas susceptible to groundwater flooding (e.g. decomposed – weathered bedrock zones may be noteworthy groundwater sources, buried alluvial sand - gravel deposits along watercourse lines are highly susceptible to groundwater flooding).
8. Cemeteries are not recommended to be located in areas where:
    a. The groundwater level is shallow

b. Seasonal or ephemeral floods occur
c. The substrate is very permeable (e.g., sands and gravels, fractured rocks, karst structures)

Should you have any further queries in relation to this submission please do not hesitate to contact Tim Baker 02 6841 7403.

Yours sincerely

Vickie Chatfield
Manager Water Regulatory Operations- West
Department of Industry- Natural Resources Access Regulator

Appendix B Coffey Monitoring Well Installation Report

Unit 2, 16 Mildura Street
Fyshwick
ACT 2609 Australia

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coffey.com

24 January 2019

Our ref: 754-CBREN225122-L01

Eco Logical Australia
2/11 London Circuit
Canberra ACT 2601
Sent via email: RichardC@ecoaus.com.au

Attention: Dr Richard Cresswell

Dear Richard,

Monitoring Well Installation, Queanbeyan-Palerang Proposed Cemetery Site

1. Introduction

Eco Logical Australia (ELA) on behalf of Queanbeyan Palerang Regional Council (QPRC) engaged Coffey Services Australia Pty Ltd (Coffey) to install groundwater monitoring wells at three locations at a site located within Lot 2 DP112382 and Lot 126 DP754881, situated at 1241 Old Cooma Road, Googong (herein as the 'site'). Based on information provided by ELA, Coffey understands the site is being considered as a proposed development site for future use as a cemetery. The site location is shown in Figure 1, Attachment A, while a site layout plan is presented in Figure 2.

ELA have been assisting Queanbeyan-Palerang Regional Council (QPRC) with environmental factors, including an assessment of groundwater to assess the suitability of the site for the proposed use. Based on feedback from the regulator, a local understanding of the groundwater levels is required for 12 - 24 months period for the proposed future cemetery site.

This letter report summarises monitoring well installation works undertaken at the site by Coffey, which have been carried out in general accordance with our proposal (ref: 754-CBREN225122-P01) and the Minimum Construction Requirements for Water Bores in Australia 2012.

2. Background

A previous geotechnical assessment was undertaken at the study site by ACT Geotechnical Engineers in 2017[1], which included an investigation of subsurface conditions via ten auger holes. The assessment found depth to rock at the site is generally between 1m and 3.5m bgl in the northern portion of the site, with depth to bedrock exceeding 3.5m in the southern portion of the site.

---

[1] ACT Geotechnical Engineers Pty Ltd (2017). *1241 Old Cooma Road, Googong NSW Geotechnical Investigation Report*. Dated 13 April 2017, Ref: MD/C8640

Groundwater was not encountered within the upper 3.5m bgl across the study area and the soils were mostly dry to moist.

A registered groundwater bore search was conducted by ELA which indicated five (5) bores were placed on-site and/or within the 200m reporting boundary with bore depth around 20m bgl. Coffey subsequently carried out a site inspection on 07 July 2018 to assess/inspect the five indicated groundwater bores both on-site and around the site, which included gauging the bores for depth to water and total depth where they were readily accessible. In addition, where possible collection of water samples for field water quality measurement was undertaken. During the assessment one bore at the site (GW0209031.1) was able to be gauged with total well depth at 18.84m below ground level (bgl), and depth to groundwater at 2.04m bgl.

3. Objectives

The objective of works undertaken during this investigation was to supervise the installation of groundwater monitoring wells at three locations within the site, to assess depth to groundwater and to allow flow directions beneath the site to be interpreted.

4. Scope of works

4.1. Preliminaries and project management

The proposed scope of work was to drill and install 3 groundwater wells upto 20mbgl over two days of site activities. During site investigation works it was noted that shallow groundwater was noted in alluvial soils above the expected rock underlying the site. Therefore, in consultation with ELA during the first day of site works, the scope was amended such that three shallow boreholes / wells were to be drilled into the alluvial soils and then two deeper boreholes approximately 4m into the underlying rock would be drilled and installed, resulting in five wells in total being installed at the three nominated locations across the site.

The general scope of work for this assessment included the following preliminaries:

- Engagement of licenced drilling and service locating subcontractors;
- Preparation of a site safety plan, including Environmental Safe Work Method Statements (ESWMS) for all work tasks and a Site Safety Management Plan in accordance with our Health, Safety, Security and Environment (HSSE) Management System, and;
- Liaison with relevant staff from ELA and QPRC, along with site tenants.

4.2. Borehole drilling and installation

A Coffey environmental scientist/engineer attended the site between 18 and 20 December 2018, to select borehole locations, manage site safety and supervise service location and monitoring well drilling and installation works. Fieldwork methodology for borehole excavation included the following:

- Mobilisation to the site and liaison with the site tenant;
- Selection of the three investigation locations in accordance with the site plan provided by ELA (sent via email on 14 December 2018);
- Clearance of borehole locations from underground services utilising an accredited service locator, with reference to Dial-Before-You-Dig (DBYD) plans;
- Drilling of 100mm diameter boreholes utilising a track-mounted Geoprobe 7822DT drilling rig, and;

- Logging the borehole soil returns in accordance with the Unified Soil Classification System (USCS);

Boreholes were advanced using hand auger methods in the upper 0.5m bgl to minimise the risk of damage to unidentified buried services at the site. Boreholes were then advanced using the drilling rig with a solid-stem flight auger attachment until practical refusal in bedrock, below which, boreholes were advanced to target depth using an air hammer attachment. Selected site photographs for drilling works are shown in Attachment B, while bore logs for encountered ground conditions are shown in Attachment C.

4.3. Monitoring well installation

Where water-bearing formations were encountered in boreholes, 50 mm monitoring wells were installed in accordance with the Minimum Construction Requirements for Water Bores in Australia 2012. The general construction of monitoring wells included the following:

- Monitoring wells were lined with Class 18 PVC piping, with PVC slotted screens (3m in length) placed adjacent to the water-bearing formation;
- Boreholes were backfilled using gravel pack approximately 0.5m to 1m above the top of the screens. A minimum 500mm bentonite plug was installed over the underlying gravel pack, to isolate the targeted water bearing zone from other formations and prevent transfer of water between zones;
- Boreholes were backfilled to surface level using a cement/bentonite grout mix, with flush-mounted gatic covers installed to minimise risk of injury to, or interference from, livestock and site users.

Monitoring well locations were also recorded using hand-held GPS to an accuracy of ± 5m. GPS Coordinates are shown on each of the bore logs. Positions are provided in the MGA94 (Zone 55) co-ordinate system. Collection of survey data for well elevations was not included in the scope for this project.

4.4. Well development and monitoring

Following well installation on 20 January 2019 the wells were gauged then developed to collect field water quality measurements. These works included the following:

- All five wells were gauged to measure depth to groundwater from the top of the well casing;
- Monitoring wells were developed by purging a minimum of three well volumes, or until water quality measurements taken from purged groundwater had stabilised;
- Water quality measurements were then taken using a field calibrated TPS 90FL-T water quality meter, which included field measurements for dissolved oxygen (DO), Electrical Conductivity (EC), pH, redox potential, temperature and turbidity, and;
- Well headspace was measured using a photoionisation detector (PID) to determine the presence of volatile organic compounds in the wells.

5. Summary of ground conditions

Table 5.1 below provides a summary of subsurface conditions observed at the site, for detail, reference should be made to the Borehole Logs and accompanying explanation sheets, included as Appendix C.

Table 5.1 - Summary of ground conditions encountered during borehole drilling works

Material	Description	Depth to Top of Unit (m)	Range of Unit Thickness (m)
Topsoil	silty CLAY, low plasticity, brown, with rootlets and organic fines	0	0.05 to 0.2
Alluvium	Silty CLAY to clayey SAND, low to medium plasticity clay, brown to pale brown, fine to coarse grained sand, with traces of fine to medium grained gravel	0.05 to 0.2	1.0 to 4.0
Residual Soil	Clayey SAND, fine to medium grained, pale brown, medium plasticity clay, very dense	1.0 to 4.0	0.75 to 1.5
Dacite Bedrock	Extremely and highly weathered, very low to low strength	3.1 to 7.6	0.2 to 2.3
	Moderately to slightly weathered, generally low to medium strength	6.9 to 7.6	Unproven

6. Monitoring well installation summary

Three monitoring wells (MW01A, MW02A and MW09A) were installed in the shallow alluvial aquifer across the site at three locations, while two wells (MW02B and MW09B) were installed deeper in fractured bedrock at two locations shown in Figure 2. A summary of monitoring well construction details is shown in Table 6.1, below.

Table 6.1 - Summary of monitoring well construction details

Field ID	Depth to water (mbtoc)	Screen depth interval (m bgl)	Inferred water-bearing formation
MW01A	2.99	4.4 – 7.4	Alluvium
MW02A	2.77	3.7 – 6.7	Alluvium
MW02B	2.74	7.9 – 10.9	Fractured Bedrock
MW09A	3.19	4.0 – 7.0	Colluvium/Alluvium
MW09B	4.28	9.2 – 12.2	Fractured Bedrock

Soils encountered at the site generally comprised layers of alluvial silty CLAY and clayey SAND to depths of 1-4m below ground level (bgl), underlain by residual clayey SAND and DACITE bedrock.

7. Hydrogeological observations

Groundwater quality and gauging data measurements collected during field activities conducted on 22 January 2019 are presented in Table 1, Attachment D. Groundwater gauging and field measured water quality results are summarised in table 7.1 below:

Table 7.1 - Summary of groundwater monitoring results within shallow and deeper wells .

Measurement	Shallow wells (alluvium)	Deep wells (fractured rock)
Depth to standing water level (mbtoc)	2.77 to 3.19	2.74 to 4.28
Dissolved Oxygen (mg/L)	2.27 to 4.36	1.22 to 3.05
Oxidation-reduction potential (mV)	72 to 137	68 to 87
pH units	6.51 to 6.69	6.36 to 6.4
Electrical conductivity (µS/cm)	690 to 1594	1315 to 1464
Turbidity (NTU)	486 to 755	17.0 to 31.8

8. Closure

Groundwater wells were installed at three nominated locations across the site. Three monitoring wells (MW01A, MW02A and MW09A) were installed within shallow alluvial water-bearing zones, while two additional monitoring wells (MW02B and MW09B) were installed in deeper water-bearing zones within fractured bedrock.

The single gauging event in January 2019 indicated depths to groundwater between 2.77m and 3.19m in the shallow aquifer wells and 2.74m and 4.28m in the deeper fractured rock aquifer.

Longer term monitoring of groundwater levels is necessary to have a better understanding of seasonal variance in the groundwater elevations beneath the site. Coffey understand this will be undertaken under a separate scope and report. It should also be noted that a survey of well elevations was not included within the scope for this project. Survey data for elevations would be required to determine and groundwater flow direction beneath the site.

We draw your attention to the attached sheets titled "Important Information about your Coffey Environmental Report" which should be read in conjunction with this letter.

If you have any further questions, please do not hesitate to contact the undersigned.

For and on behalf of Coffey

Michael Carbone
Senior Associate Environmental Scientist

Attachments

Important Information about your Coffey Environmental Report

Attachment A – Figures 1 to 2

Attachment B – Selected site photographs

Attachment C – Borehole logs and well construction details

Attachment D – Well gauging and water quality data

Important information about your **Coffey** Environmental Report

Introduction

This report has been prepared by Coffey for you, as Coffey's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice.

