REVIEW OF ENVIRONMENTAL FACTORS

Addendum #2 – Pre-treatment Plant

Lachlan River Pre-Treatment Plant REF

Prepared for: PARKES SHIRE COUNCIL

the environmental factor
Ecology
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Review of Environmental Factors – Addendum #2 Lachlan River Pre-treatment Plant

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This REF Addendum (Addendum) has been prepared by The Environmental Factor (TEF) under Division 5.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act), on behalf of Parkes Shire Council (PSC or Council). It examines and considers to the fullest extent possible all matters affecting or likely to affect the environment by reason of the changes proposed to the construction of the planned pre-treatment plant which will be undertaken by PSC as development without consent under State Environmental Planning Policy (Transport and Infrastructure) 2021. The original construction design (and subsequent operation) for the pre-treatment plant (PTP) was assessed by Eco Logical Australia (ELA) in its report 'Lachlan River Pumping Station Augmentation, Pre-Treatment Plant and Solar Photovoltaic (PV) Array – Review of Environmental Factors' (Project REF).

This Addendum to the original Project REF has been prepared in accordance with the EP&A Act, the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation) and the Guidelines for Division 5.1 assessments prepared by the Department of Planning and Environment (DPE) (DPE Guidelines). It demonstrates how the environmental factors specified in the DPE Guidelines (which simply adopt the factors specified in s 171(2) of the EP&A Regulation) have been taken into account when considering all the matters affecting or likely to affect the environment by reason of the revised proposal.

The information, statements, recommendations, and commentary (together the "Information") contained in this Addendum have been prepared by TEF from material provided by PSC, ELA and DPE, including available databases. TEF has not sought any independent confirmation of the reliability, accuracy or completeness of this information. It should not be construed that TEF has carried out any form of audit of the information which has been relied upon. Accordingly, whilst the statements made in this report are given in good faith, TEF accepts no responsibility for any errors in the information provided by ELA, DPE or PSC nor the effect of any such errors on the analysis undertaken, suggestions provided, or this report.

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Figures, Tables and Plates

Abbreviations

Abbreviation	Description
ADD	Aboriginal Due Diligence
AHIMS	Aboriginal heritage information management system
AHIP	Aboriginal heritage impact permit
AWS	Automatic Weather Station
BC Act	*Biodiversity Conservation Act 2016*
CEMP	Construction Environmental Management Plan
DAWE	Department of Agriculture, Water and the Environment (now the Department of Agriculture, Fisheries and Forestry)
DEE	Department of Environment and Energy (now the Department of Climate Change, Energy, the Environment and Water)
DPI	Department of Primary Industries
DPE	Department of Planning and Environment (formerly OEH)
ELA	Eco Logical Australia
EPA	Environmental Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2021*
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
EPL	Environmental Protection Licence
ERSED	Erosion and Sediment
FM Act	*Fisheries Management Act 1994*
KFH	Key Fish Habitat
LoO	Likelihood of Occurrence
LRPS	Lachlan river pumping station
MNES	Matters of National Environmental Significance
NSW	New South Wales

Abbreviation	Description
OEH	Office of Environment and Heritage (now DPE)
POEO Act	*Protection of the Environment Operations Act 1997*
PCT	Plant Community Type
PSC	Parkes Shire Council
PTP	Pre-treatment Plant
PV	Photo voltaic
RAP	Registered Aboriginal Party
REF	Review of Environmental Factors
SMP	Structural Piping and Mechanical
TEC	Threatened Ecological Community
TEF	The Environmental Factor
ToS	Test of Significance
WAL	Water Access Licence
WM Act	*Water Management Act 2000*

1 SUMMARY

The Environmental Factor (TEF) has prepared this Addendum for Parkes Shire Council (PSC or Council) in order to supplement the Review of Environmental Factors (REF) by Eco Logical Australia (ELA) in its report 'Lachlan River Pumping Station Augmentation, Pre-Treatment Plant and Solar Photovoltaic (PV) Array – Review of Environmental Factors' (Project REF). The pre-treatment plant (PTP) is proposed for construction within the existing Lachlan River Pump Station (LRPS) compound, a property known as 'Tallawalla' approximately 12 km east of the township of Forbes on the Escort Way in the Forbes Local Government Area (LGA), NSW (hereafter 'the Proposal'). A revised assessment of the matters affecting or likely to affect the environment has been undertaken due to a change in PSC's proposed approach to the construction of the works. These changes are detailed in Section 2 of this Addendum with updated design drawings provided as Appendix A. The changes identified in this Addendum form part of and should be read in conjunction with the Project REF for a complete assessment of the matters affecting or likely to affect the environment by reason of the Proposal as a whole.

The following changes in the PTP design are noted and have been considered in preparing this Addendum:

- Smaller pre-treatment lagoons, with a different orientation, resulting in a reduced impact footprint compared with that proposed in the Project REF.
- Alternative access roads and arrangement to accommodate the New Eugowra Road Pump Station (NERPS). The NERPS layout is mirrored to the original design, with the suction tank adjacent to the Settled Water Pump Station. The proposed location of the NERPS has been relocated approximately 120 m from the location assessed in the Project REF.
- Waste management extended to include sludge removal from lagoons on an annual or biannual basis (depending on operational requirements). Sludge would be transported from the PTP by road and disposed of at a licensed waste management facility as per Council and EPA regulations.
- Construction of a clean water diversion bund, to be used only during the construction period (and only if required) using spoil from the construction of the lagoons.

