APPENDIX H

HYDROLOGY AND FLOODING IMPACT ASSESSMENT

TRANSGRID

ENERGYCONNECT (VICTORIAN SECTION)

HYDROLOGY AND FLOODING IMPACT ASSESSMENT

APRIL 2021

FOR DELWP LODGEMENT

Question today
Imagine tomorrow
Create for the future

EnergyConnect (Victorian Section)
Hydrology and Flooding Impact Assessment

TransGrid

WSP
Level 3, 51-55 Bolton St
Newcastle NSW 2300
PO Box 1162
Newcastle NSW 2300

Tel: +61 2 4929 8300
Fax: +61 2 4929 8382
wsp.com

REV	DATE	DETAILS
Final	30/04/2021	Final for land owner consent

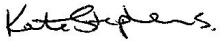
	NAME	DATE	SIGNATURE
Prepared by:	Isabella See; Karen Brakell	30/04/2021	
Reviewed by:	Kate Stephens	30/04/2021	
Approved by:	Will Parker	30/04/2021	

TABLE OF CONTENTS

CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

AEP	Annual Exceedance Probability. The probability that a design event (rainfall or flood) has of occurring in any 1 year period.
Afflux	With reference to flooding, afflux refers to the predicted change, usually in flood levels, between two scenarios. It is frequently used as a measure of the change in flood levels, between an existing scenario and a proposal scenario.
AHD	Australian height datum
ANZECC	Australian and New Zealand Environment Conservation Council
ARR	Australian Rainfall and Runoff
AIDR	Australian Institute for Disaster Resilience
Australian Government	Other than for reference to legislation which uses Commonwealth or Commonwealth land (see examples below).
Barrage	A type of diversion dam that can be used to regulate river flows.
BoM	Bureau of Meteorology
Catchment	The area drainage by a stream or body of water or the area of land from which water is collected.
CEMP	Construction Environmental Management Plan
Commonwealth DoEE	former (Australian) Department of the Environment and Energy
Construction footprint	For references to area of land on which works are proposed.
DAWE	(Australian) Department of Agriculture, Water and the Environment
DCP	Development Control Plan
Design Flood Event (DFE)	In order to identify the areas that the planning and building systems should protect new development from the risk of flood, it is necessary to decide which level of flood risk should be used. This risk is known as the design flood event.
DEM	Digital Elevation Model
Detailed design	The detailed design of the proposal, including construction methodology. This term represents the next phase of proposal development and will further develop the design and construction methodology of the proposal considering: — the performance outcomes as recommended in the EIS — mitigation measures as recommended in the EIS — any conditions of approval.
DO	Dissolved oxygen
EC	Electrical conductivity
Earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock.

EES	Environmental Effects Statement
EnergyConnect	EnergyConnect is a proposed new electricity interconnector between Wagga Wagga in New South Wales and Robertstown in South Australia, with an added connection into north-west Victoria. EnergyConnect is a joint project between TransGrid and ElectraNet, who operate the transmission networks in New South Wales (NSW), Victoria (VIC) and South Australia (SA), respectively.
EPBC Act	(Commonwealth) *Environment Protection and Biodiversity Conservation Act 1999*
Erosion	A natural process where wind or water detaches a soil particle and provides energy to move the particle.
Exclusion zone	A safe clearance area around transmission lines and structures to protect public safety, the network and to maintain access to TransGrid's assets. It delineates the area where most land use activities are prohibited.
EY	Exceedances per year. Used to define the frequency of occurrence of more frequent rainfall or flood events. For example, a design event (rainfall or flood) that has a chance of occurring once during every 6 month period is expressed as having 2 Exceedances per Year (2EY).
Flood Hazard	Potential loss of life, injury and economic loss caused by future flood events. The degree of hazard varies with the severity of flooding and is affected by flood behaviour (extent, depth, velocity, isolation, rate of rise of floodwaters, duration), topography and emergency management.
Flood prone land	Land susceptible to flooding by the largest probable flood event. Flood-prone land is synonymous with the floodplain.
Floodplain	Area of land which is inundated by floods up to and including the probable maximum flood event (i.e. flood prone land).
Freeboard	The height above the DFE or design flood used, in consideration of local and design factors, to provide reasonable certainty that the risk exposure selected in deciding on a particular DFE or design flood is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest heights and so on. Freeboard compensates for a range of factors, including wave action, localised hydraulic behaviour and levee settlement, all of which increase water levels or reduce the level of protection provided by levees. Freeboard should not be relied upon to provide protection for flood events larger than the relevant design flood event. Freeboard is included in the flood planning controls applied to developments by LGAs.
GDE	Groundwater dependent ecosystems (GDEs) are defined as ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services'.
GIS	Geographic information systems
Groundwater	Water found in the saturated zone below the water table or piezometric surface
HV	high voltage
Hydrology	Term given to the study of the rainfall and runoff process, including surface and groundwater interaction; with particular focus on the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.

Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Infiltration	The downward movement of water into soil and rock. It is largely governed by the structural condition of the soil, the nature of the soil surface (including presence of vegetation) and the antecedent moisture content of the soil. The downward movement of water into soil and rock. It is largely governed by the structural condition of the soil, the nature of the soil surface (including presence of vegetation) and the antecedent moisture content of the soil.
km	kilometres
LGA	Local government area
LiDAR	Light Detecting and Ranging
ML	megalitre
MW	Megawatts
NSW	New South Wales
Operational footprint	Refers to the areas where the physical infrastructure would be located and the areas where the operational activities would occur. This includes all proposed infrastructure elements such as the proposed transmission line (overhead) and structures, any new substation infrastructure or permanent access tracks. This also includes the corridor containing the transmission line which would require vegetation maintenance (50 metres in width).
OSD	On site detention
PMF	Probable maximum flood. The flood that occurs as a result of the probable maximum precipitation on a study catchment. The probable maximum flood is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The probable maximum flood defines the extent of flood prone land (i.e. the floodplain).
PMP	Probable Maximum Precipitation
ppm	parts per million
Peak discharge	The maximum discharge occurring during a flood event.
Peak flood level	The maximum water level occurring during a flood event.
Pollutant	Any measured concentration of solid or liquid matter that is not naturally present in the environment.

(the) proponent	The proposal is proposed to be undertaken by NSW Electricity Networks Operations Pty Ltd as a trustee for NSW Electricity Operations Trust (referred to as TransGrid). TransGrid is the operator and manager of the main high voltage (HV) transmission network in NSW and the Australian Capital Territory (ACT), and is the Authorised Network Operator (ANO) for the purpose of an electricity transmission or distribution network under the provisions of the *Electricity Network Assets (Authorised Transactions) Act 2015* (NSW). TransGrid's network enables more than three million homes and businesses to access a safe, reliable and affordable supply of electricity. The network comprises more than 100 substations and more than 13,000 km of high voltage transmission lines, underground cables, and interconnections with Queensland and Victoria. As a result, the network is instrumental to the electricity system and, therefore, the economy and facilitates energy trading across the National Electricity Market (NEM). Further information on TransGrid can be found at www.transgrid.com.au.
(the) proposal	The proposal is known as '*EnergyConnect (Victoria)*' The proposal would involves the following key features: — construction of about 1.3 kilometres of new double circuit 220 kV transmission line, with four new transmission line pole locations. At two of these locations, two poles would be installed. At the remaining locations only a single pole would be installed — the decommissioning and removal of the existing transmission line and towers — the establishment of a formal 50 metre wide easement corridor for the new transmission line — upgrade of access tracks for use during construction and operation — establishment of small sections of new access tracks. The description of the proposal as presented in the reports is indicative and based on the current level of design. The proposal would continue to be refined during detailed design.
proposal footprint	Refers to the area that would be directly impacted by both construction and operation (including the areas that would be impacted by maintenance activities) of the proposal including all proposal infrastructure elements (including the proposed transmission line alignment, i.e. the operational footprint) as well as locations for currently proposed construction elements such as access tracks, laydown and staging areas, brake/winch sites. The footprint in which the final easement corridor and transmission line is expected to be contained within. Transmission line construction activities and access tracks would be contained within this area.
proposal study area	The study area for the assessments in this report generally comprises a 200 m wide corridor between NSW/Victoria border at Monak and the Red Cliffs substation facility. The proposal would be located within the proposal study area, however the entirety of the proposal study area would not be subject to direct impacts arising from the proposal. Some technical assessments will have an additional study area specific to the methodologies of the assessment (eg for database searches, or areas of influence due to nature of the impacts (eg area of social influence). Such areas have been clearly defined in this report.
Runoff	The amount of rainfall that ends up as streamflow, also known as rainfall excess.
SA	South Australia
SES	State Emergency Services

Simple hazard	Referring to flood hazard, the simple hazard is the product of the maximum depth of floodwaters and the maximum velocity of floodwaters.
Transmission line corridor	An area up to 50 metres wide containing and directly beneath the transmission lines and other infrastructure in which TransGrid has rights to enter to access and maintain infrastructure and vegetation.
TDS	Total dissolved solids
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids
VIC	Victoria
Waterway	Any flowing stream of water, whether natural or artificially regulated (not necessarily permanent).

EXECUTIVE SUMMARY

ENERGYCONNECT (NSW – VICTORIAN SECTION)

TransGrid (electricity transmission operator in New South Wales (NSW)) and ElectraNet (electricity transmission operator in South Australia (SA)) are seeking regulatory and environmental planning approval for the construction and operation of a new High Voltage (HV) interconnector between NSW and SA, with an additional connection to Red Cliffs in north-west Victoria. Collectively, the proposed interconnector is known as EnergyConnect.

The proposal, focusing on the section of EnergyConnect in Victoria, would involve the construction and operation of an upgraded 1.3 kilometre section of 220 kilovolt (kV) transmission line between the Victorian/NSW border and the Red Cliffs substation.

OVERVIEW

This technical paper has been prepared to support the statutory planning approvals for the Victorian section of the proposal and assess the impacts to flooding and hydrology during construction and operation of the proposal. It considers impacts to:

- flooding
- geomorphology
- water quantity
- water quality.

The assessment has considered primarily the Murray River. This waterway is subject to conditions of the Basin Plan 2012 which provides a coordinated approach to water use across the Murray–Darling Basin, and provides a framework to balance environmental, social and economic considerations for water use and water quality to an environmentally sustainable level.

HYDROLOGY AND FLOODING IMPACTS

CONSTRUCTION

For the construction phase, the proposal would have negligible impact on flood behaviour because the proposal works in the floodplain are insignificant compared to the extent of the floodplain and the construction program should be managed to minimise work within the floodplain. Existing access tracks will be upgraded and result in minimal impacts.

Water quality impacts from construction of the proposal are anticipated to be short-term and limited in extent. The major sensitive elements in the proposal study area is the Murray River and the associated Kings Billabong Park located to the north and west of the proposal. The Murray River and the Kings Billabong Wetlands (within Kings Billabong Park) are of a sufficient distance and no impact is anticipated.

Construction water demands would be sourced from existing supply points such as standpipes within Red Cliffs and result in no impact to local water supplies.

OPERATION

The proposal would have minimal impact on flood behaviour due to the sparsely located transmission line structures and suspended transmission line. There would be little impact to flood behaviour for the Murray River. Negligible impacts to the flood affectation of existing roads is expected.

There is potential for water quality impacts as a result of spills or litter generated from operation and maintenance activities at transmission lines structures and in the corridor however, provided correct operational procedures and safeguards are implemented the likelihood of impacts would be low. Should there be any impacts from operation and maintenance activities it's likely the impacts would be minor.

MITIGATION AND MANAGEMENT

Impacts from the proposal during the construction phase would be managed through a Construction Environmental Management Plan (CEMP) which would include a Soil and Water Management procedure developed in line with relevant Environment Protection Authority guidelines.

Operational mitigation and management including managing spills, would be managed in accordance with TransGrid procedures and policies for the proposal.

CONCLUSION

The proposal would have minor impacts on flooding, stream condition and water quality during both the construction and operation phases, due to the use of existing upgraded access tracks and the minimal nature of the transmission pole structures across the flood prone land.

1 INTRODUCTION

1.1 PROPOSAL CONTEXT AND OVERVIEW

TransGrid (electricity transmission operator in New South Wales (NSW)) and ElectraNet (electricity transmission operator in South Australia (SA)) are seeking regulatory and environmental planning approval for the construction and operation of a new High Voltage (HV) interconnector between NSW and SA, with an additional connection to Red Cliffs in north-west Victoria. Collectively, the proposed interconnector is known as EnergyConnect.

EnergyConnect comprises several components or 'sections' (shown on Figure 1.1). The Victorian Section (referred to as 'the proposal') is the subject of this report.

EnergyConnect aims to reduce the cost of providing secure and reliable electricity transmission between NSW and SA in the near term, while facilitating the longer-term transition of the energy sector across the National Electricity Market (NEM) to low emission energy sources.

EnergyConnect has been identified as an immediate priority project in the Australian Energy Market Operator (AEMO) *2018 Integrated System Plan* (ISP) and a 'no regret' actionable project in the 2020 ISP (AEMO, 2020). This is due to its ability to 'increase transfer capacity between SA and NSW by 750 MW, achieve fuel cost savings and unlock already stranded renewable investments' within the REZs in western NSW, SA and north-west Victoria (AEMO, 2020).

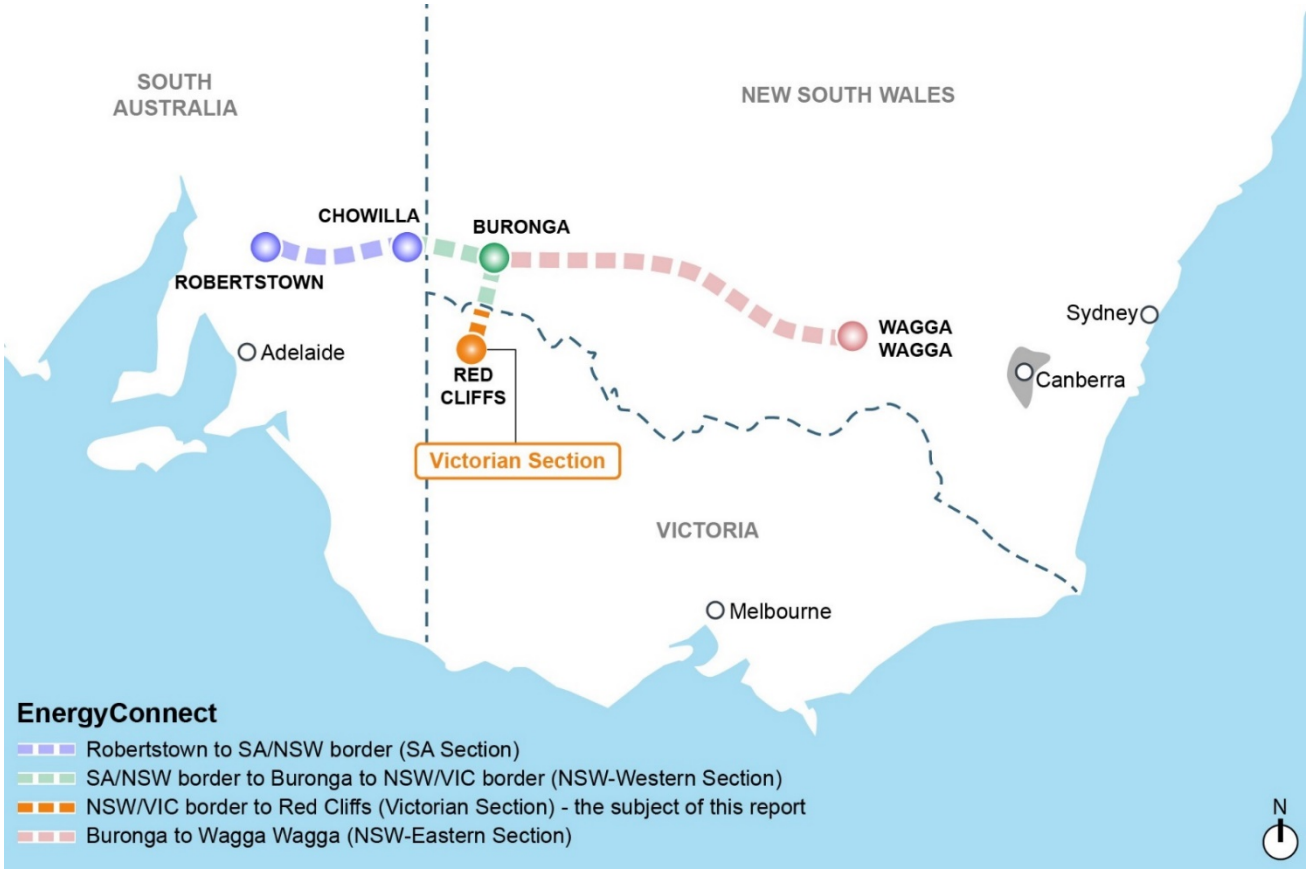


Figure 1.1 Overview of EnergyConnect

1.2 THE PROPOSAL

1.2.1 APPROVALS PATHWAY

TransGrid are seeking approval from Mildura Rural City Council for the upgrade of an existing TransGrid 220 kV single circuit transmission line to a 220 kV double circuit transmission line within a 50-metre-wide corridor that extends for approximately 1.3 kilometres. The proposal is located within a Public Conservation and Resource Zone (PCRZ).

The proposal requires primary State planning, environmental and Aboriginal heritage approvals under the *Planning and Environment Act 1987*, and *Aboriginal Heritage Act 2006.* The proposal seeks to lodge planning and environmental approvals through a planning permit to the Mildura Rural City Council and a Cultural Heritage Management Plan to the First People of Millewa Mallee Aboriginal Corporation for assessment.

1.2.2 KEY FEATURES OF THE PROPOSAL

The proposal comprises the upgrade of an existing TransGrid 220 kV single circuit transmission line between the NSW/Victorian border and the Red Cliffs substation to a 220 kV double circuit transmission line. Specifically this comprises:

- site establishment works including vegetation clearance, minor access track improvements and construction of tower pad and laydown areas
- construction of about 1.3 kilometres of new double circuit 220 kV transmission line, with four new transmission line pole locations. At two of the four locations, a double arrangement (i.e. two poles) would be installed. At the remaining locations only a single pole structure would be installed
- the decommissioning and removal of the existing 220 kV single circuit transmission line and towers once the new line is operational. Decommissioning activities would include removal of all existing towers, fittings and conductors from the corridor. Some sub surface footings would be left in place to minimise excavation and disturbance
- the establishment of a formal 50 metre wide corridor for the new transmission line and poles
- vegetation removal required to maintain appropriate clearances between ground vegetation and transmission lines. Vegetation above 4-metres in height, within a 50-metre corridor below transmission lines would require ongoing maintenance throughout the operation to ensure electrical safety clearances and protection zones are maintained. The required clearance of vegetation within the corridor would be undertaken in accordance with TransGrid maintenance guides
- upgrade of access tracks for use during construction and operation
- establishment of small sections of new access tracks.

The connection of the new transmission line to the Red Cliffs substation and disconnection of existing transmission line, would be undertaken as a separate scope of works by AusNet.

An overview of the proposal is provided in (Figure 1.2). The final location of transmission poles and transmission line corridor would be confirmed during detailed design.

Construction of the proposal would commence in late-2021. Construction timeframes for the proposal are subject to approvals, and the final program would be confirmed during detailed design.

Figure 1-2 Proposal study area overview

1.2.3 PROPOSAL LOCATION AND STUDY AREA

The proposal is located in the Kings Billabong Park, Red Cliffs, in the Sunraysia region within the Mildura Local Government Area and approximately 16 kilometres from Mildura and 544 kilometres from Melbourne respectively.

The proposal study area comprises of a 200 metre wide corridor that extends for about 1.3 kilometres and extends from the Red Cliffs substation to the north-east where it meets the Victorian/NSW border at the Murray River. The proposal study area comprises approximately 33.15 hectares of land and follows the existing 220 kV transmission line corridor and also encompasses the Red Cliffs substation facility and access track into the proposal study area (see Figure 1.2).

The bulk of the proposal study area is classified as Crown Reserve with the remainder typically freehold land.

1.2.4 PROPOSAL NEED

The proposal would increase transfer capacity between the state markets of Victoria and NSW and would supports the establishment of the missing transmission link between the SA and NSW transmission networks. The upgrade to the existing transmission line between Buronga and Red Cliffs would relieve system constraints and allow for Victorian, NSW and SA consumers to benefit from expanded access to low-cost, large-scale solar generation in north-west Victoria and south-west NSW.

The proposal is an essential component of EnergyConnect.

1.3 THE PROPONENT

The proposal would be carried out by NSW Electricity Networks Operations Pty Ltd as a trustee for NSW Electricity Operations Trust (referred to as TransGrid). TransGrid is the operator and manager of the main high voltage transmission network in NSW and the Australian Capital Territory (ACT) and is the Authorised Network Operator (ANO) for the purpose of an electricity transmission or distribution network under the provisions of the *Electricity Network Assets (Authorised Transactions) Act 2015* (NSW).

1.4 PURPOSE OF THIS TECHNICAL REPORT

WSP has been commissioned on behalf of TransGrid to prepare the hydrology and flooding assessment to support the statutory planning approvals for proposal. The purpose of the hydrology and flooding assessment is to identify potential risks and recommend potential appropriate management during the construction of the proposal.

1.5 REPORT TERMINOLOGY

The following terms are discussed throughout this report in addition to those identified in the glossary and are defined as:

- **Hydrology and Flooding study area** – For this technical study the hydrology and flooding study area associated with the proposal footprint includes the wider catchment areas of the Lower Murray River downstream of the Hume Dam and all minor watercourses within these catchments in the proposal study area.

1.6 STRUCTURE OF THIS REPORT

The structure and content of this report is as follows:

- *Chapter 1 – Introduction:* Outlines the background and need for the proposal, and the purpose of this report
- *Chapter 2 – Legislative and policy context:* Provides an outline of the key legislative requirements and policy guidelines relating to the proposal
- *Chapter 3 – Methodology:* Provides an outline of the methodology used for the preparation of this technical paper
- *Chapter 4 – Existing environment:* Describes the existing surface water catchment, including surface water resources, water quality and flooding environment
- *Chapter 5 – Assessment of construction impacts:* Describes the potential construction impacts associated with the proposal
- *Chapter 6 – Assessment of operational impacts:* Describes the potential operational impacts associated with the proposal
- *Chapter 7 – Mitigation measures:* Outlines the proposed mitigation measures for the proposal
- *Chapter 8 – Conclusion:* Provides a conclusion of the potential impacts of the proposal on the surface water environment
- *Chapter 9 – References*: Identifies the key reports and documents used to generate this report.

1.7 LIMITATIONS

The preparation of this technical report has been a desktop exercise that has relied upon information from the proponent and freely available reports and existing investigations. The impact assessment is limited to a qualitative assessment which is based upon the concept design and proposed construction schedule at the time of preparation of this report.

The assessment undertaken to inform this technical report is adequate to assess typical environmental impacts and provide recommendations for mitigation measures. Recommendations would be subject to refinement as the proposal progresses through the detailed design stage and validation is undertaken during construction.

2 LEGISLATIVE AND POLICY CONTEXT

2.1 COMMONWEALTH LEGISLATION

2.1.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Australian Department of the Agriculture, Water and the Environment and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance' (MNES).

Under the EPBC Act, proposed actions (i.e. activities or proposals) with the potential to significantly impact matters protected by the EPBC Act must be referred to the Australian Minister for the Environment to determine whether they are controlled actions, requiring approval from the Minister. The following matters are defined as protected matters by Part 3 of the EPBC Act:

- matters of national environmental significance
- the environment of Commonwealth land
- the environment in general, if proposed actions are being carried out by an Australian Government agency.

There are no impacts to MNES or the environment of Commonwealth land as part of the proposal.

2.1.2 NATIONAL WATER QUALITY MANAGEMENT STRATEGY

The National Water Quality Management Strategy (ANZECC / ARMCANZ 2018) has been developed by the Australian and New Zealand governments in cooperation with state and territory governments. Endorsed by the Australian and New Zealand Environment and Conservation Council (ANZECC), the strategy establishes objectives to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development.

The National Water Quality Management Strategy includes guidelines for protection of water resources across Australia. These guidelines have been used to determine the existing condition of rivers and water quality objectives for the proposal.

2.1.3 AUSTRALIAN AND NEW ZEALAND GUIDELINES FOR FRESH AND MARINE WATER QUALITY (ANZG 2018)

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) is a key guideline within the NWQMS that is used to identify catchment and waterway specific water quality management goals. These guidelines are an updated version of the previous guidelines referred to as the ANZECC 2000 guidelines.

The ANZG 2018 provide a process for assessing existing water quality conditions and developing water quality objectives to sustain current or likely future community values for water resources. Default guideline values for parameters are provided for different community values as generic starting points for assessing water quality where site specific information is not available. The default guideline values are used to evaluate the existing water quality conditions against long term water quality goals.

The ANZG 2018 provide the most up to date databases to derive guideline values for toxicants and sediments in aquaculture and aquatic foods, physical and chemical stressors and guideline values for agricultural water users. Where the ANZG 2018 does not provide a value, the values as used in the previous ANZECC 2000 guidelines still apply.

The default guideline values have not been designed for direct application in activities such as discharge licences, recycled water quality or stormwater quality. These values are provided for various levels of protection of waterways which are considered when describing the existing water quality and key indicators of concern. The level of protection applied in this assessment when assessing ambient water quality is for slightly disturbed to moderately disturbed ecosystems.

2.2 BASIN PLAN 2012

The Murray–Darling Basin Plan (the Basin Plan 2012) aims to provide a coordinated approach to water use across the Murray–Darling Basin's four states and the Australian Capital Territory. It provides a framework to balance environmental, social and economic considerations for water use and water quality to an environmentally sustainable level. The Plan addresses both surface and groundwater use and water quality. Elements of the plan include:

- overall environmental management objectives and outcomes
- sustainable diversion limits (SDL) – on how much surface water and groundwater can be taken from the Basin and a mechanism for adjustments to these limits
- an environmental watering plan – to protect and restore the Basin's rivers and wetlands
- a water quality and salinity management plan that sets objectives and targets
- identifying the risks to continued water availability in the Basin, and strategies to manage them
- a monitoring and evaluation program, including an annual report on the effectiveness of the Basin Plan.

The Basin Plan 2012 sets water quality targets and objectives to protect water quality in the Basin's rivers for people and livestock as well as for wetlands and floodplains. The Basin Plan requires water managers to consider water quality targets when making decisions about environmental watering and running the river. The water quality targets as presented in Table 2.1 have been adopted for this project.

The State of the Environment (SoE) 2012 report demonstrated that there was little relationship between standard water quality targets and aquatic ecosystem health, due to the highly variable nature of natural water quality regionally (see the discussion under 'Water quality by river valley' in the Water quality section of SoE 2012). This highlighted a need for regional guidelines to be established, reflecting the natural regional variability noted.

The Basin Plan 2012 (Schedule 11) outlines water quality zones and provides water quality targets which are used to assess water quality at inland monitoring stations. These replace the previous default trigger values for slightly disturbed ecosystems listed in the National Water Quality Management Strategy and are reproduced in the water resource plans for each subcatchment of the Murray Darling Basin along with water quality objectives for each catchment. These water quality objectives contribute to the overall water quality objective for the Murray-Darling Basin to maintain appropriate water quality, including salinity, for environmental, social, cultural, and economic activity and provide a context for the management of surface water quality from the proposal.

The Basin Plan 2012 and water resource plans provide values for Ramsar declared wetlands and 'Other water dependent ecosystems'. Table 2.3 shows the targets for 'Other water dependent ecosystems'.

Table 2.1 Water quality targets under the Basin Plan 2012 for 'Other water dependent ecosystems'

WATER QUALITY ZONE	TURBIDITY (NTU) (ANNUAL MEDIAN)	PH	TOTAL NITROGEN (UG/L)	TOTAL PHOSPHORUS (UG/L)	DISSOLVED OXYGEN (MG/L; OR % SATURATION) (ANNUAL MEDIAN)	PESTICIDES, HEAVY METALS AND OTHER TOXIC CONTAMINANTS[1]
Lower Central Murray (cMl)	35	6.5–8	700	80	>8 mg/L or 90–110%	the protection of 95% of species

(1) Refer to values in table 3.4.1 of the ANZECC Guidelines (Must not be exceeded)

2.2.1 WATER RESOURCE PLANS

The Basin Plan 2012 requires the preparation of water resource plans (WRP). The water resource plans set rules on how much water can be taken from the Basin, ensuring that the sustainable diversion limit is not exceeded over time. The Murray-Darling Basin Authority (MDBA) is responsible for monitoring and enforcing compliance with water resource plans. The proposal will be governed by the Victorian Murray Water Resource Plan.

The water resource plan provides a water quality management plan to support water quality management within the catchments by providing a framework to protect, improve and restore water quality. The Victorian Murray water resource plan includes water quality objectives and associated targets for the relevant target application zones as shown in Table 2.2 and Table 2.3.

Table 2.2 Victorian Murray water resource plan water resource plan water quality objectives

BASIN PLAN WATER QUALITY OBJECTIVE	DESCRIPTION	BASIN PLAN REFERENCE
Maintain water quality to protect and restore water quality dependent ecosystems	The objective is to ensure water quality is sufficient to: — protect and restore ecosystems and ecosystem functions — ensure ecosystems are resilient to climate change — maintain the ecological character of Ramsar wetlands.	9.04
Maintain the quality of raw surface water for treatment for human consumption	The objective is to minimise the risk that the quality of raw water taken for human consumption results in: — adverse human health effects — the odour of drinking water being offensive to consumers — the objective also aims to maintain the palatability of rating of drinking water at the level of good as set out in the Australian Drinking Water Guidelines.	9.05
Maintain the quality of surface water for irrigation use	The objective is to ensure the quality of surface water, when used in accordance with the best irrigation and crop management practices and principles of ecologically sustainable development, does not result in crop yield loss or soil degradation. This objective applies at sites where water is extracted by an irrigation infrastructure operator for the purpose of irrigation.	9.06
Maintain the quality of surface water for recreational use	The objective ensures a low risk to human health from water quality threats posed by exposure through ingestion, inhalation or contact during recreational use of NSW Murray and Lower Darling Water resources.	9.07

BASIN PLAN WATER QUALITY OBJECTIVE	DESCRIPTION	BASIN PLAN REFERENCE
Maintain good levels of water quality	The objective is to maintain the value of a water quality characteristic if it is at a level that is better than the target value set out in Section 6.	9.08
Salt export	For the River Murray System – To ensure adequate flushing of salt from the system into the Southern Ocean. This objective is expected to be achieved by the discharge of an average of two million tonnes of salt from the River Murray System into the Southern Ocean during each water accounting period (this takes into consideration cyclical climate influences, existing works and measures like salt interception schemes that prevent substantial quantities of salt entering the system and which complement this approach).	9.09

The Basin Plan 2012 and water resource plans provide values for Ramsar declared wetlands and 'Other water dependent ecosystems'. Table 2.3 shows the targets for 'Other water dependent ecosystems'.

Table 2.3 Water quality targets under the Victorian Murray water resource plan – Murray and Western Plains (Slightly to moderately modified)

WRP AREA	TURBIDITY (NTU)	PH	TOTAL NITROGEN (UG/L)	TOTAL PHOSPHORUS (UG/L)	DISSOLVED OXYGEN (% SAT)		TOXICANTS (% PROTECTION)
Lowlands of Campaspe, Loddon, Avoca, Wimmera and Mallee basins	75th percentile	25th – 75th percentile	75th percentile	75th percentile	25th percentile	Maximum	
	≤40	6.8-7.8	≤900	≤50	≥65	130	95% level of protection[1]

(1) Refer to values in table 3.4.1 of the ANZECC Guidelines (Must not be exceeded)

Table 2.4 shows the applicable Victorian end of valley salinity targets.

Table 2.4 Salinity (electrical conductivity) End-of-Valley targets under the Victorian Murray water resource plan

END OF VALLEY BASIN	MEAN SALT LOAD PER YEAR (T/YR)	END OF VALLEY TARGETS (ABSOLUTE VALUE)	
		Median (50%ile)	Peak
River Murray at Lock 6 (gauging site 426200)	+15 EEC[12]	–	412

(1) Equivalent Electrical Conductivity – refer to Basin Salinity Management Strategy Operational Protocols Version 2.0, Murray-Darling Basin Commission, Figure 4, pg. 100.

(2) The target relates to Victoria's contribution to river salinity throughout the entire Mallee zone. This contribution is assessed using the EM2 model, rather than modelled surface water salinity.

2.3 STATE LEGISLATION

2.3.1 WATER ACT 1989

The *Water Act 1989* provides the legal framework for water management and use across Victoria, including the issuing and allocation of water entitlements and the provision of water services by State-owned water corporations and catchment management authorities.

The proposal will not require a licence under section 67 – works on a waterway, such as diversion drains, stream crossings, etc. But a permit application must be referred to the relevant floodplain management authority to construct or carry out works within or in proximity of designated waterways and within flood overlays, refer to Section 2.3.3.

The *Water Act 1989* also governs access to water for bulk entitlements, environmental entitlements and water licences. Part 4 of the Act concerns bulk entitlements and environmental entitlements and Section 51 of the Act concerns water licences. Generally water is issued to individual users by the relevant water corporation, via a water share or a licence.

2.3.2 PLANNING AND ENVIRONMENT ACT 1987

The Planning and Environment Act 1987 (P&E Act) provides for a framework within which decisions about the use and development of land can be made. This Act is administered by the Minister for Planning. Planning Schemes set out the relevant planning policies which guide decision makers when administering the use and development of land and provides specific guidance on the use and development of projects. Each planning scheme applies zones and overlays to land with provisions which development must comply with to be permitted.

The proposal footprint lies with Land Subject to Inundation Overlay (LSIO). Section 44.04-2, 31/07/2018, VC148 Planning Provision, outlines that a planning permit will be required for works associated with development prior to construction, including, roadworks, if the water flow path is redirected or obstructed.

2.3.3 ENVIRONMENT PROTECTION ACT 1970; ENVIRONMENT PROTECTION ACT 2017

The *Environment Protection Act 1970* aims to prevent pollution and environmental damage by setting environmental quality objectives and establishing programs to meet them. The Environment Protection Act 2017 establishes the powers, duties and functions of the Environment Protection Authority (EPA). These include the administration of both the 1970 Act and the 2017 Act and any regulations and orders made pursuant to them, recommending State environment protection policies (SEPPs), issuing works approvals, licences, permits, pollution abatement notices and implementing National Environment Protection Measures. The 1970 Act will be repealed upon the commencement of the amendments to the 2017 Act on 1 July 2021.