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Coffey may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Coffey has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

Your report has been written for a specific purpose

Your report has been developed for a specific purpose as agreed by us and applies only to the site or area investigated. Unless otherwise stated in the report, this report cannot be applied to an adjacent site or area, nor can it be used when the nature of the specific purpose changes from that which we agreed.

For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination pose in the context of the agreed purpose. Such risks may be financial (for example, clean up costs or constraints on site use) and/or physical (for example, potential health risks to users of the site or the general public).

Limitations of the Report

The work was conducted, and the report has been prepared, in response to an agreed purpose and scope, within time and budgetary constraints, and in reliance on certain data and information made available to Coffey.

The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Coffey should be kept appraised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statues and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

Interpretation of factual data

Environmental site assessments identify actual conditions only at those points where samples are taken and on the date collected. Data derived from indirect field measurements, and sometimes other reports on the site, are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions.

Variations in soil and groundwater conditions may occur between test or sample locations and actual conditions may differ from those inferred to exist. No environmental assessment program, no matter how comprehensive, can reveal all subsurface details and anomalies. Similarly, no professional, no matter how well qualified, can reveal what is hidden by earth, rock or changed through time.

The actual interface between different materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of a suitably qualified and experienced environmental consultant through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other unrecognised features encountered on site. Coffey would be pleased to assist with any investigation or advice in such circumstances.

Recommendations in this report

This report assumes, in accordance with industry practice, that the site conditions recognised through discrete sampling are representative of actual conditions throughout the investigation area. Recommendations are based on the resulting interpretation.

Should further data be obtained that differs from the data on which the report recommendations are based (such as through excavation or other additional assessment), then the recommendations would need to be reviewed and may need to be revised.

Report for benefit of client

Unless otherwise agreed between us, the report has been prepared for your benefit and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

Coffey assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report.

To avoid misuse of the information presented in your report, we recommend that Coffey be consulted before the report is provided to another party who may not be familiar with the background and the purpose of the report. In particular, an environmental disclosure report for a property vendor may not be suitable for satisfying the needs of that property's purchaser. This report should not be applied for any purpose other than that stated in the report.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, a suitably qualified and experienced environmental consultant should be retained to explain the implications of the report to other professionals referring to the report and then review plans and specifications produced to see how other professionals have incorporated the report findings.

Given Coffey prepared the report and has familiarity with the site, Coffey is well placed to provide such assistance. If another party is engaged to interpret the recommendations of the report, there is a risk that the contents of the report may be misinterpreted and Coffey disowns any responsibility for such misinterpretation.

Data should not be separated from the report

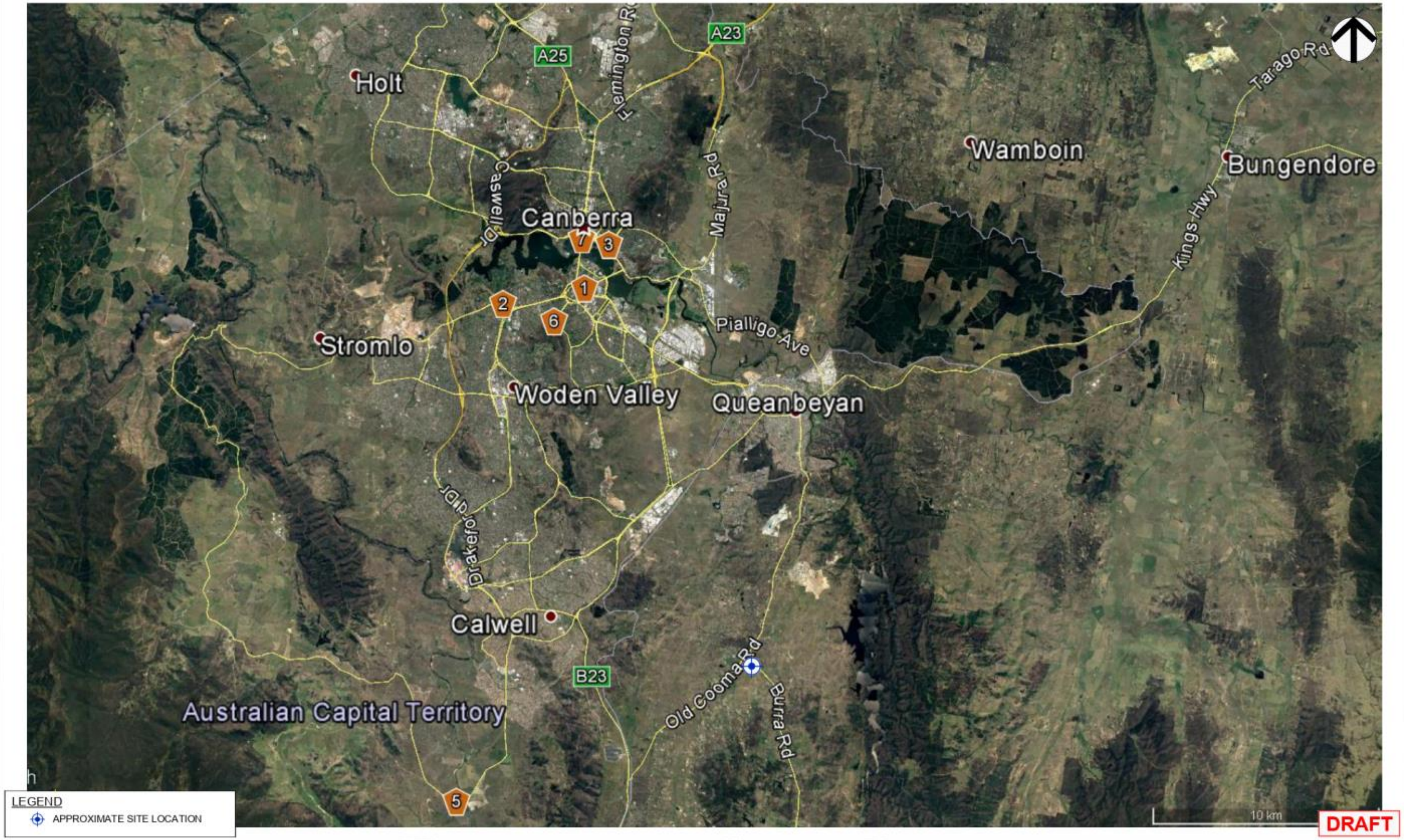
The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

This report should be reproduced in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

Responsibility

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.

Attachment A – Figures



LEGEND
⊕ APPROXIMATE SITE LOCATION

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

0 2.5 5 7.5 10
Scale (kilometres)

AERIAL IMAGERY COPYRIGHT: ©Land and Property Information (2018)
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drawn	PP / AW
approved	-
date	14 / 01 / 19
scale	AS SHOWN
original size	A3

coffey
A TETRA TECH COMPANY

client: QUEANBEYAN-PALERANG REGIONAL COUUNCIL
project: QPRC GROUNDWATER WELL INSTALLATION
1241 OLD COOMA RD, GOOGONG, NSW
title: GROUNDWATER MONITORING SITE LOCATION PLAN
project no: 754-CBREN225122-R01 figure no: FIGURE 1 rev: A

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

50 0 50 100 150 200
Scale (metres) 1:4000

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drawn	PP / AW
approved	-
date	14 / 01 / 19
scale	AS SHOWN
original size	A3

coffey
A TETRA TECH COMPANY

client: QUEANBEYAN-PALERANG REGIONAL COUUNCIL

project: QPRC GROUNDWATER WELL INSTALLATION
1241 OLD COOMA RD, GOOGONG, NSW

title: GROUNDWATER MONITORING WELL LOCATION PLAN

project no: 754-CBREN225122-R01
figure no: FIGURE 2
rev: A

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Attachment B – Selected site photographs

Attachment B – Selected Site Photographs

Figure 1 - Location of MW01A in the south west portion of the site, marked by an orange traffic cone. Borehole MW01A was positioned adjacent to a shed and stockyard, on generally flat alluvial soils.

Figure 2 - Location of MW02A and MW02B, in the western portion of the site, marked by an orange traffic cone. Boreholes were situated on flat alluvial soil and spaced approximately 1.5m apart.

Figure 3 - Location of MW09A, in the eastern portion of the site, marked by an orange traffic cone. Borehole MW09A was excavated into alluvial soil in a slight valley.

Figure 4 – Drilling borehole MW02B. Boreholes were excavated using a solid stem flight auger attachment from 0.5m bgl until auger refusal in bedrock, below which, deeper boreholes (MW02B and MW09B) were drilled into bedrock using an air hammer methods.

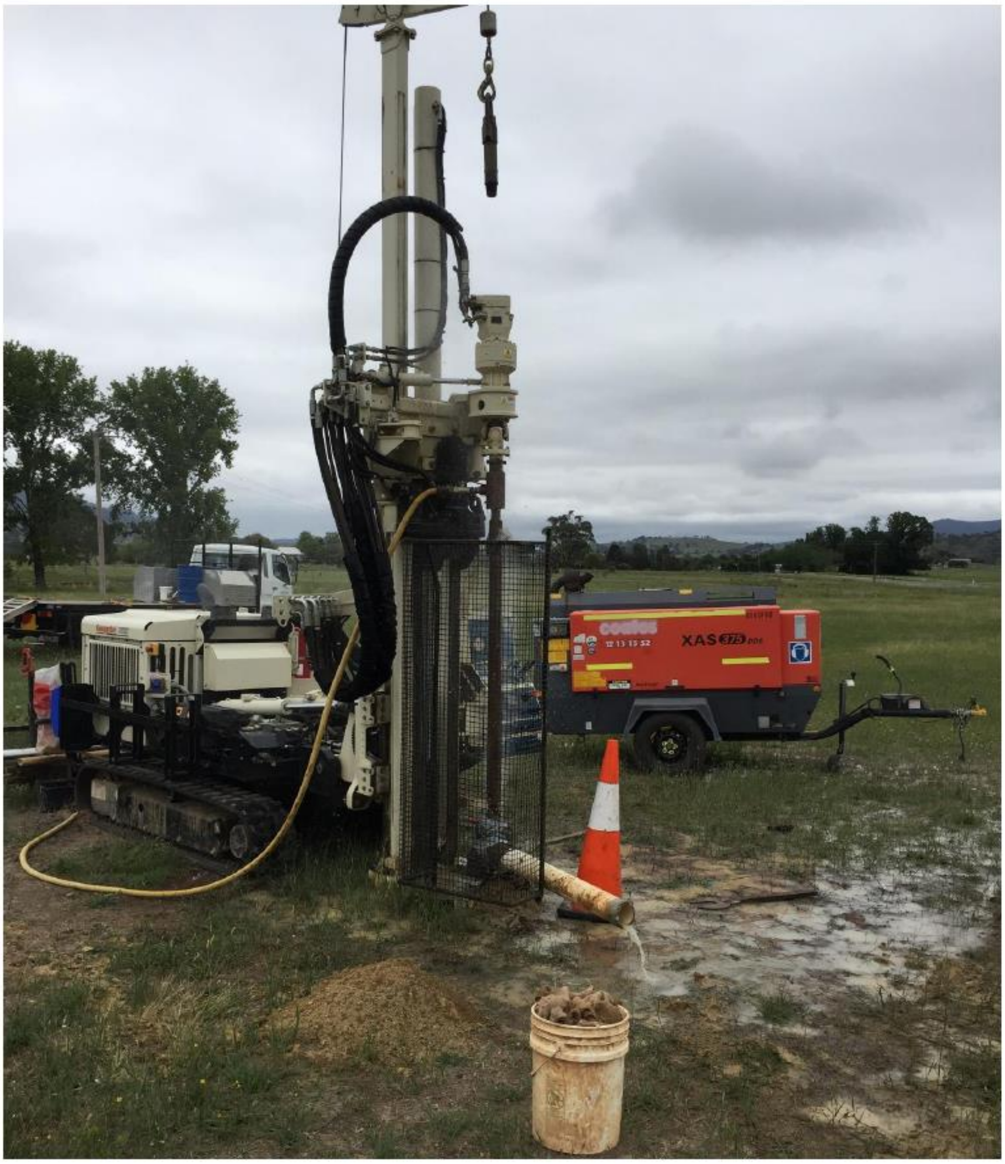

Figure 5 - Groundwater encountered during drilling for MW02B, using an air hammer attachment.