The subject site included in this Addendum is derived from the footprint identified in the GHD final design drawings, dated 24/08/2023 (Appendix A). The direct impact area (identified as the subject site in this addendum) includes a 20 m buffer surrounding the design drawings to account for construction vehicle movement. A 25m buffer was identified around the subject site to account for indirect impacts (identified as the study area).

Potential impacts to Aboriginal heritage from the expanded study area were assessed in accordance with the Aboriginal 'Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales. OzArk completed an Aboriginal Due Diligence (ADD) assessment in November 2022 with an addendum then completed in October 2023 to extend the study area to include the proposed expanded impact area. The Aboriginal site, AHIMS ID 43-3-0108 identified within the Project REF study area is partially covered by the active Aboriginal Heritage Impact Permit (AHIP) C0001096 (active until May 2025). The AHIP covers the area immediately adjacent to the PTP. The due diligence assessment concluded the proposed works will have an impact on the ground surface, however, assuming strict implementation of the safeguards outlined in the ADD, addendum and AHIP, no Aboriginal objects or intact archaeological deposits are likely to be harmed by the Proposal.

If the construction methodology or assessment impact footprint (subject site) are amended, re-assessment of the potential impacts to Aboriginal heritage would be required. The original ADD and the addendum have been included in this report as Appendix C.

A permit obtained under Part 7 s200 of the *Fisheries Management Act 1994* (FM Act) (Fisheries permit) is not required for the above-mentioned works; liaison with DPI – Fisheries is ongoing to inform this process. In addition, DPE Water have advised that an application for a Water Supply Works Approval (WSWA) is required. Given the additional changes made with the revised scope of works including additional construction activities within Waterfront Land, Council will continue to consult with DPE Water to ascertain if the works require an amendment to the existing Controlled Activity Approval under the WM Act.

Due to works being completed within a known flood plain, Council engaged a consultant to complete a flood risk and impact assessment to determine the flood immunity of the proposed lagoons and potential flood impacts to adjacent properties as a result of changes to flood behaviour due to the presence of the proposed lagoons' bunds on the Lachlan River floodplain. The report was completed in May 2023 and outlines findings and recommendations from the risk assessment. The final report has been included as Appendix D.

The potential additional impacts associated with the updated design are outlined within this REF addendum. All work will be completed under the guidance of a Construction Environmental Management Plan (CEMP) to manage potential environmental impacts associated with the work. Once operational, the Proposal is not expected to cause any significant environmental or community impacts. The proposed infrastructure upgrade is anticipated to have positive socio-economic benefits for the local community, through the provision of safe, reliable water infrastructure to a growing urban area. Given the nature, scale and extent of impacts, and assuming strict implementation of the environmental safeguards outlined in the Project REF and this addendum, the Proposal is **unlikely to have a significant adverse impact** on the environment. It is considered that all matters affecting or likely to affect the environment by reason of the Proposal have been considered as required by s5.5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1 Site Description

The PTP is proposed for construction on Council owned land, Lot 81 DP750183, immediately north of the Lachlan River. The subject site is comprised primarily of cleared agricultural cropping land with remnant native vegetation along the property boundary, and riparian vegetation adjacent to the Lachlan River.

Plant Community Types (PCTs) verified in Section 5.3 of the Project REF identified two (2) small patches of native PCTs present within the Addendum study area, including PCT 5 – *River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains* and PCT 277 – *Blakelys Red Gum – Yellow Box grassy tall woodland* within the addendum study area. PCT 277 constitutes part of the Threatened Ecological Community (TEC) *White Box – Yellow Box – Blakelys Red Gum Grassy Woodland and Derived Native Grassland*, listed as critically endangered under the *Biodiversity Conservation Act 2016* (BC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The broader locality is a mixture of cleared agricultural land used for grazing and cropping, with small patches of native vegetation scattered throughout.

Table 1 Site details

Site details	
Road name / Property name Lot /DP	The addendum study area is located on The Escort Way, occurring within the Lachlan River, and immediately to the north of the Lachlan River on Council owned land- Lot 1 DP568768.
Closest crossroad(s)	• Fairview Road • Littles Road
Land zoning	RU1 – Primary Production
IBRA region	NSW South Western Slopes
IBRA sub region	Lower Slopes

Plate 1 - Subject Site for PTP (Source: OzArk 2022)

Plate 2 - Subject Site looking towards LRPS (Source: OzArk 2022)

1.2 Terms and definitions

The terms and definitions used throughout this report are described in Table 2.

Table 2 Terms and definitions

Term	Description
Subject site	The subject site included in this Addendum is derived from the footprint identified in the GHD final design drawings, dated 24/08/2023 (Appendix A). The direct impact area includes a 20 m buffer surrounding the design drawings to account for construction vehicle movement. The area to be directly affected, including machinery access, stockpile, excavation and trenching measures **11.72 ha** (Refer Figure 1).
Study area	Includes the subject site (as described above) and any proximal areas that could be potentially directly or indirectly impacted by the Proposal. For the purposes of this addendum, an indirect construction buffer, consistent with the Project REF of 10m is included around the subject site to allow for indirect impacts for a total area of **15.98 ha** (refer Figure 1).
Locality	Is the area within 10 kilometres of the subject site