2.3.4 STATE ENVIRONMENT PROTECTION POLICY (WATERS)

The SEPP (Waters) sets the framework for the protection of the uses and values of Victoria's surface water environments. The policy sets out uses and values of water environments that communities want to protect (known as beneficial uses), establishes objectives and indicators which describe the environmental quality required to protect beneficial uses (known as environmental quality objectives), and provides guidance to authorities, agencies, businesses and communities to protect and rehabilitate environmental water to levels to meet the environmental objectives (known as the attainment program). The beneficial values for the proposal study area are:

- Water Dependent Ecosystems and Species That Are Slightly to Moderately Modified
- Human Consumption After Appropriate Treatment
- Agriculture and Irrigation
- Human Consumption of Aquatic Foods
- Aquaculture (where the environmental quality is suitable and an aquaculture licence has been approved in accordance with the Fisheries Act 1995)
- Industrial and Commercial
- Water-Based Recreation (Primary Contact, Secondary Contact and Aesthetic Enjoyment)
- Traditional Owner Cultural Values
- Cultural and Spiritual Values.

2.3.4.1 ENVIRONMENTAL QUALITY INDICATORS AND OBJECTIVES

Table 1 Schedule 3 of SEPP (Waters) sets out the water quality objectives for key environmental indicators. The values for the objectives and indicators for the proposal are shown in Table 2.5.

For the beneficial use of water dependent ecosystems and species, the SEPP (Waters) recognises different levels of ecosystem protection and sediment quality objectives for inland and marine waters.

Table 2.5 Environmental quality indicators and objectives for Murray and Western Plains – Lowlands of Campaspe, Loddon, Avoca, Wimmera and Mallee basins

ENVIRONMENTAL QUALITY INDICATORS	ENVIRONMENTAL QUALITY OBJECTIVES
Total Phosphorus (µg/L) 75th percentile	≤ 50
Total Nitrogen (µg/L) 75th percentile	≤ 900
Dissolved oxygen (percent saturation) — 25th percentile — Maximum	 ≥ 65 130
Turbidity (NTU) 75th percentile	≤ 40
Electrical Conductivity (µS/cm@ 25°C) 75th percentile	≤ 2000
pH (pH units) — 25th percentile — 75th percentile	 ≥ 6.8 ≤ 7.8
Toxicants Water (% protection)	95
Toxicants Sediment	Low

2.3.4.2 PERFORMANCE CRITERIA

CONSTRUCTION RUNOFF

Clause 42 of the SEPP (Waters) requires construction works be managed:

- to minimise, the risk to beneficial uses, so far as reasonably practicable, including risks from land disturbance, soil erosion and the discharge of sediment and other pollutants to surface waters
- monitor surface waters where the construction activity adjoins or crosses surface water to assess if beneficial uses are being protected
- comply with guidelines published or approved by the Environmental Projection Authority in relation to the construction activity.

The clause notes that persons responsible for construction activities should implement effective management practices that are consistent with relevant guidelines. These guidelines include the Environmental Guidelines for Major Construction Sites (EPA 1996) and Construction Techniques for Sediment Pollution Control (EPA 1991).

Where construction activities adjoin or cross surface waters, construction managers need to monitor affected surface waters, to assess if beneficial uses are being protected.

FLOODING

Clause 46 of the SEPP (Waters) requires Councils and Catchment Management Authorities to ensure the management and protection of beneficial uses of floodplains, and in particular:

- land use development or works on flood prone areas do not increase the risk of pollutants being transported during flood events which would pose a risk to beneficial uses, and
- waterways and their floodplains retain sufficient flood detention capacity to moderate peak flows to protect the beneficial uses of downstream waterways.

2.4 OTHER POLICY AND GUIDELINES

Other guidelines relevant to the design, assessment and management of surface water resources for the proposal include:

- Commonwealth, Australian Institute for Disaster Resilience, Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia, Handbook 7, 2017
- Department of Environment, Land, Water and Planning, Victoria Floodplain Management Strategy, 2016
- Environmental guidelines for major construction sites, EPA, 1996
- Construction Techniques for Sediment Pollution Control, EPA, 1991
- Australian Rainfall & Runoff 2019, Engineers Australia, 2019.

3 METHODOLOGY

3.1 OVERVIEW

The hydrology and flooding study area associated with the proposal footprint includes the wider catchment areas of the Lower Murray River at and downstream of the proposal.

The proposed methodology for the hydrology and flooding impact assessment included considering all surface water resources such as permanent and intermittent; rivers, creeks, dams, lakes and any other features that either store, transport or use surface water. The proposed methodology has been separated into aspects that can be considered separately but as a whole inform the complete understanding of surface water resource. These separable aspects for assessment include:

- flooding impact assessment
- stream condition assessment
- water quantity – impact assessment including long term impacts to catchment health
- water quality impact assessment.

A qualitative approach to the impact assessment has been adopted. This approach is deemed appropriate to assess typical environmental impacts from the transmission structures in the proposal study area and associated typical construction activities. The associated infrastructure, such as the towers to support the transmission line is at preliminary design stage and be subject to refinement as the proposal progresses through the detailed design stage and validation is undertaken during construction.

The proposed methodology for each aspect of the surface water environment is presented in the following sections 3.2 to 3.5.

3.2 FLOODING

A qualitative assessment was carried out to understand existing flood behaviour in the proposal study area and to assess potential impacts to flooding, and flood risks to the proposal. This involved:

- a desktop review of historic flood information to understand the health of waterways and flood risks across the study area
- a review of the preliminary flood risk assessments for the study area (refer to Appendix A). This was completed by Beca and was carried out to quantify the flood risk for the proposal
- a qualitative assessment of potential impacts to or from flooding behaviour based on an understanding of the existing flooding environment, construction methodology and proposal design
- identifying mitigation and management measures to minimise flood risk to or caused by the proposal. These may include design features, management plans and monitoring.

3.2.1 REVIEW EXISTING FLOOD INFORMATION

This task included a desktop review of existing flood studies, Bureau of Meteorology (BOM) flood gauge data, VIC Department of Environment, Land, Water and Planning Floodway mapping data, Mildura Rural City Council flood information, historic flood event aerial photography and newspaper articles on flood events. In addition, the State Emergency Services (SES) flood data portal was accessed to gather flood intelligence for the flooding and hydrology study area.

The existing data has then been used to understand existing flooding conditions across the proposal area. This has included inferring flood extents based on historic flood photos and anecdotal information from newspaper articles. The flood information has been mapped where available but it is largely unavailable in a geospatial format so images and text has been the main approach to presenting the information.

3.2.2 PRELIMINARY FLOOD RISK ASSESSMENT

A preliminary flood risk assessment was completed for the proposal to understand the existing flood risk in the proposal area at the Murray River (Beca 2020). The methodology for the flood risk assessment is as follows (Email correspondence, TransGrid to WSP, 10/07/2020):

- A 400 metre grid resolution was adopted for the topographic conditions, based upon Hydrologically Enforced Shuttle Radar Topography Mission (SRTM) data which forms the only project-wide dataset available (the 400 m by 400 m grid provides interpretation of the topography that can be used for the flood risk assessment).
- The hydrologic assessment converts the rainfall across the study area to flows across the study area and adopted the following parameters:
  - the 400-metre grid data was used to define watercourses
  - an 1% Annual Exceedance Probability (AEP) design rainfall (i.e. a single design flood) was assessed
  - the 24 hours storm duration was assessed using a single representative temporal pattern across the catchment.
- The hydraulic assessment converts the flows to flood depths and velocities across the study area and adopted the following method:
  - a two dimensional hydraulic model was built using the 400 metre grid topographic data
  - the 1% AEP flows generated for the hydrologic assessment were input into the hydraulic model
  - the model was then checked against stream flow and water level gauge information of the Murray River and Murrumbidgee River, and relevant surrounding gauges, and designated (2012) CSIRO flood extents, to ensure that major flowpaths were defined by the model and therefore deemed the model fit for purpose
  - outputs from the hydraulic flood risk assessment were:
    - values for the maximum depth, maximum velocity and maximum simple hazard in the 1% AEP
    - point values for the maximum depth, maximum velocity and maximum simple hazard in the 1% AEP event at tower locations.

The limitations of the assessment were:

- The SRTM data is a global terrain dataset captured via the Space Shuttle Endeavour as part of an international effort to develop global digital elevation models. Random sampling of the SRTM data through spot tests conducted by Beca (2020) demonstrated that within the project corridor this vertical accuracy is closer to ± seven to eight metres vertically, relative to Light Detection and Ranging (LiDAR) elevation information.
- The 400 metre modelling grid may not capture actual terrain levels and other geographical features and a vertical buffer of ± three metres is recommended to be applied to the flood depths produced from the flood risk assessment.
- The assessment was prepared for the purpose of a classification of the flood risk to the proposed transmission alignment and associated towers.

3.2.3 IMPACT ASSESSMENT

A qualitative assessment for identifying the impact of the construction and operation of the proposal to flood behaviour has been completed. This has involved overlaying the proposal study area over available flood information and identifying qualitative changes to flood behaviour, including changes to flood extents and flood velocities. Changes to flood depths and flood duration could not be adequately assessed due to the preliminary design of the proposal. The assessment also considered potential changes to flood behaviour for structures, such as buildings and infrastructure (predominantly roads) in the floodplain. While the assessment is qualitative, the severity of the impact has been assessed based on potential changes to existing flood risks. For example, areas of the proposal with simple hazard values above 1m^2/s, could cause changes to the flood risk.

3.2.4 FLOOD MITIGATION AND MANAGEMENT

Where the proposal is deemed to have an impact to flood behaviour, mitigation measures and long term management actions have been recommended in Section 7. Management measures have included management of the flood risk to the proposal to minimise damage and recovery to the proposal infrastructure following a flood event and changes to flood risk as a result of the proposal.

3.3 STREAM CONDITION

River condition in Victoria is assessed using the Index of Stream Condition (ISC). The ISC measures the environmental condition of river reaches. The Index of Stream Condition – The Third Benchmark of Victorian River Condition ('ISC3') (Department of Environment and Primary Industries, 2013) report provides a summary of river health for major rivers and stream in Victoria using data collected over a six-year period from 2004–2010.

The impact assessment has then included:

- review of the stream conditions for the Murray River reach in the proposal study area
- qualitative assessment of the potential impacts on the stream conditions
- identification of mitigation and management measures to minimise changes to stream conditions.

3.4 WATER SUPPLY AND WATER RESOURCES

The water supply, water storage and water demands of the existing environment as well as understanding the potential water demands of the proposal has been assessed. The understanding of the water quantity informs the volumes of water for all demands such as agriculture, industry, potable and the environment. The assessment involved:

- a desktop review of existing water supply and water storages
- identification of existing environmental water requirements in the vicinity of the proposal study area
- a review of proposed construction and operational water demands
- qualitative assessment of potential impacts to water availability for the construction of the proposal
- identification of mitigation and management measures to minimise loss of available surface water.

3.5 WATER QUALITY

Water quality refers to the chemical and physical quality of the water in all surface water features for the catchment and the proposal study area. Water quality affects all aspects of the environment and must be understood to protect the existing and future environments. The assessment involved:

- a desktop review of available previous water quality studies to determine the existing water quality baseline conditions
- identification of the water quality assessment criteria
- a comparison of the baseline to the Basin Plan Water quality objectives and targets
- a qualitative assessment of the potential pollutants and impacts to the water quality environment from construction and operation activities
- identification of mitigation and management measures to minimise impacts to water quality.

3.5.1 DESKTOP REVIEW

To inform an understanding of the existing environment a desktop review was carried out. As the proposal study area is located adjacent to the Murray River, which forms the border of NSW and Victoria, data and reports were taken from both jurisdictions. The following documents and data sources were reviewed:

- Index of Stream Condition, The Third Benchmark of Victorian River condition (VIC Department of Environment and Primary Industries, 2010)
- *State of the Catchments* (NSW Office of Environment and Heritage, 2010)
- National Water Quality Assessment (Sinclair Knight Merz, 2011)
- VIC State of the Environment (VIC EPA, 2018)
- NSW State of the Environment (NSW EPA, 2018)
- *Darling Water Resource Plan* (NSW Department of Primary Industries (DPI), 2018)
- Basin Plan 2012 Annual report 2018-2019 (MDBA, 2020).

3.5.2 WATER QUALITY ASSESSMENT CRITERIA

Table 1 Schedule 3 of SEPP (Waters) and the Basin Plan 2012 provides the beneficial values and the ANZG 2018 guidelines provide the associated water quality indicators and default guideline values (refer to Section 2.2). The following water quality parameters are commonly used as indicators of waterway health and have been adopted as the basis of this assessment:

- pH is a measure of acidity or alkalinity. Although pH can naturally vary in aquatic ecosystems depending on site-specific factors, most natural freshwater systems range from 6.5 to 8.0 pH units (ANZG 2018). pH is an important parameter to monitor as it can significantly impact the physiological processes of aquatic biota when changes to the natural pH range occur (ANZG 2018). Furthermore, it can influence the solubility of nutrients and pollutants such as metals, thereby increasing the potential for toxicity, particularly where unnaturally low pH values are observed.
- Turbidity is a measure of water clarity and is usually measured in situ (in the field) using a water quality meter. Turbidity is highly variable in river systems across Australia, with some systems being naturally more turbid than others. Hence, water quality guidelines are tailored for the different regions of Australia. Elevated turbidity can impair respiratory processes of aquatic organisms and reduce light penetration, thus affecting growth of aquatic plants.
- Nutrients are an important indicator of water quality and originate from a range of point and diffuse sources, particularly the discharge of sewage effluent and agricultural runoff (fertilisers, waste from livestock). Excessive nutrients can result in eutrophication and algal blooms, can significantly impact aquatic ecosystem health, and reduce ecological and recreational values of freshwater resources. Concentrations of total nitrogen (TN) and phosphorus (TP) were used to examine compliance with water quality guidelines.
- Electrical conductivity is a surrogate for total dissolved salts and was used in the National Water Quality Assessment 2011 as a measure of salinity. Reduction in the frequency of high flows resulting from river regulation and drought, combined with land clearing, have the potential to increase salinity in freshwater systems. Some systems are naturally saline, particularly where saline groundwater dominates, and geology and soils are high in salt content. Other factors affecting instream conductivity include evaporation and dilution during high flows arising from extensive rainfall. Evaporative losses, particularly in inland lakes, can result in concentration of salts, which is reflected in elevated conductivities. Flood events can flush salts from the landscape into waterways following prolonged drought, which can lead to an initial increase in conductivity, which may be followed by a reduction over time as a result of dilution. It is possible for levels to reach critical thresholds whereby the health of aquatic biota may be compromised.

- Dissolved oxygen (DO) is the amount of oxygen that is present in water. DO is considered an important measure of water quality as it is a direct indicator of an aquatic resource's ability to support aquatic life. Low levels of oxygen can occur when excess organic materials, such as large algal blooms, are decomposed by microorganisms. Biota that access oxygen from the water column such as fish, tadpoles and macroinvertebrates, are highly susceptible to decreases in dissolved oxygen.

3.5.3 IMPACT ASSESSMENT

The qualitative assessment of the potential water quality impacts considers:

- the existing water quality environment
- the potential pollutants and impacts to the water quality environment from construction and operation activities
- the effectiveness of the identified mitigation measures
- any residual impacts post-mitigation and the likely performance against the water quality objectives.

The construction impact assessment aims to identify potential water quality impacts based on current understanding of the likely construction approach and construction methods.

The operational impact assessment identifies potential impacts to water quality during operation of the proposal.

3.5.4 WATER QUALITY MITIGATION MEASURES

In addition to design guidelines and requirements, other mitigation measures are identified to minimise and manage potential impacts to waterways in Section 7. The mitigation measures focus on performance outcomes that should be used to inform future stages of the design.

3.5.5 WATER QUALITY MONITORING

Section 7 outlines a monitoring program to assess the performance of the proposed design and mitigation measures to meet the proposal specific criteria. The monitoring program was developed to focus on the common pollutants and complement existing historic data and monitoring programs.

4 EXISTING ENVIRONMENT

4.1 CATCHMENTS AND WATERWAYS

The proposal is located adjacent to the Murray River. Refer to Figure 4.1. The Murray River is Australia's longest river at about 2,500 kilometres long. It has its headwaters in the Australia Alps and runs west across the inland plains to South Australia where it reaches its outlet at Goolwa. The Murray River runs along the border of the Lower Darling and Lower Murray catchments as shown in Figure 4.1, however is located in NSW. The Lower Darling and Lower Murray catchments are sub-catchments of the Murray-Darling Basin (Murray Darling Basin Authority, 2020).

The Lower Murray catchment is about nine per cent of the Murray Darling Basin and includes the area at the borders of NSW, Victoria and South Australia and continues to the outlet of the basin in South Australia.

In its lower catchment, the River Murray flows through semi-arid mallee country, where the only substantial water source is the river itself. The region contains many significant wetlands including the Riverland wetland (and the Chowilla Floodplain), and lakes Alexandrina and Albert and the Coorong at the Murray Mouth.

The Lower Murray River systems have been modified with a weir system that is highly regulated, making it difficult to return flow to pre-development conditions. Threats to the river system include flow regulation, over extraction of water for consumptive purposes, and the construction of structures that impede flooding. These threats are leading to a decline in the health of floodplain, wetland, lake and riverine ecosystems.

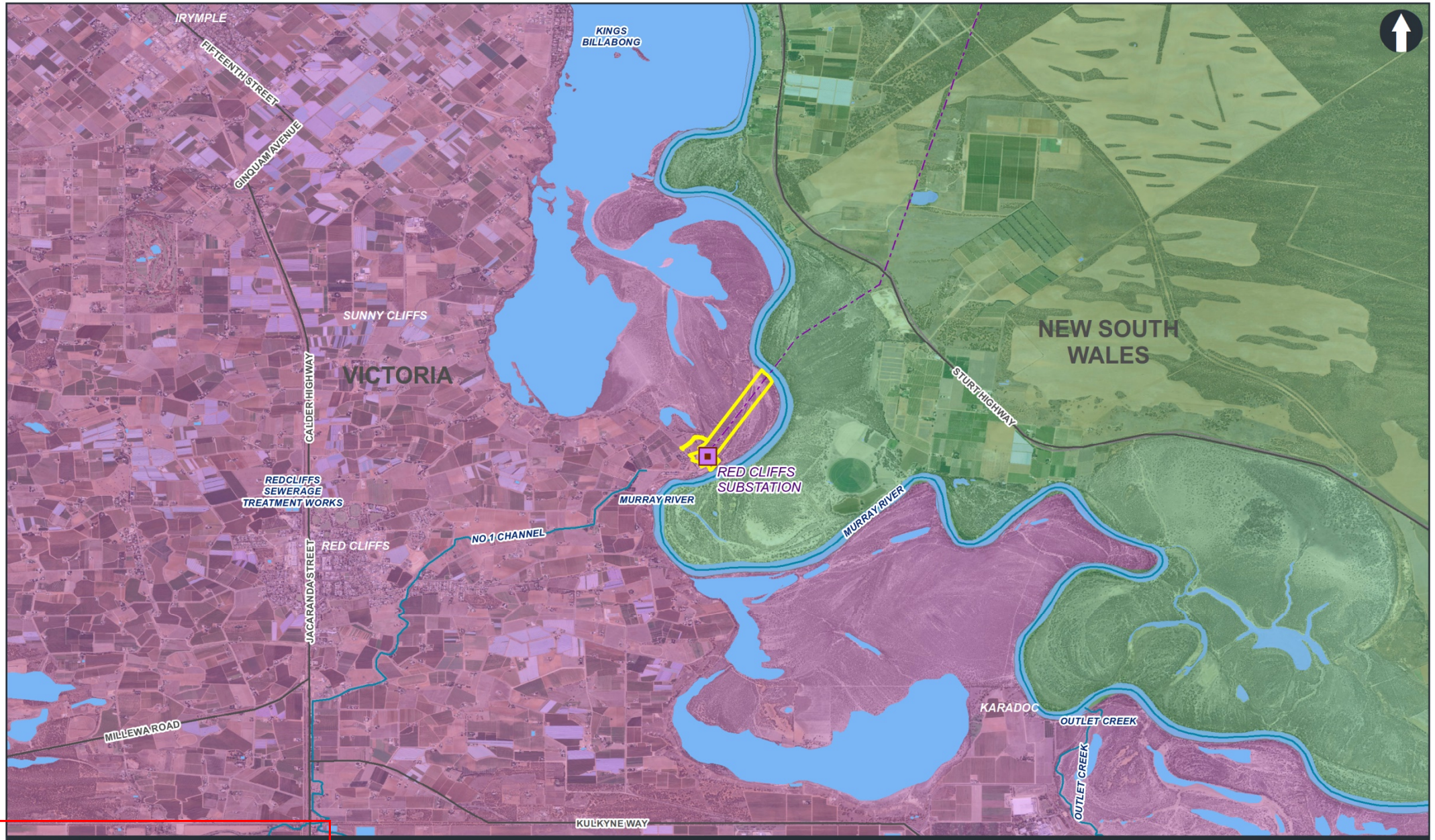


Figure 4.1

Catchments for the hydrology and flooding study

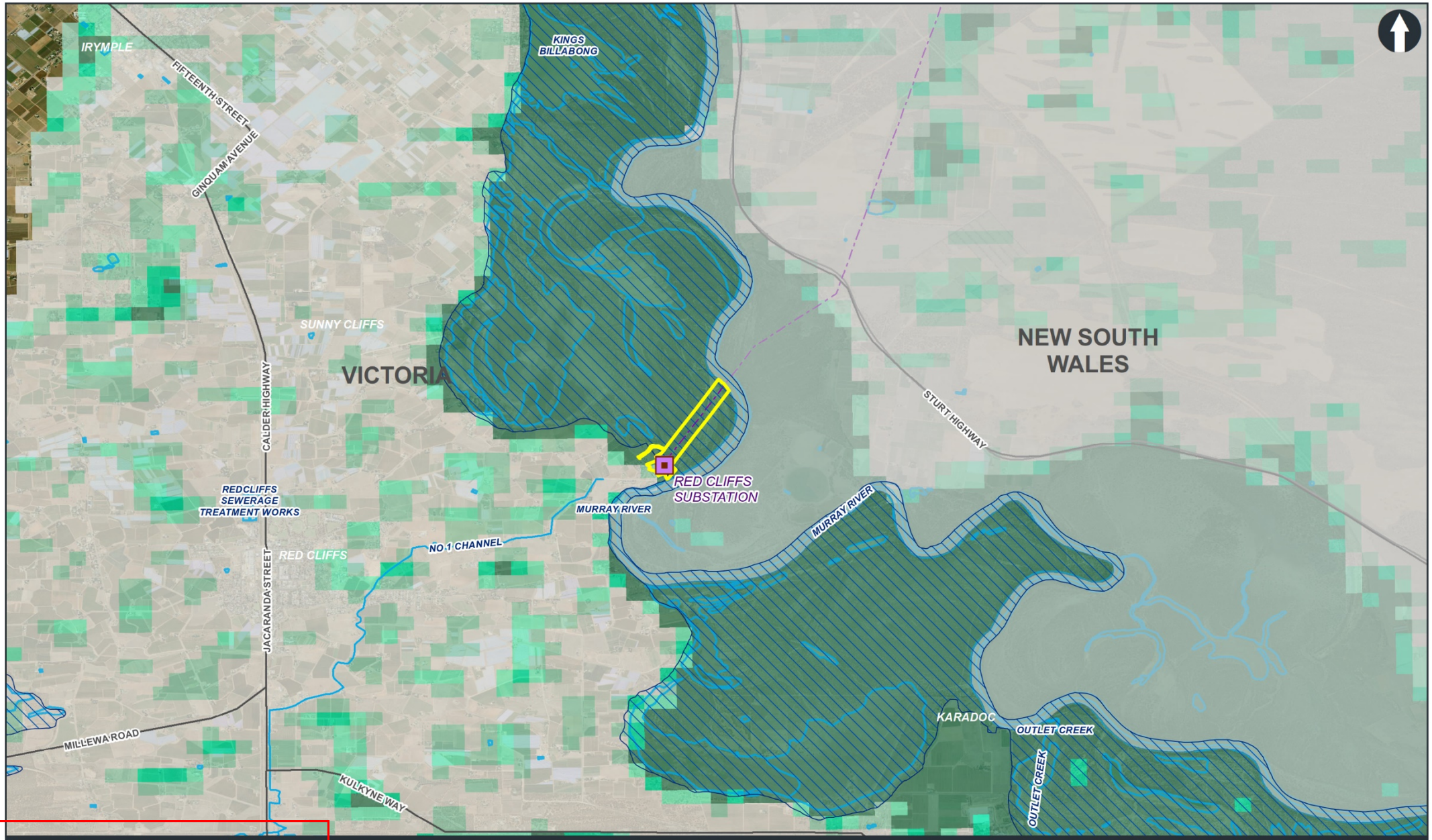


Figure 4.2

Existing flood depths for 1% Annual Exceedance Probability (AEP) (BECA, 2020) and Victorian flood overlay

F:\WSP O365\EnergyConnect - General\5_Shared\54_Production\Maps\15_SurfaceWater\PS117658_SW_009_A3.mxd

4.2 CLIMATE AND RAINFALL

The region has a semi-arid climate with hot summers and cool winters. The average temperature range is around 16–33°C in summer and around 16–4°C in winter.

The closest weather station to the proposal area at Mildura (Irymple, station number: 076015) records an average annual rainfall of 271 millimetres (1908–2020). Rainfall is typically fairly evenly spread across the year, with higher peak rainfall values in winter and spring

4.2.1 CLIMATE CHANGE

Victorian Climate Projection 2019 (VCP2019) have been developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to provide high resolution projections for Victoria. The VPC2019 projects described how the climate of Victoria may respond to global warming under the Intergovernmental Panel on Climate Change (IPCC) medium and high emissions scenarios Representative Concentration Pathways (RPC) of 4.5 and 8.5.

The VPC2019 projections have been prepared for the Mallee region which indicate rainfall is projected to decline in winter and spring (medium to high confidence) and autumn (low to medium confidence). Extreme rainfall events are expected to become more intense on average through the century (high confidence) (DELWP, 2019).

The projected decrease in mean annual rainfall will impact the overall water availability in the proposal area but higher projected temperatures will also mean higher rates of evaporation which will further exacerbate the loss of water. The projected higher temperatures are estimated to result in increased rainfall intensities. This will change the behaviour of a flood event such that peak flood levels will occur faster but it is not likely to have a significant impact on the duration of flood events across the proposal area because flooding is dominated by the upstream catchments. Refer to section 4.4 for a description of flood behaviour.

4.3 TOPOGRAPHY

The topography of the proposal study area is flat land on the southern bank of the Murray River. To the west, north and east are lakes and billabongs including Kings Billabong (less than 1 km to the west), Lake Hawthorn (greater than 10 km to the west), Lake Ranfurly (greater than 10 km to the west) and Lake Gol Gol (greater than 10 km to the north).

4.4 FLOODING CONDITIONS

The proposal is located within an area subject to inundation as marked by the Mildura Planning Scheme maps and the DELWP online mapping tool indicates the proposal study area to be located within a floodway.

A high level flood risk assessment has been completed by Beca (2020) to understand the potential extent of flooding in the vicinity of the proposal. The assessment estimated the flood extent for the 1% Annual Exceedance Probability (AEP) event. Based on the risk assessment, the proposal is located within the floodplain of the Murray River.

Depths in the main river channel of the Murray River are estimated to be up to six metres and between two to four metres across the floodplains for the proposal study area (Beca 2020). The flood risk assessment indicates that peak velocities in the Murray River at the proposal are less than one metre per second.

Flood data for the Murray River is largely historic due to much of the flow being regulated through releases from the Hume Dam. Flood depths are not necessarily the issue, but flood extents are more the focus for flooding in the proposal study area.

The six largest riverine floods on record at Mildura occurred (in order of decreasing magnitude) 1870, 1956, 1917, 1931, 1975, and 1974. The 1870 flood at Mildura was above normal river level for about seven months. The second largest flood on record was observed in 1956 and was approximately 0.2 metres lower than the 1870 event. The two levees, one on the Victorian side and one on the New South Wales side, failed in this event and resulted in an increase to the flood extent. The benchmark flood extent adopted for the Murray River is based on the 1956 flood event. Analysis of flood records indicates that this flood is very close to the one per cent AEP event. However, without detailed modelling based on current conditions, flood levels and risks to the municipality under various flood scenarios are limited (Mallee Catchment Management Authority, 2018).

4.4.1 FLOOD AFFECTED FEATURES

The Beca flood risk assessment has been used to understand the flood affectation of features in the proposal study area. It is noted that this affectation is limited to the information available and does not supersede any local information sourced from local studies or supplied by Mildura Rural City Council.

No existing buildings or structures were identified within the flood prone areas or within the flood overlay.

4.4.2 FLOOD EMERGENCY MANAGEMENT ARRANGEMENTS

A Municipal Emergency Management Plan (Mildura Rural City Council, 2018) sets out the emergency management arrangements for the LGA of Mildura. The plan does not provide guidance specific to flood events. The plan relies upon the Bureau of Meteorology for notification of a flood event and the SES FloodSafe website for guidance for household emergency plans.

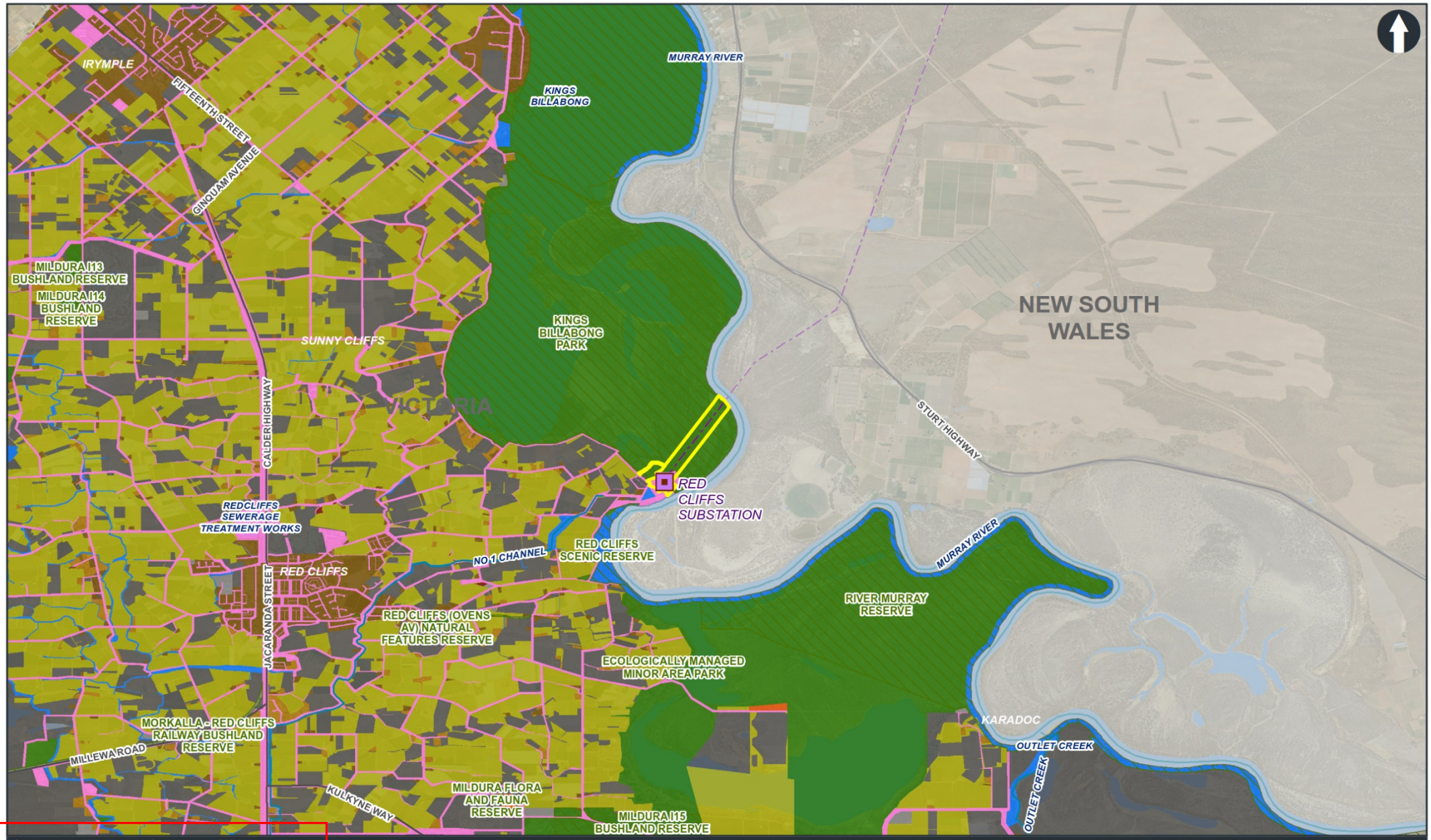


Figure 4.3

Land use within and surrounding the proposal study area (based on NSW Land Use Categories 2013)

4.5 WATER SUPPLY AND WATER RESOURCES

Existing water supplies to the urban area are from the Murray River, with raw water being supplied for outdoor use and filtered water for indoor use from Lower Murray Water Corporation. (Lower Murray Water Corporation accessed 12/10/2020 5:05 PM). Rainwater collected from roofs is another source of domestic water supply for the urban area.

In Victoria water entitlements are governed under the *Water Act 1989* with Section 51 concerning water licences. The Victorian Water Register is the public register of all water-related entitlements in Victoria

As at 28 September 2020, the licenced environmental water includes, two access licences with adaptive environmental water conditions in the Murray Water Source.

As at 28 September 2020, there are other licences that are not identified as licenced environmental water but are intended to be used for environmental purposes, these include 36 other access licences with share components in the Murray Water Source.

4.6 LAND USES

The proposal study area is located within the King Billabong Park. This park is a recreational area including camping areas, walking tracks and a boat ramp. Other land uses around the proposal study area include:

- Murray River to the east of the proposal
- community space (Red Cliffs Boat Ramp Camping Area) to the east of the proposal study area along the Murray River
- commercial/industrial and residential areas to the south of the proposal
- agricultural land to the southwest of the proposal
- Red Cliffs substation immediately to the south of the new transmission line (which the line would be connected into).

4.7 REGIONAL GEOLOGY

The proposal study area lies within geological deposits of:

- Alluvium (Qa1): Gravel, sand, silt: variably sorted and rounded; generally unconsolidated; includes deposits of low terraces; alluvial floodplain deposits within the northern portion of the site
- Woorinen Formation (Qxw): Dune deposits, unconsolidated; mainly red-brown siliceous silty sand, red calcareous silty clay, and sand clay within the southern portion of the site.

4.8 POTENTIAL ACID SULFATE SOIL

Based on the Australian Soil Resource Information System website (www.asris.csiro.au) accessed on 11 August 2020, the site would have an extremely low probability of occurrence of acid sulfate soils.

4.9 REGIONAL HYDROGEOLOGY

Based on data obtained from Lotsearch report (refer Appendix B) depth to the water table at the proposal study area is inferred to be five to ten meters below ground level (mBGL) and salinity is between 13,000 to 35,000 mg/L. The aquifer at the site is described to be porous, extensive of low to moderate productivity.