Figure 6 – Hand auger excavation in borehole MW02A. All boreholes were excavated/drilled using hand auger methods within the upper 0.5m bgl to minimise the likelihood of damage to underground services.

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Attachment C – Bore logs

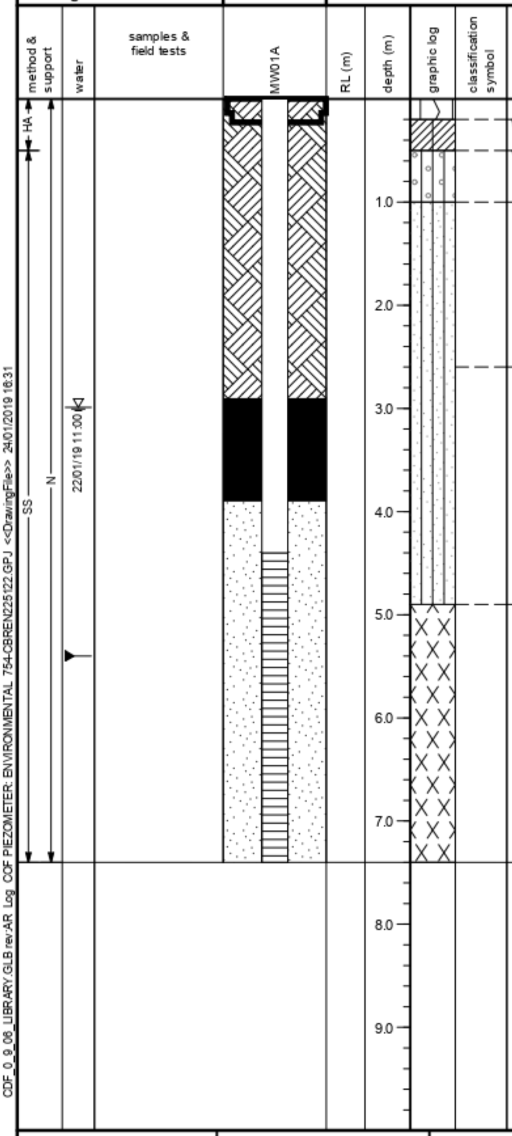
coffey
A TETRA TECH COMPANY

Environmental Log - Monitoring Well

Hole ID.	***MW01A***
sheet:	1 of 1
project no.	***754-CBREN225122***
client:	***Eco Locgical Australia***
principal:	
project:	***QPRC Monitoring Well Installation***
location:	***1241 Old Cooma Rd, Googong NSW***
date started:	***20 Dec 2018***
date completed:	***20 Dec 2018***
logged by:	***TX***
checked by:	***MC***

position: E: 700,090; N: 6,074,233 (MGA94)
surface elevation: Not Specified
angle from horizontal: 90°
equipment type: Geoprobe 7822DT, Track mounted
drilling fluid: None
hole diameter : 100 mm

drilling information | **well details** | **material substance**



material description SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
TOPSOIL: SILT: brown, with traces of fine angular gravel and rootlets.	D	F	**TOPSOIL**
Silty CLAY: low to medium plasticity, brown.	D	F	**ALLUVIUM**
Gravelly SILT: low to medium liquid limit, brown, fine to medium sub-angular gravel.	D	F	
Sandy SILT: low to medium liquid limit, brown, medium to coarse grained sand.	D	F - St	**RESIDUAL SOIL**
Sandy SILT: low to medium liquid limit, brown, medium to coarse grained sand, increasing penetration resistance.	<Wp	VSt	
DACITE: grey-brown, extremely weathered, recovered as gravelly sand, medium to coarse grained sand, fine to medium sub-angular gravel.	D	VSt - H	
5.7 m: increasing mositure	W	H	
Monitoring Well MW01A terminated at 7.40 m Refusal			**well details:** bore construction license: DL2090, Class 2 drilling company: Epoca Environmental` driller: Daniel Fox **backfill details:** 0.0-2.9m: Grout 2.9-3.9m: Bentonite 3.9-7.4m: Sand **standpipe MW01A details:** stickup: 0.0m 4.4-7.4m: screen

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method

AD	auger drilling*
AS	auger screwing*
HA	hand auger
W	washbore
AH	air hammer
HA	hand auger
SS	solid stem flight auger
*	bit shown by suffix
e.g.	AD/T
B	blank bit
T	TC bit
V	V bit

support

M	mud
C	casing
N	nill

water

▼	10-Oct-12 water level on date shown
▶—	water inflow
—◀	water outflow

samples & field tests

ALT	air lift test
B	bulk disturbed sample
D	disturbed sample
E	environmental sample
SS	split spoon sample
U##	undisturbed sample ##mm diameter
WS	water sample
HB	hammer bouncing
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
PID	photoionization detector
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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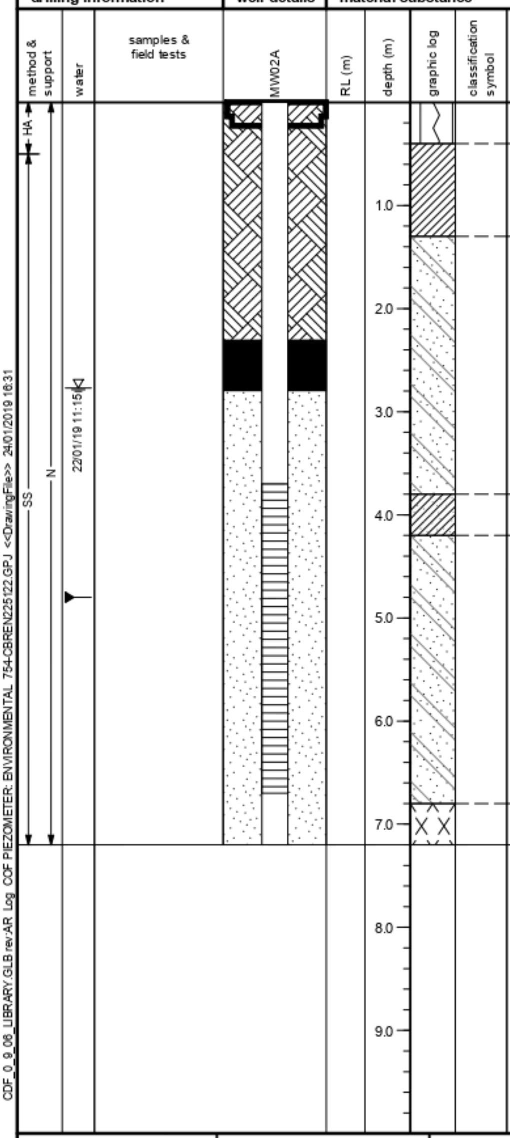
Environmental Log - Monitoring Well

Hole ID.	***MW02A***
sheet:	1 of 1
project no.	***754-CBREN225122***
client:	***Eco Locgical Australia***
principal:	
project:	***QPRC Monitoring Well Installation***
location:	***1241 Old Cooma Rd, Googong NSW***
date started:	***19 Dec 2018***
date completed:	***19 Dec 2018***
logged by:	***PP***
checked by:	***MC***

position: E: 700,189; N: 6,074,447 (MGA94)
surface elevation: Not Specified
angle from horizontal: 90°
equipment type: Geoprobe 7822DT, Track mounted
drilling fluid: None
hole diameter : 100 mm

drilling information | **well details** | **material substance**



material description SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
TOPSOIL: Silty CLAY: low plasticity, grey, trace fine sand, rootlets and fine to medium gravel.	D	F	**TOPSOIL**
CLAY: medium to high plasticity, brown-grey mottled, trace fine to medium sand.	<Wp	F	**ALLUVIUM**
CLAYEY SAND: fine to medium grained, brown, sand is rounded, medium plasticity clay.	D - M	MD	
Sandy CLAY: medium plasticity, brown, fine to medium sand, traces of fine sub-rounded gravel.	<Wp	F - St	**RESIDUAL SOIL**
CLAYEY SAND: fine to medium grained, pale grey-brown, medium plasticity clay, sand is rounded to sub-rounded, traces of fine sub-rounded gravel.	M - W		
DACITE: red-brown, highly to extremely weathered, very low to medium strength.			**WEATHERED BEDROCK**
Monitoring Well MW02A terminated at 7.20 m Refusal			**well details:** bore construction license: DL2090, Class 2 drilling company: Epoca Environmental` driller: Daniel Fox **backfill details:** 0.0-2.3m: Grout 2.3-2.8m: Bentonite 2.8-7.2m: Sand **standpipe MW02A details:** stickup: 0.0m 3.7-6.7m: screen

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method

AD	auger drilling*
AS	auger screwing*
HA	hand auger
W	washbore
AH	air hammer
HA	hand auger
SS	solid stem flight auger
*	bit shown by suffix
e.g.	AD/T
B	blank bit
T	TC bit
V	V bit

support

M	mud
C	casing
N	nill

water

▼	10-Oct-12 water level on date shown
▶	water inflow
◀	water outflow

samples & field tests

ALT	air lift test
B	bulk disturbed sample
D	disturbed sample
E	environmental sample
SS	split spoon sample
U##	undisturbed sample ##mm diameter
WS	water sample
HB	hammer bouncing
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
PID	photoionization detector
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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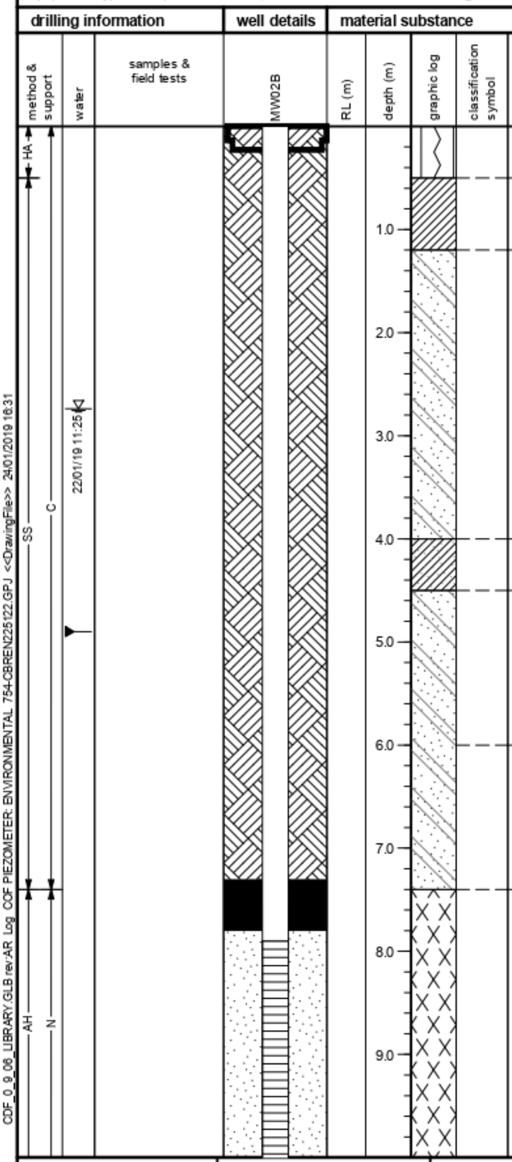
Environmental Log - Monitoring Well