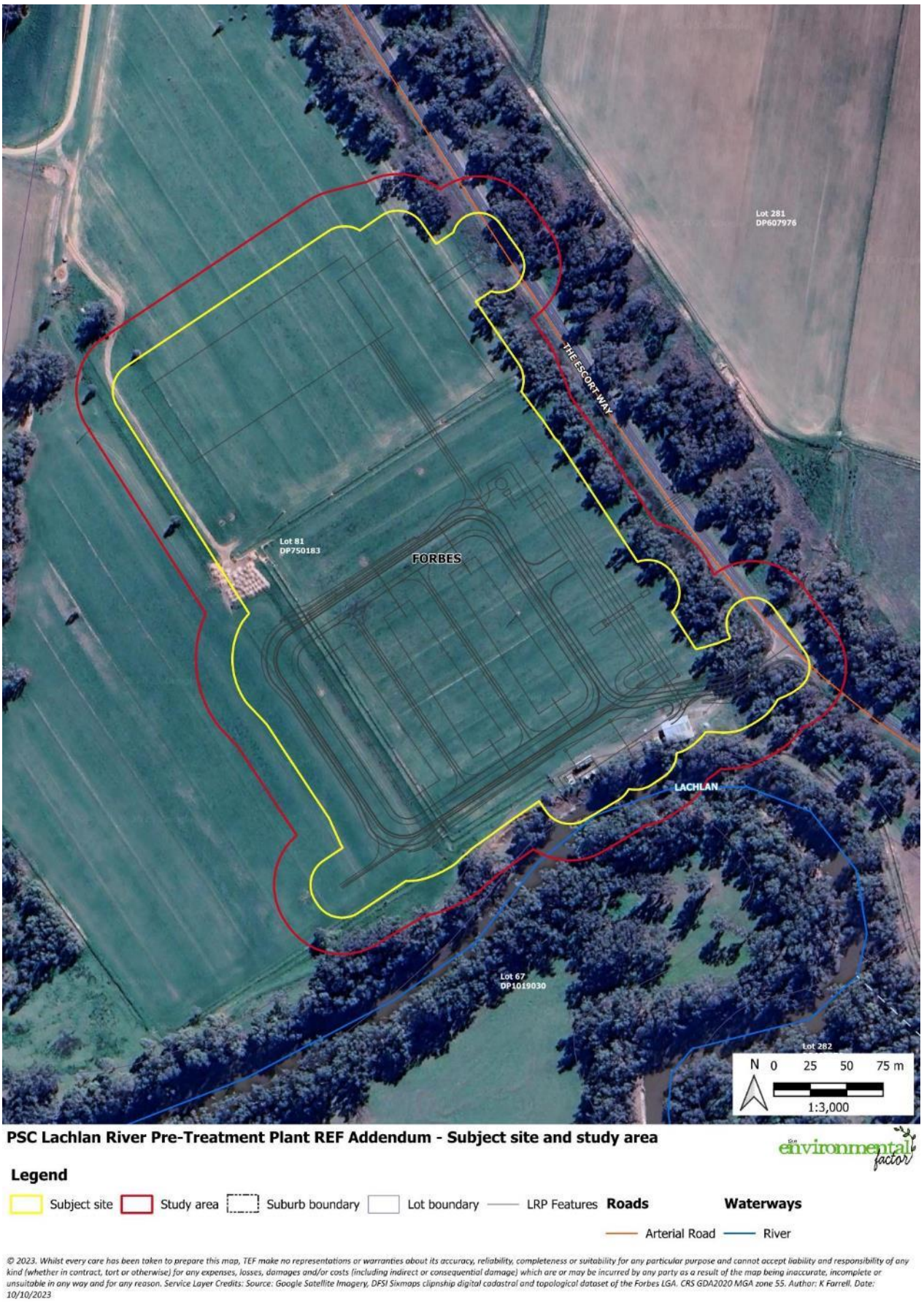


Figure 1 Addendum Study Area and proposed infrastructure at the LRPS Pre-Treatment Plant

2 DESCRIPTION OF CHANGES TO PROPOSAL

The proposed addendum works, as assessed herein, constitute four (4) specific changes including:

I. Smaller pre-treatment lagoons, with a different orientation, resulting in a reduced impact footprint for this aspect compared with that proposed in the Project REF.
II. Alternative access roads and arrangement to accommodate the New Eugowra Road Pump Station (NERPS). The NERPS layout is mirrored to the original design, with the suction tank adjacent to the Settled Water Pump Station. The proposed location of the NERPS has been relocated approximately 120 m from the location assessed in the Project REF. Note: the two (2) access roads from the Escort Way shown in Figure 1 are being assessed as separate REFs.
III. Waste management extended to include sludge removal from lagoons on an annual or biannual basis (depending on operational requirements). Sludge would be transported from the PTP by road and disposed of at a licensed waste management facility as per Council and EPA regulations.
IV. Construction of a clean water diversion bund, to be used only during the construction period (and only if required) using spoil from the construction of the lagoons.

The following sections provide further detail on relevant aspects of the works.

2.1 Changes to Proposed Construction Activities

2.1.1 Reducing the size and orientation of the pre-treatment lagoons

Changes related to the construction of smaller pre-treatment lagoons compared with those assessed in the Project REF include:

- Excavation for the sediment lagoons. External lagoon embankment with external batters only, with a nominated embankment level of RL **245.25 m** AHD. This provides 0.54 m freeboard above the advised 1% AEP flood level of RL **244.71 m** AHF.
- Proof-rolling of lagoons will be undertaken to ensure the subgrade is smooth and free of stones.
- The preferred option agreed with PSC and design partners is using clay won from site as a lining for the lagoons.
- The acceptance criteria for the permeability of the clay lining comes from the EPA Wastewater Lagoon Construction Guidelines (2019). The material requires a permeability of less than or equal to 1×10^{-9} m/s. Geotechnical investigations have confirmed the in-situ material has low enough permeability to provide an effective barrier between the water in the lagoon and the ground water.
- Geotechnical investigation shows the in-situ material is suitable to provide an effective barrier to water stored in the lagoons. There is also sufficient suitable material available to be excavated for construction of the lagoon embankments. That is, the entire embankments can be constructed using material suitable to be used as clay lining. The geotechnical investigation report provides further detail regarding the extents of suitable material and construction phase testing requirements, including advice for contractors for liming rates required for fill used for the infrastructure pad. Geotechnical investigation report has been included as Appendix B.