4.10 GROUNDWATER DATABASE SEARCH

No registered groundwater bores are identified within a 1000 metre radius of the site boundary, the closest bores are located 1050 metres away and listed for observation/investigation purposes.

4.11 WETLANDS

The proposal is located within the Kings Billabong Park, which contains important wetlands including Ducksfoot Lagoon and Baggs Lagoon providing important environmental and recreational values. The wetlands in the park provide a range of habitats including River Red Gum forest, Black Box-chenopod woodland and reed beds. The area also supports a high number of native flora and fauna species (Mallee CMA, 2018). The proposal study area itself is situated at the southern reach of the Kings Billabong Park and is dominated woodland communities, with localised areas subject to temporary flooding.

The Kings Billabong is listed on the Australian Government Directory of Important Wetlands which means it is considered a national significant wetland.

4.12 STREAM CONDITION

The Index of Stream Condition Third Report (ISC3) (VIC Department of Environment and Primary Industries, 2010) results show the stream condition of the Murray River in the Mallee Basin adjacent to the proposal study area to be poor. It is noted that the reaches both upstream and downstream also scored a poor rating. The ISC score for the reach of the Murray River adjacent to the proposal study area are presented in Table 4.1. The scores for each category are marked out of 10, with ten being the highest rating and one being the lowest.

Table 4.1 Murray River Reach 11 in the Mallee Basin ICS3 ratings

REACH ID	LOCATED	REACH LENGTH (KM)	HYDROLOGY	PHYSICAL FORM	STREAM SIDE ZONE	WATER QUALITY	AQUATIC LIFE	ISC SCORE	CONDITION
11	Mallee Basin #14	38.5	1	5	7	8	NA	21	poor

The ratings indicate the following:

- Hydrology – the low rating indicates extremely modified flow regimes due to irrigation, where flows are harvested in winter and released in summer to meet agricultural demands.
- Physical form – the moderate rating indicates a stable river bank condition but there are major barriers to fish migration, due to the artificial weirs.
- Streamside zone – the high rating indicates diverse streamside woody vegetation and the absence of willows within 40 metres of the river's edge.
- Water quality – refer to section 4.13.
- Aquatic life – no rating available.

Overall the condition is poor due to the modified flow regime and river bank form which is due to the modified flow.

4.13 WATER QUALITY

A desktop review was undertaken of existing water quality conditions. Water quality data and documents (refer to Section 3.5) from the broader catchment areas was reviewed to provide an understanding of the general water quality of the hydrology and flooding study area.

As the Murray River is located in NSW and Victoria is not directly responsible for managing the water quality in the Murray River, reports and data have been used from NSW but where available Victorian ones have been considered.

4.13.1 INDEX OF STREAM CONDITION REPORTING (2010)

The ISC3 for the Murray River reach 11 in the Mallee basin which was located closes to the proposal study area recorded a water quality score of 8/10, as presented in Table 4.1 above. This rating is based on water quality sampling of Total Phosphorus. Turbidity, Salinity (EC) and pH and the rating indicates the water quality is good.

4.13.2 NSW STATE OF THE CATCHMENTS (2010)

The 2010 NSW State of the Catchments reports (NSW Government, 2010) documented the condition of, and pressures on, 13 catchments under the NSW Monitoring Evaluation and Reporting program. The reports used turbidity and total phosphorus (TP) as indicators of water quality performance for all catchments for the period from 2005–2008.

At the Murray River at Merbein monitoring site, the site closest to the proposal study area, data from the 2005–2008 period showed 4 per cent of samples exceeded the ANZECC 2000 guidelines for both TP and turbidity.

The overall macroinvertebrate condition, fish condition and hydrologic condition was rated as poor. 'Overall, the flow regime had fewer high flows, and reduced annual volumes and variability, with little change to low and zero flows and flow seasonality. This pattern reflects the diversion of a significant volume of water from the system and the effect of differentially harvesting high flows' (MDBC 2008).

4.13.3 NATIONAL WATER QUALITY ASSESSMENT (SINCLAIR KNIGHT MERZ, 2011)

The National Water Quality Assessment (Sinclair Knight Merz, 2011) was commissioned as a nationwide water quality assessment to provide a snapshot of water quality across inland waters of Australia. The assessment collated water quality data from a series of sources across Australia and compared them to the relevant ANZECC 2000 water quality objectives for the region. The water quality data examined in the assessment included turbidity, salinity, pH, nutrients and algal blooms (specifically cyanobacterial blooms), and faecal contamination (microbial quality). The report classified water quality for each of these parameters between 'Very poor' to 'Good' based on the percentage of samples that were compliant with the ANZECC 2000 objectives. These classifications are shown in Table 4.2.

Table 4.2 National Water Quality Assessment 2011 – Water quality classifications against ANZECC 2000 guidelines

CLASSIFICATION	PERCENTAGE COMPLIANCE WITH ANZECC 2000 GUIDELINES VALUES
Good	>75%
Fair	50–75%
Poor	25–50%
Very Poor	<25%

Water quality in the Mid Murray catchment which includes the proposal study area was generally good with turbidity, salinity, pH and nutrients complying for ANZECC/ARMCANZ (2000) guidelines for the majority of samples. Twenty sites were included in the water quality assessment, two of which rated 'fair' for turbidity and pH, with all other samples rating 'good'. Median turbidity ranged from 6 to 40 NTU and the median pH was 7 pH units, with a maximum of 9 pH units recorded at four sites along the Murray River.

4.13.4 VICTORIAN STATE OF THE ENVIRONMENT 2018 (VIC EPA, 2018)

The Victorian State of the Environment (SoE) report, prepared every five years, is an environmental report card that measures the health of Victoria's environment. This report is a key tool to enable transparent evaluation and disclosure of the condition of Victoria's environment.

The report provides an analysis and rating of the various water quality parameters in Victoria's CMAs over the years 2010–2017. The Mallee CMA was rated as 'good' for dissolved oxygen, however noted that the Murray Riverina river basin was rated lower than 'good' due to influence from NSW river systems. Dissolved oxygen levels were generally worst in 2010–2011 likely due to large flow events that followed the millennium drought which mobilised accumulated organic matter. Dissolved oxygen levels improved in the following years.

Salinity and pH in the Mallee CMA were rated as excellent over the monitoring period. Longer-term trends showed that salinity levels had been higher in the millennium drought years from 1996–2010 and that salinity levels had decreased after increased rainfall levels in the following years.

The Vic SoE 2018 did not report any data for either TP or TN in the Mallee CMA.

4.13.5 NSW STATE OF THE ENVIRONMENT 2018 (NSW EPA, 2018)

Prepared every three years, the NSW State of the Environment reports on the status of key environmental issues facing New South Wales including waterway health. This report uses the same classifications for water quality samples as shown in Table 4.2. Figure 4.4 shows that the site located upstream of the proposal study area on the Murray River recorded 'Good' ratings for both TP and TN. The next site downstream of this has a 'Fair' rating for TN and 'Good' for TP.

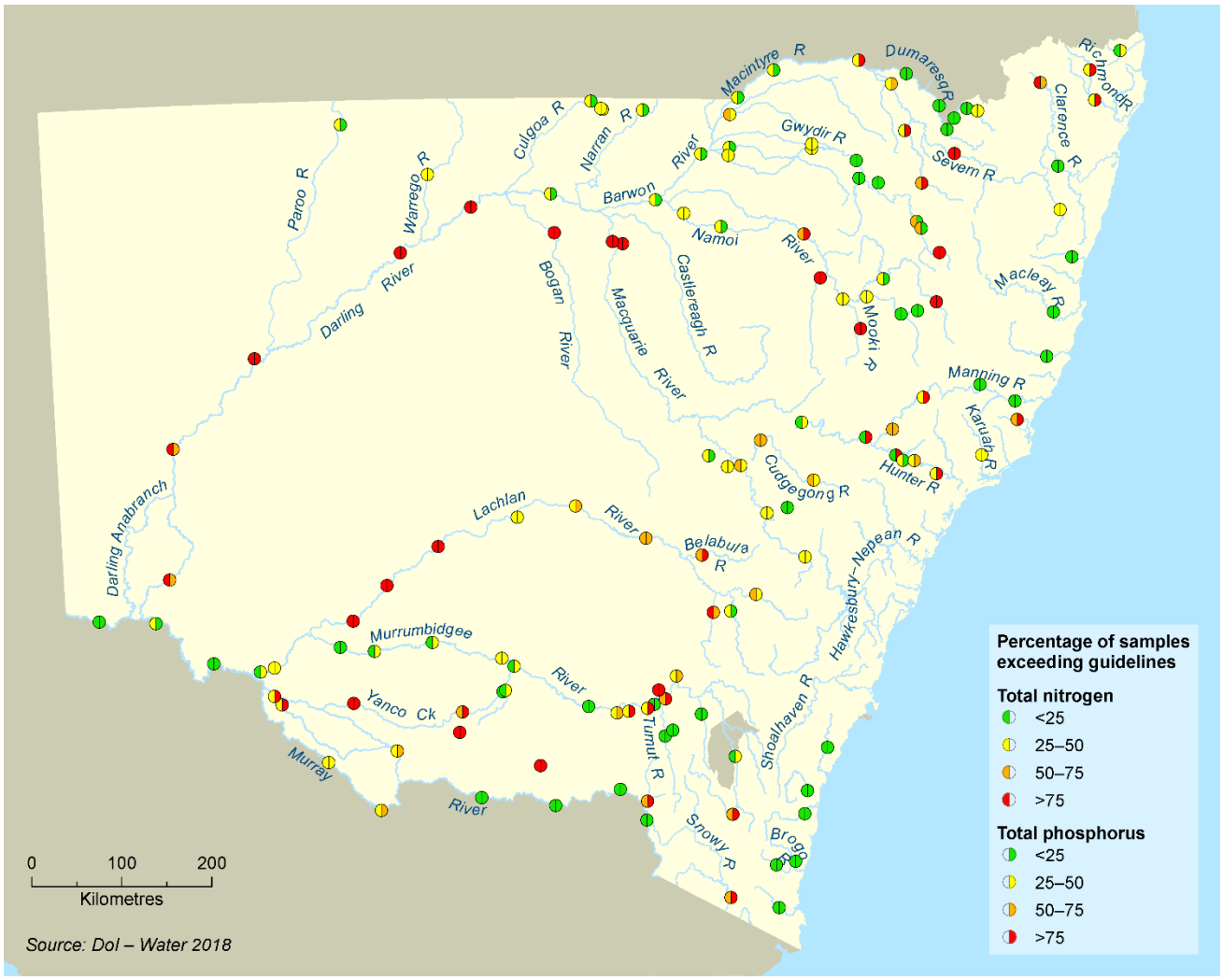


Figure 4.4 Per cent of samples exceedances for nutrient values as assessed by the 2018 State of the Environment report

4.13.6 VICTORIA MURRAY WATER RESOURCE PLAN

The Victorian Murray Resource Plan describes the water quality in the Murray area as highly variable spatially and temporally, but with a general trend of decrease quality from east to west in the Murray River and south to north in the tributaries.

The trend in decreasing water quality from east to west is most evident in salinity concentrations along the Murray River, with major increases in concentration occurring between the Torrumbarry Weir and Swan Hill (east and upstream of the proposal study area) resulting from lower inflows and higher salt loads. Increasing gradients also occur from east to west for other water quality parameters such as dissolved organic carbon, filterable reactive phosphorus, total Kjeldahl nitrogen, total phosphorus and turbidity (Henderson, Liu, & Baldwin, 2013).

4.13.7 NSW DARLING WATER RESOURCE PLAN, (DPI, 2018)

The Darling Water Resource Plan (DPI, 2018) rated the condition of the Lower Murray-Darling as poor to good using an integrated indicator of TN, TP, pH, turbidity and dissolved oxygen. The indicator was calculated using the frequency and amplitude of exceedances of the Basin Plan 2012 water quality targets during 2010–11 and 2014–15.

The monitoring sites on the Murray River on either side of the proposal study area received 'Good' and 'Fair' ratings. Nutrients (nitrogen and phosphorus) and suspended sediments are mostly low in the Murray River.

WaQI Scores: Blue = Excellent (100-95), Green = Good (94-80), Orange = Fair (79-60), Red = Poor (59-1).

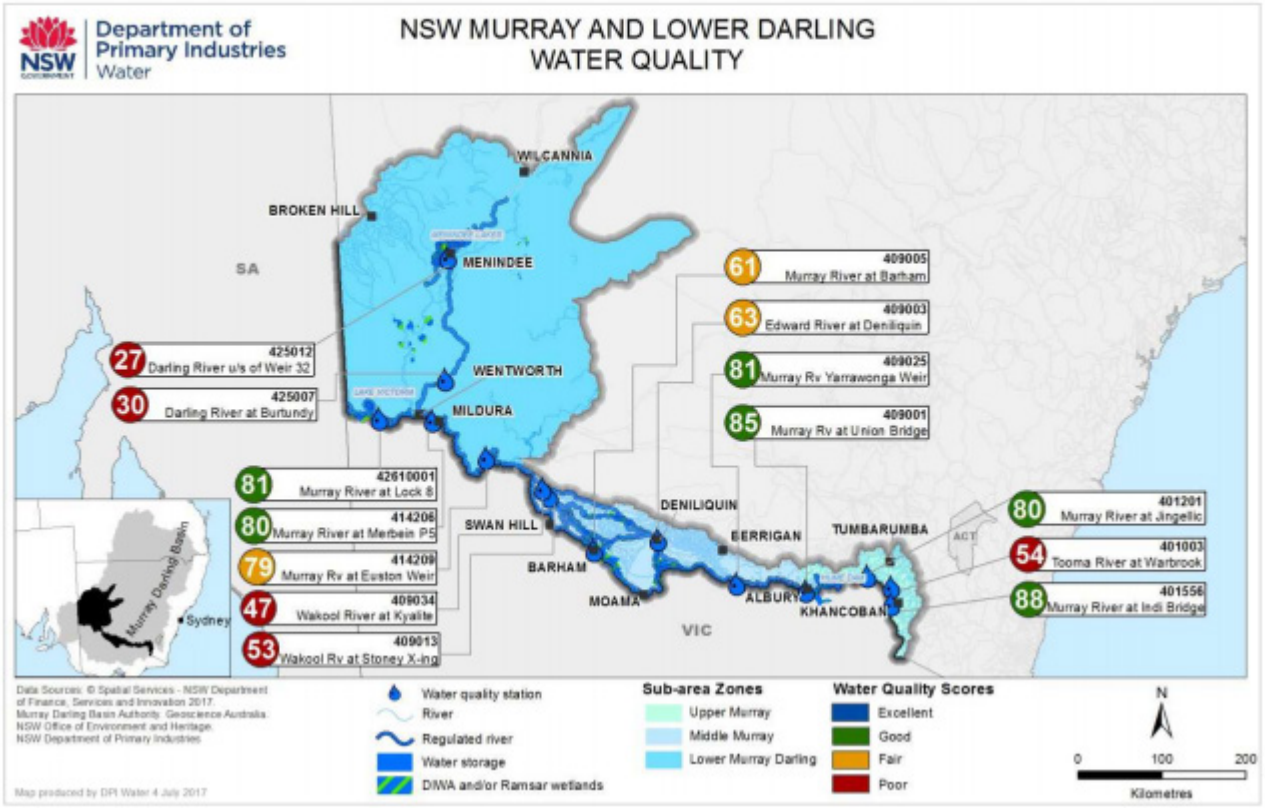


Figure 4.5 Water quality ratings – Darling Water Resource Plan, DPI, 2018

4.13.8 SUMMARY OF EXISTING WATER QUALITY

The reviewed reports have used the ANZECC 2000 guideline trigger values, now the ANZG guideline values, to assess water quality condition. The NSW State of the Catchments (Section 4.13.1) report in 2010 identified the TP and turbidity were largely below the ANZECC 2000 guidelines which was confirmed again in 2011 with the National Water Quality Assessment (Section 4.13.3). The 2018 Victorian State of the Environment Report (Section 4.13.4) scored an overall rating of the Murray River as good. The Victorian 2010 Index of Stream Conditions report (Section 4.13.1) also rated the water quality good.

Overall, it can be deduced that the waterway near the proposal study area often achieves the water quality targets identified for the proposal in Table 2.1.

5 ASSESSMENT OF CONSTRUCTION IMPACTS

5.1 FLOODING

During construction, the impacts to flood behaviour are likely to be temporary, localised and insignificant. The floodplain for the Murray River as described in Section 4.4 and the following construction activities are considered:

- construction of access tracks (noting existing tracks would be used where available) for construction machinery and materials to access each transmission line structure site
- earthworks and establishment of construction pads for each transmission line structure
- construction of footings and foundation works for the new transmission line structures including boring and/or excavation and concrete pours
- laydown and staging areas
- brake/winch sites.

The earthworks required for the transmission line structures would cause the temporary redistribution of flood flows which may have impacts on other nearby infrastructure, including structures. The construction planning during detailed design would consider how these temporary changes would be managed to prevent significant impacts occurring.

Large stockpiles and significant foundation works may result in changes to flood behaviour beyond the proposal footprint as it could redistribute and redirect floodwaters, and subsequently impact other land and infrastructure, including floodplain harvesting works. Construction planning during detailed design would consider how these temporary changes would be managed to prevent significant impacts occurring.

All other facilities would be located away from the flood prone area and therefore would have no impact on flood behaviour.

Section 4.4.1 identified existing flood affected roads as Woomera Avenue, Wonega Avenue and the access road into King Billabong Park. The flood affectation of these roads is unlikely to change due to the proposal construction activities because there would be no significant change to flood behaviour in the adjacent floodplain which affects flooding at the road.

5.2 STREAM CONDITION

There is a major waterway crossing at the Murray River as part of the proposal. Transmission line structures would be constructed at least 50 metres from the edge of the river and there would be no temporary or permanent crossings constructed as part of the proposal. As there would be transmission line structures built adjacent to existing structure within the flood prone land there would be minor impacts to stream conditions and these would include:

- changes in streamside vegetation
- increased sediment load from runoff from construction areas.

These impacts would be minor and not likely to impact the overall stream condition.

5.3 WATER SUPPLY AND WATER RESOURCES

Water would be required during construction for:

- dust suppression on construction sites and access tracks
- wetting backfill material, if it is too dry for effective compaction.

Water would either be sourced from existing infrastructure sources in Victoria and NSW, including (but not limited to) standpipes in Red Cliffs.

5.4 WATER QUALITY

The construction of the proposal has the potential to further degrade the water quality of the waterways within the proposal study area and areas downstream of this area, if not properly managed. The construction activities assessed with regard to water quality impacts include but are not limited to:

- construction of access tracks to allow construction machinery and materials to access each transmission line structure site
- earthworks and establishment of construction pads for each transmission line structure
- construction of footings and foundation works for the new transmission line structures including boring and/or excavation, steel fabrication works and concrete pours
- laydown and staging areas
- brake/winch sites.

Based on these activities, construction of the proposal may lead to increases of the following pollutants into waterways:

- sediment from vegetation and top soil clearing, soil excavation, movement and storage and stormwater runoff through disturbed sites
- chemicals, fuels and hydrocarbons from use, refuelling and maintenance of equipment and construction machinery
- contaminants of concern related to previous land uses – heavy metals, Total recoverable hydrocarbons (TRH), - Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX), Polycyclic aromatic hydrocarbon (PAH), organochlorine pesticides (OCP) and organophosphorus pesticides (OPP)
- heavy metals such as zinc, lead, copper, nickel, cadmium and chromium from disturbance of contamination and use and maintenance of vehicles and plants
- gross pollutants such as paper and plastic packaging and materials from material use on construction sites and general construction staff litter.

The construction of the proposal may degrade water quality if not properly managed which may subsequently have impacts to surrounding ecology, sensitive receivers and other water uses. The likelihood and magnitude of risks would vary depending on the stage of construction, the area of disturbance and presence of high rainfall or wind weather events. A Construction Environmental Management Plan (CEMP) and associated Soil and Water Management Sub-Plan (SWMP) would be prepared. The SWMP would identify the measures required to be implemented at construction work sites and this would limit the impact of the proposal. These would be soil and water measures which are commonly applied and well understood and are discussed in further detail in Chapter 7. Potential construction water quality impacts associated with key construction activities are discussed below.

5.4.1 EARTHWORKS

Earthworks would be required for construction of transmission line structures and for the upgrade of access roads. The proposal footprint at each transmission line structure for structure assembly and stringing would require a small amount of clearing and ground levelling . Excavation depths of up to 11 metres deep (at the potential deepest locations) are expected. Vegetation clearing, top soil clearing and earthworks, as well as other activities like vehicle movements and changes to natural drainage lines may lead to increased erosion and export of sediment to waterways during construction. These risks would be ongoing throughout the life of the construction phase and would be highest at locations with a slope of greater than 2.5 per cent and that are frequently disturbed. Risks of sediment transport and erosion would also increase during high rainfall and wind weather events.

Earthworks would increase the amount of disturbed and exposed soil available, which may impact the surface water quality of the environment through:

- changes to surface water run-off or evaporation due to clearing vegetation coverage. This may increase run-off volumes at both the temporary or long-term time scale
- increased surface water run-off due to soil stabilisation earthworks. Soil stabilisation may result in change to the permeability of the natural soils
- mobilisation of saline soils that may affect salinity levels and potentially damage concrete and metal structures
- mobilisation of contaminants or heavy metals that are present in soils
- increased turbidity, lowered dissolved oxygen levels and increased nutrients in water ways
- potential impacts to groundwater quality where there is interaction between the surface and groundwater (refer to section 4.10)
- reduction in channel habitat from sediment transport and deposition.

These potential impacts would be accounted for in the CEMP. These would include requirements for progressive erosion and sediment control measures and on site management protocols. Implementation of appropriate soil and water construction management measures would be anticipated to minimise impacts to water quality impacts from construction of the proposal. Additionally, impacts would be limited to the duration of construction and would be a short term. As such construction of the proposal would not cause significant changes to the water quality environment.

5.4.2 STOCKPILING AND SPOIL HANDLING

The construction of the proposal would generate spoil, vegetation waste and general construction and demolition waste that would be stored in stockpiles.

Stockpiling of earthwork materials poses a risk to water quality in receiving environments through the increased likelihood of movement of sediment. Stockpiling of mulched vegetation from clearing of trees and shrubs poses a risk of tannins leaching into watercourses, and increased loads of organics in watercourses. The discharge of water that is high in tannins may increase the biological oxygen demand of the receiving environment, which may in turn result in a decrease in available dissolved oxygen. Once discharged to the environment, tannins may also reduce visibility and light penetration, and change the pH of receiving waters. These impacts may affect aquatic ecosystems in receiving environments.

This material would be minimised and reused where practicable. Excess spoil stockpiled in locations that are open to rainfall or runoff would include appropriate management measures such as sediment fences and diversion drains to mitigate the impact of sediment movement offsite. Correct implementation of stockpile management protocols would mitigate and mange impacts to the receiving environments water quality.

5.4.3 POTENTIAL FOR SPILLS AND LITTER

The following activities have the potential to result in release of contaminants, oils, fuels, grease, chemicals and gross pollutants into the waterways in and surrounding the proposal:

- machinery and equipment operation, refuelling, maintenance and wash down
- spills and failure of machinery
- disturbance of contaminated soils
- inadequate management of chemicals, spoil, material stockpiles and litter from construction sites
- wastewater generated during construction.

Pollutants from these activities may be picked up in runoff from the site and enter the waterways and be transported downstream of the final proposal impact footprint. Water quality and ecological impacts may result from release of these contaminants into the catchment. Mitigation and management measures such as bunding, silt fences and other physical measures, would be implemented as part of the construction of the proposal. This would reduce the potential for release of chemicals from construction sites and into waterways.

5.4.4 SUMMARY OF WATER QUALITY IMPACTS

Water quality impacts from the construction of the proposal are anticipated to be short-term and limited in extent.

The key water quality objectives for the proposal, based on the Basin Plan 2012, is to appropriately manage water quality, including salinity, for environmental, social, cultural, and economic activity and therefore protect downstream environments from the potential impacts of surface runoff and discharge during construction and operation. The detailed water quality objectives for the proposal are defined in section 2.2. It is anticipated that through correct implementation of the standard mitigation measures during construction as described in Chapter 7 that there would be minimal impacts to the existing water quality condition of the hydrology and flooding study area. As such construction of the proposal would not cause significant changes to the water quality environment against the identified water quality objectives.

6 ASSESSMENT OF OPERATIONAL IMPACTS

6.1 FLOODING

The proposal's operational features would consist of transmission line tower structures in the floodplain and the supported transmission line. The structures could be spaced every 300-metres with a footing area of approximately 5-metres by 5-metres at each pole location and the transmission line structure above. The structures would consist of poles which will result in minimal loss of floodplain area. The footing connections at the base of each transmission structure would therefore be the only component of the structure within the floodplain. It is estimated that there would be insignificant impacts to flood behaviour such that there would be minimal to no change to flood levels, flood depths, and flood velocities, and no loss of flood storage as a result of the structures and footings being located in flooded areas.

Permanent access tracks are not expected to impact flood behaviour, where they are located away from overland flow paths. Major watercourse crossings are not proposed.

The impact to flood levels from the proposal would only be localised and would not affect the large flood extents experienced on the Murray River. The proposal is not predicted to have an impact on the flood affectation of structures (including buildings) and infrastructure (including roads) located near the proposal study area. As such there is not expected to be any change to use of the roads during a flood emergency.

6.2 STREAM CONDITION

The transmission line pole structures are located within the flood prone area of the Murray River but no impacts to stream condition are expected. It is expected that the new structures would be as close as possible to the existing structures and therefore not change any aspects of the stream conditions in the proposal study area.

6.3 WATER SUPPLY AND WATER RESOURCES

No significant quantities of water would be required during operation for maintenance activities of the proposal.

6.4 WATER QUALITY

There is potential for water quality impacts as a result of spills or litter generated from operation and maintenance activities at transmission line structures, however, these impacts would be minor and localised. Provided correct operation procedures and safeguards are implemented the residual likelihood of impacts would be low. There would not be any impacts to water quality expected as a result of the presence of the transmission lines in the landscape. As such operation of the proposal would not cause significant changes to the water quality environment against the identified water quality objectives.

7 MITIGATION MEASURES

Section 5 and 6 identified a range of impacts as a result of the proposal during construction and operation. The impacts are largely related to water quality. The following sections provide the mitigation measures which would be implemented for the proposal. Table 7.1 details the measures for pre-construction, construction and, operational phases of the proposal.

A Construction Environmental Management Plan (CEMP) and associated Soil and Water Management Sub-Plan (SWMP) will be developed. This SWMP would have the purpose of minimising and managing impacts on the soils and water environments during construction phase.

Table 7.1 Mitigation measures

ID	IDENTIFIED MITIGATION MEASURE	APPLICABLE LOCATION(S)
Pre Construction		
FL1	The Environment Protection Authority shall be notified of any proposed changes to waters under SEPP (Waters)	Access track upgrade
Construction		
FL2	All erosion and sediment control must be undertaken in accordance with: — Best Practice Erosion and Sediment Control, IESCA, 2008 — EPA Publication 1834: Civil construction, building and demolition guide, 2020 Construction Techniques for Sediment Pollution Control, EPA, 1991.	All construction locations
FL3	As a minimum, the following erosion and sediment control practices must be undertaken: — Unformed access routes must be stabilised if damage is anticipated. — Disturbed areas that are inactive or shut down must be stabilised to minimise erosion. Measures should be put in place to achieve 60% ground cover (or equivalent). — Excess spoil must be stockpiled & stabilised to minimise erosion (such as covering or compacting) and excess sediment loading in nearby waterways. — Locate stockpiles clear of drainage & steep areas. Ensure they are protected from erosion & do not encroach upon any waterway, footpath, nature strip or road. — Waste spoil must be classified & disposed of in accordance with VIC EPA requirements & TransGrid's Waste Management Procedure/Spoil Management Work Instruction to prevent rainfall runoff from the spoil polluting nearby waterways. — Sediment filters should be used where there is a risk of sediment entering drainage structures/waterways or migrating off site. — Remove collected sediment after a storm event and dispose of to prevent remobilisation (either reuse, stockpile or dispose of). — Control vehicle access/egress to minimise tracking of material onto paved surfaces/ roads, particularly during wet weather or when the sites are muddy. — Where sediment is on hard surfaces it must be removed by means other than washing. — Install a sealed receptacle on site to allow for residues from concrete chutes. Concrete may be discharged into prepared excavations/formwork or designated waste receptacles only. — Stabilise surfaces to original condition or as designed. — All disturbed areas where works are complete must be progressively stabilised so that within 60 days no completed areas remain exposed to potential erosion damage. — Where possible, saline, acid sulfate or contaminated soils should be avoided and where not possible would be dealt with in line with the relevant guidelines and contaminated land procedures.	All construction locations

ID	IDENTIFIED MITIGATION MEASURE	APPLICABLE LOCATION(S)
FL3	A flood emergency management procedure would be prepared for the construction works of transmission line towers structures located within flood prone land. The procedure would complement the existing Mildura Local Flood Plan arrangements and would provide a series of activities that need to take place should a flood event occur. These activities would focus on the flood emergency and then during the recovery period to assist with starting work again after the flood event. The procedure would be in place before construction in these areas commences.	At transmission line tower structure sites located within the flood prone land surrounding waterways
Operation		
FL7	Control measures to manage surface water impacts during operation and maintenance procedures, including measures for managing spills, would be developed and implemented as part of the operations environment management plans for the proposal.	Operation and maintenance activities located within proximity of waterways

It is anticipated that implementation of appropriate soil and water construction management measures as discussed above would mitigate and minimise the potential impacts on flooding and water quality. As such construction and operation of the proposal would not cause significant changes to the flooding environment or to the water quality environment against the Basin Plan 2012 water quality objectives (refer to Section 2.2).

8 CONCLUSION

The impacts of the proposal to flooding within the area are likely to be temporary, localised and minor. Impacts to flood behaviour during construction would be associated with works for the transmission line tower structures, all of which are located within the flood extent. For all other facilities, it is anticipated that they would be located away from flood prone area and therefore would have no impact on flood behaviour.

The existing monitoring of the Murray River indicates that the existing water quality is generally compliant with the Basin Plan values. Construction activities and operation of the proposal will need to manage water quality from the proposal to ensure the Basin Plan water quality objectives are met. Appropriate soil and erosion management practices would ensure in minimal impact to water quality outside of the proposal study area.

Mitigation and management measures have been identified for pre-construction, construction and operations phases of the proposal. It is anticipated that correct implementation of appropriate soil and water construction management measures would mitigate and minimise the potential geomorphic and water quality impacts. These should be documented in the CEMP.

9 REFERENCES

BECA, March 2020, *Project EnergyConnect – Hydrological Risk Assessment – Final Dataset.*

Bureau of Meteorology, 2020b, National Groundwater Information System – Australian Groundwater Explorer, *Australian Government*, Canberra ACT, data downloaded 25/09/2020.

Bureau of Meteorology, Murray Darling Basin Climate and Water, data downloaded 22/09/2020.

Colquhoun, G. P., Hughes K. S., Deyssing L., Ballard J. C., Phillips G., Troedson A. L., Folkes C. B., and Fitzherbert J. A., 2019 New South Wales Seamless Geology dataset, version 1.1 [Digital Dataset], Geological Survey of New South Wales, *NSW Department of Planning and Environment*, Maitland.

Department of Infrastructure, Planning and Environment -Water, Water Allocation Statement Water availability and allocation update, 3 August 2020.

Mallee CMA, 2018, King's Billabong Floodplain Management Unity Environmental Water Management Plan.

Murray-Darling Basin Authority, 2019a, Lake Victoria Annual Report 2018, *Murray-Darling Basin Authority,* Canberra, ACT.

Murray Darling Basin Authority, 2020, https://www.mdba.gov.au/, accessed: 12/06/20.

Murray Darling Basin Authority, 2020, Basin Plan 2012, Annual Report 2018-2019.

Murray Darling Basin Commission, date unknown, available at: https://www.mdba.gov.au/sites/default/files/archived/mdbc-tlm-reports/525_menindeelakesdarling.pdf.

Murray Darling Wetland Working Group, 2020, https://www.murraydarlingwetlands.com.au/what-we-do/projects/successful/environmental-watering/201322840294.asp, Accessed: 18/06/20.

NSW Department of Agriculture, Water and the Environment, Protected Matters Search Tool, accessed 22/09/2020, < http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf>.

NSW EPA, 2018, State of the Environment.

NSW Department of Primary Industries, 2020, Murrumbidgee Catchment, available at: https://www.dpi.nsw.gov.au/fishing/habitat/your-catchment/murrumbidgee.

NSW Government Department of Planning, Industry and Environment, 2019a, NSW Murray-Darling Basin Porous Rock Water Resource Plan Fact Sheet, *Department of Planning, Industry and Environment*, Publication 19/94, dated July 2019.

NSW Department of Planning, Industry and Environment, 2019, *River Styles Framework.*

NSW Government, 2010, State of the Catchments.

NSW Office of Water, 2012a, Water Sharing Plan Lower Murray-Darling Basin Unregulated and Alluvial Water Sources Background Document, *NSW Department of Primary Industries – Office of Water*, dated January 2012, Sydney, NSW.

OEH, 2013a. NSW Landuse 2013. NSW Office of Environment and Heritage, Sydney.

Parsons Brinckerhoff, 2013, Groundwater Model Lake Victoria Consent Reporting, *NSW Office of Water*, document number 2114851A PR_7249 RevE, dated 2 August 2013.

Sinclair Knight Merz, 2011, National Water Quality Assessment.

Strudwick, S, Murrayriver.com.au, Home > About The Murray > The Murray River is a very regulated river system, Accessed 13/07/2020 3:22 PM.

VIC Department of Environment and Primary Industries, 2010, Index of Stream Condition, The Third Benchmark of Victorian River condition, Available: https://www.water.vic.gov.au/__data/assets/pdf_file/0024/34809/ISC_Part1_Introduction.pdf.