Hole ID.	***MW02B***
sheet:	1 of 2
project no.	***754-CBREN225122***
client:	***Eco Locgical Australia***
principal:	
project:	***QPRC Monitoring Well Installation***
location:	***1241 Old Cooma Rd, Googong NSW***
date started:	***18 Dec 2018***
date completed:	***19 Dec 2018***
logged by:	***PP***
checked by:	***MC***

position: E: 700,187; N: 6,074,445 (MGA94)
surface elevation: Not Specified
angle from horizontal: 90°
equipment type: Geoprobe 7822DT, Track mounted
drilling fluid: None
hole diameter : 100 mm

drilling information | **well details** | **material substance**



material description SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
TOPSOIL: Silty CLAY: low plasticity, dark grey, rootlets and organic fines.	<Wp	S	**TOPSOIL/COLLUVIUM**
CLAY: high plasticity, brown-grey mottled, traces of fine to medium sand.	<Wp	F	**ALLUVIUM**
CLAYEY SAND: fine to medium grained, brown, rounded to sub-rounded, medium plasticity clay, traces of fine sub-angular gravel.	D	MD	
Sandy CLAY: medium plasticity, brown, fine to medium grained sand, traces of gravel.	<Wp	St	**RESIDUAL SOIL**
CLAYEY SAND: fine to medium grained, pale brown, medium plasticity clay, traces of fine gravel, sub-rounded.	D - M	MD	
CLAYEY SAND: fine to medium grained, pale brown, medium plasticity clay, traces of fine gravel, sub-rounded.	W	MD	
DACITE: red-brown-grey mottled, slighty weathered, high strength.			**WEATHERED BEDROCK**

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method

AD	auger drilling*
AS	auger screwing*
HA	hand auger
W	washbore
AH	air hammer
HA	hand auger
SS	solid stem flight auger
*	bit shown by suffix
e.g.	AD/T
B	blank bit
T	TC bit
V	V bit

support

M	mud
C	casing
N	nill

water

▼	10-Oct-12 water level on date shown
▶—	water inflow
—◀	water outflow

samples & field tests

ALT	air lift test
B	bulk disturbed sample
D	disturbed sample
E	environmental sample
SS	split spoon sample
U##	undisturbed sample ##mm diameter
WS	water sample
HB	hammer bouncing
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
PID	photoionization detector
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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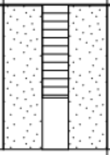
Environmental Log - Monitoring Well

Hole ID.	***MW02B***
sheet:	2 of 2
project no.	***754-CBREN225122***
client:	***Eco Locgical Australia***
principal:	
project:	***QPRC Monitoring Well Installation***
location:	***1241 Old Cooma Rd, Googong NSW***
date started:	***18 Dec 2018***
date completed:	***19 Dec 2018***
logged by:	***PP***
checked by:	***MC***

position: E: 700,187; N: 6,074,445 (MGA94)
surface elevation: Not Specified
angle from horizontal: 90°
equipment type: Geoprobe 7822DT, Track mounted
drilling fluid: None
hole diameter : 100 mm

drilling information			well details	material substance							
method & support	water	samples & field tests		RL (m)	depth (m)	graphic log	classification symbol	**material description** **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	**structure and additional observations**
AH N					11.0			**DACITE**: red-brown-grey, extremely weathered seam, very low strength. **DACITE**: red-brown-grey, slightly weathered, high strength.			
					12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0			Monitoring Well MW02B terminated at 11.40 m Target depth			**well details:** bore construction license: DL2090, Class 2 drilling company: Epoca Environmental` driller: Daniel Fox **backfill details:** 0.0-7.3m: Grout 7.3-7.8m: Bentonite 7.8-11.4m: Sand **standpipe MW02B details:** stickup: 0.0m 7.9-10.9m: screen

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method

AD	auger drilling*
AS	auger screwing*
HA	hand auger
W	washbore
AH	air hammer
HA	hand auger
SS	solid stem flight auger
*	bit shown by suffix
e.g.	AD/T
B	blank bit
T	TC bit
V	V bit

support

M	mud
C	casing
N	nill

water

▼ 10-Oct-12 water level on date shown
▶ water inflow
◀ water outflow

samples & field tests

ALT	air lift test
B	bulk disturbed sample
D	disturbed sample
E	environmental sample
SS	split spoon sample
U##	undisturbed sample ##mm diameter
WS	water sample
HB	hammer bouncing
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
PID	photoionization detector
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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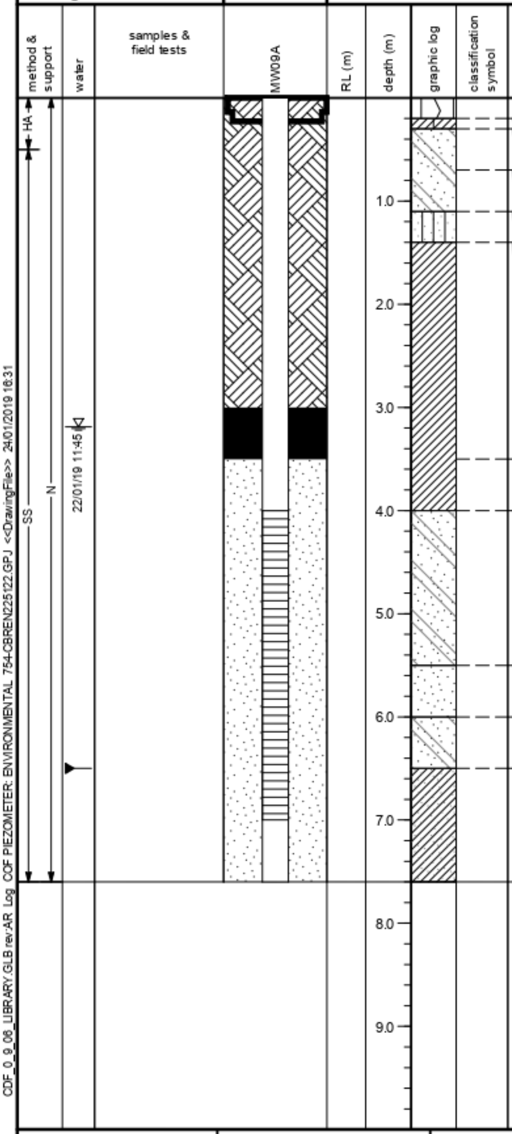
Environmental Log - Monitoring Well

Hole ID.	***MW09A***
sheet:	1 of 1
project no.	***754-CBREN225122***
client:	***Eco Locgical Australia***
principal:	
project:	***QPRC Monitoring Well Installation***
location:	***1241 Old Cooma Rd, Googong NSW***
date started:	***18 Dec 2018***
date completed:	***18 Dec 2018***
logged by:	***PP/TX***
checked by:	***MC***

position: E: 700,702; N: 6,074,185 (MGA94)
surface elevation: Not Specified
angle from horizontal: 90°
equipment type: Geoprobe 7822DT, Track mounted
drilling fluid: None
hole diameter : 100 mm

drilling information | **well details** | **material substance**



material description SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
TOPSOIL: Clayey SILT: low liquid limit, brown, significant rootlets.	M	MD	**TOPSOIL**
Silty CLAY: low to medium plasticity, brown, traces of fine sub-rouned gravel.	D	S	**COLLUVIUM**
	D	MD	**ALLUVIUM**
CLAYEY SAND: medium to coarse grained, brown, low plasticity clay, traces of fine to medium sub-rounded gravel.	D	MD	
CLAYEY SAND: fine grained, yellow-brown, low plasticity clay.	D	L	
Sandy SILT: low liquid limit, yellow-brown, fine to medium grained sand, traces of fine to medium sub-rounded gravel.	D - M	F	
CLAY: medium plasticity, brown, traces of fine grained sand, occasional orange mottling.			
CLAY: medium plasticity, brown, significant medium to coarse sand, traces of fine sub-rounded gravel.	M	F	
CLAYEY SAND: fine to medium grained, brown, low plasticity clay.	D - M	S	
SAND: fine to medium grained, brown, traces of clay and fine sub-rounded gravel.	D	MD	
CLAYEY SAND: medium to coarse grained, brown, medium plasticity clay, traces of fine gravel.	D		
Sandy CLAY: medium plasticity, brown, medium to coarse grained sand.	M		**RESIDUAL SOIL**
Monitoring Well MW09A terminated at 7.60 m Refusal			

well details:
bore construction license: DL2090, Class 2
drilling company: Epoca Environmental`
driller: Daniel Fox
backfill details:
0.0-3.0m: Grout
3.0-3.5m: Bentonite
3.5-7.6m: Sand
standpipe MW09A details:
stickup: 0.0m
4.0-7.0m: screen

CDF_0_9_06_LIBRARY.GLB rev:AR Log COF PIEZOMETER: ENVIRONMENTAL 754-CBREN225122.GPJ <<DrawingFile>> 24/01/2019 16:31

method

AD	auger drilling*
AS	auger screwing*
HA	hand auger
W	washbore
AH	air hammer
HA	hand auger
SS	solid stem flight auger
*	bit shown by suffix
e.g.	AD/T
B	blank bit
T	TC bit
V	V bit

support

M	mud
C	casing
N	nill

water

▽	10-Oct-12 water level on date shown
▶	water inflow
◀	water outflow

samples & field tests

ALT	air lift test
B	bulk disturbed sample
D	disturbed sample
E	environmental sample
SS	split spoon sample
U##	undisturbed sample ##mm diameter
WS	water sample
HB	hammer bouncing
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
PID	photoionization detector
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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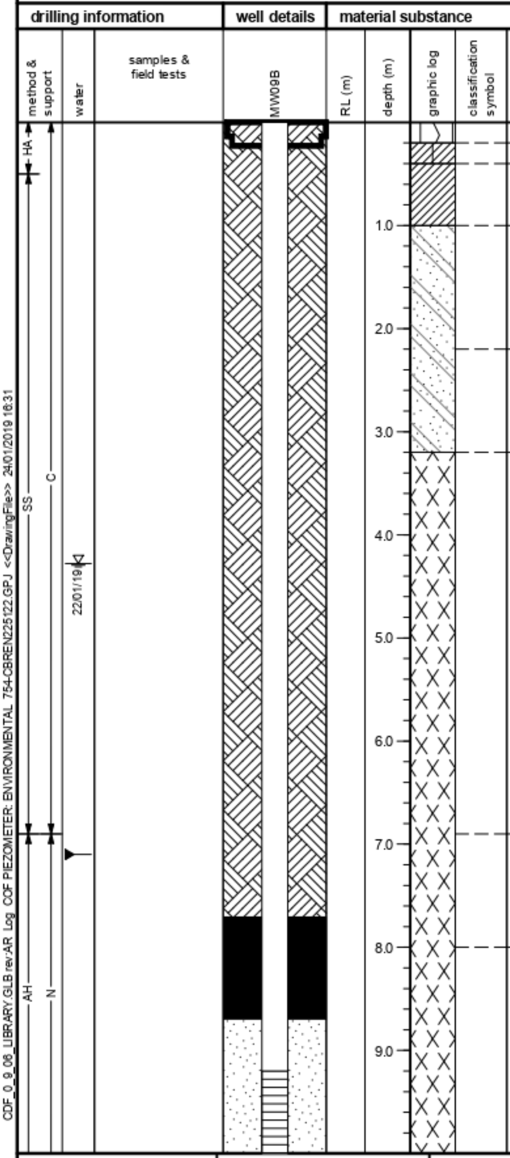
Environmental Log - Monitoring Well