The proposed pre-treatment plant footprint and associated infrastructure is identified in Figure 1, with detailed design drawings included as Appendix A.

2.1.2 Alternative access road and alteration to the location of the NERPS

Works involved with the realignment of access roads to accommodate the NERPS infrastructure include:

- The Project REF did not identify NERPS features, however the footprint is encompassed within the Project REF Study Area. The NERPS includes ancillary infrastructure related to the operation of the PTP.
- Location of the NERPS has been relocated approximately 120 m from the location assessed in the Project REF.
- Construction of a loop road around the lagoons.
- The access road will be 6m wide, and approximately 900 m length, including access to The Escort Way. The two (2) access points from the Escort Way is being assessed under separate REFs (see TEF, 2023).
- The access road will be an unpaved, all-weather surface.

The proposed access road / loop road alignment is shown in Figure 1 and Appendix A.

2.1.3 Incorporating additional waste management facilities to include sludge removal from lagoons

The works involved with incorporating additional waste management facilities includes:

- Sludge is to be removed from lagoons on an annual or biannual basis by a contractor (depending on operational requirements).
- Sludge would be transported from the PTP by road and disposed of at a licensed waste management facility as per Council and EPA regulations.
- Truck movements related to the removal of sludge are anticipated to be infrequent and very unlikely to add any strain to local roads.

2.1.4 Construction of a clean water diversion bund

- This design component is included as an optional item within the design. The bund would only be constructed if the risk of flooding of the site was considered high enough to justify construction.
- The construction of the clean water diversion bund will take place to mitigate the risk of floodwater entering the lagoon area during construction.
- Material to form the diversion bund would be gained from excess fill excavated from the lagoons.
- Following construction of the PTP, the diversion bund would be removed, and excess fill disposed of accordingly.

Table 3 Types of works anticipated to be included in construction phase (based on final design from GHD)

Types of works	Comments
Site preparation works	• Site demarcation. • Clearing of vegetation where works are proposed. • Stockpiling and removal of waste green material. • Establishment of access routes for excavation and construction equipment, including placement of signage. • Establishment of layby areas, storage facilities and site office. • Installation of all ERSED control structures as per Environmental Control Plan • Construction of clean water diversion bund (if required)
Lagoon Construction	• Grub out stumps and roots greater than 75mm diameter to a minimum depth of 500 mm below subgrade areas and existing surface infill areas. • Backfill grub holes with suitable spoil from excavations compacted in layers to the density of the surrounding undisturbed soil. • Strip out topsoil and stockpile clear of the works area a minimum of 40m from any waterways. • Excavation of sediment lagoons and deposition of cut material to form lagoon walls. • Removal of any waste materials and transfer to spoil disposal area. • Battering of banks to stabilize • Treatment of external batter with hydraulic mulch (hydromulch) with seed mixture that is suitable to the local climate and reduces operational requirements.
Site rehabilitation works	• Site restoration works to achieve correct levels to stabilise and prevent erosion. • Disposal of excess fill material to licensed facility (if required). • Spreading seed, planting trees as per site restoration plan. • Monitoring of site to ensure hydromulching and revegetation measures are effective and no major erosion or long-term ecological damage occurs as a result of construction works.

A Construction Environmental Management Plan (CEMP) will be prepared prior to construction commencing.

2.2 Operation Activities

The potential changes to site operations as identified in the Project REF includes the addition of waste management infrastructure, reduced sediment lagoon footprint, and additional access road infrastructure. There is no additional water use or supply anticipated. The Project REF notes that Council is not exempt from Licensing for the purpose of water supply and conveying water; hence a water use and water supply approval would be required under s89 and s90 of the WM Act. This addendum does not include works pertaining to water extraction specifically, however the LRPS Augmentation, PTP & Solar Array REF Addendum #1 (TEF, 2022), details Water Access Licence (WAL) requirements as they relate to the Lachlan River Pumping Station (LRPS). Council will continue to consult with Department of Environment (DPE) Water to ascertain if the works require an amendment to the existing Controlled Activity Approval under the WM Act.

2.3 Justification for the Proposed Works

Parkes Shire is experiencing an increased demand for the existing water supply from changing climatic conditions coupled with significant growth in the industrial and residential sectors. This has led Council to propose a series of independent strategic water infrastructure initiatives aimed at supporting greater water security within Parkes and throughout the central west region as part of the proposed future Special Activation Precinct (SAP) developments. This is known as the Parkes Water Security Program 'the Program'.

The Program is roughly divided into six (6) distinct, standalone proposals updated according to various funding streams and works programs. The LRPS augmentation and pre-treatment plant are part of the broader *Lachlan to Parkes Water Supply Duplication and Pump Station Augmentation* project.