APPENDIX A

BECA REPORT

EnergyConnect Flood Study - Phase 1– Stage 1

Desktop Assessment and Spatial Analysis

Prepared for TransGrid
Prepared by Beca Pty Ltd
ABN 85 004 974 341

5 November 2019

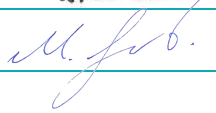
Contents

Appendices

Revision History

Revision Nº	Prepared By	Description	Date
1	Natasha Webb	Revision A	10/10/2019
2	Natasha Webb	Revision B	18/10/2019
3	Natasha Webb	Revision C	05/11/2019

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Natasha Webb**		05/11/2019
Reviewed by	**Luke McLean**		05/11/2019
Approved by	**Mark Jacob**		05/11/2019
on behalf of	Beca Pty Ltd		

1 Introduction

The following report outlines Stage 1 of the hydrological study of the proposed 330 kV EnergyConnect transmission line. Stage 1 consists of a desktop assessment and spatial analysis of the:

- Proposed 330 kV interconnector routes, provided in the following KMZ files from TransGrid:
  - 330kV-(Boarder- Buronga -Darlington Point -Wagga) & 220kV-Redcliffs (Rev2).kmz
  - Darlington South Route Option (PEC).kmz
- 2 km corridor (i.e. 1 km either side of the route centreline).
- Preliminary tower locations, provided in the following KMZ files:
  - Optimum Spotting - Buronga to Border.kmz
  - Optimum Spotting - Buronga to Red Cliffs.kmz
  - Optimum Spotting - Darlington Point to Buronga.kmz
  - Optimum Spotting - Wagga Wagga to Darlington Point.kmz
- Desktop access tracks, as outlined in:
  - Basis of Design and Cost Estimation – Access Tracks for Dry Weather Access Only Revision 3 (Beca Pty Ltd, August 2019).
- Attributing catchment and waterways.

This document outlines the methodology and results from Stage 1 – Desktop Assessment and Spatial Analysis.

DISCLAIMER:

Stage 1 Spatial Analysis is a topographical flow path analysis between the proposed route and stream order.

Stage 1 is **NOT** a flood study of the proposed alignments. This analysis does **NOT** provide flood levels, depths or hazard classes for the proposed alignments and tower locations. This information would be provided as the outcome of Stage 2 - Targeted 2D Tuflow HPC modelling.

This topographical flow path analysis:

- Identifies intersections between the proposed route/preliminary tower locations and waterways,
- Categorises the intersections to inform areas where the initial development route alignment and tower locations should be given greater attention caused by increased interaction with surface and flood water.

This analysis does **NOT** provide:

- Water levels, flood depths, flood velocities, or flood hazard classes along the alignments.
- Identify areas of historical flooding levels along the alignments.
- Identify areas along the stream and river orders subject to flood breakout, floodway flows or flood storage.
- Identify at any level of detail the irrigation systems within proximity to the towers locations and adjacent catchments, nor quantify their potential effect on flowpaths.
- Identify or consider major waterway or river control structures within the catchments.
- Identify the property title or property ownership of the corridor and tower locations.
- Frequency and severity information of storms for the catchment.
- Potential for debris loading along the identified waterways.
- Accuracy check on source data used in open source databases.
- Ground truthing.

The information produced in this report is for the sole purpose of the assessment of the proposed transmission line route for the EnergyConnect project. The information has been produced based upon the validity of the project data provided at the time of undertaking this analysis and is considered appropriate for

this stage of the assessment. The information provided in these files are **NOT** be used for alternative purposes.

2 Project Description

2.1 Route Description

The proposed 330 kV transmission line route travels from Wagga Wagga to the South Australia New South Wales border. The route is divided into 3 route alignments (outlined in Table 2-1), with the route extents shown in Figure 2-1.

Preliminary tower locations have been placed at approximately 600 m intervals along the route, with desktop assess tracks defined for the work areas around towers.

Table 2-1 EnergyConnect Proposed Routes

Route	Description	Data Source (KMZ File)
Alignment 1	NSW/SA Border to Buronga	330kV-(Boarder- Buronga -Darlington Point - Wagga) & 220kV-Redcliffs (Rev2).kmz
	Red Cliffs to Buronga	
Alignment 2	Buronga to Darlington Point	330kV-(Boarder- Buronga -Darlington Point - Wagga) & 220kV-Redcliffs (Rev2).kmz
	Darlington Point to Wagga Wagga	
Alignment 3	Darlington South Route Option	Darlington South Route Option (PEC).kmz

2.2 Catchment Description

The proposed route traverses the Murray Darling Basin, as shown in Figure 2-1. This basin is the catchment for Australia's largest river system and covers over 1 million km^2. The basin is bounded by the Great Dividing Range. The north and west of the basin is flat and semi- arid, with the environment ranging from saltbush shrublands and mulga lands to farm land.

The Murray Darling Basin contains Australia's 3 longest rivers; the Darling/Barwon river system, the Murray River and the Murrumbidgee River. The proposed route intersects each of these river systems, with the Murrumbidgee River running along parallel to Alignment 2 and Alignment 3.

The Murrumbidgee River is the third longest river (approximately 1,500 km in Australia at approximate, whose catchment presents 8% of the Murray-Darling Basin (Murray-Darling Basin Authority, 2019) and is contains many wetland and riverine environments. This river starts in the Australian Alps and ends on the semi-arid riverine plains. It contributes to 16% of the Murray-Darling basin water (Murray-Darling Basin Authority, 2019). Historical accounts and records described numerous occasions of riverine flooding of Murrumbidgee that have caused flood damage, loss of property and disruption to services (Murray-Darling Basin Authority, 2019).

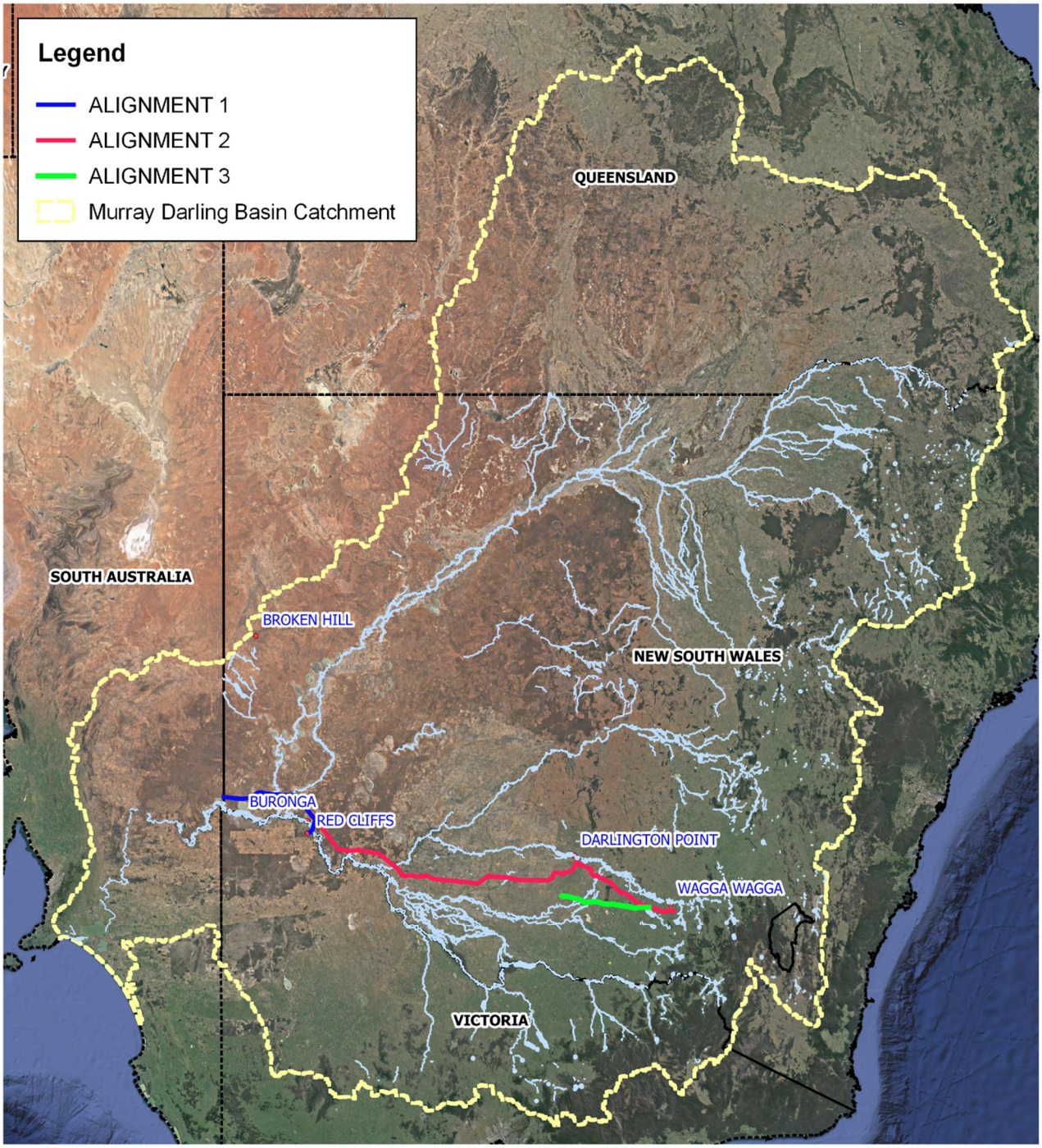


Figure 2-1 Energy Connect Proposed Route and Catchment Area (Murray Darling Basin)

3 Methodology

3.1 Desktop Assessment

The desktop assessment was undertaken to determine the data availability and suitability to progress to the spatial assessment, and to form part of the flood modelling for Stage 2. It consisted of data collation and a high-level gap analysis, utilising the rating system described in Table 4-1. This rating system was used to flag issues that may affect the uses and acceptability of the data/information.

3.2 Spatial Analysis

Based upon the data collated from the Desktop Assessment, a spatial analysis was undertaken for the Murray Darling Basin. The spatial analysis was performed on the NASA Shuttle Radar Topography Mission (SRTM) Hydro Enforced Lidar (2011, GeoScience Australia). The SRTM 1 sec Hydro Enforced Lidar provides coverage of the whole basin, with a resolution of 1 arc-sec (approximately 30-m grid).

The spatial analysis consisted of the following processes:

1. Watershed analysis for catchment delineation and stream line definition of the Murray Darling Basin to identify sub-catchments and waterways and tributaries.
2. Stream Order (Strahler) analysis of the stream lines defined from Watershed.
3. Conflict analysis of between the stream lines to identify the number of conflicts between the waterways with:
   - Preliminary Tower Locations;
   - Proposed route corridor; and
   - Desktop Access Tracks.
4. Categorisation of the conflict locations to identify locations/towers that would require further assessment of the alignment and require flood modelling. This categorisation was based upon the waterways stream order, as stream order is a relative measure of the size of streams. It can be used to infer characteristics of streams, i.e. the smallest tributaries (referred to as first-order streams) are dominated by overland flow, while a stream that is fifth-order or larger constitutes a river. The rating systems for conflict locations are further described below in Section 3.2.1.

The processes outlined above are repeatable to provide flexibility should updated and/or additional design data be provided.

3.2.1 Conflict Categorisation

Two rating systems have been developed for the categorisation of the conflict locations, based upon the preliminary tower locations, proposed route corridor and desktop assessment:

Rating System 1: Conflicts between waterways and preliminary tower locations

For the identification of conflicts between waterways and preliminary tower locations, a conflict location has been identified if the tower intersects with a waterway and/or is within a buffer width of a waterway. A buffer width has been applied to the analysis to identify towers that are located within the cross-section of a waterway or within the waterways corresponding flood plain.

Rating System 1 is outlined in Table 3-1.

A buffer width for each rating category was developed through interrogation of several identified waterways for each stream order and the SRTM Lidar and aerial photographs. The buffer widths were developed through interrogations of waterways and their corresponding stream orders along the proposed route alignments. This interrogation involved reviewing a sample of waterways for each stream order; where the cross-sectional profiles were measured and compared to the terrain profiles of the surrounding floodplain and aerial satellite photographs. From this interrogation, a buffer width for each stream order was developed to represent the potential areas around the tower that would be influenced and at risk from a nearby waterway. For example, a tower within 300 m of a waterway with stream order of 7 would be within the floodplain of the waterway and be potentially at risk. It would consequently have a conflict categorisation of CAT 3.

Table 3-1 Conflict Categorisation Rating System for Preliminary Tower Location

Description	Conflict Category	Stream Order	Buffer Width Rule
Tower location conflicts with (or is within 50 m of) minor tributaries. No flood modelling required. Consider a review location.	CAT 1	1	50 m
	CAT 1	2	50 m
Tower location conflicts with (or is within 100 m of) mid-order waterways. Review tower location and consider flood modelling.	CAT 2	3	100 m
	CAT 2	4	200 m
Tower location conflicts with (or is within 200 – 300 m of) major waterways and rivers. Review tower location, and route and location should be changed. Flood modelling should be considered.	CAT 3	5	200 m
	CAT 3	6	200 m
	CAT 3	7	300 m
	CAT 3	8	300 m
	CAT 3	9	300 m
	CAT 3	10	300 m
	CAT 3	11	300 m

Rating System 2: Conflicts between waterways and proposed route corridor or desktop access tracks

For the identification of conflicts between waterways and proposed route corridor or desktop access tracks, a conflict location has been identified if the corridor or access track intersects with a waterway.

Rating System 2 is outlined in Table 3-2.

Table 3-2 Conflict Categorisation Rating System for Proposed Route Corridor or Desktop Access Tracks

Description	Conflict Category	Stream Order
No conflict or minimal conflict with low order tributary. No change or flood modelling required.	CAT 1	1 – 2
Conflict on minor riverway. Route/tower/access track location to be revised if possible, otherwise flood modelling required at Stage 2.	CAT 2	3 – 4
Conflict on high stream order tributary or major waterway. Flood modelling required at Stage 2.	CAT 3	Greater than 5

4 Results

4.1 Desktop Assessment

It consisted of data collation and a high-level gap analysis, utilising the rating system described in Table 4-1. This rating system was used to flag issues that may affect the uses and acceptability of the data/information.

The data collated and gap assessment findings are outlined in Table 4-2.

Table 4-1 High Level Data Gap Analysis Rating System

Category	Description	Review Rating	Fit for Use
No issue	The data/information reviewed is acceptable to progress to spatial analysis and/or use for Stage 2.	0	Yes
Minor Issue	The data/information has a potential issue, but unlikely to significantly affect spatial analysis or Stage 2.	1	Yes
Moderate Issue	The data/information has a potential issue that could affect the spatial analysis and/or Stage 2. It may be resolved by explanation or acceptance of limitations of data.	2	More information required
Major Issue	The data/information reviewed has potential issues that are unable to be resolved and should be rectified before used in spatial analysis or Stage 2.	3	No

Table 4-2 Data collated and gap analysis results

Description	Format	Source	Findings/Comments	Rating
Proposed Route – Alignment 1 and Alignment 2	KMZs	TransGrid	KMZ assumed to show the full route for Alignment 1 and Alignment 2. It was required to be processed into GIS format for the spatial analysis and to create the 2km corridor.	0
Proposed Route – Alignment 3	KMZs	TransGrid	KMZ assumed to show the full route for Darlington South Route Option. It was required to be processed into GIS format for the spatial analysis and to create the 2km corridor.	0
Preliminary Tower Locations	KMZs	Beca	KMZ showed tower locations only for the full route for Alignment 1 and Alignment 2. Tower locations range from 350 to 600 m. Towers for Alignment 3 were not included for the spatial analysis.	1
Desktop Assess Tracks	DWG	Beca	DWG shows desktop assess track of Alignment 2 of the proposed route and include existing, new access track and major and minor roads. Access tracks for Alignment 1 and Alignment 3 were not included for the spatial analysis.	1
SRTM 1 Sec Hydro Enforced Lidar	Esri Database (.adf)	Creative Commons © GeoScience Australia	This 2011 Lidar covers the whole of Australia and captures flow paths based on SRTM elevations and mapped stream lines and supports delineation of catchments and related hydrological attributes. Although the SRTM lidar is at 1 arc-sec resolution (approximately 30m grid) and is the only opensource Lidar dataset covering whole Murry Darling Catchment and utilised for large regional modelling. It was used for the spatial analysis and will be utilised for Stage 2.	0
TransGrid Project Lidar	.laz	TransGrid	High quality project lidar covering the corridor. This lidar does not cover the full catchment area (over 1 million km^2) required for the spatial analysis or the full catchment to be modelled in Stage 2. However, a vertical assessment will be performed between the SRTM Lidar and the project lidar data, as a difference check during Stage 2.	1
Aerial Imagery	JPEG	Esri World Imagery	Aerial Imagery at resolution to provide sufficient detail. Latest aerial imagery for the whole of the Murray Darling Basin. No high resolution imagery has been obtained due to the scale of the spatial analysis. Imagery is fit for spatial analysis.	0
Land Use and Soil Classes	Shp Esri Databases (.gbd)	Creative Commons © NSW Department of Planning, Industry and Environment	Data is dated 2017 and is the latest data for the whole of NSW. Although land use may have changed within the last 2 years, quantifying the changes would be effort and resource intensive, with marginal effect on Stage 2. The data is deemed suitable to be used in Stage 2.	1

Description	Format	Source	Findings/Comments	Rating
Vegetation Classes	Shp Esri Databases (.gbd)	Creative Commons © NSW Department of Planning, Industry and Environment	Data is dated 2016 and is the latest database available for the whole of NSW. Although vegetation extents may have changed within the last 3 years, quantifying changes would be effort and resource intensive, with marginal effect on Stage 2. The data is deemed suitable to be used in Stage 2.	1
Murray Darling Basin Catchment Files	Esri Databases (.gbd)	Creative Commons © Murray Darling Basin Authority	The Murray Darling Basin Database is an open source database of the whole basin to provide spatial information on relationships and characteristics of hydrological features (Streams, Aquifers, Storages, Wetlands and man-made structures). Useful database for comparison with spatial analysis results.	0
Surface Water Information (Hydrology Database)	Esri Databases (.gbd)	Creative Commons © GeoScience Australia	The National Surface Hydrology Database is an open source database of the whole of Australia to provide spatial information on relationships and characteristics of hydrological features (Catchments, Streams, Aquifers, Storages, Wetlands and man-made structures) Useful database for comparison with spatial analysis results.	0
NSW Irrigation System Information	NA	NA	No data has been sourced for Stage 1 and will not be sourced until agreement on flood modelling methodology and commencement of Stage 2. This data has the potential to impact the outcome from Stage 2. However, is excluded from the scope of the flood modelling, as Stage 2 is to model an open system (see disclaimer).	2
Stream Gauge Data	NA	NA	No data has been sourced for Stage 1 and will not be sourced until agreement on flood modelling methodology and commencement of Stage 2. Stream gauge information has the potential to impact the outcomes from Stage 2 and will be sourced at commencement of Stage 2.	2
Rainfall Data	CSV TXT	Bureau of Metrology (BoM) Australian Rainfall and Runoff (ARR) 2019 Data Hub	BoM website and ARR2019 datahub provides required data for Stage 2. Specific data based upon spatial distribution will be sourced upon commencement of Stage 2.	0
Temporal Patterns, Areal Distribution and Reduction Factors etc	CSV TXT	Bureau of Metrology (BoM) ARR 2019 Data Hub	ARR 2019 datahub provides required data for Stage 2. Specific data based upon spatial distribution will be sourced upon commencement of Stage 2.	1

4.2 Spatial Analysis

The digital files have been generated and provided of the conflict locations and categorisation identified through Stage 1 Spatial Analysis. The information contained within these files is for the sole purpose of the assessment of the proposed transmission line route for the EnergyConnect project. The information has been produced based upon the validity of the project data provided at the time of undertaking this analysis and is considered appropriate for this stage of the assessment. The information provided in these files is **NOT** be used for alternative purposes.

A summary of the GIS files produced, and their attributes is outlined in Table 5-1. Appendix A contains the summary tables that outline the total number of each conflict category locations for:

- Preliminary Tower Locations;
- Route Corridor; and
- Desktop Access Tracks.

5 Recommendations

The digital files provided can be used within GIS software to review these conflict locations to inform design development for route alignment and tower locations. For example:

- Map 1 (located in Appendix A) provides an example of the spatial analysis output files at the proposed route at Darlington Point. This map shows four locations along the proposed route which are Category 3 (RED Triangles and Dots). This flags that these locations and towers should be reviewed by designers to determine whether the route can avoid several major waterways within the area, minimise the number of towers within these regions and other possible solutions.

The outcomes of Stage 1 will be used to form the flood modelling approach for Stage 2 – Targeted 2D Tuflow HPC modelling and will be developed with consultation with TransGrid.

Table 5-1 Summary of GIS Files produced for Stage 1 Spatial Analysis

No.	File Name	Description	Attribute			Format	Projection
			No.	Name	Description		
1	20191010_EC_Stage1_Streamline_001	Derived stream lines	0	STR_ID	Stream Id	KML shp	WGB84
			1	STR_ORD	Stream Order (Strahler)		
			2	from_node	Upstream node/junction of stream line		
			3	to_node	Downstream node/junction of stream line		
2	20191010_EC_Stage1_Tower_Categorised_001	Conflict categorised preliminary tower locations	0	NAME	Name	KML shp	WGB84
			1	SOURCE	Name of source route KMZ file		
			2	ST_ID	Tower identifier		
			3	STR_ID	Conflicts stream Id		
			4	STR_ORD	Conflicts Stream Order (Strahler)		
			5	CATEGORY	Conflict Category based on Table 3-1		
3	20191010_EC_Stage1_RouteCorridor_Categorised_001	Conflict categorised locations with route corridor	0	OBJECTID	Conflict location identifier	KML shp	WGB84
			1	STR_ID	Conflicts stream Id		
			2	STR_ORD	Conflicts Stream Order (Strahler)		
			3	CATEGORY	Conflict Category based on Table 3-2		

No.	File Name	Description	Attribute			Format	Projection
			No.	Name	Description		
4	20191010_EC_Stage1_AccessTrack_Categorised_001	Conflict categorised locations with desktop access tracks	0	OBJECTID	Access track identifier	KML shp	WGB84
			1	TYPE	Name of type of access track or road type		
			2	STR_ID	Conflicts stream Id		
			3	STR_ORD	Conflicts Stream Order (Strahler)		
			4	CATEGORY	Conflict Category based on Table 3-2		
5	20191010_EC_Stage1_DesktopAccessTracks_001	Desktop access tracks	0	TYPE	Name of type of access track or road type	KML shp	WGB84
			1	SOURCE	Name of source DWG file		
6	20191010_EC_Stage1_RouteCorridor_001	Combined route corridor (2km wide)	0	NAME	Name of source alignment KMZ	KML shp	WGB84
			1	PERIMETER	Route corridor perimeter		
			2	AREA	Route corridor enclosed area		

APPENDIX A

From the spatial analysis, the following tables summarise the total number of each conflict category locations for:

- Preliminary Tower Locations;
- Route Corridor (2km wide); and
- Desktop Access Tracks (New Access Track, Existing Access Tracks, Minor Roads and Major Roads)

Preliminary Tower Locations

Table 5-2 Summary of the number of preliminary tower location conflicts

Conflict Category	No. of Towers
CAT 1	126
CAT 2	156
CAT 3	208
Towers with no conflict (NA)	787

Route Corridor

Table 5-3 Summary of the number of conflict locations along the route corridor.

Conflict Category	No. of Conflict Locations
CAT 1	1682
CAT 2	393
CAT 3	127

Access Tracks

Table 5-4 Summary of the number of conflict location on desktop access tracks (Access Tracks New)

Conflict Category	No. of Conflict Locations
CAT 1	175
CAT 2	45
CAT 3	15

Table 5-5 Summary of the number of conflict location on desktop access tracks (Access Tracks Existing)

Conflict Category	No of Conflict Locations
CAT 1	50
CAT 2	15
CAT 3	6

Table 5-6 Summary of the number of conflict location on desktop access tracks (Major Roads)

Conflict Category	No of Conflict Locations
CAT 1	85
CAT 2	21
CAT 3	8

Table 5-7 Summary of the number of conflict location on desktop access tracks (Minor Road)

Conflict Category	No of Conflict Locations
CAT 1	319
CAT 2	89
CAT 3	23

DARLINGTON POINT

Legend

20191027_EC_Stage1_Tower_Categorised_001

- No conflict (Not Categorised)
- CAT 1
- CAT 2
- CAT 3

20191027_EC_Stage1_RouteCorridor_Categorised_001

- CAT 1
- CAT 2
- CAT 3

20191027_EC_Stage1_AccessTrack_Categorised_001

- CAT 1
- CAT 2
- CAT 3

- 20191027_EC_Stage1_RouteCorridor_001
- SRTM_CONTOURS_2m_Interval (2km corridor)

20191027_EC_Stage1_DesktopAccessTracks_001

- ACCESS_TRACK (Existing)
- ACCESS_TRACK (NEW)
- MAJOR_ROAD
- MINOR_ROAD

20191027_EC_Stage1_Streamline_001 (STREAM ORDER)

- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11

MAP 1 - Conflict Locations at Darlington Point
EnergyConnect
20191027

APPENDIX B

LOTSEARCH REPORT

LOTSEARCH

LOTSEARCH ENVIRO PROFESSIONAL

Address: Red Cliffs, Mildura, VIC 3496

Date: 01 Sep 2020 14:46:09

Reference: LS014487 EP

Dataset Listing

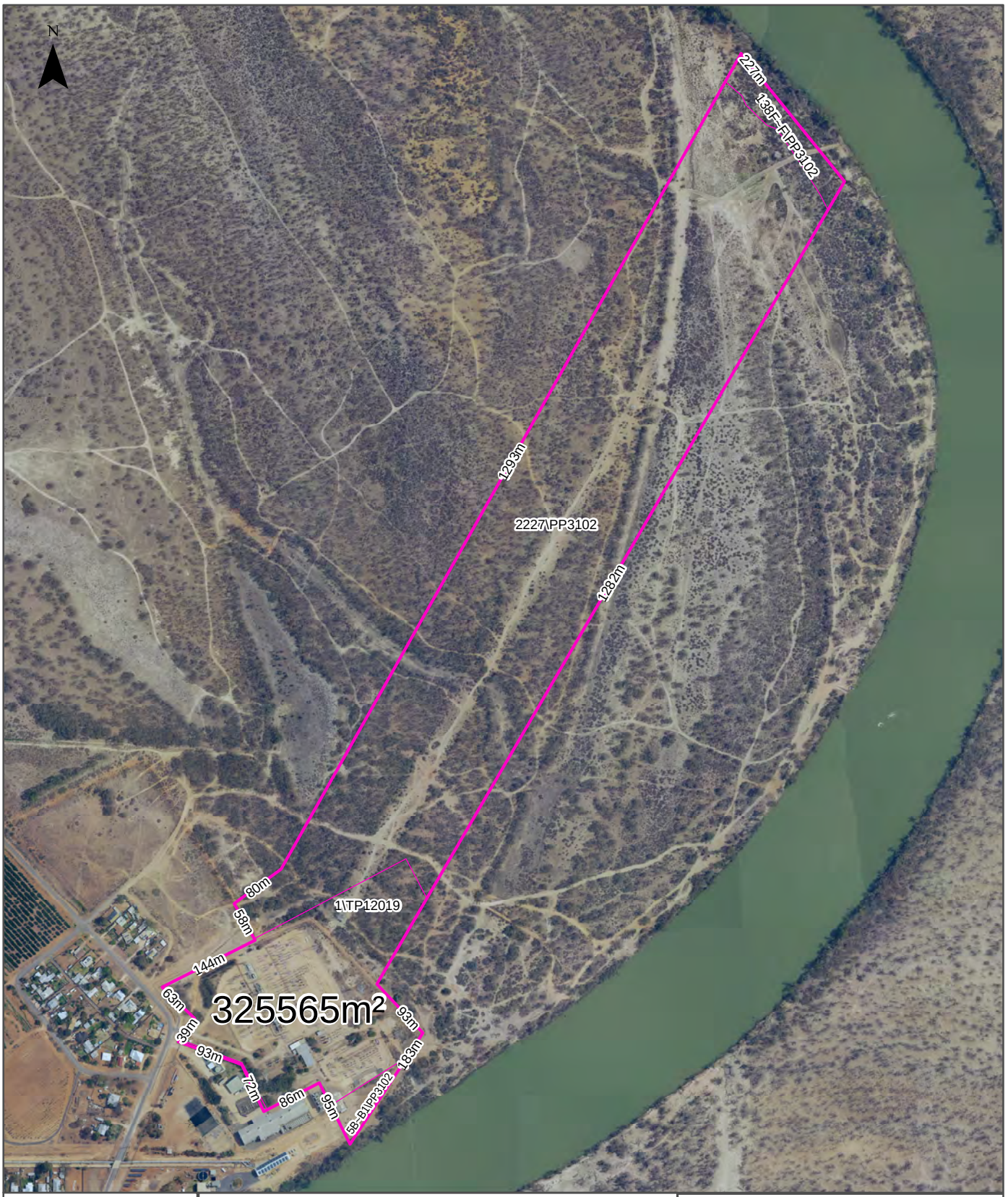
Datasets contained within this report, detailing their source and data currency:

Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	Dataset Buffer (m)	No. Features Onsite	No. Features within 100m	No. Features in Buffer
Topographic and Cadastre data	State Government Victoria - Department of Environment, Land, Water & Planning	12/08/2020	12/08/2020	Monthly	-	-	-	-
Current EPA Priority Sites	Environment Protection Authority (Vic)	31/08/2020	31/07/2020	Monthly	1000	0	0	0
Former EPA Priority Sites & other Remedial Notices	Environment Protection Authority (Vic)	04/11/2019	04/11/2019	Monthly	1000	0	0	0
EPA PFAS Site Investigations	Environment Protection Authority (Vic)	03/08/2020	10/10/2019	Monthly	2000	0	0	0
Defence PFAS Investigation & Management Program - Investigation Sites	Department of Defence	11/08/2020	11/08/2020	Monthly	2000	0	0	0
Defence PFAS Investigation & Management Program - Management Sites	Department of Defence	11/08/2020	11/08/2020	Monthly	2000	0	0	0
Airservices Australia National PFAS Management Program	Airservices Australia	28/08/2020	28/08/2020	Monthly	2000	0	0	0
Defence 3 Year Regional Contamination Investigation Program	Department of Defence	17/08/2020	17/08/2020	Monthly	2000	0	0	0
EPA Environmental Audit Reports	Environment Protection Authority (Vic)	28/08/2020	28/08/2020	Monthly	1000	0	2	2
EPA Groundwater Zones with Restricted Uses	Environment Protection Authority (Vic)	28/08/2020	28/08/2020	Monthly	1000	0	0	0
Current EPA Licensed Activities	Environment Protection Authority (Vic)	28/08/2020	28/08/2020	Monthly	1000	0	0	0
Former EPA Licensed Activities	Environment Protection Authority (Vic)	28/08/2020	28/08/2020	Monthly	1000	0	0	0
EPA Works Approvals	Environment Protection Authority (Vic)	31/08/2020	31/08/2020	Monthly	1000	0	0	0
National Waste Management Facilities Database	Geoscience Australia	15/05/2020	07/03/2017	Quarterly	1000	0	0	0
Statewide Waste and Resource Recovery Infrastructure Plan Facilities	State Government Victoria - Department of Sustainability	27/11/2014	31/12/2012	None planned	1000	0	0	0
EPA Prescribed Industrial Waste	Environment Protection Authority (Vic)	12/08/2020	12/08/2020	Quarterly	1000	0	0	0
EPA Victorian Landfill Register	Environment Protection Authority (Vic)	15/07/2020	15/07/2020	Quarterly	1000	0	0	0
Former Gasworks	Various historical sources collated by Lotsearch	15/08/2017	15/08/2017	Not required	1000	0	0	0
National Liquid Fuel Facilities	Geoscience Australia	12/08/2020	15/03/2012	Quarterly	1000	0	0	0
Historical Business Directories (Premise & Intersection Matches)	Hardie Grant; Sands & McDougall, State Library Victoria			Not required	150	0	0	0
Historical Business Directories (Road & Area Matches)	Hardie Grant; Sands & McDougall, State Library Victoria			Not required	150	-	0	0
Historical Business Directory Dry Cleaners & Motor Garages/Service Stations (Premise & Intersection Matches)	Hardie Grant; Sands & McDougall, State Library Victoria			Not required	500	0	0	0
Historical Business Directory Dry Cleaners & Motor Garages/Service Stations (Road & Area Matches)	Hardie Grant; Sands & McDougall, State Library Victoria			Not required	500	-	0	0
Features of Interest	State Government Victoria - Department of Environment, Land, Water & Planning	28/08/2020	28/08/2020	Quarterly	1000	9	11	14
Hydrogeology Map of Australia	Commonwealth of Australia (Geoscience Australia)	08/10/2014	17/03/2000	As required	1000	1	1	1
Groundwater Salinity	State Government Victoria - Department of Environment, Land, Water & Planning	14/08/2015	29/08/2012	Unknown	0	2	-	-
Groundwater Salinity	State Government Victoria - Department of Environment, Land, Water & Planning	14/08/2015	29/08/2012	Unknown	0	2	-	-

Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	Dataset Buffer (m)	No. Features Onsite	No. Features within 100m	No. Features in Buffer
Surface Elevation	State Government Victoria - Department of Environment, Land, Water & Planning	14/08/2015	23/09/2013	Unknown	0	1	-	-
Basement Elevation	State Government Victoria - Department of Environment, Land, Water & Planning	14/08/2015	23/09/2013	Unknown	0	1	-	-
Groundwater Boreholes WMIS	State Government Victoria - Department of Environment, Land, Water & Planning	14/07/2020	14/07/2020	Quarterly	2000	0	0	17
Groundwater Boreholes Earth Resources Database	State Government Victoria - Department of Economic Development, Jobs, Transport and Resources	27/07/2018	17/02/2010	As required	2000	0	0	13
Groundwater Boreholes Fed Uni	Federation University Australia	21/12/2017	07/01/2014	As required	2000	0	0	0
Historical Mining Activity - Shafts	State Government Victoria - Department of Economic Development, Jobs, Transport and Resources	18/10/2018	20/07/2018	As required	1000	0	0	0
Geological Units 1:250,000	State Government Victoria - Department of Economic Development, Jobs, Transport and Resources	13/01/2015	24/06/2014	Unknown	1000	2	-	2
Geological Structures 1:250,000	State Government Victoria - Department of Economic Development, Jobs, Transport and Resources	13/01/2015	24/06/2014	Unknown	1000	0	-	0
Shear zones 250k	State Government Victoria - Department of Economic Development, Jobs, Transport and Resources	13/01/2015	24/06/2014	Unknown	1000	0	-	0
Atlas of Australian Soils	ABARES	19/05/2017	17/02/2011	As required	1000	1	1	1
Victorian Soil Type Mapping	State Government Victoria - Department of Economic Development, Jobs, Transport and Resources	24/08/2017	21/03/2016	Unknown	1000	2	3	5
Atlas of Australian Acid Sulfate Soils	CSIRO	19/01/2017	21/02/2013	As required	1000	1	2	2
Coastal Acid Sulfate Soils	State Government Victoria - Department of Economic Development, Jobs, Transport and Resources	28/03/2017	30/03/2011	None planned	1000	0	0	0
Planning Scheme Zones	State Government Victoria - Department of Environment, Land, Water & Planning	01/09/2020	26/08/2020	Monthly	1000	2	3	7
Planning Scheme Overlay	State Government Victoria - Department of Environment, Land, Water & Planning	01/09/2020	26/08/2020	Monthly	1000	4	5	5
Commonwealth Heritage List	Australian Government Department of the Environment and Energy - Heritage Branch	18/08/2020	20/11/2019	Quarterly	1000	0	0	0
National Heritage List	Australian Government Department of the Environment and Energy - Heritage Branch	18/08/2020	20/11/2019	Quarterly	1000	0	0	0
Victorian Heritage Register	State Government Victoria - Department of Environment, Land, Water & Planning	19/05/2020	19/05/2020	Quarterly	1000	0	0	0
Cultural Heritage Sensitivity	State Government Victoria - Department of Premier and Cabinet	01/09/2020	06/08/2020	Quarterly	1000	5	5	12
Bushfire Prone Area	State Government Victoria - Department of Transport, Planning and Local Infrastructure	24/07/2020	24/07/2020	Quarterly	1000	1	1	1
Fire History	State Government Victoria - Department of Environment, Land, Water & Planning	01/09/2020	18/08/2020	Quarterly	1000	1	1	1
Flood - 1 in 100 Year Modelled Flood Extent	State Government Victoria - Department of Environment, Land, Water & Planning	19/05/2020	31/12/2014	Quarterly	1000	1	1	1
Victorian Coastal Inundation Sea Level Rise	State Government Victoria - Department of Environment, Land, Water & Planning	10/04/2018	24/10/2017	Unknown	1000	0	0	0
Native Vegetation (Modelled 2005 Ecological Vegetation Classes)	State Government Victoria - Department of Environment, Land, Water & Planning	13/01/2015	31/12/2005	None planned	1000	7	7	12
Ramsar Wetland Areas in Victoria	State Government Victoria - Department of Environment, Land, Water & Planning	28/03/2017	24/06/2013	None planned	1000	0	0	0
Groundwater Dependent Ecosystems Atlas	Bureau of Meteorology	14/08/2017	15/05/2017	Unknown	1000	2	4	6
Inflow Dependent Ecosystems Likelihood	Bureau of Meteorology	14/08/2017	15/05/2017	Unknown	1000	1	3	6