Hole ID.	***MW09B***
sheet:	1 of 2
project no.	***754-CBREN225122***
client:	***Eco Locgical Australia***
principal:	
project:	***QPRC Monitoring Well Installation***
location:	***1241 Old Cooma Rd, Googong NSW***
date started:	***19 Dec 2018***
date completed:	***20 Dec 2018***
logged by:	***PP/TX***
checked by:	***MC***

position: E: 700,755; N: 6,072,954 (MGA94)
surface elevation: Not Specified
angle from horizontal: 90°
equipment type: Geoprobe 7822DT, Track mounted
drilling fluid: None
hole diameter : 100 mm



material description SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
TOPSOIL: Silty CLAY: low plasticity, dark brown, rootlets and organic fines, traces of fine to medium sand.	D - <Wp	F	**TOPSOIL**
Silty CLAY: medium plasticity, grey, traces of rootlets, fine sand.	<Wp <Wp	F F - St	**TOPSOIL/COLLUVIUM** **COLLUVIUM**
CLAY: medium to high plasticity, red-brown-grey mottled, traces of rootlets.	D - M	MD	
CLAYEY SAND: fine to medium grained, pale brown, low plasticity clay, traces of fine to medium sub-rounded to sub-angular gravel.			
CLAYEY SAND: medium to coarse grained, brown, traces of fine sub-angular gravel, poorly graded.		MD	
DACITE: grey-brown, extremely weathered, recovered as gravelly sand, medium to coarse grained, fine angular gravel (igneous fragments).	D - M M	VD	**WEATHERED BEDROCK**
changed to air hammer, auger refusal at 6.9m			
DACITE: grey-brown, slightly weathered, very high strength, water inflow observed.			
DACITE: grey-brown, slightly weathered, very high strength.			

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method

AD	auger drilling*
AS	auger screwing*
HA	hand auger
W	washbore
AH	air hammer
HA	hand auger
SS	solid stem flight auger
*	bit shown by suffix
e.g.	AD/T
B	blank bit
T	TC bit
V	V bit

support

M	mud
C	casing
N	nill

water

▼	10-Oct-12 water level on date shown
▶	water inflow
◀	water outflow

samples & field tests

ALT	air lift test
B	bulk disturbed sample
D	disturbed sample
E	environmental sample
SS	split spoon sample
U##	undisturbed sample ##mm diameter
WS	water sample
HB	hammer bouncing
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
PID	photoionization detector
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Environmental Log - Monitoring Well

Hole ID.	***MW09B***
sheet:	2 of 2
project no.	***754-CBREN225122***

client:	***Eco Locgical Australia***	date started:	***19 Dec 2018***
principal:		date completed:	***20 Dec 2018***
project:	***QPRC Monitoring Well Installation***	logged by:	***PP/TX***
location:	***1241 Old Cooma Rd, Googong NSW***	checked by:	***MC***

position: E: 700,755; N: 6,072,954 (MGA94) surface elevation: Not Specified angle from horizontal: 90°
equipment type: Geoprobe 7822DT, Track mounted drilling fluid: None hole diameter : 100 mm

drilling information			well details	material substance							
method & support	water	samples & field tests		RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
AH N					11.0 12.0	X X		DACITE: grey-brown, slightly weathered, very high strength. *(continued)*			**WEATHERED BEDROCK**
					13.0 14.0 15.0 16.0 17.0 18.0 19.0			Monitoring Well MW09B terminated at 12.20 m Target depth			**well details:** bore construction license: DL2090, Class 2 drilling company: Epoca Environmental` driller: Daniel Fox **backfill details:** 0.0-7.7m: Grout 7.7-8.7m: Bentonite 8.7-12.2m: Sand **standpipe MW09B details:** stickup: 0.0m 9.2-12.2m: screen

CDF_0_9_06_LIBRARY.GLB rev:AR Log COF PIEZOMETER: ENVIRONMENTAL 754-CBREN225122.GPJ <<DrawingFile>> 24/01/2019 16:31

method

AD	auger drilling*
AS	auger screwing*
HA	hand auger
W	washbore
AH	air hammer
HA	hand auger
SS	solid stem flight auger
*	bit shown by suffix
e.g.	AD/T
B	blank bit
T	TC bit
V	V bit

support

M	mud
C	casing
N	nill

water

▼ 10-Oct-12 water level on date shown
▶ water inflow
◀ water outflow

samples & field tests

ALT	air lift test
B	bulk disturbed sample
D	disturbed sample
E	environmental sample
SS	split spoon sample
U##	undisturbed sample ##mm diameter
WS	water sample
HB	hammer bouncing
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
PID	photoionization detector
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Attachment D – Water quality and gauging data

Table 1
Water Quality Measurements
QPRC proposed cemetery site, January 2019

Well ID	Date Measured	Total well depth	Depth to water	Dissolved Oxygen	Redox Potential (ORP)	pH	EC	Temperature	Total Purge Volume	Comments
		(mbtoc)	(mbtoc)	(mg/L)	(mV)		(µS/cm)	(°C)	(L)	
MW01A	22 January 2019	7.4	2.99	4.36	137	6.69	821	15.5	70	No odour or sheen, turbid (580 NTU)
MW02A	22 January 2019	7.2	2.77	3.87	72	6.51	1594	15.5	35	No odour or sheen, cloudy (486 NTU)
MW02B	22 January 2019	11.4	2.74	3.05	87	6.36	1315	13.5	70	No odour or sheen, slightly cloudy (17.0 NTU)
MW09A	22 January 2019	7.0	3.19	2.27	101	6.61	690	13.7	30	No odour or sheen, very cloudy (755 NTU), PID = 3.9ppm
MW09B	22 January 2019	12.2	4.28	1.22	68	6.4	1464	10.0	55	No odour or sheen, slightly cloudy (31.8 NTU)

Notes

mbtoc = metres below top of well casing
L = Litres
ID = Identification
mg/L = milligrams per litre
mV = millivolts

MW = Monitoring Well
µS/cm = microsiemens per centimetre
WQP = Water Quality Probe
°C = degrees
NTU = Nephelometric turbidity units

Equipment

TPS 90FL-T

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Appendix C Registered groundwater bore details

Hydro Code	Latitude	Longitude	Easting	Northing	Ref Elevation (mAHD)	Bore Depth (m)	Drilled Depth (m)	Drilled Date	Major Lithology	Lithological description	Function Type
GW400062.1.1	-35.442476	149.189309	698713	6075684	756	90	90	4/02/1992	DCIT	Dacite	Household Use
GW020893.1.1	-35.457886	149.214262	700940	6073924	793.14	0	13.7	1/10/1952	CLAY	Clay yellow	Unknown
GW020903.1.1	-35.453719	149.207595	700345	6074400	782.08	0	7.9	1/01/1953	CLAY	Clay yellow some sand	Stock water
GW020890.1.1	-35.453442	149.202317	699866	6074441	776.15	19.8	19.8	1/10/1952	PRPR	Porphyry water supply	Unknown
GW067501.1.1	-35.437996	149.207135	700342	6076145	789.09	42	42	12/10/1989	GRNT	Black granite	Household Use
GW400206.1.1	-35.43233	149.213428	700927	6076761	778.12	39.6	39.6	28/04/1997	None	Soft shale.	Household Use
GW401352.1.1	-35.441325	149.189609	698743	6075811	756.63	78	78	31/12/1991	SLTE	Slate, soft	Household Use
GW401068.1.1	-35.458808	149.198345	699493	6073854	775.49	36	36	21/10/1999	BRKN	Broken brown shale	Household Use
GW400503.1.1	-35.442026	149.189296	698713	6075734	758.72	60.8	60.8	28/11/1994	None	Topsoil	Unknown
GW400504.1.1	-35.439188	149.196655	699388	6076034	735.8	60.8	60.8	5/12/1994	DCIT	Dacite	Household Use
GW400813.1.1	-35.437753	149.199745	699672	6076187	759.01	54	54	22/04/1998	HDBD	Hard grey black granite	Household Use
GW401683.1.1	-35.443137	149.202545	699913	6075584	788.92	121	121	23/05/2001	GRNT	Granite, broken	Household Use
GW401777.1.1	-35.471224	149.194716	699133	6072484	784.25	84	84	20/08/2001	SHLE	Shale, highly weathered yellow	Household Use
GW402438.1.1	-35.463971	149.19178	698884	6073295	776.22	75	75	26/05/2003	TPSL	Topsoil, and clay	Household Use
GW402285.1.1	-35.443879	149.188005	698591	6075531	738.38	66	66	18/12/2002	DCIT	Dacite	Household Use
GW020904.1.1	-35.45483	149.207317	700317	6074277	780.21	19.8	19.8	1/02/1953	PRPR	Porphyry decomposed	Stock water
GW402298.1.1	-35.438405	149.199269	699627	6076116	752.54	85	85	24/03/2003	SHLE	Shale, soft yellow	Household Use
GW401991.1.1	-35.439906	149.199848	699676	6075948	753.75	48	48	5/02/1992	DCIT	Dacite	Stock water
GW063668.1.1	-35.433997	149.211761	700772	6076579	773.01	22.9	22.9	1/09/1986	GRNT	Granite soft bands water supply	Household Use
GW020892.1.1	-35.456775	149.203428	699959	6074069	780.38	20.4	20.4	1/11/1952	CLAY	Clay yellow	Unknown
GW402109.1.1	-35.436553	149.215528	701108	6076288	789.63	23	23	2/12/2002	SHLE	Shale, weathered soft yellow	Household Use
GW400502.1.1	-35.444078	149.187975	698588	6075509	736.75	38	38	23/11/1994	None	Volcanics	Household Use