The Project REF addendum #1 (TEF 2022) details the proposed LRPS augmentation to increase the output flow from the current maximum flow capacity of 188L/s to 222 L/s. To increase the efficiency of water transfer to the Parkes Water Treatment Plant (WTP), the pre-treatment plant proposal identified in the Project REF would improve the quality of the raw water being transferred to the Parkes WTP by reducing the turbidity of river water and removing suspended impurities and solids before transferring the raw water to the Parkes WTP.

The construction of a Photo Voltaic (PV) array is also proposed in the Project REF, to allow for operational flexibility and reliability of the water supply scheme and reduce operational costs.

2.4 Options Considered

The following options were considered for modification to the LRPS PTP works following finalization of the Project REF:

> **Option 1** – reduce the sediment lagoon footprint and change orientation, install additional waste management infrastructure, reduce access road width and alignment, and rearrange NERPS infrastructure layout.
>
> **Option 2** – Proceed with the original construction works identified in the Project REF.

Council elected to proceed with Option 1 as this provided the most efficient, economically viable approach to complete the PTP works to compliment the required works to the LRPS augmentation and align with the objectives of the Parkes Water Security Program.

3 LEGISLATIVE CONTEXT AND STAKEHOLDER CONSULTATION

The majority of the Legislative Context as detailed in the Project REF was considered to remain relevant for the proposed design changes. The below table includes a summary of the predicted legislative changes commensurate with the proposed design addition.

Table 4 Summary of legislative outcomes

Legislation	Proposed change	Consistent with Project REF?
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	-	Yes – MNES within the study area remain unlikely to be significantly impacted by the proposed works
State		
Biodiversity Conservation Act 2016 (BC Act)	-	Yes – proposed addendum works are not anticipated to have a significant impact, provided that mitigation measures are implemented in accordance with the Project REF and this addendum.
Environmental Planning and Assessment Act 1979 (EP&A Act)	-	Yes – However, development permitted without consent (as per the provisions of the *State Environmental Planning Policy (Transport and Infrastructure) 2021* (TISEPP) are now referred to as **Division 5.1 assessment** rather than Part 5. Legislative outcomes do however remain consistent with the Project REF.
Fisheries Management Act 1994 (FM Act)	- Project REF states that a permit is required under Section 219 and 200 of the FM Act. This pertains to the works associated with the pump station augmentation and not the PTP.	A permit obtained under Part 7 s200 of the *Fisheries Management Act 1994* (FM Act) (Fisheries permit) is not required for the works; liaison with DPI – Fisheries is ongoing to inform this process.
Heritage Act 1977 (Heritage Act)	-	Yes – proposed works do not require approval under s57 of the Act.
Local Land Services Act, Local Land Services Amendment Act (LLS Amendment Act)	-	Yes – the proposal is not subject to the LLS Amendment Act, as the proposed works would be carried out by Council, a determining authority as defined by the Act.

Legislation	Proposed change	Consistent with Project REF?
National Parkes and Wildlife Act (NPW Act)	additional excavation to accommodate the proposed changes to access.	Yes – AHIP C0001096 partially covers any impacts that are proposed by the works. ADD addendum includes expanded impact area (Appendix C).
Protection of the Environment and Operations Act 1997 (POEO Act)	-	Yes – the proposed addendum works are considered achievable to carry out without causing significant water pollution, therefore a licence is not required.
Water Management Act 2000 (WM Act)	-	The Project REF notes that Council is not exempt from Licensing for the purpose of water supply and conveying water; hence a water use and Water Supply Works Approval would be required under s89 and s90 of the WM Act. Given the additional changes made with the revised scope of works including additional construction activities within Waterfront Land and the potential changes to flooding patterns, Council will continue to consult with NRAR and Department of Environment (DPE) Water to ascertain if the works require an amendment to the existing Controlled Activity Approval under the WM Act.
State Environmental planning Policies		
State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP)	-	The Infrastructure SEPP has been repealed and replaced with the *State Environmental Planning Policy (Transport and Infrastructure) 2021* (TISEPP). The proposed works are permissible without consent under Division 24 s2.159 of the TISEPP.
State Environmental Planning Policy 55 – Remediation of Land (SEPP 55)	-	Yes – the addendum study area is not identified as being contaminated land
State Environmental Planning Policy (Koala Habitat Protection) 2021 (Koala Habitat Protection SEPP)	-	SEPP has been repealed and replaced with the *State Environmental Planning Policy (Biodiversity and Conservation) 2021 (see below)*

Legislation	Proposed change	Consistent with Project REF?
State Environmental Planning Policy (Biodiversity and Conservation) 2021	- No impact changes, there are however legislative changes since the Project REF was submitted.	No - Chapter 3 of the *State Environmental Planning Policy (Biodiversity and Conservation) 2021* applies to Koala habitat protection. This chapter of the Biodiversity and Conservation SEPP 2021 only applies to proposals under Part 4 'Development' of the EP&A Act. The Proposal is being assessed under Division 5.1 of the EP&A Act, therefore this chapter of the Biodiversity and Conservation SEPP does not apply to the Proposal and this has not been considered further in preparation of this REF addendum. However, the Koala is listed as an endangered species under both the BC Act and EPBC Act, and thus also requires assessment under these Acts. This was undertaken in the Project REF and has not changed since the original assessment.
Local Environmental Plan		
Forbes Local Environmental Plan 2013 (Forbes LEP)	-	Yes – proposed addendum works are located within land zoned RU1 (Primary Production).