Site Diagram

Red Cliffs, Mildura, VIC 3496



Legend

- Site Boundary
- Internal Parcel Boundaries

Total Area:	325565m²
Total Perimeter:	3807m

Scale: 0 25 50 100 150 200 250 Meters

Data Sources: Aerial Imagery © Aerometrex Pty Ltd

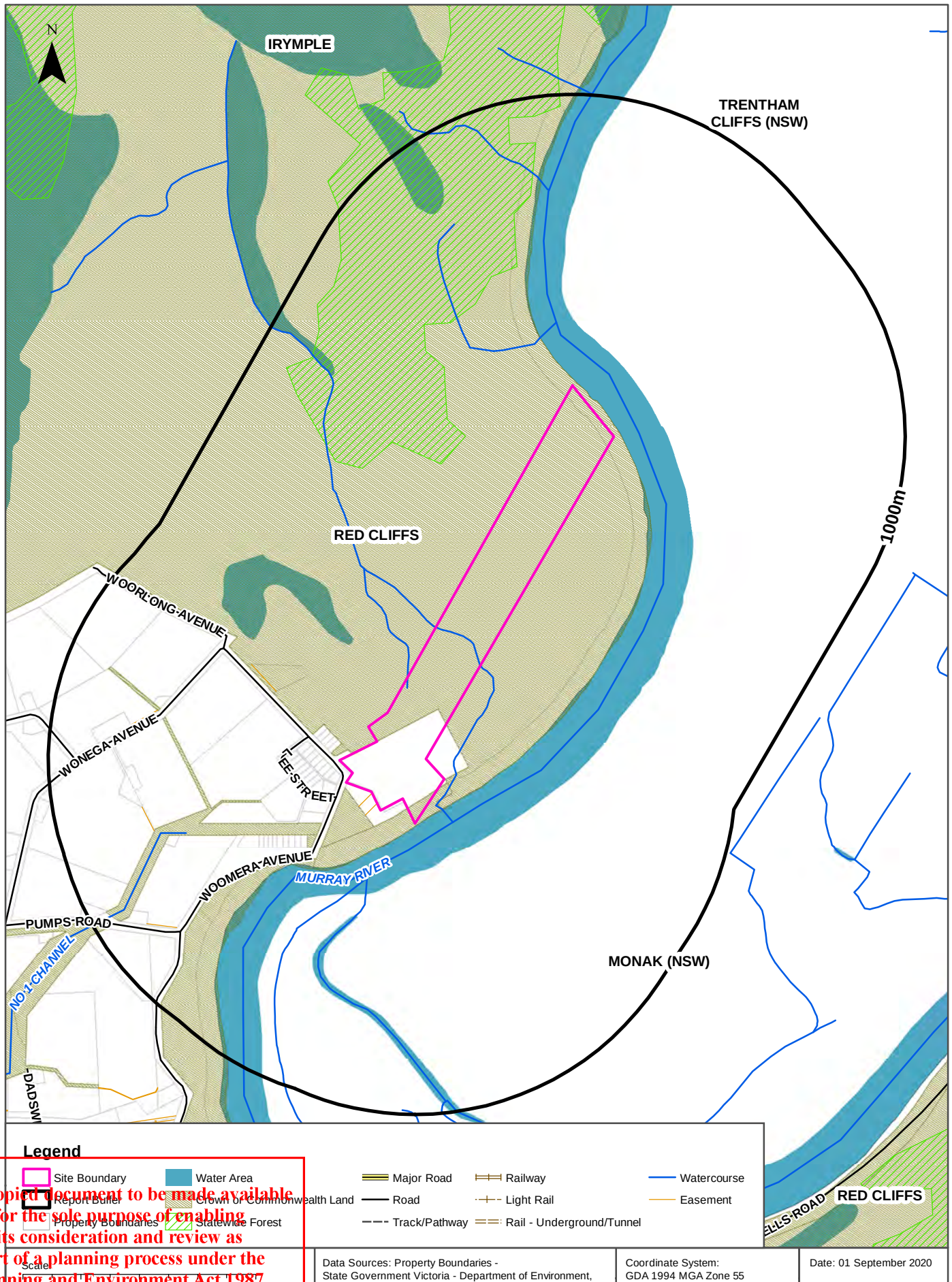
Disclaimers:
Measurements are approximate only and may have been simplified or smaller lengths removed for readability.
Parcels that make up a small percentage of the total site area have not been labelled for increased legibility.

Coordinate System: GDA 1994 MGA Zone 55

Date: 01 September 2020

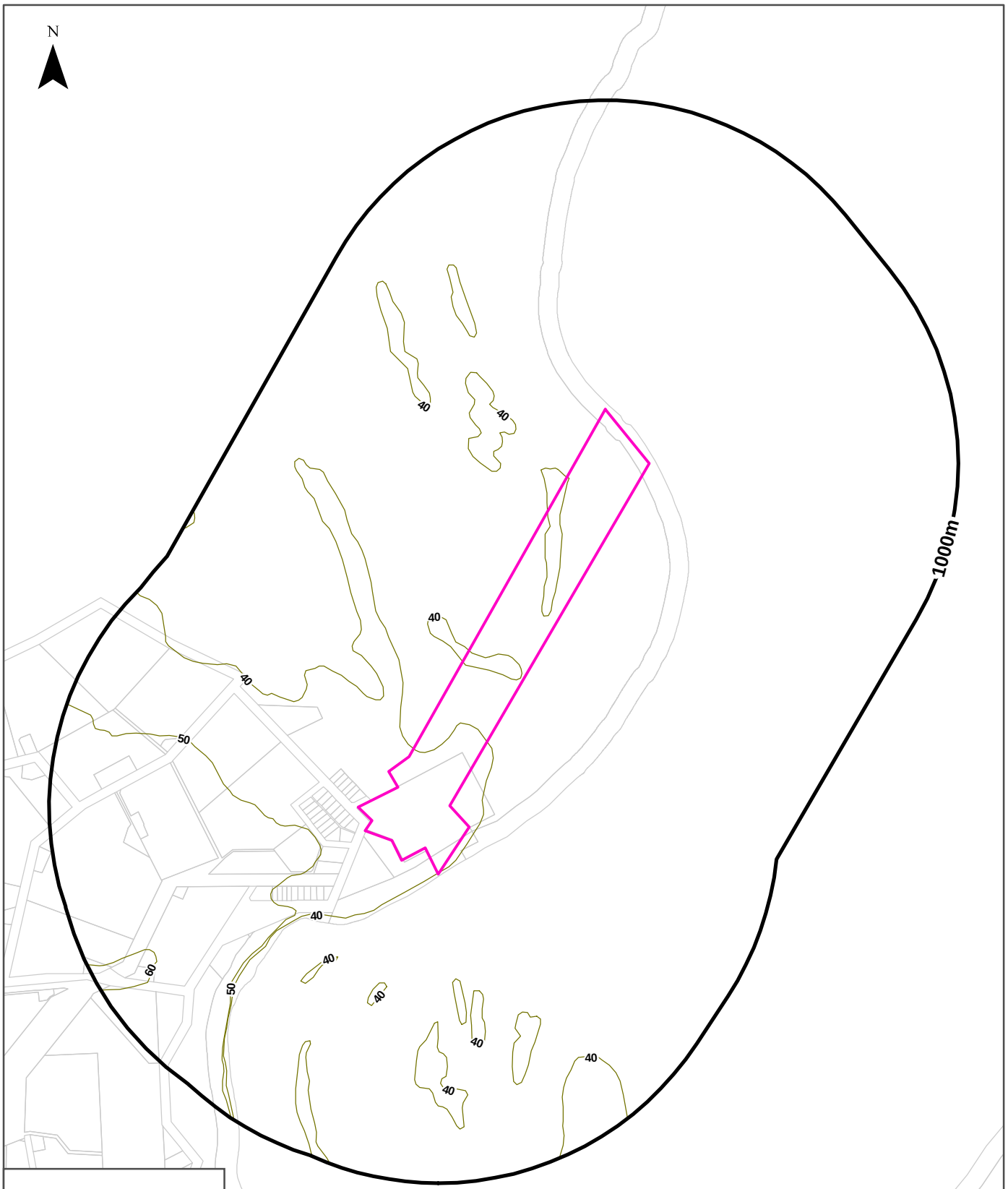
Topographic Data

Red Cliffs, Mildura, VIC 3496



Elevation Contours (m AHD) 10m Interval at 1:25,000

Red Cliffs, Mildura, VIC 3496



Legend

- Site Boundary
- Report Buffer
- Property Boundaries
- Elevation Contour (m AHD)

Accuracy & Currency: This 10m interval contour data was originally captured in 1974 at 1:25,000 scale. The accuracy of this data means that it must not be used for any design or engineering works, but only as a general guide to topography.The planimetric accuracy is that not more than 10% of well-defined points will be in error more than 16m, with a worse case scenario of +/- 30m. For vertical positional accuracy of points determined from contours there is an expectation that the elevation accuracy (standard deviation) will be half the value of the contour interval.

Scale: 0 200 400 600 800 Meters

Data Sources: Property Boundaries - State Government Victoria - Department of Environment, Land, Water & Planning

Coordinate System: GDA 1994 MGA Zone 55

Date: 01 September 2020

EPA Priority Sites & Pollution Notices

Red Cliffs, Mildura, VIC 3496

Current EPA Priority Sites Register

Sites on the current EPA priority sites register that exist within the dataset buffer:

Notice No	Address	Suburb	Issue	Loc Conf	Dist (m)	Direction
N/A	No records in buffer					

Priority Sites Data Custodian: State Government Victoria - Environment Protection Authority (EPA)

Former EPA Priority Sites & Other Pollution Notices

Sites within the dataset buffer that have been issued a Pollution Notice:
Note. Due to pollution notices being revoked and removed from published lists this is not an exhaustive list of all past pollution notices.

Notice No	Notice Type	Company	Address	Suburb	Status	Issue	Date Issued	Loc Conf	Dist	Dir
N/A	No records in buffer									

Pollution Notice Data Custodian: State Government Victoria - Environment Protection Authority (EPA)

PFAS Investigation & Management Programs

Red Cliffs, Mildura, VIC 3496

EPA PFAS Site Investigations

Sites being investigated by the EPA for PFAS contamination within the dataset buffer:

Map ID	Site Name	Address	Location Confidence	Distance	Direction
N/A	No records in buffer				

EPA PFAS Site Investigations Data Custodian: State Government Victoria - Environment Protection Authority (EPA)

Defence PFAS Investigation & Management Program Investigation Sites

Sites being investigated by the Department of Defence for PFAS contamination within the dataset buffer:

Map ID	Base Name	Address	Location Confidence	Distance	Direction
N/A	No records in buffer				

Defence PFAS Investigation & Management Program Data Custodian: Department of Defence, Australian Government

Defence PFAS Investigation & Management Program Management Sites

Sites being managed by the Department of Defence for PFAS contamination within the dataset buffer:

Map ID	Base Name	Address	Location Confidence	Distance	Direction
N/A	No records in buffer				

Defence PFAS Investigation & Management Program Data Custodian: Department of Defence, Australian Government

Airservices Australia National PFAS Management Program

Sites being investigated or managed by Airservices Australia for PFAS contamination within the dataset buffer:

Map ID	Site Name	Impacts	Location Confidence	Distance	Direction
N/A	No records in buffer				

Airservices Australia National PFAS Management Program Data Custodian: Airservices Australia

Defence Sites

Red Cliffs, Mildura, VIC 3496

Defence 3 Year Regional Contamination Investigation Program

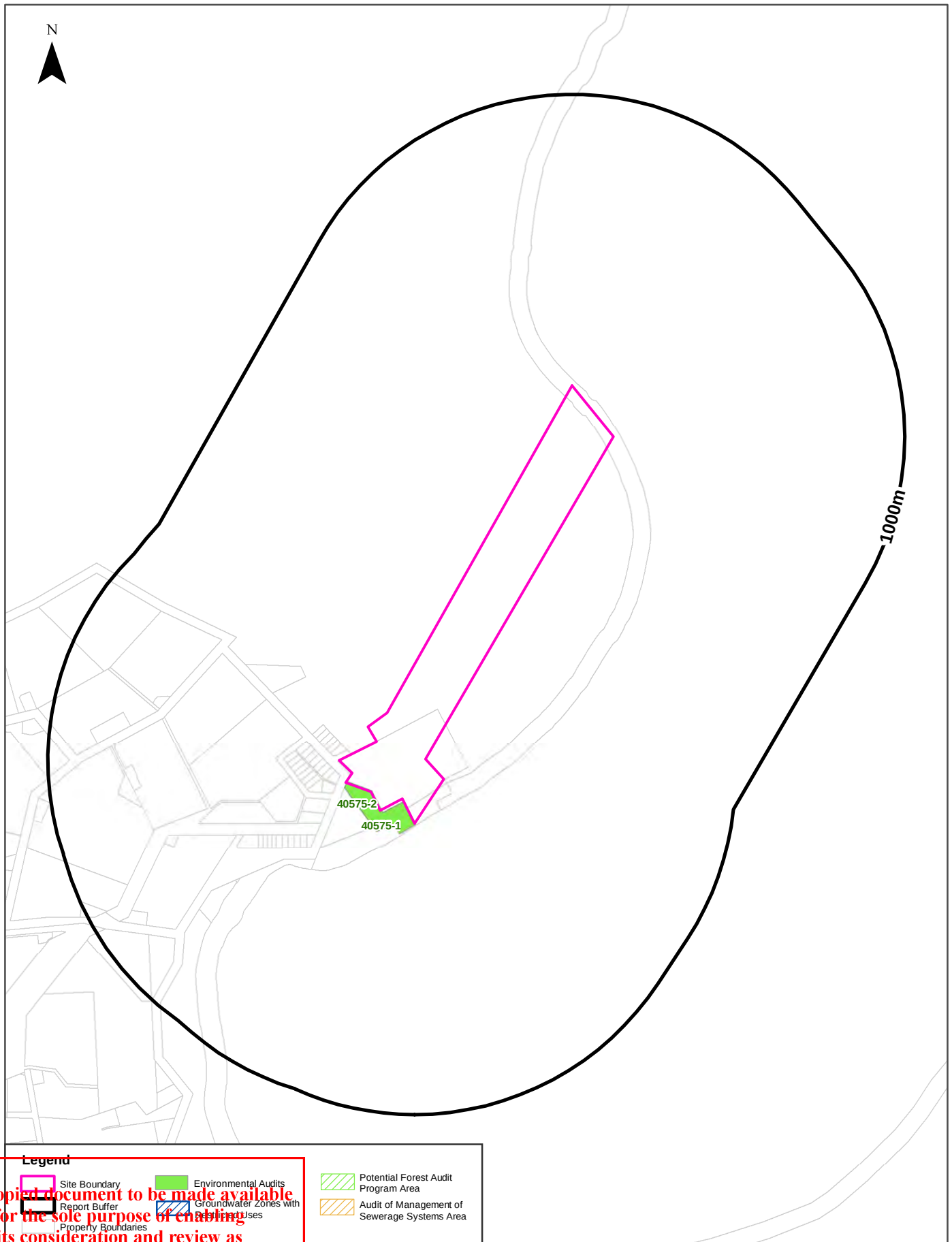
Sites which have been assessed as part of the Defence 3 Year Regional Contamination Investigation Program within the dataset buffer:

Property ID	Base Name	Address	Known Contamination	Loc Conf	Dist	Dir
N/A	No records in buffer					

Defence 3 Year Regional Contamination Investigation Program, Data Custodian: Department of Defence, Australian Government

EPA Records - Audit Reports & GQRUZ

Red Cliffs, Mildura, VIC 3496



EPA Records

Red Cliffs, Mildura, VIC 3496

EPA Environmental Audits

EPA environmental audit records that exist within the dataset buffer:
Note. Please click on CARMS No. to activate a hyperlink to online documentation. If link does not work, documentation may still be accessible via the EPA Interaction Portal.

CARMS No	Transaction No	Site	Address	Suburb	Date Complete	Audit Category	Loc Conf	Distance	Direction
40575-1	8001105	RED CLIFFS POWER STATION WOOMERA AV	RED CLIFFS POWER STATION WOOMERA AV	RED CLIFFS	05/06/2000	53X Statement	Premise Match	0m	South West
40575-2	8001106	RED CLIFFS POWER STATION WOOMERA AV	WOOMERA AV, RED CLIFFS VIC 3496 718 WOOMERA AV	RED CLIFFS	14/03/2001	53X Statement	Premise Match	0m	South West

Environmental Audit Data Custodian: State Government Victoria - Environment Protection Authority (EPA)

EPA Records

Red Cliffs, Mildura, VIC 3496

EPA Groundwater Zones with Restricted Uses

EPA GQRUZ records that exist within the dataset buffer:
Note. Please click on CARMS No. to activate a hyperlink to online documentation.

CARMS No	EPA Id	Site History	Site Address	Restricted Uses	Status	Loc Conf	Distance	Direction
N/A	No records in buffer							

Environmental GQRUZ Data Custodian: State Government Victoria - Environment Protection Authority (EPA)

EPA Activities

Red Cliffs, Mildura, VIC 3496

EPA Licensed Activities

EPA licensed activities that exist within the dataset buffer:

Trans No	Licence No	Licence Type	Organisation	Premise Ref	Premise Address 1	Premise Address 2	Activities	Loc Conf	Dist (m)	Direction
N/A	No records in buffer									

Licensed Activity Data Custodian: State Government Victoria - Environment Protection Authority (EPA)

Former EPA Licensed Activities

Former EPA licensed activities that exist within the dataset buffer:

Licence No	Organisation	Premise Address	Suburb	Activities	Loc Conf	Dist (m)	Direction
N/A	No records in buffer						

Former Licensed Activity Data Custodian: State Government Victoria - Environmental Protection Authority (EPA)

EPA Works Approvals

EPA works approvals that exist within the dataset buffer:

Transaction No	Status	Approval No	Organisation	Premise Address	Suburb	Scheduled Categories	Loc Conf	Dist (m)	Direction
N/A	No records in buffer								

Works Approvals Data Custodian: State Government Victoria - Environment Protection Authority (EPA)

Waste Management Facilities & Landfills

Red Cliffs, Mildura, VIC 3496

National Waste Management Site Database

Sites on the National Waste Management Site Database within the dataset buffer:

Site Id	Owner	Name	Address	Suburb	Class	Landfill	Reprocess	Transfer	Comments	Loc Conf	Dist (m)	Direction
N/A	No records in buffer											

Waste Management Facilities Data Source: Australian Government Geoscience Australia

Statewide Waste and Resource Recovery Infrastructure Plan Facilities

Statewide Waste and Resource Recovery Infrastructure Plan Facilities within the dataset buffer:

Map Id	Owner	Site Name	Address	Suburb	Category	Sub Category	Loc Conf	Distance	Direction
N/A	No records in buffer								

SWRRIPF Data Source: State Government Victoria - Department of Sustainability

EPA Prescribed Industrial Waste

EPA Prescribed Industrial Waste treaters, disposers and permitted transporters within the dataset buffer:

Map Id	Company Name	Address	Suburb	Treatment /Disposal	Transport	Accredited Agent	EPA List Status	Loc Conf	Dist' (m)	Direct
N/A	No records in buffer									

Prescribed Industrial Waste Data Source: State Government Victoria - Environment Protection Authority (EPA)

EPA Victorian Landfill Register

EPA Victorian Landfill Register sites within the dataset buffer:

Landfill Register No.	Site	Address	Operating Status	Est. Year Of Closure	Waste type	Loc Conf	Dist' (m)	Direction
No records in buffer								

EPA Victorian Landfill Register Data Source: State Government Victoria - Environment Protection Authority (EPA)

Former Gasworks and Liquid Fuel Facilities

Red Cliffs, Mildura, VIC 3496

Former Gasworks

Former Gasworks identified from various historical sources within the dataset buffer:
Note - As this is a dataset collated from various historical sources, it is not an exhaustive list of all former Gasworks

Map Id	Site Name	Date Opened	Year Closed	Location Confidence	Distance	Direction
N/A	No records in buffer					

Former Gasworks Data Source: Collated from various historical sources

National Liquid Fuel Facilities

National Liquid Fuel Facilties within the dataset buffer:

Map Id	Owner	Name	Address	Suburb	Class	Operational Status	Operator	Revision Date	Loc Conf	Dist (m)	Direction
N/A	No records in buffer										

National Liquid Fuel Facilities Data Source: Geoscience Australia

Historical Business Directories

Red Cliffs, Mildura, VIC 3496

Business Directory Records 1905-1991
Premise or Road Intersection Matches

Universal Business Directory and Sands & McDougall Directory records, from years 1991, 1980, 1970, 1960, 1950, 1945, 1925 & 1905, mapped to a premise or road intersection within the dataset buffer:

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Property Boundary or Road Intersection	Direction
	No records in buffer						

Business Directory Records 1905-1991
Road or Area Matches

Universal Business Directory and Sands & McDougall Directory records, from years 1991, 1980, 1970, 1960, 1950, 1945, 1925 & 1905, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Road Corridor or Area
	No records in buffer					

Business Directory Content reproduced with permission of UBD and Hardie Grant Media Pty Ltd DD 01/08/2018 and Sands & McDougall's Directory of Victoria (Digitised by State Library Victoria)

Historical Business Directories

Red Cliffs, Mildura, VIC 3496

Dry Cleaners, Motor Garages & Service Stations Premise or Road Intersection Matches

Dry Cleaners, Motor Garages & Service Stations from Sands & McDougall's Directories and UBD Business Directories, mapped to a premise or road intersection within the dataset buffer.

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Property Boundary or Road Intersection	Direction
	No records in buffer						

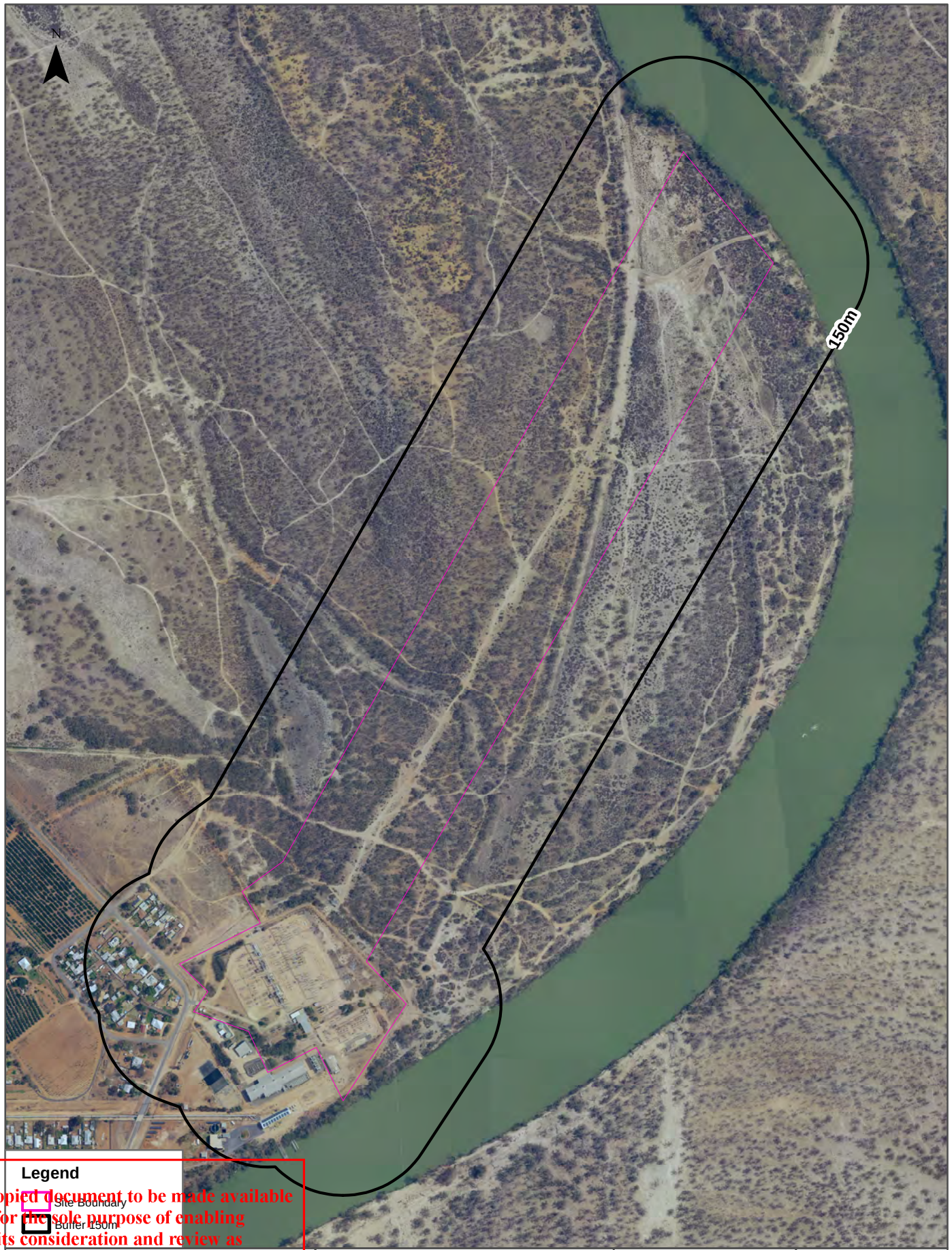
Dry Cleaners, Motor Garages & Service Stations
Road or Area Matches

Dry Cleaners, Motor Garages & Service Stations from UBD Business Directories and Sands & McDougall's Directories, mapped to a road or an area within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published.

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Road Corridor or Area
	No records in buffer					