Hydro Code	Latitude	Longitude	Easting	Northing	Ref Elevation (mAHD)	Bore Depth (m)	Drilled Depth (m)	Drilled Date	Major Lithology	Lithological description	Function Type
GW403097.1.1	-35.444116	149.214394	700986	6075451	808.53	100	100	22/04/2001	TPSL	Topsoil	Household Use
GW403206.1.1	-35.44473	149.207586	700366	6075397	850.52	156	156	13/01/2004	CLAY	Clay	Household Use
GW403582.1.1	-35.449801	149.193442	699070	6074863	756.62	42	42	30/10/2002	SFBD	Soft volcanics	Unknown
GW403149.1.1	-35.43495	149.204271	700090	6076489	773.08	42	42	1/07/2005	SHLE	Shale, brown	Household Use
GW403879.1.1	-35.45677	149.193501	699058	6074090	781.55	71	71	30/10/2006	CLAY	Clay/shale - fine	Household Use
GW404208.1.1	-35.440783	149.191723	698936	6075867	743.04	82	0	7/02/2003	n/a	n/a	Household Use
GW405005.1.1	-35.442774	149.198739	699568	6075632	757.28	66	66	22/09/2008	TPSL	Topsoil	Household Use
GW404566.1.1	-35.465893	149.186025	698357	6073093	775.42	42	0	28/06/1999	n/a	n/a	Household Use
GW404883.1.1	-35.441447	149.196842	699399	6075783	743.22	10	0	1/11/1991	n/a	n/a	Household Use
GW404954.1.1	-35.444451	149.185841	698393	6075472	755.25	102	102	11/12/2008	BSLT	Basalt	Household Use
GW411306.1.1	-35.459158	149.196508	699325	6073819	775.11	36	36	22/04/2010	CLAY	Clay - brown	Stock water
GW409828.1.1	-35.432707	149.206032	700255	6076734	751.92	45	45	20/12/2009	TPSL	Topsoil	Household Use
GW414710.1.1	-35.435691	149.206984	700334	6076401	765.88	60	0	26/11/2002	n/a	n/a	Household Use
GW414353.1.1	-35.470525	149.193577	699031	6072564	783	114	114	11/05/2010	GRNT	Granite, blue	Household Use
GW414415.1.1	-35.433867	149.212607	700849	6076592	778.35	23.5	0	10/09/2010	n/a	n/a	Household Use
GW414765.1.1	-35.460443	149.193788	699075	6073682	775.22	5	0	15/09/2011	n/a	n/a	Household Use

Green shaded bores occur within the project area; orange shaded bores occur within 200 m of the project boundary

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QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

24 JUNE 2020

ITEM 9.2	PROPOSED QUEANBEYAN CEMETERY SITE
ATTACHMENT 11	LANDSCAPE ASSESSMENT AND EARLY CONCEPT OPTIONS

LANDSCAPE DESIGN REPORT

NEW CEMETERY AT GOOGONG

GOOGONG
NATURAL
HERITAGE
SCENIC
MEMORIAL
SUSTAINABLE
GRACEFUL
REFLECTIVE

A dignified, modern and functional memorial cemetery that provides extensive new botanical plantings, outdoor reflective garden spaces and matches the community spirit...

PREPARED FOR
QPRC

PREPARED BY
INDESCO

MAY 2020

CONTENTS

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PROJECT BACKGROUND AND SITE APPRECIATION

A respectful landscape...

PROJECT BACKGROUND

As Queanbeyan Palerang's population expands over the next 15 years and the existing Queanbeyan Cemetery in Lanyon Drive nears capacity, there is a need for a new memorial cemetery. After a number of viability studies, ranging from geotechnical, to aboriginal due diligence, confirmed the viability of the site, it was purchased in early 2017 with the purpose of constructing a contemporary style memorial park on a portion of the 36ha property.

The RFQ brief states the design will 'be in the form of a scenic and serene park, having emphasis on landscaping, tree planting and possible water features. The remainder of the property will see extensive buffer planting around the boundaries, and a restored natural landscape (where appropriate) will form part of the design.'

The development of the memorial park is not yet approved and requires significant planning and engagement with the community which is expected to take 4-5 years to finalise. This planning is underway.

In the meantime, an initial Landscape Concept Design is required as part of the community engagement process. The purpose of the Landscape Concept Design is to articulate effectively to the community what the memorial park will look like and what kind of opportunities it has to offer. It will also give the community an opportunity to be involved in the design process and to provide feedback on the design.

This report will outline the entire design process from initial site investigations and analysis through to completed concept masterplan. It will include analysis, concept sketch designs, detail plans, sections, staging plans and cost estimates.

SITE APPRECIATION

The project site is located at 1187 and 1241 Old Cooma Road, Googong, NSW. It is approximately 5km to Googong estate, 10km to Queanbeyan and 30km to Canberra City Centre.

The site has a rural setting; surrounded by farms and Australian landscape. Adjacent to the site are two residential estates. Across Old Cooma Road to the west is Mount Campbell Estate - an established rural subdivision which has minor views over the site. To the south is the Burrabella Residential Estate, which shares a fence with the site.

The site consists of an existing farm dwelling and associated infrastructure, an existing creek-line/gully, approximately 4 dams, significant mature trees and windbreak planting to the southern boundary. These existing features offer a wealth of opportunities for establishing a framework for the design including:

- Improving water, environmental and visitor amenity quality by enhancing the creek-line and or re-purposing the dams as contemplative water features
- Retaining existing trees and wind breaks in addition to new proposed canopy trees to provide a suitable coverage of shade trees, buffers and ecological areas
- Utilising or re-purposing existing access roads, farm tracks and formal tree planting groves
- Analysing existing site topography to determine the most suitable development arrangements

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SOCIAL IMPACT ASSESSMENT RESPONSES

Delivering high quality work through strong process

SOCIAL IMPACT ASSESSMENT RESPONSES

KEY SOCIAL IMPACTS	LANDSCAPE PLAN RESPONSE	QPRC AND COMMUNITY RESPONSE
COMMUNITY TRUST Decreased levels of community trust in the planning decision making process leading to potential negative impacts to levels of social wellbeing.	Propose Community Workshop or 'Have your Say' engagement to draw out community inspiration, unique design ideas and to include adjacent community in design and planning process	Comprehensive Communications Management Plan - Community Workshops
TRAVEL AND CONGESTION **Cumulative risks to the ways people travel on a day to day basis due to perceptions that existing traffic congestion will be exacerbated leading to longer travel times and more stressful driving experiences.**	- Explore alternative Cemetery entry off Burra Road - Implement road improvements recommended in the Transport Impact Assessment - Utilise existing old church for memorial functions and traffic calming	- Comprehensive Communications Management Plan - Detailed survey to assist with site servicing off Burra Road
RURAL CHARACTER Risks to community cohesion arising from potential changes to the rural character of the area, with associated negative health impacts including higher risks of social isolation.	- Re-use and adapt existing site infrastructure including grazing activities - Improve levels of social inclusion and people orientated spaces - High quality robust urban design and landscape architecture - Mature tree screening - Create picturesque, beautiful and functional memorial park	- Include local residents in design process - Improve waterways and prevent erosion (40m protection zone to creek) - No crematorium on site
DECREASED PROPERTY VALUES Fear of potential decreased property values leading to speculative market behaviour and consequently higher risks of financial stress.	- Increased parkland character and tree planting along Old Cooma Road - Improved Landscape Amenity and layered screening - Target opportunities to involve locals in design process and to manage concerns relating to property value	- QPRC liaison with local residents as part of the Comprehensive Communications Management Plan - On site staff as permanent care takers and community guardians
ACCESS TO CEMETERY SERVICES Risks to the community's ability to access cemetery services and facilities, with a potential shortfall of interment space if the proposal does not progress.	- Create Cemetery as an outstanding destination beyond burial memorials but also as a place for contemplation, recreation and cultural story telling	- QPRC to commence exhibition of Draft Cemetery Strategy - Landscape Plan to be exhibited mid 2020 - Improve Public Transport, pedestrian, cycling and other networks

01

SITE ANALYSIS

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01

SITE PHOTOS

Existing Farm House
Actions: Retain shaded character

Driveway with existing trees to single side
Actions: Reinforce tree lined avenue

Open Garage infrastructure
Actions: Caretaker re-use, site storage

Farm House rear yard
Actions: suitable level ground for park

Existing Dam behind Farm House
Actions: Reshape into central water feature as park focal point and stormwater management system

Rural infrastructure and equipment
Actions: Integrate into site interpretation

Native tree groves
Actions: Retain significant and healthy trees

Exotic tree bosques
Actions: Ideal for use as garden feature

01

SITE PHOTOS

Wind break/stabilisation trees
Actions: Use to define spatial edges

Row of existing Poplars
Actions: Define way-finding paths

Looking back at Dam and Farmhouse
Actions: Enhance Vistas

Eroded gully and old car
Actions: Stabilise embankment, screen

Seasoned timber on site
Actions: Re-use as informal landscape timber seats and edges

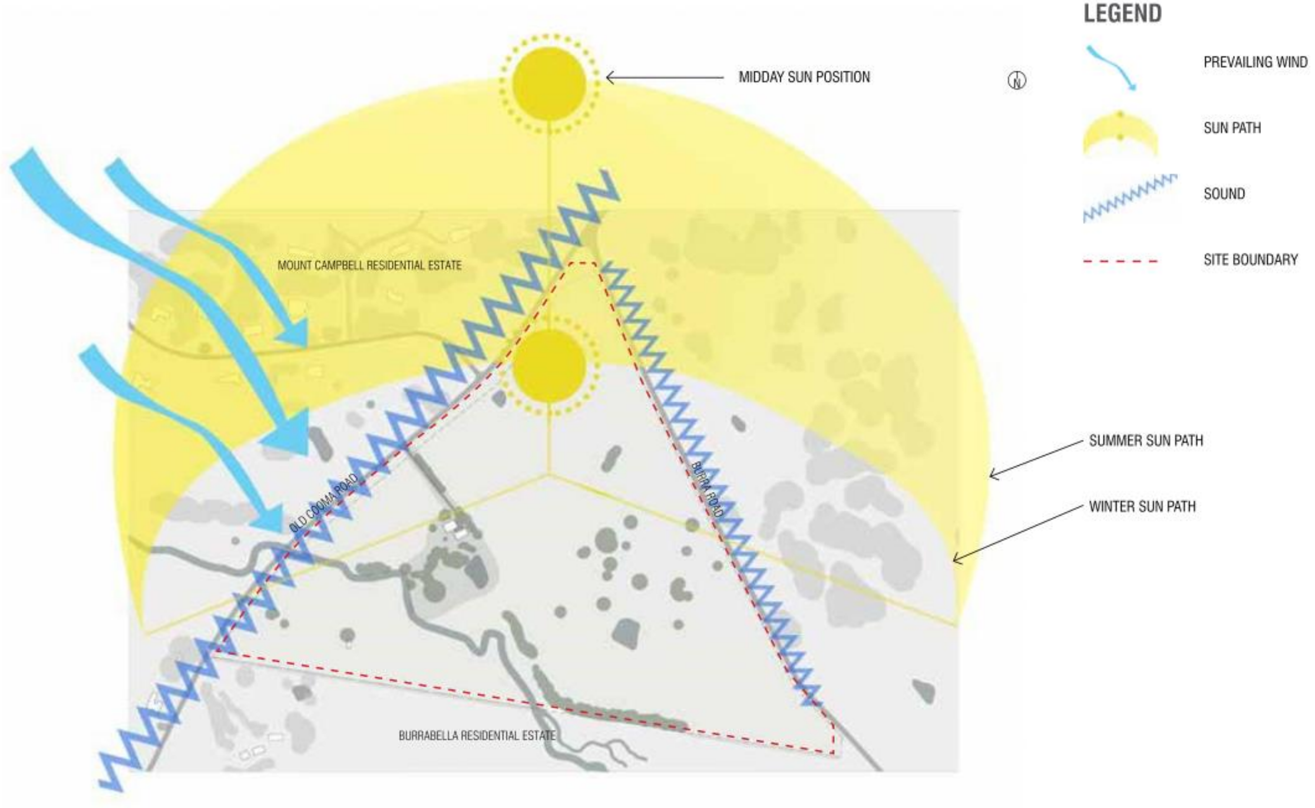
Mature trees and rocky outcrops
Actions: Feature detinatation tree as part of walking trail loop. Re-use rocks where possible

Views back across to Burra Rd and hills
Actions: Frame views, investigate Burra Rd Entry

Gully looking South East
Actions: Improve gully with re-profiling and riparian planting. Top of southern gully banks suitable for burial.