3.1 Community and Agency Consultation

3.1.1 Stakeholder Consultation

As noted in the Project REF, the property where the proposed works will occur are within the bounds of Lot 81 DP 750183, owned by Council. Consultation with adjacent landholders and TfNSW is required to discuss and advise on the changes to flooding patterns in the surrounding area as identified in the flood risk and impact assessment report (Appendix D).

3.1.2 Agency Consultation

Council will continue to liaise with the DPI Fisheries, TfNSW and DPE Water to obtain advice and any necessary permits to enable project delivery.

4 ENVIRONMENTAL ASSESSMENT

This section of the REF addendum provides a description of the potential environmental impacts associated with the proposed alternative design and construction of the Pre-treatment Plant.

All existing Safeguards and mitigation measures outlined in the Project REF remain applicable to the Proposal and must be implemented as part of the additional works that are the subject of this addendum. Additional site-specific environmental safeguards have been identified where necessary. Not all of the proposed additional works alter the identified impacts for each of the environmental aspects. Table 5 below provides a summary of anticipated impacts for each environmental consideration within the amended study area. Where the new proposed works would not alter the environmental impacts identified in the Project REF, the additional works are not discussed further.

Table 5 Summary of design changes for environmental impacts

Environmental Consideration	Impacts associated with additional works?
Geology and Soils	**Yes – temporary negative as additional excavation of soils required**
Ground and Surface Water	**Yes – temporary negative as additional excavation may impact waterways through runoff of sediment**
Biodiversity	No – Captured in Project REF
Aboriginal Heritage	**Yes – additional areas to be impacted within the Registered PAD identified in the Project REF.**
Historic Heritage	No – captured in Project REF
Landscape and Visual Amenity	No – Captured in Project REF
Noise and Vibration	No – captured in Project REF
Traffic and Transport	**Yes – amended access to The Escort Way, however impacts are captured in a separate REF (TEF, 2023). Potential flood impacts on the Escort Way.**
Air Quality	No – Captured in Project REF
Socio-economic Considerations	No – Captured in Project REF
Energy and Climate	No – Captured in Project REF
Bushfire Risk	No – Captured in Project REF

4.1 Geology and Soils

4.1.1 Existing Environment

The existing environment was described in Chapter 5.1 of the Project REF. The addendum study area coincides with the study area identified in the Project REF, albeit over a larger area. The new study area is predominantly within the Lachlan – Bland Channels and Floodplains, characterised by moderately deep to deep alluvial soils that comprise the alluvial plains and terraces of the Lachlan River. It has also been noted that Acid Sulfate Soils (Bn(p4) – sulfidic soils) occur within the new study area.

The excavation required to complete the PTP works will impact upon the soils in the subject site, with excavation and earthmoving activities required for construction of the sediment lagoons, access road, and clean water diversion bund (if required).

4.1.2 Potential Soils and Erosion Impacts

Potential impacts associated with the addendum study area are consistent with those described in the Project REF. Despite a smaller construction footprint required for the settlement lagoons, the overall construction footprint is greater given the inclusion of all features included in the design drawings (refer Appendix A) which were not considered in the Project REF. The increased construction footprint would have a greater impact on soils and erosion with the increased construction footprint.

Potential impacts associated with the proposal are included in Table 6 below.

Table 6 Potential impacts - soils and erosion

Design Change	Construction Impacts	Operational Impacts
Excavation of a smaller settlement lagoon footprint. Earthworks to accommodate a loop road, and ancillary infrastructure	Impacts to **11.72 ha** (3.92 ha greater than proposed in the Project REF) including vegetation clearing, ground disturbance and erosion. A further **4.26 ha** has the potential to experience indirect impacts, with the consideration of a 25m buffer around the subject site. The Project REF identified a 10m buffer around the subject site as the study area.	Nil – following appropriate site remediation/stabilisation and removal of Erosion and Sediment (ERSED) controls, the PTP is not expected to impact soils and erosion once operational.

4.1.3 Environmental Safeguards – Soils and Erosion

The soils and erosion safeguards and management measures from the Project REF have been reviewed and are considered to be relevant for the revised Proposal outlined herein and must be applied to these additional works accordingly.

- No vegetation outside the approved direct impact footprint is to be impacted or removed; vegetation that is not approved for clearance is to be protected to ensure soils are not exposed unnecessarily.
- Minimise the length of time that soils are exposed by stabilising as soon as practical by seeding, spreading mulch or installing erosion control blanket as appropriate.
- Subject site rehabilitation, including removal of weeds and revegetation using appropriate native species and hydromulch on the bunds, to be undertaken to ensure soil stability and

prevention of erosion into the future. Revegetation must be maintained with a survival rate of >80%.

- Maintenance of vegetative cover on all exposed surfaces (not to be covered by hydromulch treatment) to be undertaken to ensure the stability of soils on site into the future.

4.2 Groundwater and Surface Water

4.2.1 Existing Environment

The existing environment was described in Chapter 5.2 of the Project REF (ELA, 2021) as:

"Located on the downstream extent of a heavy bend within Lachlan River, with steep vegetated banks. The banks show evidence of fluvial erosion related to heavy rainfall events and flooding. The lower profile of the bank is unvegetated indicative of prolonged inundation associated with irrigation flow releases from Wyangala Dam (GHD, 2015), as well as previous revegetation works not establishing post recent construction activities.

The Lachlan River has high turbidity due to the clay-based soils combined with low flow. Adjacent rural practices have contributed to this with ploughing, in some instances, to the top of the banks. Water quality records at the site show Electrical Conductivity, Copper and Total Phosphorus (TP) exceeded the ANZECC aquatic ecosystems trigger values. High levels of nitrogen found in the river are further reflections of the impact that farming practices have had on the river (OzArk Environmental and Heritage Management, 2015)."