Aerial Imagery 2020

Red Cliffs, Mildura, VIC 3496



Data Sources: Aerial Imagery © Aerometrex Pty Ltd

Coordinate System:
GDA 1994 MGA Zone 55

Date: 01 September 2020

Aerial Imagery 2015

Red Cliffs, Mildura, VIC 3496

Aerial Imagery 2010

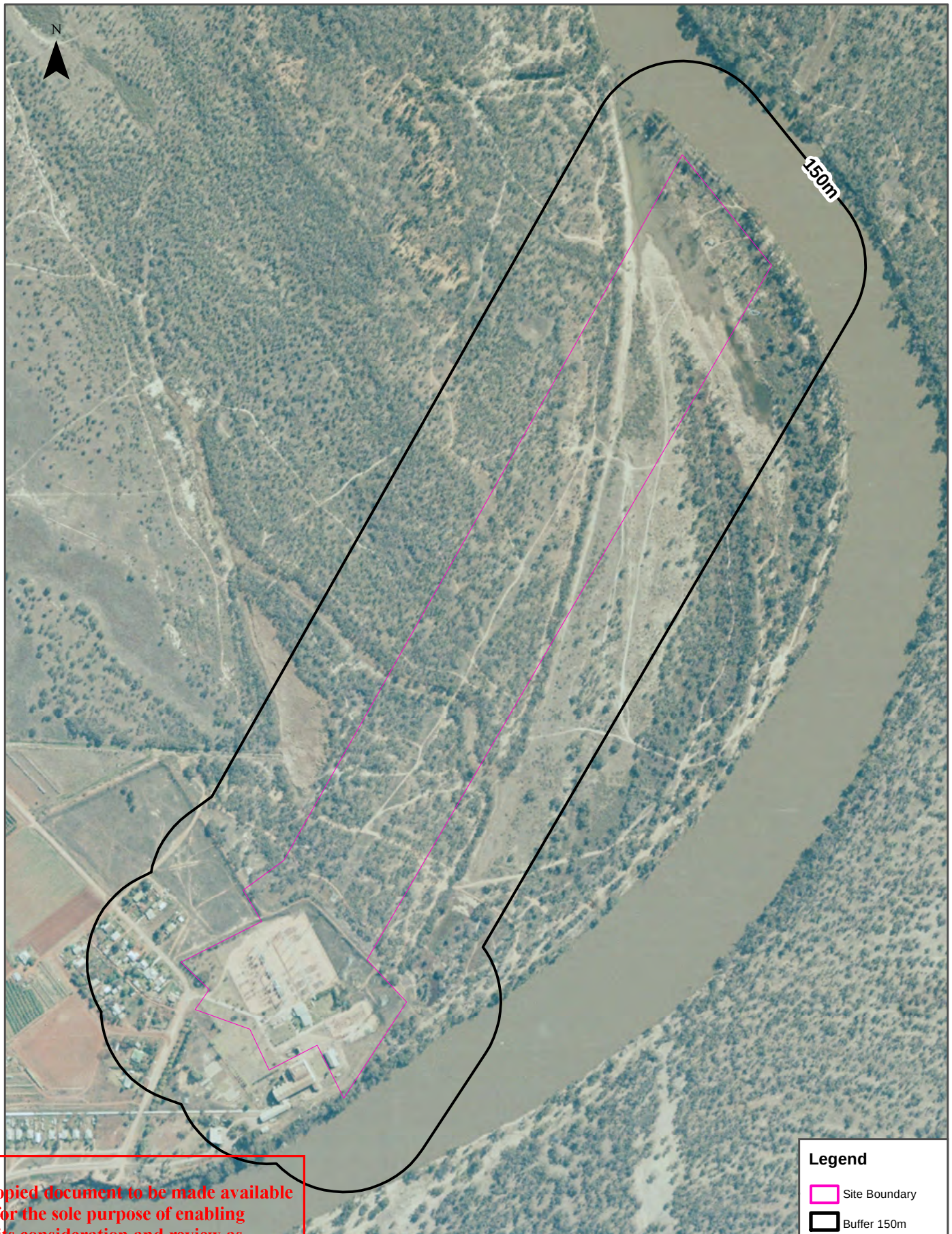
Red Cliffs, Mildura, VIC 3496

Aerial Imagery 2005

Red Cliffs, Mildura, VIC 3496

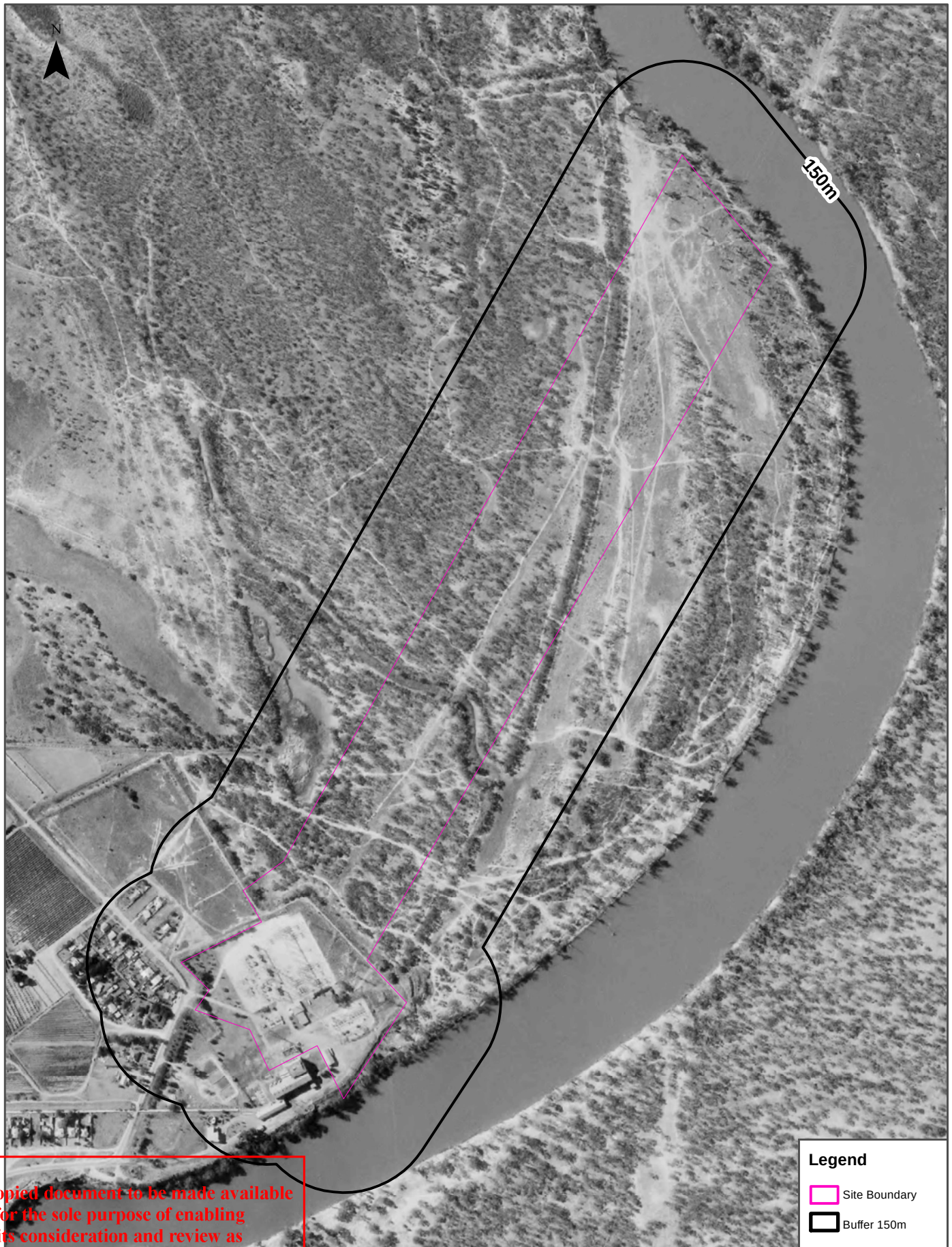
Aerial Imagery 1993

Red Cliffs, Mildura, VIC 3496



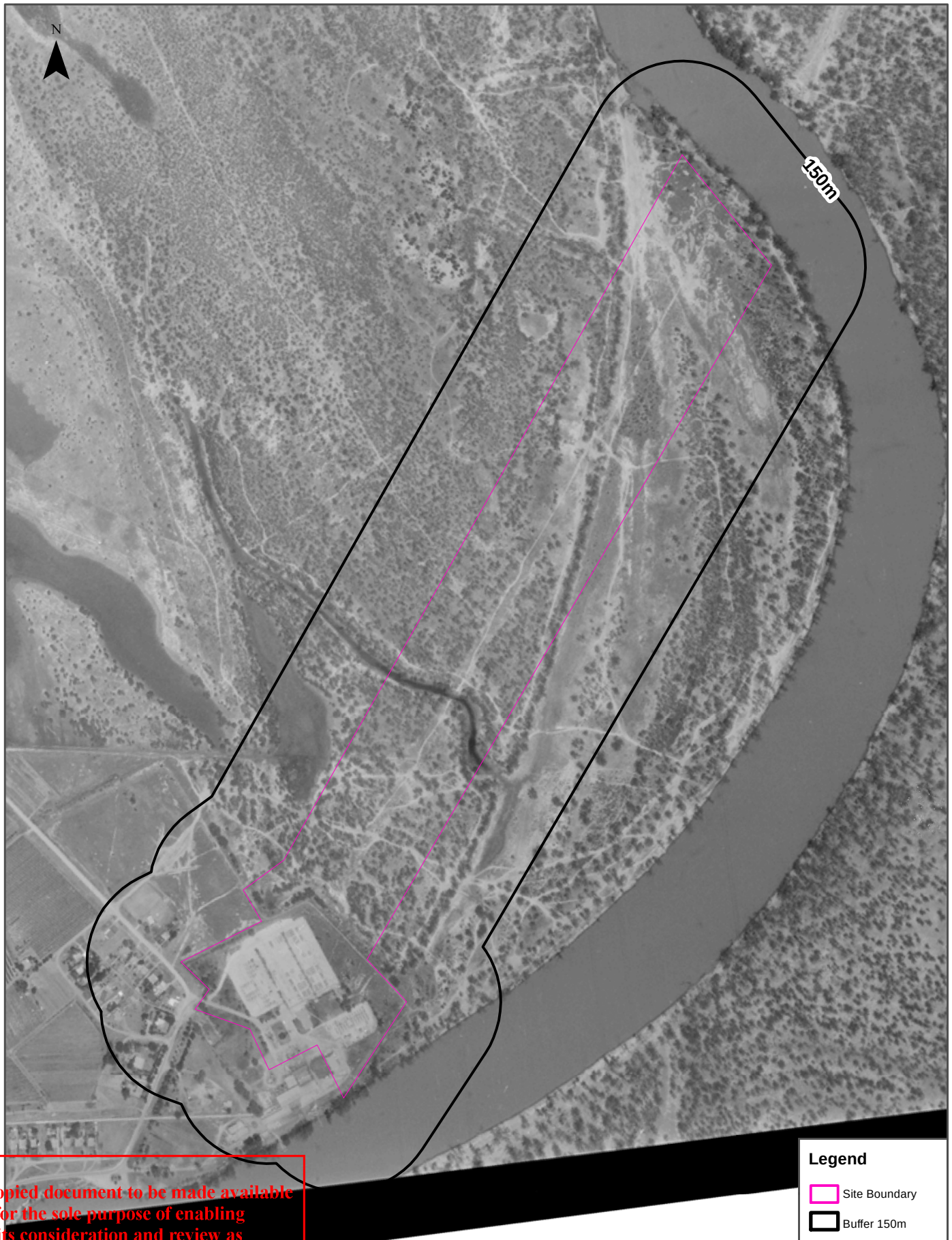
Aerial Imagery 1987

Red Cliffs, Mildura, VIC 3496



Aerial Imagery 1980

Red Cliffs, Mildura, VIC 3496

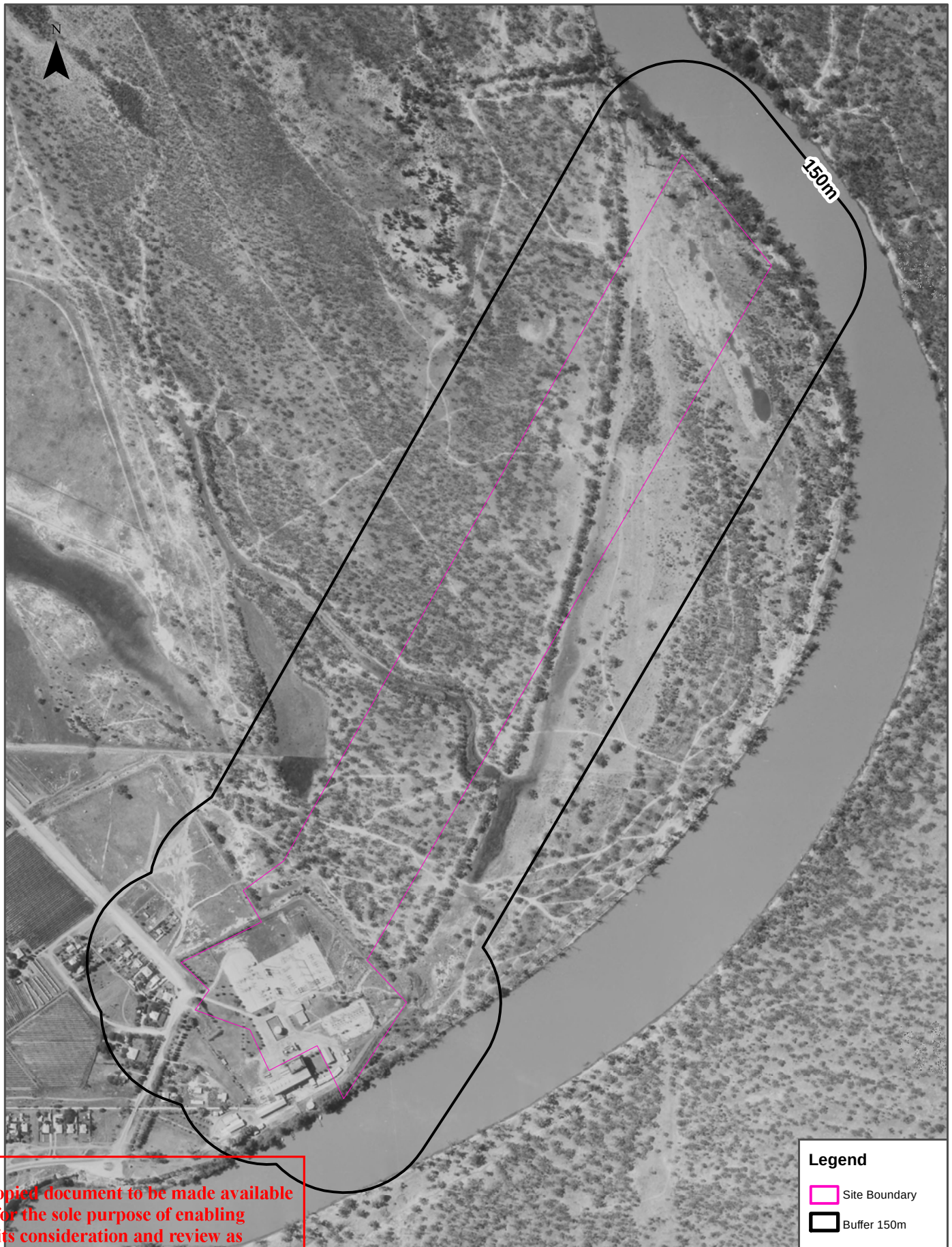


Aerial Imagery 1980

Red Cliffs, Mildura, VIC 3496

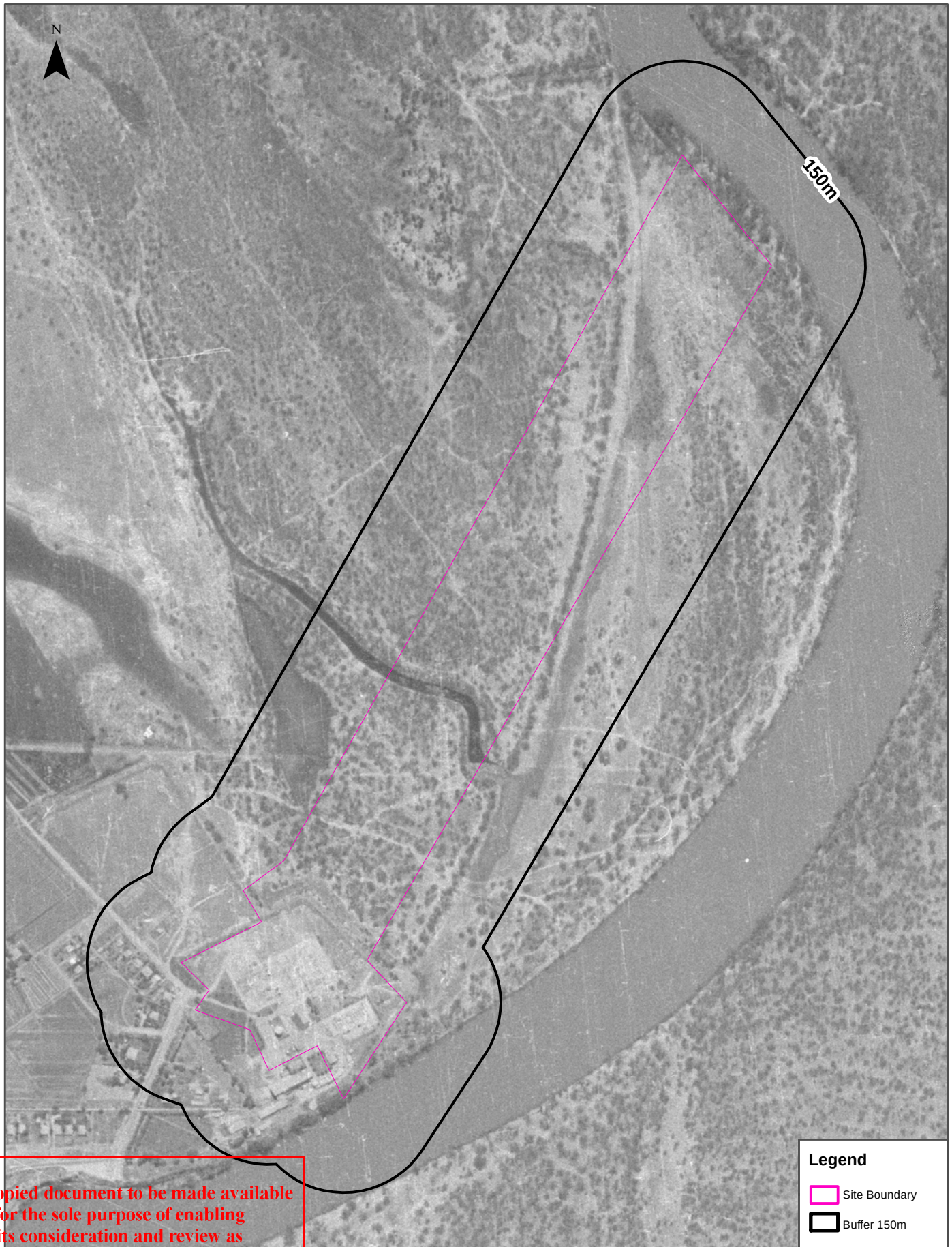
Aerial Imagery 1972

Red Cliffs, Mildura, VIC 3496



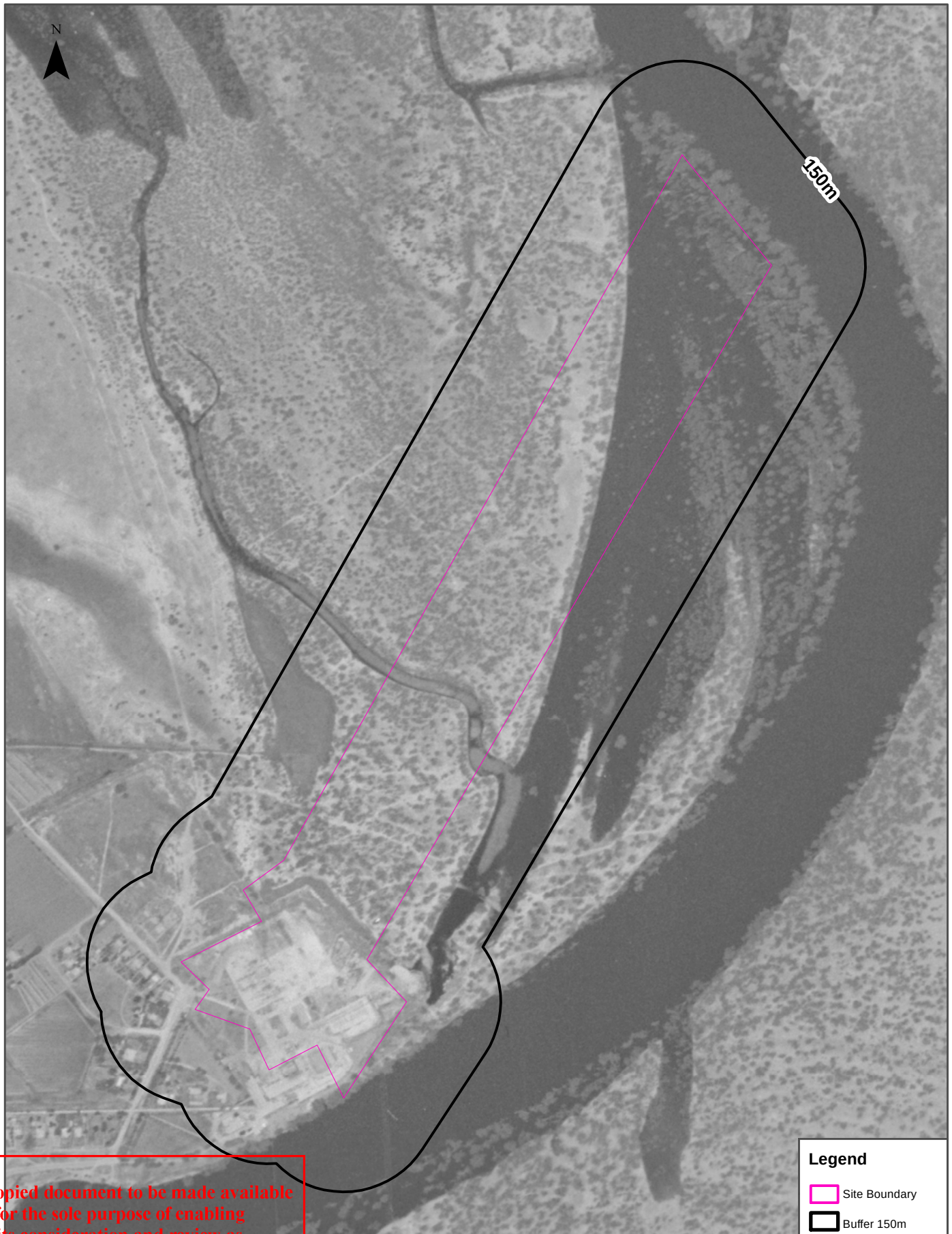
Aerial Imagery 1968

Red Cliffs, Mildura, VIC 3496



Aerial Imagery 1964

Red Cliffs, Mildura, VIC 3496



Aerial Imagery 1953

Red Cliffs, Mildura, VIC 3496

Aerial Imagery 1946

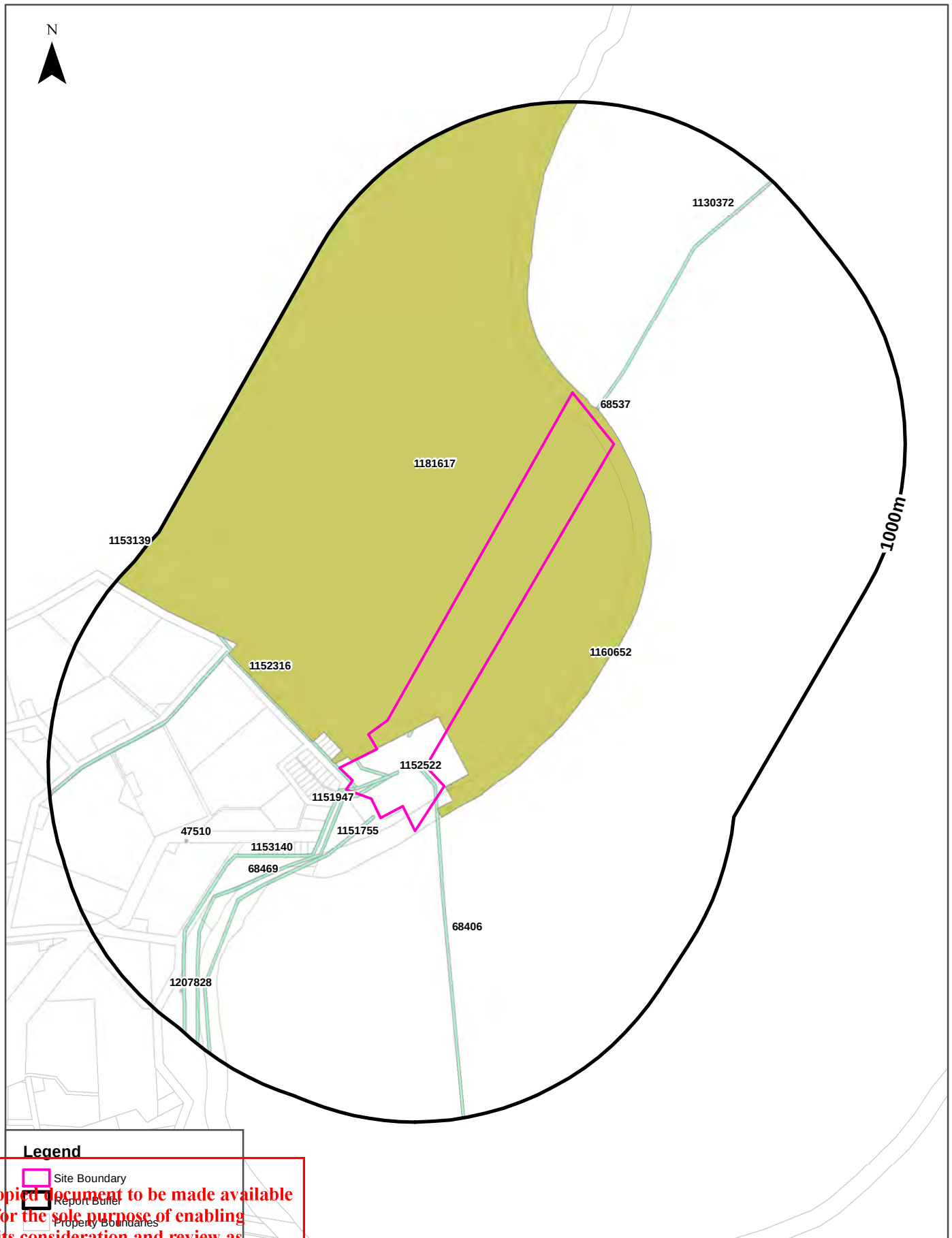
Red Cliffs, Mildura, VIC 3496

Historical Map 1977

Red Cliffs, Mildura, VIC 3496

Features of Interest

Red Cliffs, Mildura, VIC 3496



Data Sources: Property Boundaries - State Government Victoria - Department of Environment, Land, Water & Planning

Coordinate System: GDA 1994 MGA Zone 55

Date: 01 September 2020

Features of Interest

Red Cliffs, Mildura, VIC 3496

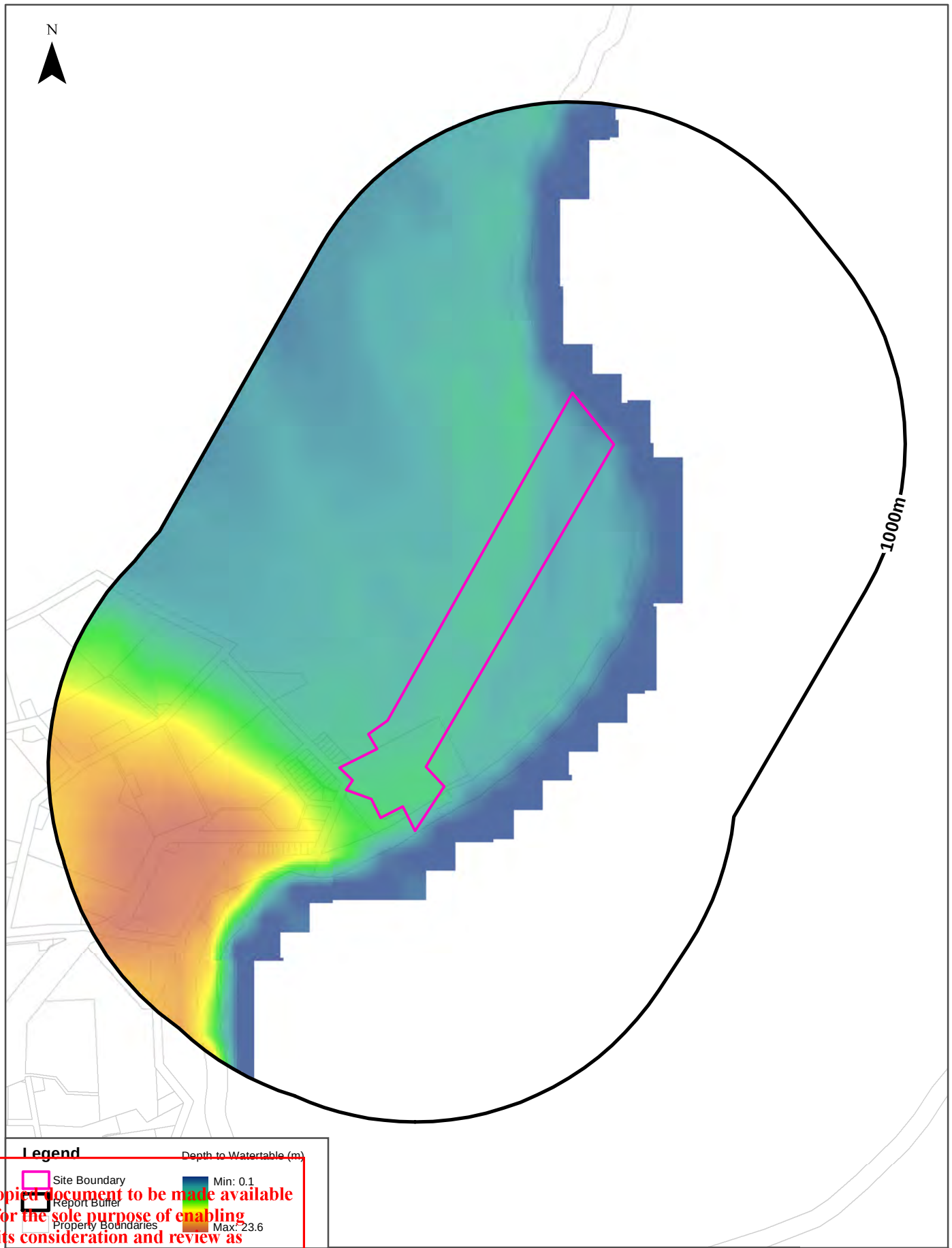
Features of Interest

Features of Interest within the dataset buffer:

Feature Id	Feature Type	Feature Sub Type	Name	Distance	Direction
68406	power line	power transmission	Kerang-Redcliffs	0m	Onsite
68537	power line	power transmission		0m	Onsite
1151755	power line	power sub transmission		0m	Onsite
1151947	power line	power sub transmission		0m	Onsite
1152316	power line	power sub transmission		0m	Onsite
1152522	power line	power sub transmission		0m	Onsite
1153139	power line	power sub transmission		0m	Onsite
1153140	power line	power sub transmission		0m	Onsite
1181617	reserve	national park	Kings Billabong Park	0m	Onsite
68469	power line	power transmission	Redcliffs-Horsham	17m	South
1130372	power line	power transmission		27m	North East
1160652	community space	camp ground	Red Cliffs Boat Ramp Camping Area	332m	East
47510	excavation site	adit		572m	South West
1207828	landmark	lookout	Red Cliffs Lookout	891m	South West

Depth to Watertable

Red Cliffs, Mildura, VIC 3496



Data Sources:- Property Boundaries: State Government Victoria - Department of Environment, Land, Water & Planning; Depth to Watertable: The State of Victoria, Department of Environment, Land, Water & Planning. Resampled (bilinear) to 10m.

Coordinate System: GDA 1994 MGA Zone 55

Date: 01 September 2020

Hydrogeology & Groundwater

Red Cliffs, Mildura, VIC 3496

Hydrogeology

Description of aquifers within the dataset buffer:

Description	Distance	Direction
Porous, extensive aquifers of low to moderate productivity	0m	Onsite

Hydrogeology Map of Australia: Commonwealth of Australia (Geoscience Australia)
Creative Commons 3.0 © Commonwealth of Australia http://creativecommons.org/licenses/by/3.0/au/deed.en

Groundwater Salinity

On-site Groundwater Salinity:

Groundwater Salinity	Percent Of Site Area
13,000 - 35,000 mg/l	96
7,000 - 13,000 mg/l	4

Depth to Watertable

On-site Depth to Watertable:

Depth to Watertable	Percent Of Site Area
5 to 10 metres	75
Less than 5 metres	25

Surface Elevation

Approximate on-site Surface Elevation:

Surface Elevation
30 AHDm to 42 AHDm

Basement Elevation

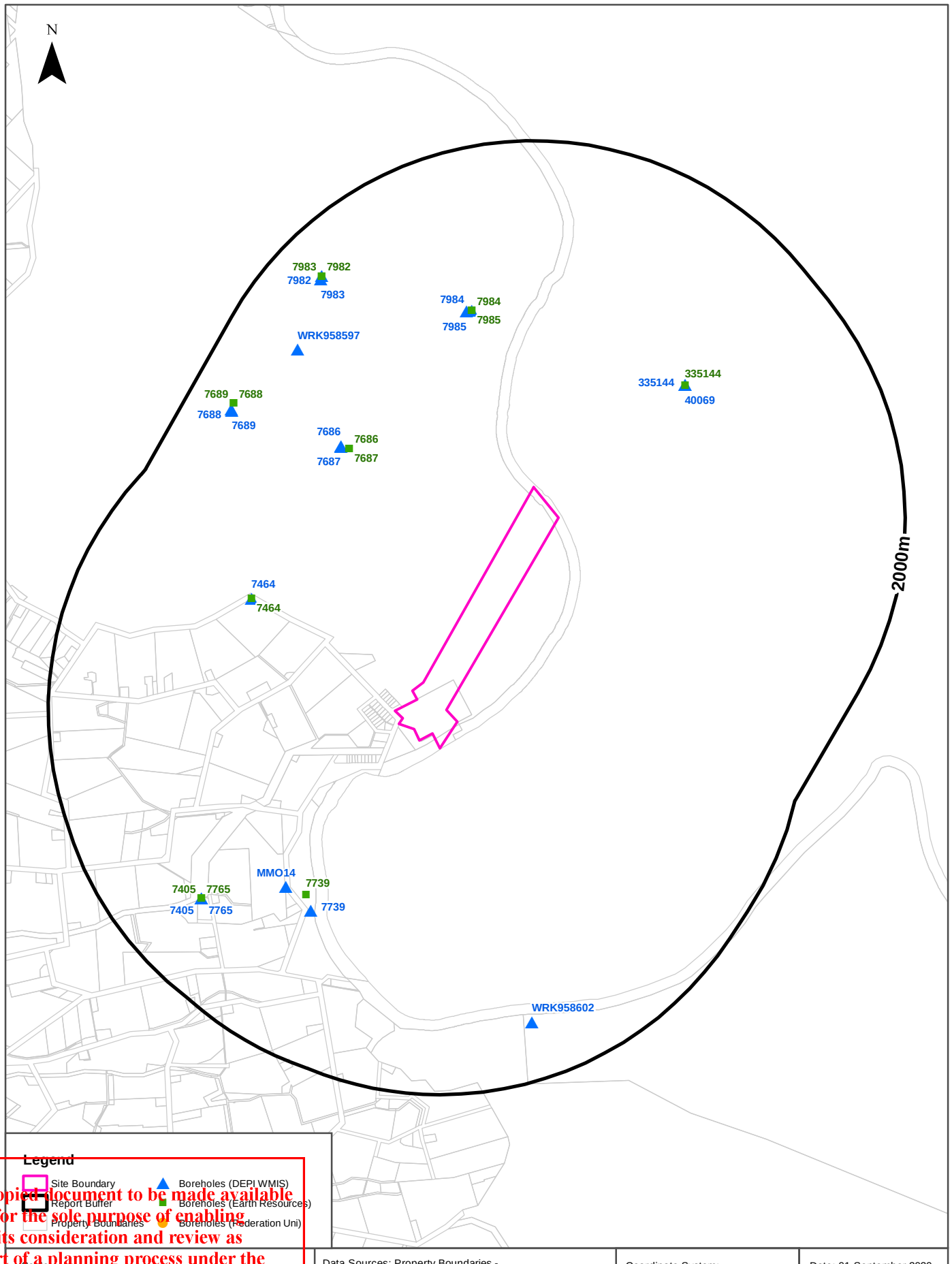
Approximate on-site Basement Elevation:

Basement Elevation - Basement Rocks comprise Lower Palaeozoic basement rocks that form the highlands and the crystalline basement; and Mesozoic rocks of the Otway and Gippsland basins both outcropping and subsurface
-351 AHDm to -328 AHDm

Groundwater Data Custodian: State Government Victoria - Dept of Environment, Land, Water & Planning
Creative Commons 3.0 © Commonwealth of Australia http://creativecommons.org/licenses/by/3.0/au/deed.en

Groundwater Boreholes

Red Cliffs, Mildura, VIC 3496



Data Sources: Property Boundaries - State Government Victoria - Department of Environment, Land, Water & Planning

Coordinate System: GDA 1994 MGA Zone 55

Date: 01 September 2020

Groundwater Boreholes

Red Cliffs, Mildura, VIC 3496

Boreholes (DELWP WMIS)

Boreholes from the Department of Environment, Land, Water & Planning's Water Measurement Information System, within the dataset buffer:

Bore Id	Use Type	Drillers Log	Construction	Latest Water Levels	Geology	Completed Date	Dist (m)	Dir
7464	Groundwater Investigation, Observation	0.00m-2.00m S/C BR HARD PLASTIC 2.00m-3.00m S/C R HARD PLASTIC 3.00m-5.00m S/C BR 4 3.61 SOFT PLASTIC 5.00m-6.00m Z/S/C R/GY/BR SOFT PLASTIC 6.00m-7.00m Z/S/C BR/GY SOFT PLASTIC		Date/time: 2020-01-09 1404 Quality: 43 WLMP: 5.61m DBNS: RWL:		1973-06-06	1050	West
40069	Groundwater Investigation, Observation			Date/time: 1986-07-11 0000 Quality: 47 WLMP: 4.03m DBNS: 3.83m RWL: 34.49mAHD		1973-07-09	1050	North East
335144	Non Groundwater					1973-07-09	1050	North East
7984	Groundwater Investigation, Observation	0.00m-0.50m GREY ZC DRY 0.50m-1.50m YELL BRN ZC MOIST 1.50m-4.00m BROWN ZC MOIST 4.00m-4.50m ORANGE FSZC MOIST 4.50m-5.00m GRY BRN FSC WET 5.00m-8.00m GREY FINES WET 8.00m-9.00m GREEN GRY MEDS WET 9.00m-10.00m YELL GREEN CS WET 10.00m-11.00m YELL FINES WET 11.00m-13.00m LIGHT YELL CS WET 13.00m-18.00m GREY FINES WET 18.00m-23.00m GREY YELL FINES WET 23.00m-24.00m LIGHT BRN FINES WET 24.00m-26.00m LIGHT RED FINES WET 26.00m-28.00m PURPLE FINES WET 28.00m-30.00m GREEN FINES WET	0.00m-28.51m INNER LINING - CASING = Pvc Class 9 28.51m-30.51m INNER LINING - SCREEN = Pvc Class 9 0.00m-0.00m OUTER LINING - GRAVEL = Cement	Date/time: 2012-06-04 1111 Quality: 47 WLMP: 2.60m DBNS: 2.32m RWL: 34.57mAHD	28.51m-30.51m Sand	1986-02-14	1080	North
7687	Groundwater Investigation, Observation		0.00m-10.20m INNER LINING - CASING = Pvc 10.20m-10.70m INNER LINING - SCREEN = Pvc 0.00m-0.00m OUTER LINING - GRAVEL = Cement	Date/time: 2020-01-09 1051 Quality: 43 WLMP: 4.95m DBNS: RWL:		1981-03-20	1082	North West
7985	Groundwater Investigation, Observation		0.00m-4.66m INNER LINING - CASING = Pvc Class 9 4.66m-6.66m INNER LINING - SCREEN = Pvc Class 9 0.00m-0.00m OUTER LINING - GRAVEL = Cement	Date/time: 2020-04-15 1201 Quality: 43 WLMP: 3.01m DBNS: RWL:		1986-02-15	1084	North
7686	Groundwater Investigation, Observation	0.00m-1.00m LIGHT GRY FSCZ DRY 1.00m-1.50m YELL BR FSZC DRY 1.50m-3.00m YELL BR/GRY FSZC MOIST 3.00m-5.50m LIGHT/DR BR FSC MOIST 5.50m-7.00m YELL BR S FINE 7.00m-13.00m GRY S MEDIUM 13.00m-17.50m BR S FINE & MED 17.50m-28.50m RED BR S FINE 28.50m-30.00m GRY FSC MOIST	0.00m-28.50m INNER LINING - CASING = Pvc 28.50m-29.00m INNER LINING - SCREEN = Pvc	Date/time: 2020-01-09 1037 Quality: 43 WLMP: 5.00m DBNS: RWL:	28.50m-29.00m Sand	1981-03-20	1085	North West