01

SITE CONDITIONS



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SITE INVENTORY

01

HYDROLOGY/GEOTECHINCAL

The hydrological and geotechnical assessments give us a picture of how water flows through the site and what the sub-surface conditions are like.

Burials plots are not possible on the north side of the site due to shallow bedrock. The rest of the site is has deep enough bedrock for burial sites, however, inundation mitigation measures may need to be taken for best outcomes.

LEGEND

WATER LEVEL IN FLOOD

- 0.500m
- 0.375m
- 0.250m
- 0.125m
- 0.000m

BEDROCK DEPTH

- ■ DEEP - Most Suitable for burial sites
- ■ INTERMEDIATE - Suitable for burial sites
- ■ SHALLOW - Unsuitable for burial sites

01

LAND USE OPPORTUNITIES AND CONSTRAINTS

LEGEND

1
- Requires minimal remediation for burial sites
- Requires access across creek
- Close proximity to adjacent property

2
- Corresponds to 20 metre buffer required on both sides of creek edge
- Opportunity for riparian restoration + crossings

3
- Good existing vegetation
- Location suggests suitability as park's central hub
- Area suitable for Water Sensitive Design/Reflection Pool

4
- Requires storm-water management + remedial works.
- Relative size would make this zone suitable for parkland character, recreation and nature trails.

5
- Bedrock too shallow for burial sites
- Opportunity for continued agricultural use
- Potential for entry road access off Burra Road
- Potential for other memorial and landscape open space features

6
- Opportunity for layered parkline buffer planting and landscape treatments that screen Old Cooma Road

02

CONCEPT DESIGN

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02

LANDSCAPE PLAN CONSIDERATIONS

Active and evolving programming is essential to concept design success

LANDSCAPE PLAN CONSIDERATIONS

TOPOGRAPHY

Burial lots, garden zones and accessible paths require level grading and suitable accessibility for all ages.

ACTIONS AND INNOVATION

The landscape plan will investigate opportunities to best site the cemetery pathways and burial lots and propose remedial terracing and planting species that will minimise visual and ecological disturbance, stabilise embankments and reduce erosion from stormwater run-off. The landscape plan will aim to maximise the burial lot yield as well as the quality of the landscape setting.

LANDSCAPE CHARACTER

Impressive rural landscape setting with opportunities for improving local environment and identity.

ACTIONS AND INNOVATION

Respond to the sites significant geological, heritage, vegetation and design opportunities by: creating activities, infrastructure and buildings that fit the site, minimise disturbance to existing vegetation, showcase design excellence, functional engineering resolution of the grade differences and linkages to existing roads, driveways and access points.

OUTDOOR ROOMS AND GARDEN TYPOLOGIES

Allow people a choice of burial options or where ashes are to be placed as well as activating a range of spaces of interest.

ACTIONS AND INNOVATION

Use a range of design principles and materials to form a place that is akin to visiting a botanical garden or beautiful park. The design will capture the local rural context whilst complimenting it with formal and informal spaces, themed gardens and water features. The site has the opportunity to improve its immediate local surroundings and be an appealing regional place to visit.

02

EARLY DESIGN STRATEGIES

Vision to reality...

TREES

Trees will form the backbone of the site's landscape structure improving the screening from Old Cooma Road, tree lined pathways for trails and way-finding and different species to represent different cultures and memorial settings.

RECOMMENDED PRIMARY SPECIES

Australia: *Eucalyptus melliodora* (Yellow Box). Species is widely used for honey production, provides good shade and is a common shade tree for parks and gardens.

Asia: *Gingko biloba* (Gingko) is a symbol of art and literature often symbolising strength, hope, peace and vitality.

Americas: *Ulmus americana* (American Elm) is an iconic shade tree with a history of use in manufacture of coffins.

Africa: *Adansonia digitata* **(**Baobab)

Middle East: *Phoenix dactylifera* (Date Palm) has long traditional uses in Islamic and Jewish culture and symbolises prosperity and triumph.

Mediterranean: *Cupressus sempervirens* (Mediterranean cypress) is an ornamental tree and a symbol of mourning and remains a principal cemetery tree in the muslim world and europe.

Europe and Central Asia: *Quercus spp* (Oak Trees) are often referred to as the tree of life and symbolise strnegth and longevity.

GARDENS AND PARKS

Given the constraints of the site and making it attractive to as many users as possible it is recommended to create a number of small pocket parks/gardens linked around the site by elegant pathways and wayfinding treatments.

RECOMMENDED SPATIAL ARRANGEMENT

Entry Sequence: Formalise main entry with consistent tree species on both sides of the avenue to re-enforce the formality and processional arrival experience.

Homestead: Central Cemetery Hub, parking and formal memorial facilities

Main Dam: Central water feature as iconic attraction, focaL point and memorial park setting

Creekline: Use waterway rehabilitation to create buffer zone or picturesque riparian settings.

Existing tree bosques: Re-use existing tree groves to form new contemplation gardens.

Open plains: Capitalise on the rural open space character to allow continued agricultural use, forest rehabilitation, passive gardens and recreation areas.

Native Forests: Enhance existing native habitat of remnant trees to provide greater low maintenance screening from roads and provide increased shade cover and habitat across site.

Rocky grasslands: Utilise existing rock outcrops to form unique geological garden settings and respond to the sites rural character.

Vistas and distant views: Frame distant mountain views whilst screening views from adjoining residential estates and roads.

ACCESS, SERVICING AND PRESENTATION

Use landscape treatments to slow traffic close to the cemetery, rationalise traffic congestion and provide a welcoming environment for visitors.

RECOMMENDED ARRIVAL SEQUENCE STRATEGIES

Road Entry: Explore potential to service the site off Burra Road instead of Old Cooma Road to alleviate congestion, particularly during funeral processions.

Existing Church Old Cooma Road: Potential for memorial activities and for the asset to be part of the memorial or cemetery operation.

Buffer Zones: Create dense buffer of native vegetation to all boundaries to screen adjoining developments.

Creek-line: Re-profile and rehabilitate existing creek-line to maximise presentation value, improve water quality, and to provide safe riparian creek-line batter slopes. Increase burial plot capacity.

Minor access roads: Combine walking trails and maintenance tracks to access the site. Create hierarchy of pedestrian networks throughout the site.

Memorial garden focal point: Create iconic gesture or defined geometric space to anchor the memorial park's activity core and provide a cohesive identity.

02

SITE PROGRAMMING

02

EARLY SKETCH CONCEPTS

PROJECT VISION

A dignified, modern and functional memorial cemetery that provides extensive new botanical plantings, outdoor reflective garden spaces and matches the community spirit.

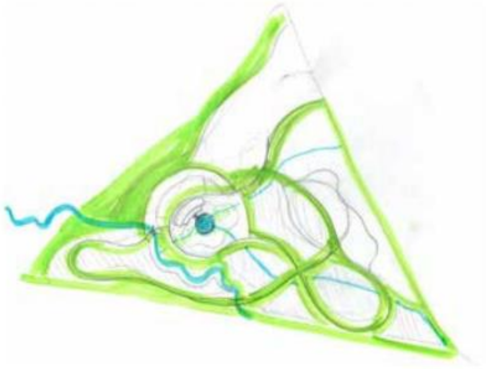
EARLY DESIGN THEMES

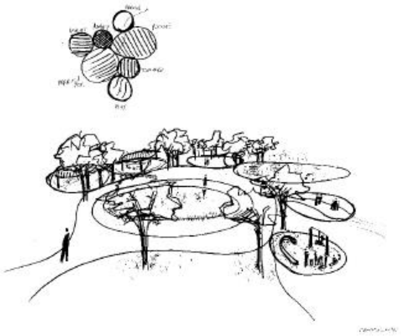
The memorial cemetery will be a place rich in the undulating rural landscape character of Googong - *'A noble and simple landscape with strong and well defined elements of which the mountain block along the skyline is dominant'.* George Seddon

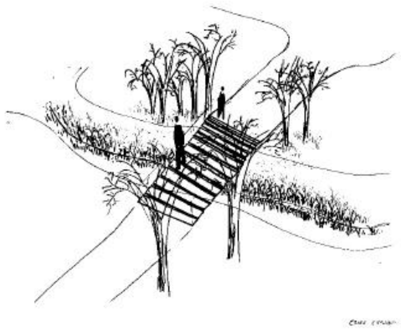
The memorial cemetery can narrate a story of the site's natural and cultural values and inform landscape responses such as colour and material choice, horticultural design or curating peaceful places for loved ones visiting the deceased that are atmospheric and aesthetically beautiful. Use of local materials and a range of botanical strategies will be explored for their local character, availability and environmental values. The design will seek to be modern and enduring and cater for as wide a range of users as possible, including young and old.

The landscape concept will endeavour to minimise environmental impacts treading lightly on the landscape, whilst maximising views, vistas and the sites iconic outlook. Landscape planting and pedestrian connectivity will be essential in establishing the structure of the cemetery grounds and in creating a sequence of 'outdoor rooms' that will lead visitors on a journey through various themes and choices for visitation and burial. Ultimately we seek to create a dignified landscape that is environmentally site-sensitive in its burial accommodations and infrastructure and respectful to the purpose and spirit of the Cemetery.