Bore Id	Use Type	Drillers Log	Construction	Latest Water Levels	Geology	Completed Date	Dist (m)	Dir
MMO14	Observation	0.00m-2.00m CLAY, RED BROWN, VERY SOFT CLAY, FINE CEMENTED SANDS 2.00m-5.00m SANDY CLAY,RED BROWN, SOFT SANDY CLAY,40% GRAIN CONTENT, FINE CEMENTED SANDS 5.00m-9.00m CLAY,RED BROWN, VERY SOFT CLAY, MINOR CEMENTED SANDS 9.00m-13.00m CLAY,GREY, VERY SOFT CLAY, LOW PLASTICITY, MINOR CEMENTED SANDS 13.00m-20.00m CLAY,RED BROWN, VERY SOFT CLAY, MINOR CEMENTED SANDS 20.00m-22.00m CLAYEY SAND, BROWN TO RED, FINE TO MEDIUM GRAINED QUARTZ SAND, POORLY SORTED, SUB ROUNDED 22.00m-25.00m SAND, DARK GREY, FINE TO MEDIUM GRAINED QUARTZ SAND, SUB ROUNDED 25.00m-29.00m SAND, BROWN, SUB ROUNDED, MEDIUM GRAINED QUARTZ SAND, WELL SORTED	0.00m-23.50m INNER LINING - CASING = Pvc Class 12 23.50m-26.50m INNER LINING - SCREEN = Pvc Class 12 26.50m-27.50m INNER LINING - CASING = Pvc Class 12	Date/time: 2020-04-14 1507 Quality: 43 WLMP: 22.05m DBNS: RWL:		2008-04-24	1142	South West
7739	Groundwater Investigation, Observation	0.00m-0.50m BR ZS FINE 0.50m-1.00m YELL BR ZS FINE 1.00m-1.50m LIGHT BR ZS FINE 1.50m-2.00m GRY BR ZS FINE 2.00m-5.00m BR ZS FINE 5.00m-8.50m BR FSC DRY 8.50m-9.00m GRY BR ZS MEDIUM 9.00m-12.00m YELL BR S MEDIUM 12.00m-13.50m LIGHT GRY S MEDIUM 13.50m-14.50m YELL BR S MEDIUM 14.50m-15.50m LIGHT GRY S MEDIUM 15.50m-16.00m YELL BR S MEDIUM 16.00m-19.50m BR/YELL BR MSC 19.50m-23.00m YELL BR S MEDIUM 23.00m-24.50m GRY S MEDIUM 24.50m-30.00m YELL BR S COARSE	0.00m-29.70m INNER LINING - CASING = Pvc 29.70m-30.20m INNER LINING - SCREEN = Pvc	Date/time: 1987-09-08 0000 Quality: 47 WLMP: 23.71m DBNS: 23.48m RWL: 36.05mAHD	29.70m-30.20m Sand	1981-09-02	1163	South West
7405	Groundwater Investigation, Observation	0.00m-0.50m R LOAM SOFT PLASTIC 0.50m-4.50m LT/BR C/S SOFT PLASTIC 4.50m-7.50m R C/S SOFT PLASTIC 7.50m-9.00m R C HARD PLASTIC 9.00m-10.00m R/BR C/S FIRM PLASTIC 10.00m-10.50m LT/BR/Y C/S FIRM PLASTIC 10.50m-12.50m Y S DRY FINE SAND 12.50m-13.50m LT/Y S DRY FINE SAND 13.50m-14.00m DR/Y C/S SOFT PLASTIC 14.00m-15.50m GY/R/BR C/S HARD PLASTIC 15.50m-16.50m BR C/S SOFT PLASTIC 16.50m-19.50m R C HARD PLASTIC PEICES SAND STONE 19.50m-21.00m R/BR/LT/Y C/S SOFT PLASTIC		Date/time: 1988-07-28 0000 Quality: 47 WLMP: 1.55m DBNS: 1.34m RWL: 59.43mAHD		1974-04-03	1520	South West
7765	Groundwater Investigation, Observation			Date/time: 2000-02-17 1400 Quality: 47 WLMP: 0.41m DBNS: -0.37m RWL: 61.14mAHD		1960-01-01	1520	South West
WRK958597	Observation	0.00m-0.50m GREY CLAY AND SAND 0.50m-1.50m YELLOW SAND AND CLAY 1.50m-6.50m YELLOW SAND		Date/time: 2007-06-08 1623 Quality: 47 WLMP: 4.92m DBNS: 4.42m RWL: 35.78mAHD		1997-02-14	1575	North West

Bore Id	Use Type	Drillers Log	Construction	Latest Water Levels	Geology	Completed Date	Dist (m)	Dir
WRK958602	Observation	0.00m-0.50m YELLOW SAND AND CLAY 0.50m-1.50m GREY CLAY 1.50m-4.50m YELLOW CLAY 4.50m-6.50m GREY CLAY AND SOME SAND 6.50m-9.00m YELLOW AND GREY SANDY CLAY		Date/time: 2007-06-08 1638 Quality: 47 WLMP: 4.35m DBNS: 3.85m RWL: 33.76mAHD		1997-05-22	1665	South
7983	Groundwater Investigation, Observation		0.00m-5.00m INNER LINING - CASING = Pvc Class 9 5.00m-7.00m INNER LINING - SCREEN = Pvc Class 9	Date/time: 2020-01-09 0941 Quality: 43 WLMP: 4.90m DBNS: RWL:		1986-02-13	1715	North West
7982	Groundwater Investigation, Observation	0.00m-0.50m GRY BRN ZC MOIST 0.50m-1.50m YELL BR. ZC WITH LIME STONE 1.50m-2.50m GRY BRN ZC MOIST 2.50m-6.00m LI YELLOW BRN FSZC DAMP 6.00m-8.00m YELLOW BRN MED S WET 8.00m-9.00m GRY GRN MED S WET 9.00m-11.00m GREY MED S WET 11.00m-13.00m GREY C/S WET 13.00m-16.00m GREY FINE S WET 16.00m-19.00m GREY MED S WET 19.00m-21.00m YELL MED S WET 21.00m-23.00m GREY FINE S WET 23.00m-26.00m LIGHT YELL FINE S WET 26.00m-27.00m RED FINE S WET 27.00m-29.00m LIGHT PURPLE FINE S WET 29.00m-30.00m GREY/RED FINE S WET	0.00m-29.18m INNER LINING - CASING = Pvc Class 9 29.18m-31.18m INNER LINING - SCREEN = Pvc Class 9 0.00m-0.00m OUTER LINING - GRAVEL = Cement	Date/time: 2007-06-10 1118 Quality: 47 WLMP: 4.49m DBNS: 4.31m RWL: 34.42mAHD		1986-02-13	1726	North West
7689	Groundwater Investigation, Observation		0.00m-10.10m INNER LINING - CASING = Pvc 10.10m-10.60m INNER LINING - SCREEN = Pvc	Date/time: 2020-04-08 1332 Quality: 43 WLMP: 3.06m DBNS: RWL:		1981-03-24	1732	North West
7688	Groundwater Investigation, Observation	0.00m-0.50m LIGHT GRY FSZC DRY 0.50m-1.00m YELL BR/LIGHT FSZC DRY 1.00m-2.50m LIGHT/YELL BR FSC MOIST 2.50m-3.00m YELL BR/LI GRY FSC WET 3.00m-9.00m YELL BR S MEDIUM 9.00m-16.50m GRY S MEDIUM 16.50m-18.50m YELL BR S FINE 18.50m-23.50m BR S FINE 23.50m-25.50m YELL BR S FINE 25.50m-29.00m BR S FINE 29.00m-30.00m GRY S FINE	0.00m-29.70m INNER LINING - CASING = Pvc 29.70m-30.20m INNER LINING - SCREEN = Pvc 0.00m-0.00m OUTER LINING - GRAVEL = Cement	Date/time: 2020-01-09 1010 Quality: 43 WLMP: 3.01m DBNS: RWL:	29.70m-30.20m Sand	1981-03-24	1736	North West

Groundwater Boreholes

Red Cliffs, Mildura, VIC 3496

Boreholes (Earth Resources Database)

Boreholes from the Earth Resources dataset, within the dataset buffer:

Bore Id	Bore Type	Company	Usage	Method	Status	Drill Date	Depth	Elevation	Accuracy (m)	Dist (m)	Direct
7686		Rural Water Commission	Groundwater Investigation			20/03/1981	28.50	38.45	300	1036	North West
7687		Rural Water Commission	Groundwater Investigation			20/03/1981	10.50	38.46	300	1036	North West
335144		Victorian Government	Groundwater Investigation			09/07/1973	7.00	38.32	300	1050	North East
7464		Rural Water Commission	Groundwater Investigation			06/06/1973	7.00	39.73	100	1050	West
7984		Rural Water Commission	Groundwater Investigation			01/01/1950		36.88	300	1081	North
7985		Rural Water Commission	Groundwater Investigation			15/02/1986	6.66	36.88	300	1081	North
7739		Rural Water Commission	Groundwater Investigation			02/09/1981	30.20	59.53	300	1101	South West
7765		Rural Water Commission	Groundwater Investigation			01/01/1960		60.77	100	1518	South West
7405		Rural Water Commission	Groundwater Investigation			30/04/1974	2.00	60.77	100	1518	South West
7982		Rural Water Commission	Groundwater Investigation			01/01/1950		38.73	300	1727	North West
7983		Rural Water Commission	Groundwater Investigation			13/02/1986	6.51	38.73	300	1727	North West
7688		Rural Water Commission	Groundwater Investigation			24/03/1981	30.20	37.34	300	1747	North West
7689		Rural Water Commission	Groundwater Investigation			24/03/1981	10.60	37.35	300	1747	North West

Boreholes (Federation University)

Boreholes from the Federation University Australia dataset, within the dataset buffer:

Bore Id	Authority	Type	Uses	Initial TD	Log	Dist (m)	Direct
N/A	No records within buffer						

Historical Mining Activity - Shafts

Red Cliffs, Mildura, VIC 3496

Historical Mining Activity - Shafts

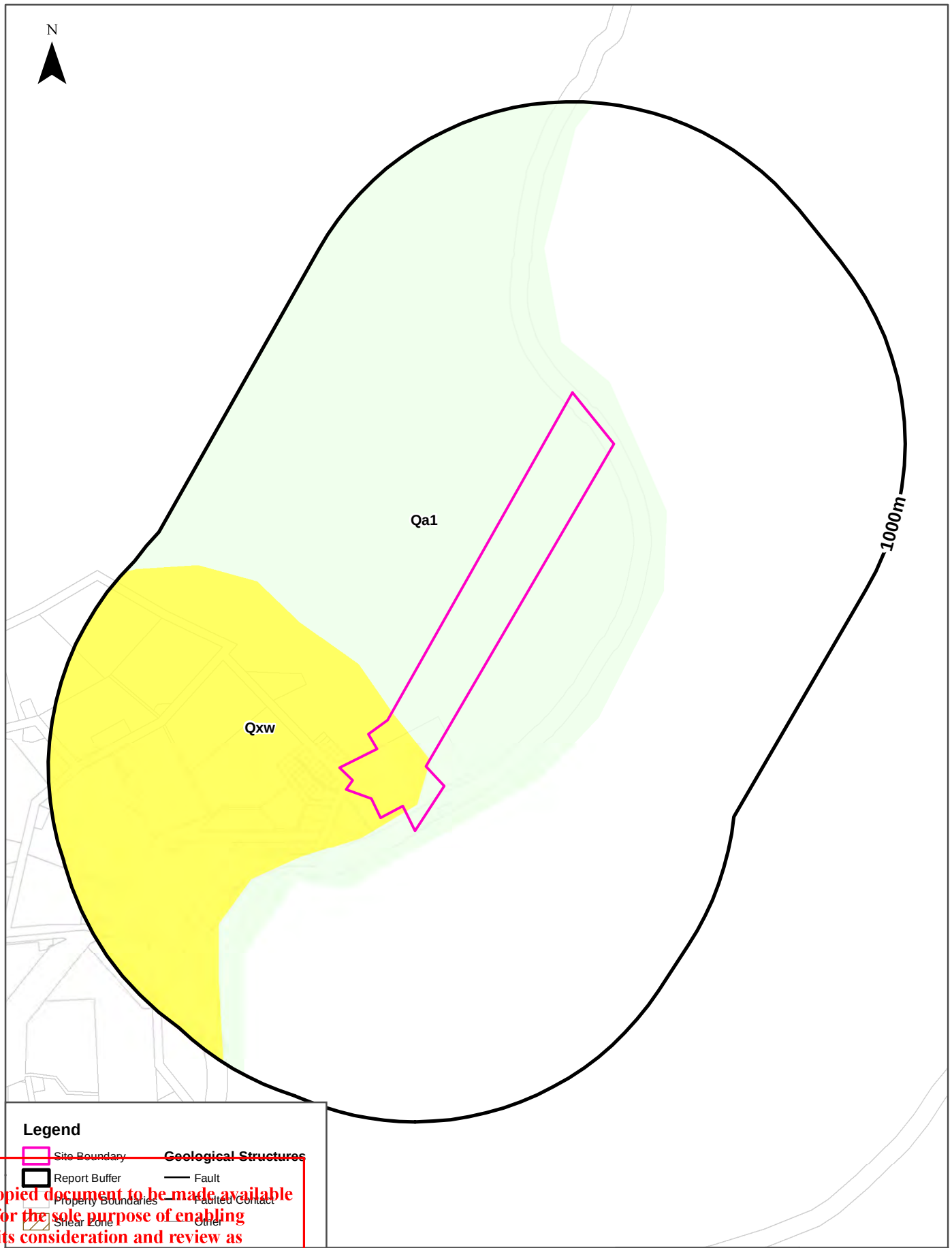
Mine Shaft Locations were collected by a variety of methods from 1869 in some areas of the state, mainly concentrating in Ballarat and Bendigo. In places a shaft may be recorded multiple times with a different source. In cases where several shaft locations are shown close together (generally with separations less than stated position errors) and they have different sources, it is possible that one shaft has been mapped several times. In cases where several shaft locations are shown close together but they have the same information source, it is possible that each shaft location represents a different shaft on the ground.

Historical Mine Shafts within the dataset buffer:

Map Id	Name	Source	Depth (m)	Collar (ft)	Fill/Cap Method	Location Desc	Location Accuracy	Distance	Direction
N/A	No records in buffer								

Geology 1:250,000

Red Cliffs, Mildura, VIC 3496



Geology

Red Cliffs, Mildura, VIC 3496

Geological Units

What are the Geological Units onsite?

Symbol	Name	Description	Geological Age	Lithology	Dataset
Qa1	alluvium(Qa1): generic	Gravel, sand, silt: variably sorted and rounded; generally unconsolidated; includes deposits of low terraces; alluvial floodplain deposits	Pleistocene to Holocene	gravel material (significant); sand (significant); silt material (significant)	1:250,000
Qxw	Woorinen Formation (Qxw): Generic	Dune deposits, unconsolidated; mainly red-brown siliceous silty sand, red calcareous silty clay, and sandy clay; calcareous nodules and palaeosols common; uppermost unit is mainly sand without calcareous nodules and clay matrix. Forms discontinuous chain	Pleistocene to Holocene	fine sand (major proportion); carbonate rock (minor proportion); sand (minor proportion); clay lithology (minor proportion)	1:250,000

What are the Geological Units within the dataset buffer?

Symbol	Name	Description	Geological Age	Lithology	Dataset
Qa1	alluvium(Qa1): generic	Gravel, sand, silt: variably sorted and rounded; generally unconsolidated; includes deposits of low terraces; alluvial floodplain deposits	Pleistocene to Holocene	gravel material (significant); sand (significant); silt material (significant)	1:250,000
Qxw	Woorinen Formation (Qxw): Generic	Dune deposits, unconsolidated; mainly red-brown siliceous silty sand, red calcareous silty clay, and sandy clay; calcareous nodules and palaeosols common; uppermost unit is mainly sand without calcareous nodules and clay matrix. Forms discontinuous chain	Pleistocene to Holocene	fine sand (major proportion); carbonate rock (minor proportion); sand (minor proportion); clay lithology (minor proportion)	1:250,000

Geology

Red Cliffs, Mildura, VIC 3496

Geological Structures

What are the Geological Faults or Faulted Contacts onsite?

Map Id	Type	Name	Contact	Positional Accuracy	Dataset
No features					1:250,000

What are the Dykes, Marker Beds and Veins onsite?

Map Id	Type	Name	Description	Positional Accuracy	Dataset
No Data Coverage					

What are the Shear Zones onsite (1:250,000 scale)?

Map Id	Type	Name	Description	Positional Accuracy	Dataset
No features					1:250,000

What are the Geological Faults or Faulted Contacts within the dataset buffer?

Map Id	Type	Name	Contact	Positional Accuracy	Dataset
No features					1:250,000

What are the Dykes, Marker Beds and Veins within the dataset buffer?

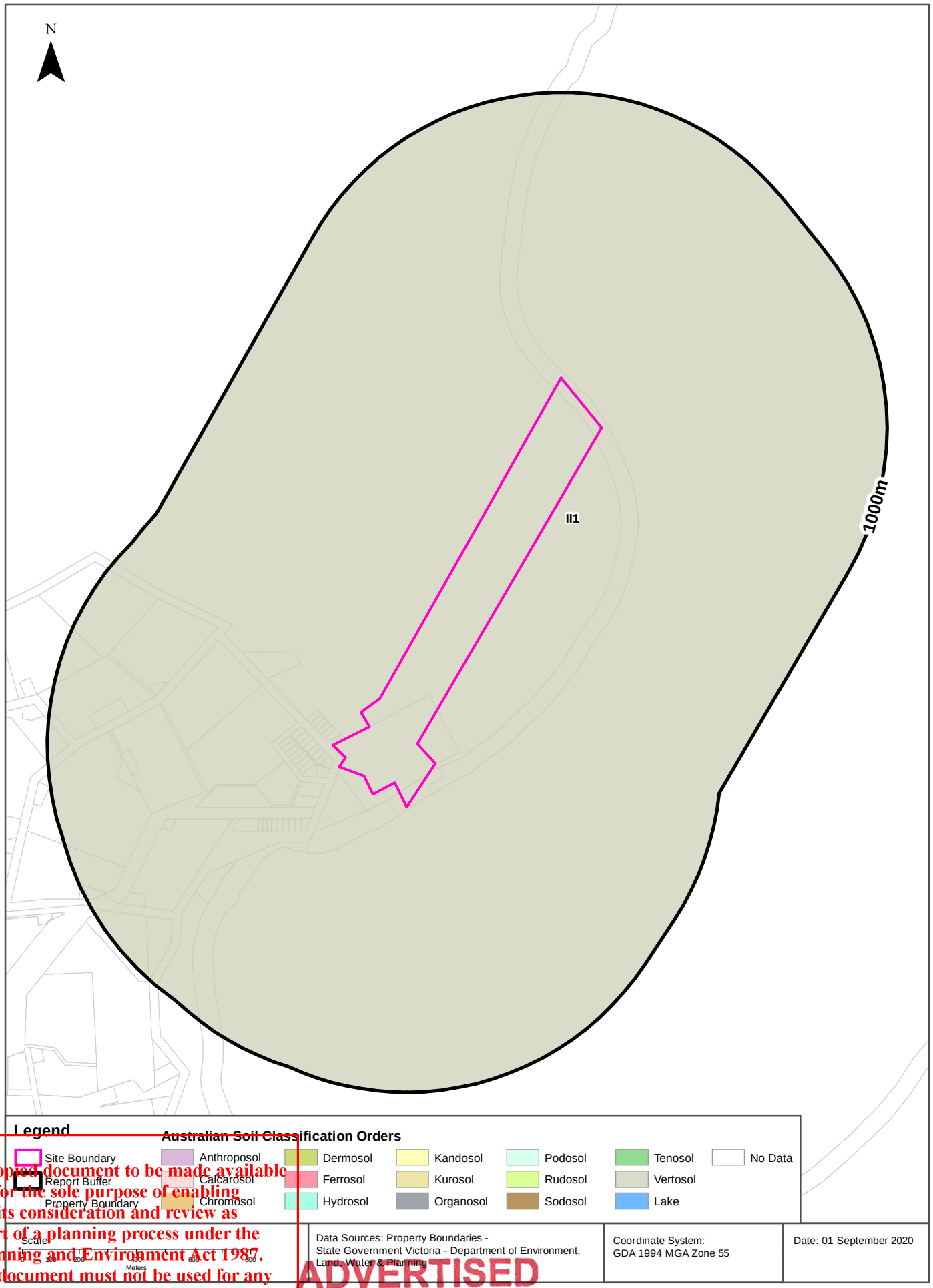
Map Id	Type	Name	Description	Positional Accuracy	Dataset
No Data Coverage					

What are the Shear Zones within the dataset buffer (1:250,000 scale)?

Map Id	Type	Name	Description	Positional Accuracy	Dataset
No features					1:250,000

Atlas of Australian Soils

Red Cliffs, Mildura, VIC 3496



Soil Landscapes

Red Cliffs, Mildura, VIC 3496

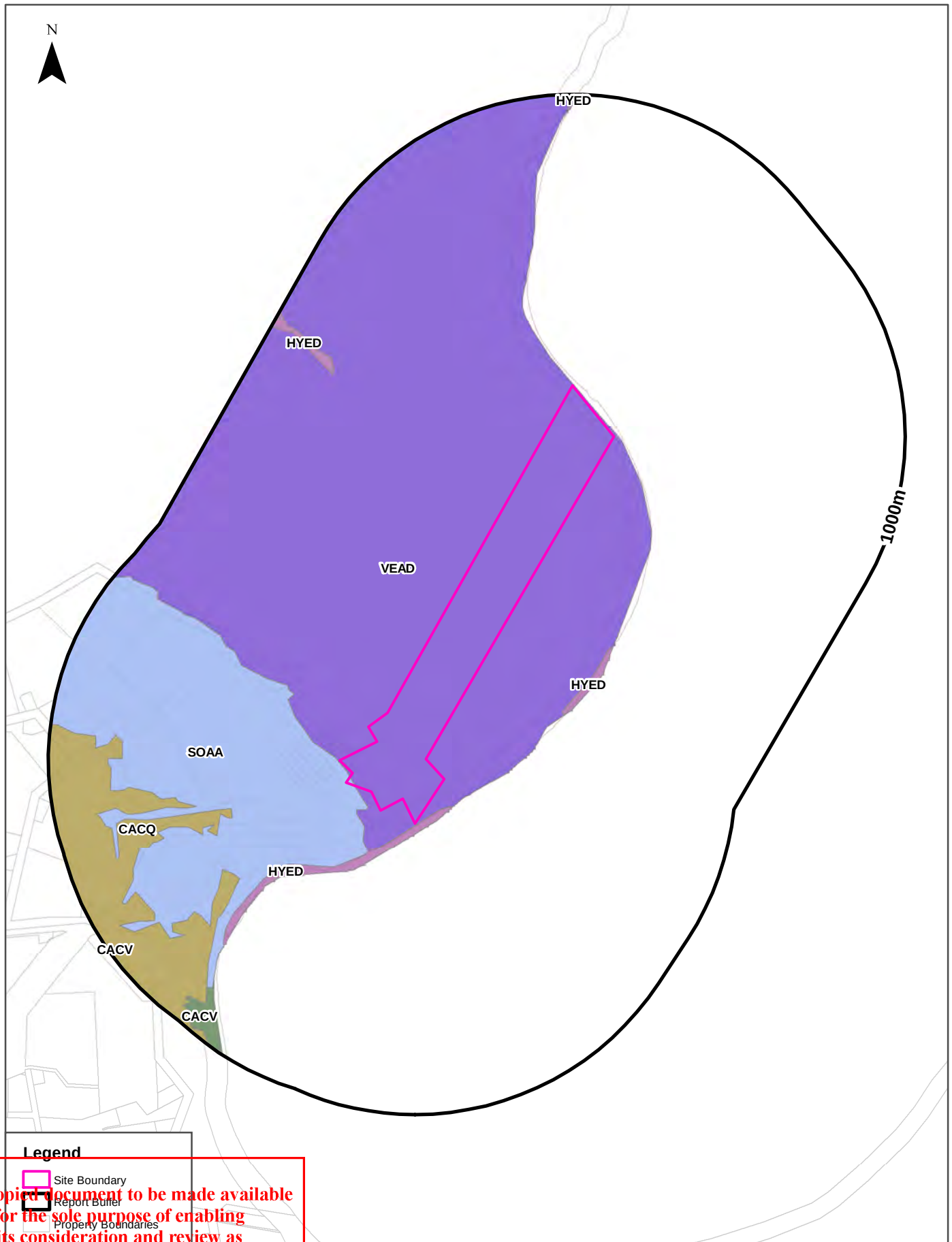
Atlas of Australian Soils

Australian soil types within the dataset buffer:

Symbol	Soil Order	Map Unit Description	Distance
II1	Vertosol	Flood-plains, terraces, residual islands, lakes: flood-plains, lake bottoms, and some terraces of cracking yellow-grey clays (Ug5.28). Associated are undulating to hillocky areas along former, and present, drainage- ways of (Ug5.28) and various unclassified and mostly undescribed (Uf) and (Um) soils; "islands" of dunes and sand sheets of brown sands (Uc5.13); and residual islands of brown calcareous earths (Gc1) (e.g. of unit DD3) and/or crusty loamy soils (Dr1.33) (e.g. of unit Nb4). The above description is slightly expanded from that given in Sheet 1, but data remain limited.	0m

Victorian Soil Type Mapping

Red Cliffs, Mildura, VIC 3496



Data Sources: Property Boundaries - State Government Victoria - Department of Environment, Land, Water & Planning	Coordinate System: GDA 1994 MGA Zone 55	Date: 01 September 2020

Soils Landscapes

Red Cliffs, Mildura, VIC 3496

Victorian Soil Type Mapping

Victorian Soil Types within the dataset buffer:

Symbol	Description	Distance
SOAA	Red Sodosols	0m
VEAD	Grey Vertosols	0m
HYED	Redoxic Hydrosols	3m
CACQ	Hypercalcic Calcarosols	404m
CACV	Hypocalcic Calcarosols	816m

Atlas of Australian Acid Sulfate Soils

Red Cliffs, Mildura, VIC 3496

Legend

Site Boundary
Report Buffer
Property Boundary

Probability of occurrence of Acid Sulfate Soils

A. High (>70%)
B. Low (6-70%)
C. Extremely Low (1-5%)
D. No Chance (0%)
No Data

Scale:
0 200 400 600 800
Meters

Data Sources: Property Boundaries & Topographic Data: State of Victoria - Department of Environment and Primary Industries

Coordinate System: GDA 1994 MGA Zone 55

Date: 01 September 2020

Acid Sulfate Soils

Red Cliffs, Mildura, VIC 3496

Atlas of Australian Acid Sulfate Soils

Atlas of Australian Acid Sulfate Soil categories within the dataset buffer:

PROBCLASS	Description	Distance
C	Extremely low probability of occurrence. 1-5% chance of occurrence with occurrences in small localised areas.	0m
A	High Probability of occurrence. >70% chance of occurrence.	36m

Acid Sulfate Soils

Red Cliffs, Mildura, VIC 3496

Coastal Acid Sulfate Soils

What are the on-site Coastal Acid Sulfate Soil types?

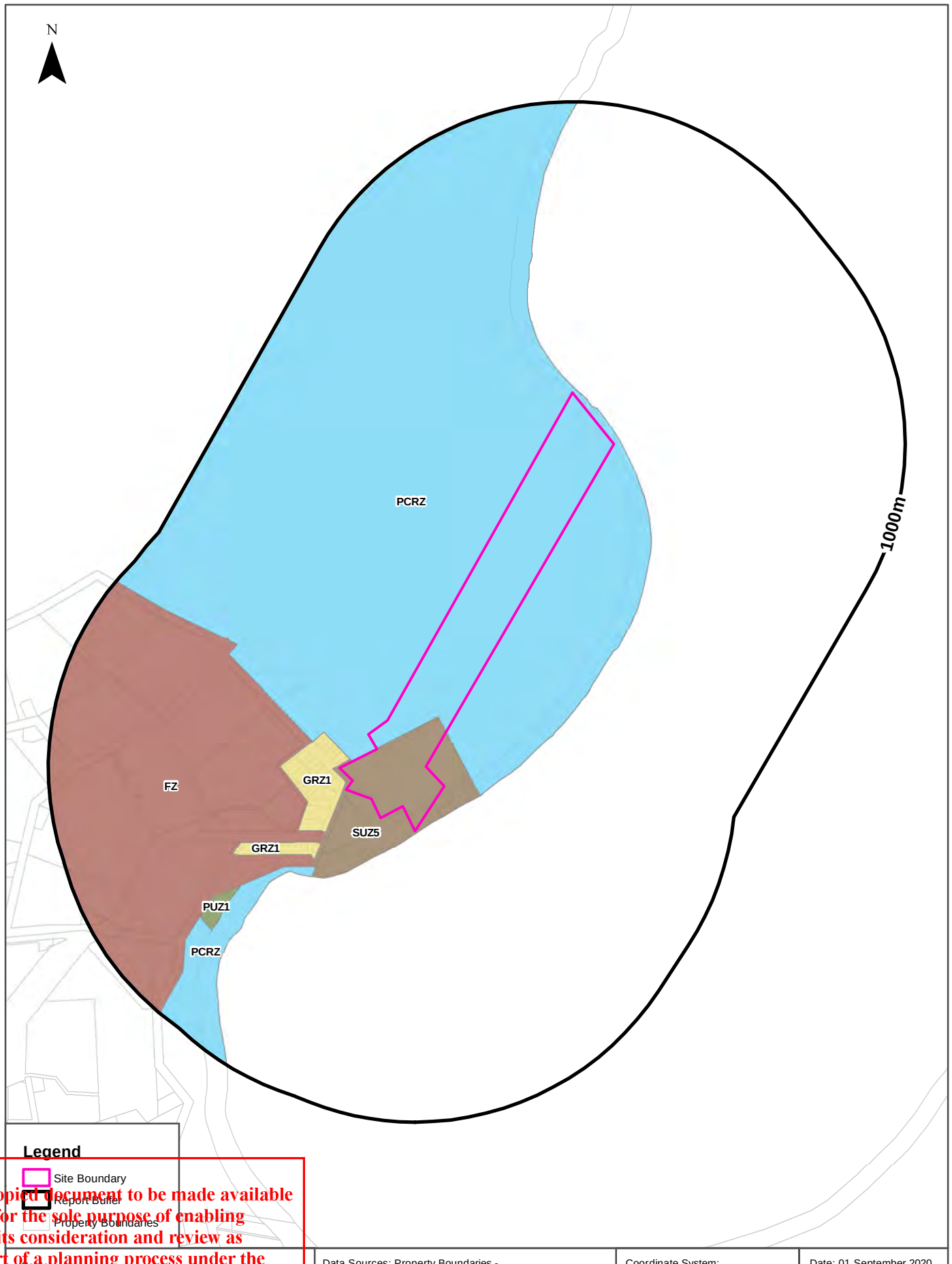
Coastal Acid Sulfate Soil Types
There are no Acid Sulfate areas onsite

What are the Coastal Acid Sulfate Soil types within the dataset buffer?

Coastal Acid Sulfate Soil Types	Distance	Direction
There are no Acid Sulfate areas within the report buffer		

Planning Zones

Red Cliffs, Mildura, VIC 3496



Data Sources: Property Boundaries - State Government Victoria - Department of Environment, Land, Water & Planning

Coordinate System: GDA 1994 MGA Zone 55

Date: 01 September 2020

Planning

Red Cliffs, Mildura, VIC 3496

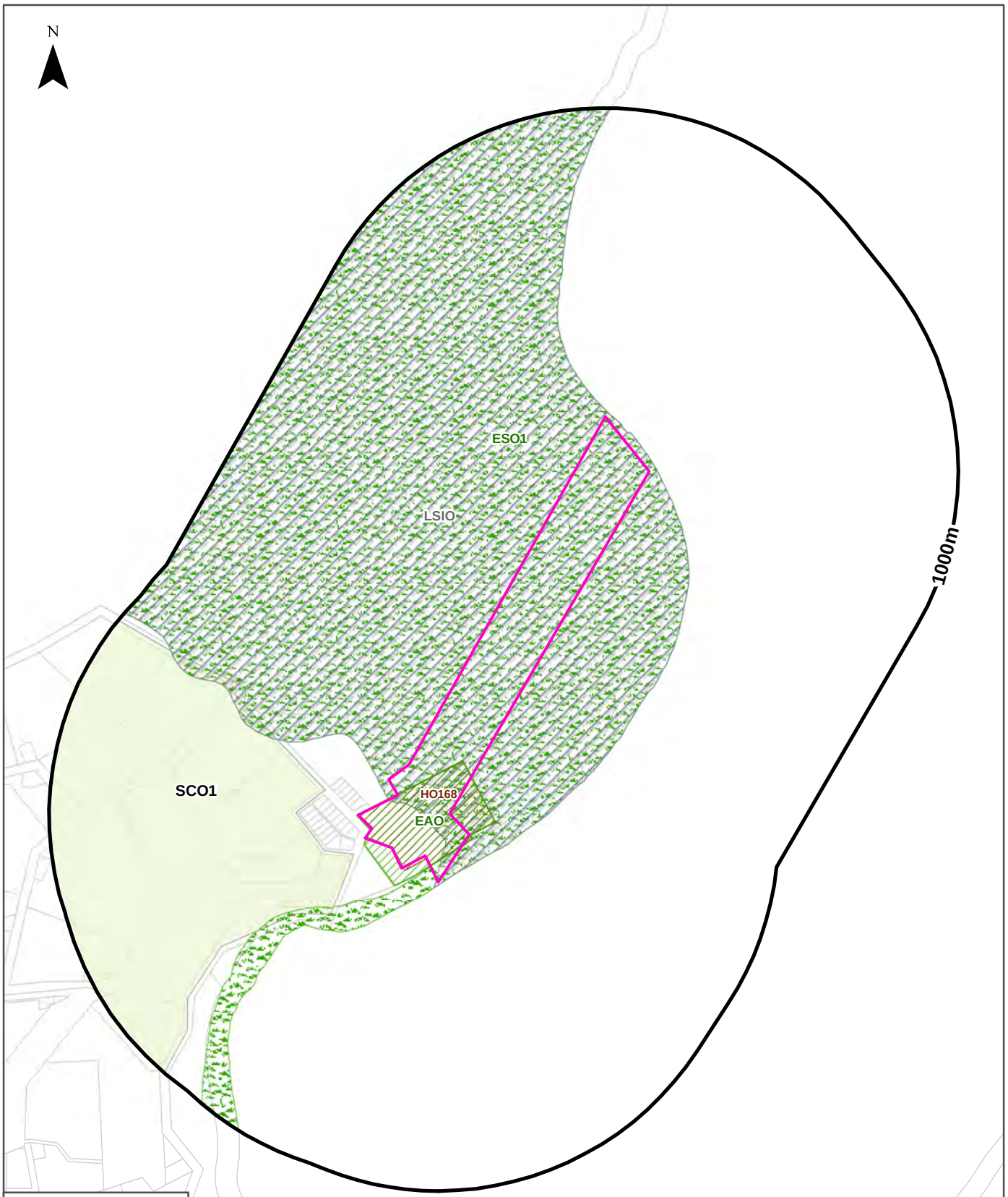
Planning Zones

Planning zones within the dataset buffer:

Zone Code	Description	Distance	Direction
PCRZ	PUBLIC CONSERVATION AND RESOURCE ZONE	0m	Onsite
SUZ5	SPECIAL USE ZONE - SCHEDULE 5	0m	Onsite
GRZ1	GENERAL RESIDENTIAL ZONE - SCHEDULE 1	10m	South West
FZ	FARMING ZONE	129m	North West
GRZ1	GENERAL RESIDENTIAL ZONE - SCHEDULE 1	206m	South West
PCRZ	PUBLIC CONSERVATION AND RESOURCE ZONE	279m	South East
PUZ1	PUBLIC USE ZONE - SERVICE AND UTILITY	485m	South West

Planning Overlays

Red Cliffs, Mildura, VIC 3496



Data Sources: Property Boundaries - State Government Victoria - Department of Environment, Land, Water & Planning

Coordinate System: GDA 1994 MGA Zone 55

Date: 01 September 2020

Planning

Red Cliffs, Mildura, VIC 3496

Planning Overlays

Planning overlays within the dataset buffer:

Zone Code	Description	Distance	Direction
ESO1	ENVIRONMENTAL SIGNIFICANCE OVERLAY - SCHEDULE 1	0m	Onsite
LSIO	LAND SUBJECT TO INUNDATION OVERLAY	0m	Onsite
EAO	ENVIRONMENTAL AUDIT OVERLAY	0m	Onsite
HO168	HERITAGE OVERLAY (HO168)	0m	Onsite
SCO1	SPECIFIC CONTROLS OVERLAY - SCHEDULE 1	62m	West

Heritage

Red Cliffs, Mildura, VIC 3496

Commonwealth Heritage List

What are the Commonwealth Heritage List Items located within the dataset buffer?

Place Id	Name	Address	Place File No	Class	Status	Register Date	Distance	Direction
N/A	No records in buffer							

Heritage Data Source: Australian Government Department of the Environment and Energy - Heritage Branch
Creative Commons 3.0 © Commonwealth of Australia https://creativecommons.org/licenses/by/3.0/au/deed.en

National Heritage List

What are the National Heritage List Items located within the dataset buffer?
Note. Please click on Place Id to activate a hyperlink to online website.

Place Id	Name	Address	Place File No	Class	Status	Register Date	Distance	Direction
N/A	No records in buffer							

Heritage Data Source: Australian Government Department of the Environment and Energy - Heritage Branch
Creative Commons 3.0 © Commonwealth of Australia https://creativecommons.org/licenses/by/3.0/au/deed.en

Victorian Heritage Register

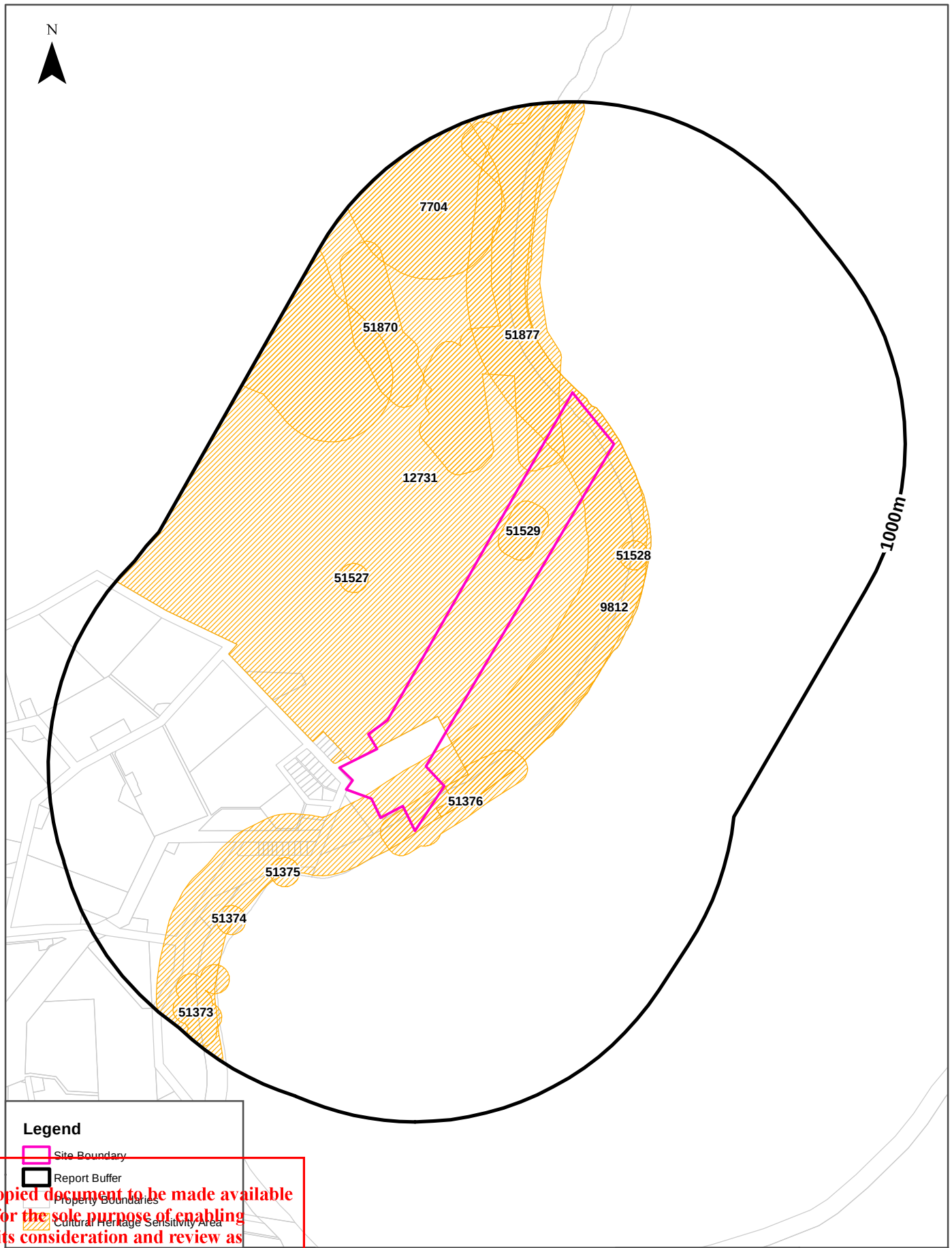
What are the Victorian Heritage Register items located within the dataset buffer?:

VHR Number	Description	Distance	Direction
N/A	No records within buffer		

Victorian Heritage Register Data Custodian: State Government Victoria - Dept of Environment, Land, Water & Planning
Creative Commons Attribution 4.0 International © Commonwealth of Australia http://creativecommons.org/licenses/by/4.0/

Cultural Heritage Sensitivity

Red Cliffs, Mildura, VIC 3496



Data Sources: Property Boundaries - State Government Victoria - Department of Environment, Land, Water & Planning

Coordinate System: GDA 1994 MGA Zone 55

Date: 01 September 2020

Heritage

Red Cliffs, Mildura, VIC 3496

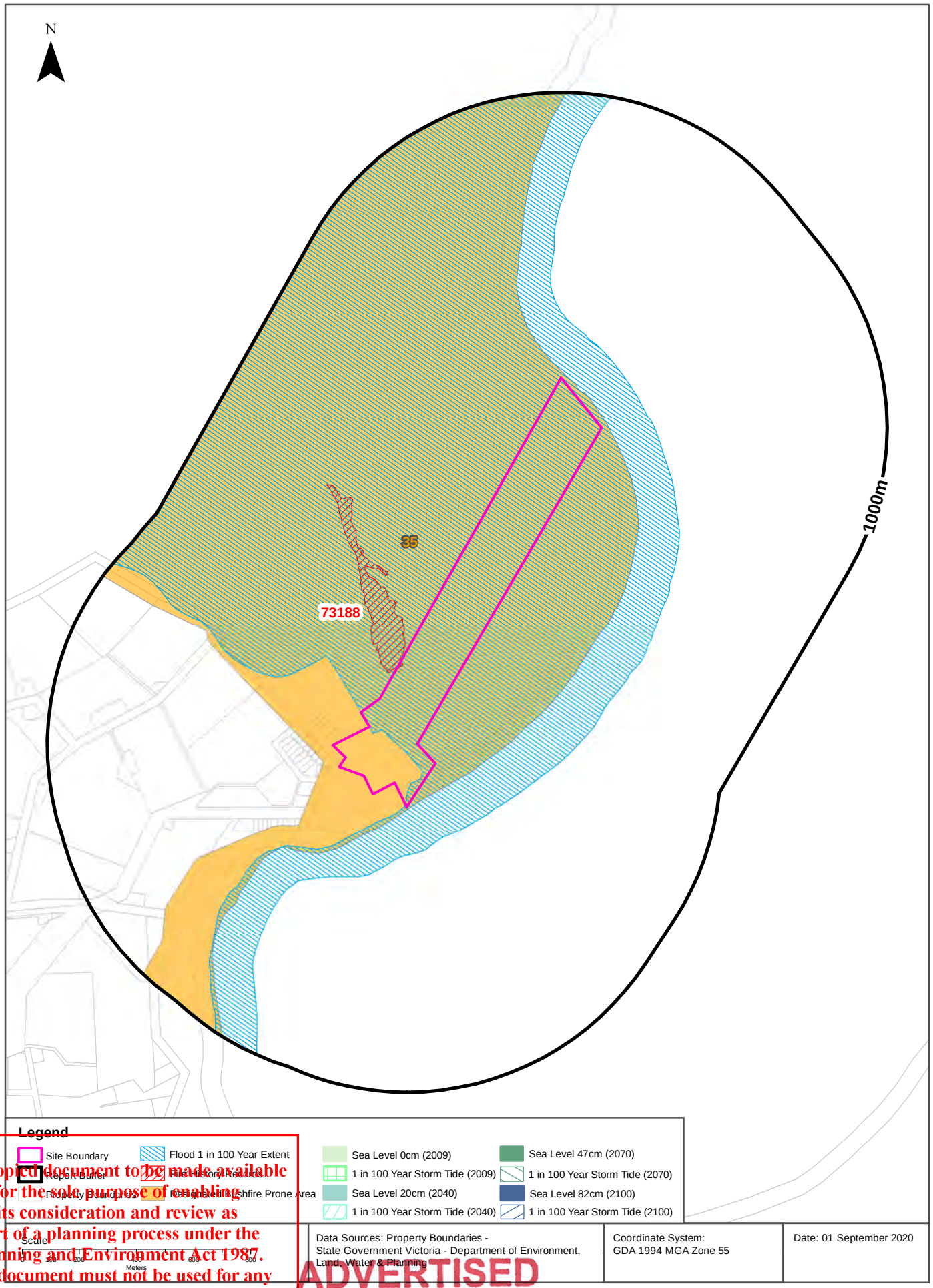
Cultural Heritage Sensitivity

Areas of Cultural Heritage Sensitivity as specified in Division 3 of Part 2 in the Victorian Aboriginal Heritage Regulations 2018, within the dataset buffer:

Map Id	Distance	Direction
12731	0m	Onsite
9812	0m	Onsite
51529	0m	Onsite
51877	0m	Onsite
51376	0m	Onsite
51528	203m	East
51527	291m	West
51375	303m	South West
51870	453m	North
7704	532m	North
51374	547m	South West
51373	742m	South West

Natural Hazards

Red Cliffs, Mildura, VIC 3496



Natural Hazards

Red Cliffs, Mildura, VIC 3496

Bushfire Prone Areas

What are the designated bushfire prone areas within the dataset buffer?

Map ID	Feature	Plan No	LGA	Gazetted Date	Distance	Direction
35	Designated Bushfire Prone Area	LEGL./13-195	MILDURA	08/08/2013	0m	Onsite

Fire History

What are the fire history records of fires primarily on public land, within the dataset buffer?

Map Id	Fire Type	Fire Key	Season	Fire No	Fire Name	Treatment	Fire Cover	Start Date	Dist (m)	Direction
73188	BUSHFIRE	W2002078	2002	8		FIRE	90-100	22/09/2001	0m	Onsite

Flood - 1 in 100 year modelled flood extent

What 1 in 100 year flood extent features exist within the dataset buffer?

Feature	Source	Method	Scale	Modified Date	Distance	Direction
100 Year Flood Outline	Unknown	No contours & some flood info		01/01/2000	0m	Onsite

Natural Hazards

Red Cliffs, Mildura, VIC 3496

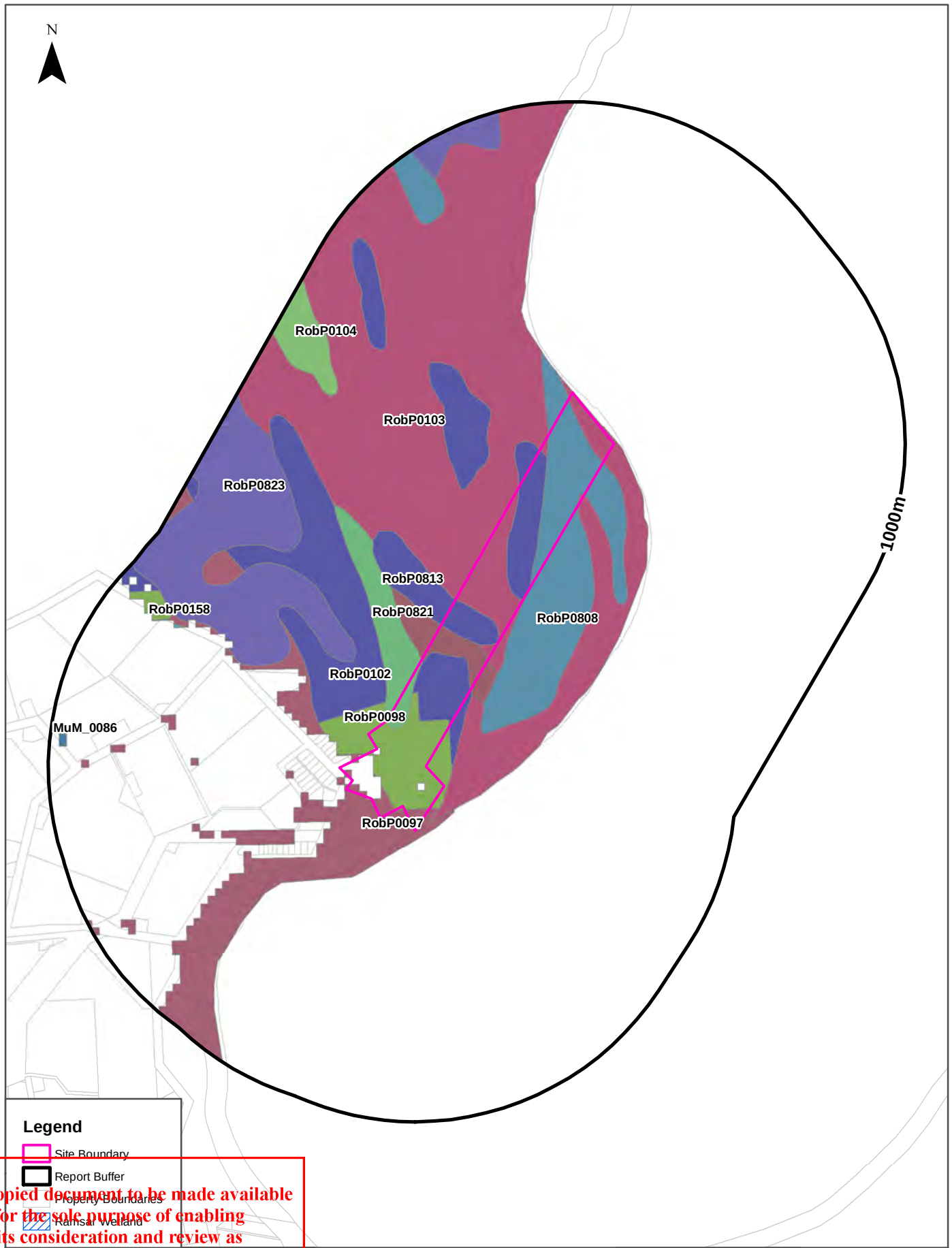
Victorian Coastal Inundation Sea Level Rise

What coastal inundation sea level rise features exist within the dataset buffer?

Description	Distance	Direction
No records within buffer		

Ecological Constraints - Native Vegetation 2005 & Ramsar Wetlands

Red Cliffs, Mildura, VIC 3496



Ecological Constraints

Red Cliffs, Mildura, VIC 3496

Native Vegetation (Modelled 2005 Ecological Vegetation Classes)

What native vegetation exists within the dataset buffer?

Veg Code	EVC Name	EVCCode	Group	Subgroup	Bioregion	Conservation Status	Geographic Occurance	Distance
RobP0097	Semi-arid Woodland	0097	Plains Woodlands or Forests	Semi-arid(non-Eucalypt)	Robinvale Plains	Vulnerable	Naturally Restricted	0m
RobP0098	Semi-arid Chenopod Woodland	0098	Plains Woodlands or Forests	Semi-arid(non-Eucalypt)	Robinvale Plains	Vulnerable	Naturally Restricted	0m
RobP0102	Low Chenopod Shrubland	0102	Plains Grasslands and Chenopod Shrublands	Clay soils	Robinvale Plains	Depleted	Minor	0m
RobP0103	Riverine Chenopod Woodland	0103	Riverine Grassy Woodlands or Forests	Broader plain	Robinvale Plains	Depleted	Common	0m
RobP0808	Lignum Shrubland	0808	Riverine Grassy Woodlands or Forests	Creekline and/or swampy	Robinvale Plains	Least Concern	Naturally Restricted	0m
RobP0813	Intermittent Swampy Woodland	0813	Riverine Grassy Woodlands or Forests	Creekline and/or swampy	Robinvale Plains	Depleted	Naturally Restricted	0m
RobP0821	Tall Marsh	0821	Wetlands	Freshwater	Robinvale Plains	Depleted	Rare	0m
RobP0823	Lignum Swampy Woodland	0823	Riverine Grassy Woodlands or Forests	Creekline and/or swampy	Robinvale Plains	Depleted	Naturally Restricted	202m
RobP0104	Lignum Swamp	0104	Wetlands	Freshwater	Robinvale Plains	Vulnerable	Naturally Restricted	705m
RobP0158	Chenopod Mallee	0158	Mallee	Calcareous dunefields	Robinvale Plains	Vulnerable	Minor	730m
MuM_0086	Woorinen Sands Mallee	0086	Mallee	Calcareous dunefields	Murray Mallee	Depleted	Common	939m
MuM_0097	Semi-arid Woodland	0097	Plains Woodlands or Forests	Semi-arid(non-Eucalypt)	Murray Mallee	Vulnerable	Common	943m

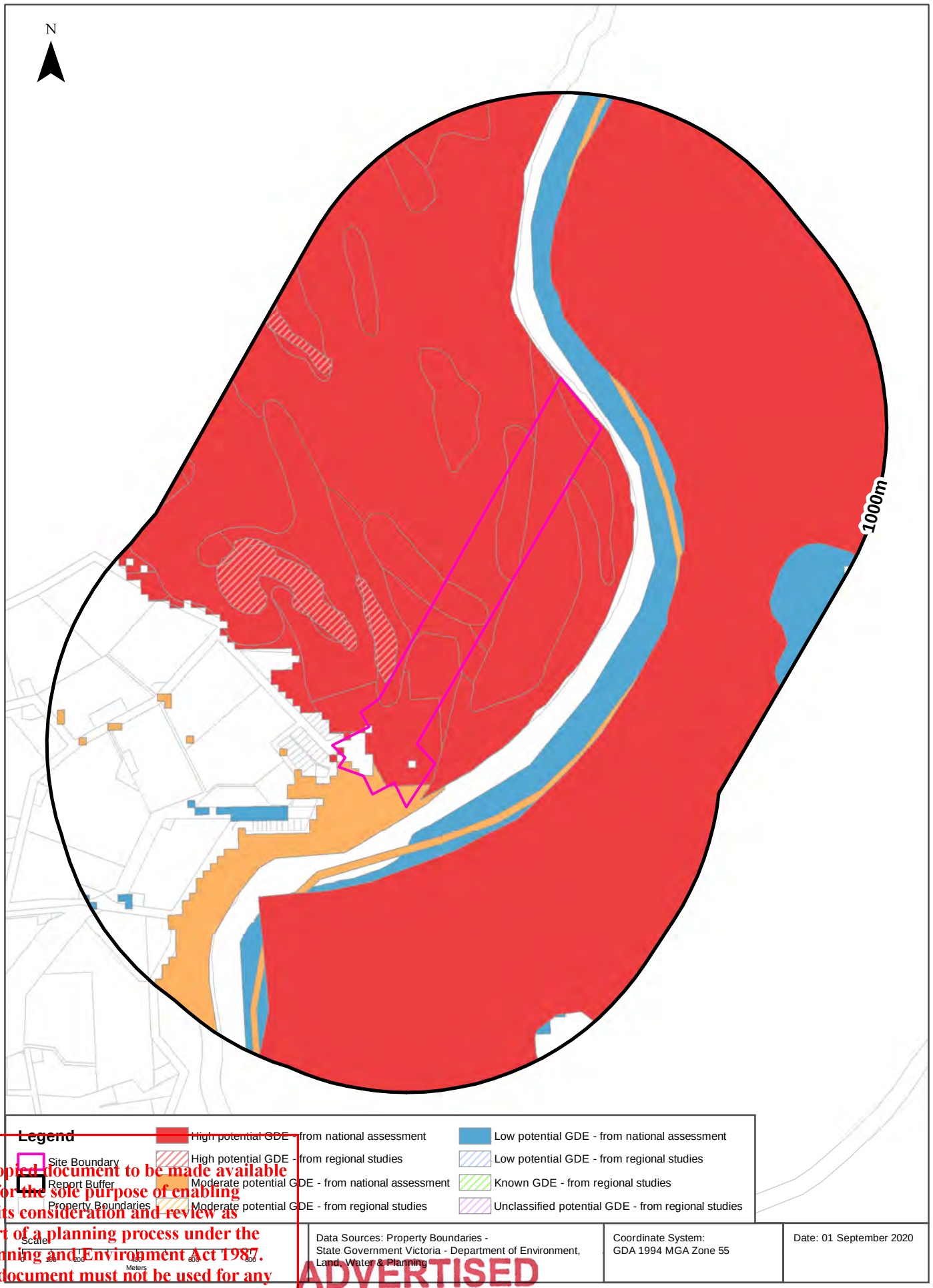
Ramsar Wetlands

What Ramsar wetland areas exist within the dataset buffer?

Map ID	Site Name	Lake Name	Distance	Direction
N/A	No records within buffer			

Ecological Constraints - Groundwater Dependent Ecosystems Atlas

Red Cliffs, Mildura, VIC 3496



Ecological Constraints

Red Cliffs, Mildura, VIC 3496

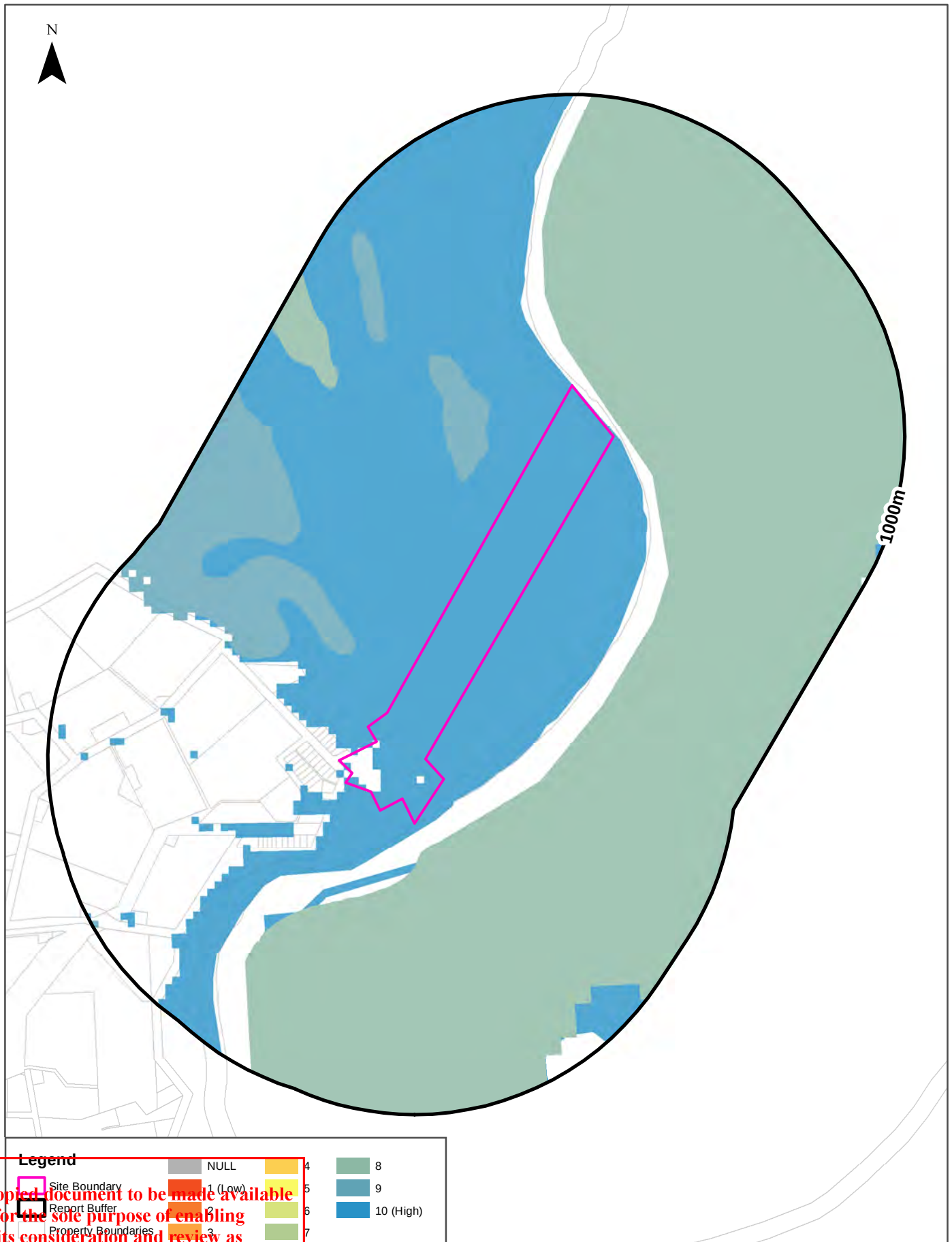
Groundwater Dependent Ecosystems Atlas

What GDEs exist within the dataset buffer?

GDE Type	Name	GDE Potential	Geomorphology	Ecosystem Type	Aquifer Geology	Distance
Terrestrial		High potential GDE - from national assessment	Fixed west-east calcareous longitudinal dunes.	Vegetation		0m
Terrestrial		Moderate potential GDE - from national assessment	Fixed west-east calcareous longitudinal dunes.	Vegetation		0m
Aquatic	Power Station Wetland	High potential GDE - from regional studies	Fixed west-east calcareous longitudinal dunes.	Wetland		3m
Aquatic		Low potential GDE - from national assessment	Fixed west-east calcareous longitudinal dunes.	Wetland		35m
Aquatic	MURRAY RIVER	Moderate potential GDE - from national assessment	Fixed west-east calcareous longitudinal dunes.	River		113m
Terrestrial		Low potential GDE - from national assessment	Fixed west-east calcareous longitudinal dunes.	Vegetation		224m

Inflow Dependent Ecosystems Likelihood

Red Cliffs, Mildura, VIC 3496



Ecological Constraints

Red Cliffs, Mildura, VIC 3496

Inflow Dependent Ecosystems Likelihood

What IDEs exist within the dataset buffer?

GDE Type	Name	IDE Likelihood	Geomorphology	Ecosystem Type	Aquifer Geology	Distance
Terrestrial		10	Fixed west-east calcareous longitudinal dunes.	Vegetation		0m
Aquatic	Power Station Wetland	10	Fixed west-east calcareous longitudinal dunes.	Wetland		3m
Aquatic		8	Fixed west-east calcareous longitudinal dunes.	Wetland		35m
Terrestrial		9	Fixed west-east calcareous longitudinal dunes.	Vegetation		140m
Terrestrial		8	Fixed west-east calcareous longitudinal dunes.	Vegetation		705m
Aquatic	Psyche Runner	9	Fixed west-east calcareous longitudinal dunes.	Wetland		710m

Inflow Dependent Ecosystems Likelihood Data Source: The Bureau of Meteorology

Location Confidences

Where Lotsearch has had to georeference features from supplied addresses, a location confidence has been assigned to the data record. This indicates a confidence to the positional accuracy of the feature. Where applicable, a code is given under the field heading “LC” or “LocConf”. These codes lookup to the following location confidences:

LC Code	Location Confidence
Premise match	Georeferenced to the site location / premise or part of site
General area or suburb match	Georeferenced with the confidence of the general/approximate area
Road match	Georeferenced to the road or rail
Road intersection	Georeferenced to the road intersection
Feature is a buffered point	Feature is a buffered point
Land adjacent to geocoded site	Land adjacent to Georeferenced Site
Network of features	Georeferenced to a network of features

USE OF REPORT - APPLICABLE TERMS

The following terms apply to any person (End User) who is given the Report by the person who purchased the Report from Lotsearch Pty Ltd (ABN: 89 600 168 018) (Lotsearch) or who otherwise has access to the Report (Terms). The contract terms that apply between Lotsearch and the purchaser of the Report are specified in the order form pursuant to which the Report was ordered and the terms set out below are of no effect as between Lotsearch and the purchaser of the Report.

1. End User acknowledges and agrees that:
   (a) the Report is compiled from or using content (**Third Party Content**) which is comprised of:
      (i) content provided to Lotsearch by third party content suppliers with whom Lotsearch has contractual arrangements or content which is freely available or methodologies licensed to Lotsearch by third parties with whom Lotsearch has contractual arrangements (**Third Party Content Suppliers**); and
      (ii) content which is derived from content described in paragraph (i);
   (b) Neither Lotsearch nor Third Party Content Suppliers takes any responsibility for or give any warranty in relation to the accuracy or completeness of any Third Party Content included in the Report including any contaminated land assessment or other assessment included as part of a Report;
   (c) the Third Party Content Suppliers do not constitute an exhaustive set of all repositories or sources of information available in relation to the property which is the subject of the Report (**Property**) and accordingly neither Lotsearch nor Third Party Content Suppliers gives any warranty in relation to the accuracy or completeness of the Third Party Content incorporated into the report including any contaminated land assessment or other assessment included as part of a Report;
   (d) Reports are generated at a point in time (as specified by the date/time stamp appearing on the Report) and accordingly the Report is based on the information available at that point in time and Lotsearch is not obliged to undertake any additional reporting to take into consideration any information that may become available between the point in time specified by the date/time stamp and the date on which the Report was provided by Lotsearch to the purchaser of the Report;
   (e) Reports must be used or reproduced in their entirety and End User must not reproduce or make available to other persons only parts of the Report;
   (f) Lotsearch has not undertaken any physical inspection of the property;
   (g) neither Lotsearch nor Third Party Content Suppliers warrants that all land uses or features whether past or current are identified in the Report;
   (h) the Report does not include any information relating to the actual state or condition of the Property;
   (i) the Report should not be used or taken to indicate or exclude actual fitness or unfitness of Land or Property for any particular purpose
   (j) the Report should not be relied upon for determining saleability or value or making any other decisions in relation to the Property and in particular should not be taken to be a rating or assessment of the desirability or market value of the property or its features; and
   (k) the End User should undertake its own inspections of the Land or Property to satisfy itself that there are no defects or failures
2. The End User may not make the Report or any copies or extracts of the report or any part of it available to any other person. If End User wishes to provide the Report to any other person or make extracts or copies of the Report, it must contact the purchaser of the Report before doing so to ensure the proposed use is consistent with the contract terms between Lotsearch and the purchaser.
3. Neither Lotsearch (nor any of its officers, employees or agents) nor any of its Third Party Content Suppliers will have any liability to End User or any person to whom End User provides the Report and End User must not represent that Lotsearch or any of its Third Party Content Suppliers accepts liability to any such person or make any other representation to any such person on behalf of Lotsearch or any Third Party Content Supplier.
4. The End User hereby to the maximum extent permitted by law:
   (a) acknowledges that the Lotsearch (nor any of its officers, employees or agents), nor any of its Third Party Content Supplier have any liability to it under or in connection with the

Report or these Terms;

(b) waives any right it may have to claim against Third Party Content Supplier in connection with the Report, or the negotiation of, entry into, performance of, or termination of these Terms; and

(c) releases each Third Party Content Supplier from any claim it may have otherwise had in connection with the Report, or the negotiation of, entry into, performance of, or termination of these Terms.

5. The End User acknowledges that any Third Party Supplier shall be entitled to plead the benefits conferred on it under clause 4, despite not being a party to these terms.
6. End User must not remove any copyright notices, trade marks, digital rights management information, other embedded information, disclaimers or limitations from the Report or authorise any person to do so.
7. End User acknowledges and agrees that Lotsearch and Third Party Content Suppliers retain ownership of all copyright, patent, design right (registered or unregistered), trade marks (registered or unregistered), database right or other data right, moral right or know how or any other intellectual property right in any Report or any other item, information or data included in or provided as part of a Report.
8. To the extent permitted by law and subject to paragraph 9, all implied terms, representations and warranties whether statutory or otherwise relating to the subject matter of these Terms other than as expressly set out in these Terms are excluded.
9. Subject to paragraph 6, Lotsearch excludes liability to End User for loss or damage of any kind, however caused, due to Lotsearch's negligence, breach of contract, breach of any law, in equity, under indemnities or otherwise, arising out of all acts, omissions and events whenever occurring.
10. Lotsearch acknowledges that if, under applicable State, Territory or Commonwealth law, End User is a consumer certain rights may be conferred on End User which cannot be excluded, restricted or modified. If so, and if that law applies to Lotsearch, then, Lotsearch's liability is limited to the greater of an amount equal to the cost of resupplying the Report and the maximum extent permitted under applicable laws.
11. Subject to paragraph 9, neither Lotsearch nor the End User is liable to the other for:

(a) any indirect, incidental, consequential, special or exemplary damages arising out of or in relation to the Report or these Terms; or

(b) any loss of profit, loss of revenue, loss of interest, loss of data, loss of goodwill or loss of business opportunities, business interruption arising directly or indirectly out of or in relation to the Report or these Terms,

irrespective of how that liability arises including in contract or tort, liability under indemnity or for any other common law, equitable or statutory cause of action or otherwise.

12. These Terms are subject to New South Wales law.

ABOUT US

WSP is one of the world's leading engineering professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors, environmental specialists, as well as other design, program and construction management professionals. We design lasting Property & Buildings, Transportation & Infrastructure, Resources (including Mining and Industry), Water, Power and Environmental solutions, as well as provide project delivery and strategic consulting services. With approximately 50,000 talented people globally, we engineer projects that will help societies grow for lifetimes to come.