CONCEPT DEVELOPMENT







02

PRELIMINARY LANDSCAPE CONCEPTS

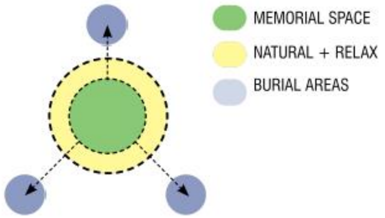

MEMORIAL WATER FEATURE


FEATURE GATHERING PLAZA


CIRCULAR MEMORIAL SPACE


ECO BURIAL

CONCEPT 1 CIRCLE OF HARMONY - CIRCLE OF LIFE + UNIFYING GEOMETRY



02

PRELIMINARY LANDSCAPE CONCEPTS

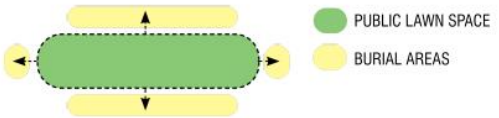

MEMORIAL + COMMUNITY PARK


CONTEMPORARY LANDSCAPE ELEMENTS


PUBLIC LAWN SPACE


LAWN BURIAL

CONCEPT 2 ORGANIC/RURAL - RURAL PARKLAND SETTING


🟩 PUBLIC LAWN SPACE
🟨 BURIAL AREAS

02

PRELIMINARY LANDSCAPE CONCEPTS

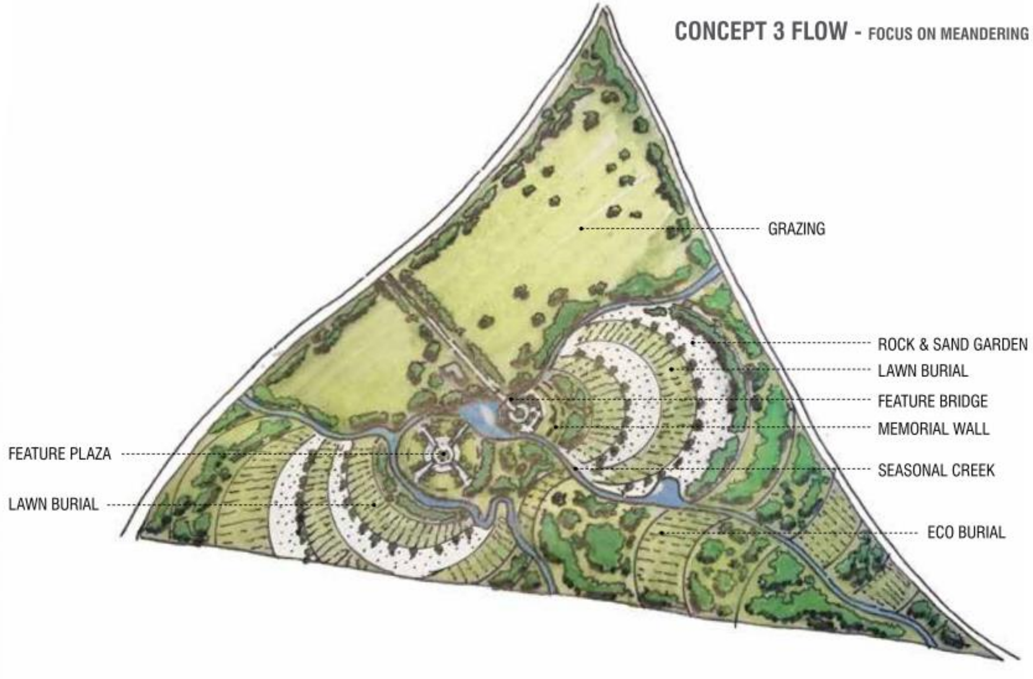
LANDSCAPE PATTERNS AND LANDFORMS

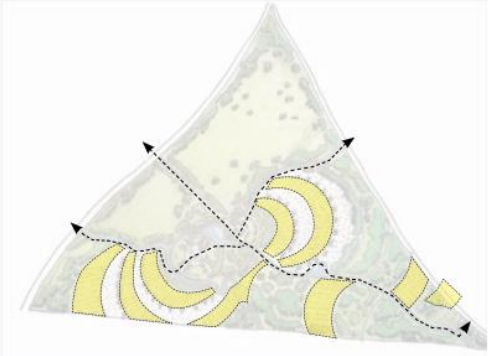
SCULPTURAL LANDSCAPE ELEMENTS

FLORAL GARDENS ABD BURIALS

SAND BURIAL AREA

CONCEPT 3 FLOW - FOCUS ON MEANDERING SPIRAL PATHS, ACTIVITY AREAS AND MEDITATION





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PRELIMINARY LANDSCAPE CONCEPTS

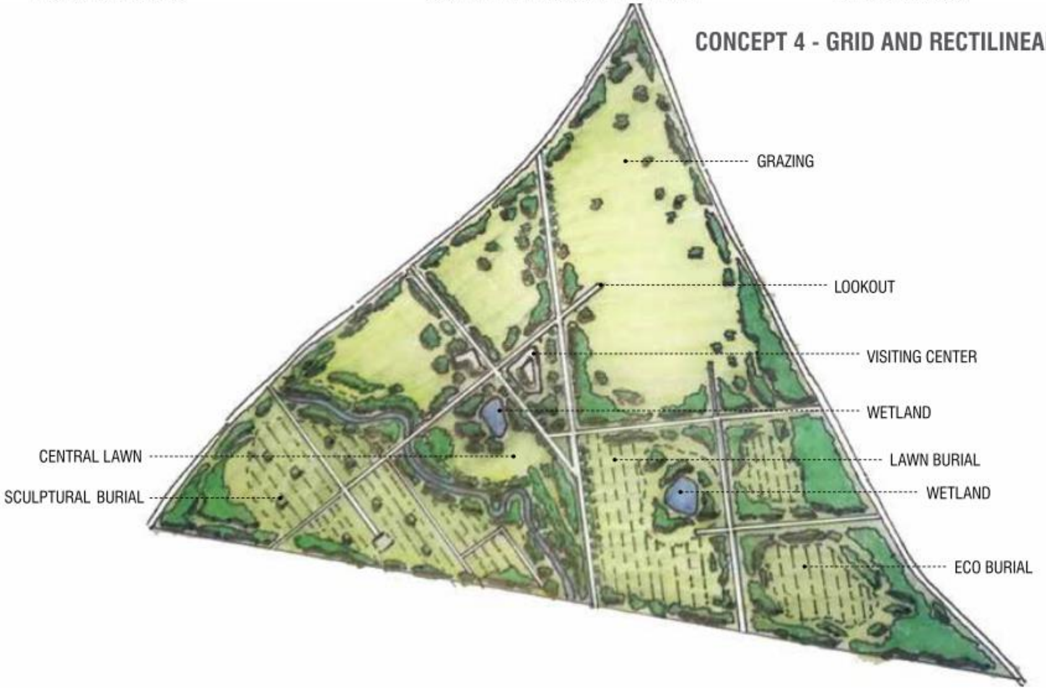
RECTILINEAR ELEMENTS

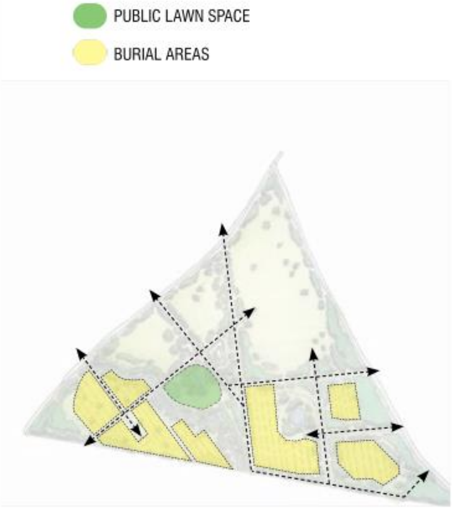
CONTEMPORARY LANDSCAPE ELEMENTS

PUBLIC LAWN SPACE

NATURAL BURIAL

CONCEPT 4 - GRID AND RECTILINEAR - NEW WAY TO EXPLORE TRADITIONS





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02

PRELIMINARY LANDSCAPE CONCEPTS

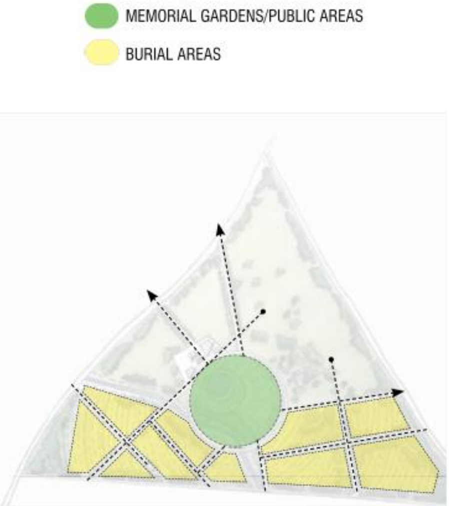
RECTILINEAR ELEMENTS

CONTEMPORARY LANDSCAPE ELEMENTS

PUBLIC LAWN SPACE

NATURAL BURIAL

CONCEPT 5 - COMBINATION OF 1 AND 4



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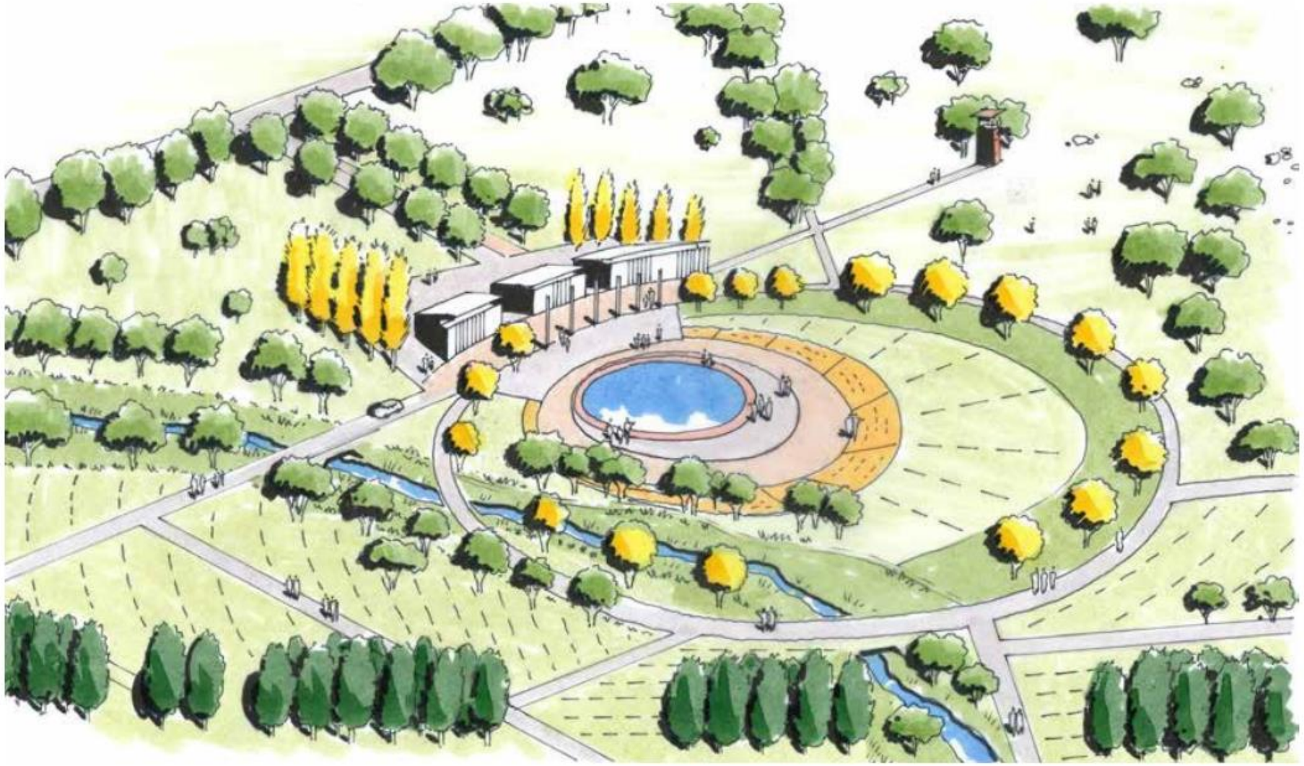
PRELIMINARY LANDSCAPE CONCEPTS

PERSPECTIVE OF MEMORIAL PARK CENTRAL WATER FEATURE



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PRELIMINARY LANDSCAPE CONCEPTS

INDICATIVE SITE PERSPECTIVE OPTION 4

02

PRELIMINARY LANDSCAPE CONCEPTS

INDICATIVE SITE PERSPECTIVE OF CENTRAL REFLECTION POOL

02

PRELIMINARY LANDSCAPE CONCEPTS

INDICATIVE PERSPECTIVE - VIEW FROM EVAN'S ROAD