The Lachlan River is an 8th order waterway (calculated using the Strahler method on a 1:25,000 topographic map), and therefore identified as Key Fish Habitat (KFH) by DPI Fisheries.

The addendum Proposal includes the construction of a temporary clean water diversion bund to mitigate the risk of floodwater entering the PTP construction site following heavy rains. The clean water diversion bund is to be constructed if required.

4.2.2 Potential Waterways Impacts

Potential impacts associated with the proposed works are consistent with those described in the Project REF.

The proposed excavation required to accommodate the PTP works, and ancillary infrastructure works does incur a risk of impact to waterways given the proximity to a major waterway and vulnerable groundwater in the vicinity (refer **Error! Reference source not found.**). The main potential impact to waterways would arise from the potential for spills of fuels and other contaminants during construction which could enter runoff exiting the site and end up in adjacent wetlands and waterways. There is also the risk of sedimentation within surface water exiting the site and impacting on waterways, in particular the Lachlan River. Excavation required for the sediment lagoons and trenching required for any ancillary infrastructure would need to take into consideration the identified groundwater vulnerability of the site (refer Macquarie Geotech *Geotechnical Investigation Report*, 2022, Appendix B), and construction techniques must adhere to the Safeguards outlined in Section 4.2.3.

However, risk of impact to surface waters and groundwaters are anticipated to be minimal provided that the Safeguards outlined in Section 4.2.3 are adhered to.

Potential impacts associated with the proposal are included in Table 7 below:

Table 7 Potential impacts - Waterways

Design Change	Construction Impacts	Operational Impacts
Excavation of a smaller settlement lagoon footprint. Earthworks to accommodate a loop road, and ancillary infrastructure.	Increased potential for erosion and sedimentation into waterways following ground disturbance due to the increased impact footprint.	Nil – following appropriate site remediation and removal of Erosion and Sediment (ERSED) controls, the PTP is not expected to significantly impact waterways, with the designed bund heights providing flood immunity of up to the 1% AEP flood event and no adverse flood impact on design flood levels to surrounding properties for the 1%, 5% and 10% AEP flood events.
Construction of a temporary clean water diversion bund	Material for the clean water diversion bund would be sourced from the material excavated from the sediment lagoons. The construction of a clean water diversion bund would minimise both clean surface water entering the site, and the sediment laden surface water exiting the site and potentially impacting the adjacent Lachlan River.	Nil – the clean water diversion bund would be removed and remediated following construction.

4.2.3 Environmental Safeguards – Waterways

The surface and groundwater safeguards and management measures from the Project REF have been reviewed and are considered to be relevant for the revised Proposal outlined herein and must be applied to these additional works accordingly.

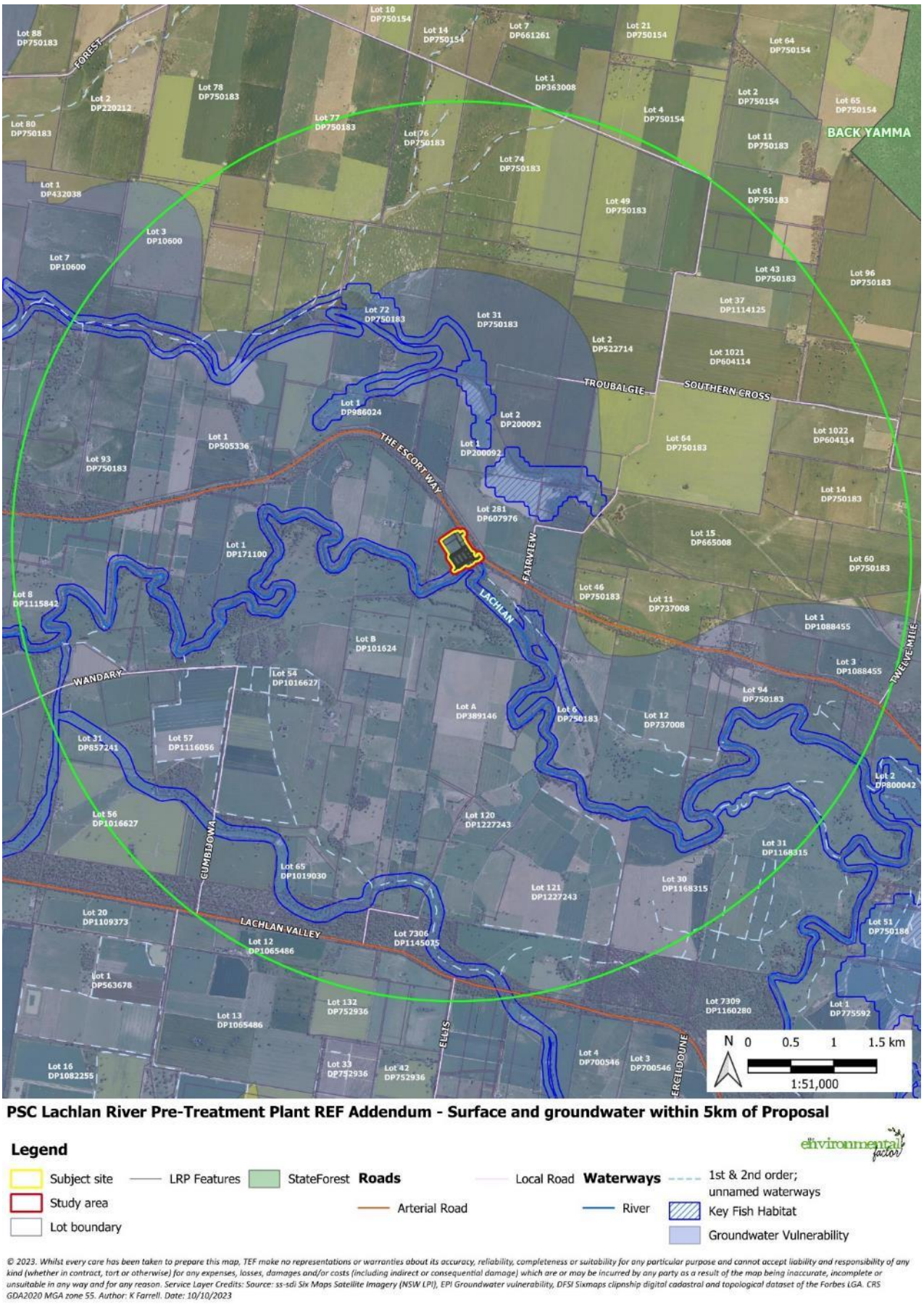
Several additional safeguards for surface and groundwater have been recommended:

- If 'dirty' site water is collected from within the direct impact footprint, it is to be redirected to filtration devices to trap sediments and other pollutants, and dissipate flow velocities, prior to discharging to the surrounding environment. Drainage and runoff should be controlled in such a way that no foreign substrates or materials leave the site.
- All litter, including cigarette butts and food wrappers, is to be collected in a suitable receptacle and disposed of appropriately throughout the construction phase to ensure these do not end up polluting waters.
- Vehicle wash-down and/or cement truck washout (if required) is to occur offsite unless it forms part of sediment control, where it is to occur in a suitably bunded area with controlled run-off.

- Segregate and stockpile topsoil removed from the area a minimum of 40 m from any waterway and use measures such as silt fences and holding ponds to prevent stockpile runoff from entering drainage lines or waterways.
- Minimise the length of time that soils are exposed by stabilising as soon as practical by seeding, spreading mulch or installing erosion control blanket as appropriate.
- Ensure soils/sediment disturbed by construction works do not migrate into the waterway by strategic placement of sediment filters in conjunction with the above-mentioned soil stabilisation techniques.
- Biosecurity and water health protection measures should be implemented throughout the construction phase, including:
  - Machinery should arrive on site in a clean, washed condition, free of fluid leaks, pests and/or weeds/spores.
  - Regular weed control should be undertaken in disturbed areas throughout the construction period to prevent weeds from spreading into waterways, if notifiable/listed weed material is present.
  - Ensure all pesticide/herbicides used are registered for use within a waterway, as per NSW DPI guidelines. Alternatively, opt to remove weeds mechanically where possible.
- Spill response protocols for plant, equipment and chemicals used or stored on site during construction are to be available and accessible at all times to prevent and minimise potential for Pollution of Waters (s120 POEO Act).
- A Soil and Water Management Plan will be developed as part of the CEMP for the Proposal, detailing:
  - Water quality parameters
  - Appropriate monitoring locations and frequency
  - Location and types of ERSED controls
  - Proposed revegetation and stabilisation measures to be undertaken

Operation

- Subject site rehabilitation, including removal of weeds and revegetation using appropriate native species and hydromulch on the bunds, to be undertaken to ensure soil stability and prevention of sediment runoff from the site into the future. Revegetation must be maintained with a survival rate of >80%.



PSC Lachlan River Pre-Treatment Plant REF Addendum - Surface and groundwater within 5km of Proposal

Legend

Subject site
Study area
Lot boundary
LRP Features
StateForest
Roads
Arterial Road
Local Road
Waterways
River
1st & 2nd order; unnamed waterways
Key Fish Habitat
Groundwater Vulnerability

Figure 2 Surface and Groundwater within 5km of subject site

4.3 Aboriginal Heritage

4.3.1 Existing Environment

The existing environment was described in Chapter 5.4 of the Project REF. Potential impacts to Aboriginal heritage from the expanded study area were assessed in accordance with the Aboriginal 'Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales. OzArk completed an Aboriginal Due Diligence (ADD) assessment in November 2022 with an addendum then completed in October 2023 to extend the study area to include the proposed expanded impact area. The Aboriginal site, AHIMS ID 43-3-0108 identified within the Project REF study area is partially covered by the active Aboriginal Heritage Impact Permit (AHIP) C0001096 (active until May 2025). The AHIP covers the area immediately adjacent to the PTP. The due diligence assessment concluded the proposed works will have an impact on the ground surface, however, assuming strict implementation of the safeguards outlined in the ADD and addendum, no Aboriginal objects or intact archaeological deposits are likely to be harmed by the Proposal. If the construction methodology or assessment impact footprint (subject site) are amended, re-assessment of the potential impacts to Aboriginal heritage would be required. The original ADD and the addendum have been included in this report as Appendix C.

4.3.2 Potential Aboriginal Heritage Impacts

Potential impacts associated with the addendum study area are consistent with those described in the Project REF. The addendum works will impact a larger area than identified in the Project REF, and impacted areas have been assessed via the ADD (Appendix C).

The level of disturbance (historic and recent) within the addendum study area means there is a low chance of intact sub-surface deposits being impacted during construction works. The study area is however considered a sensitive landscape as it is within 200m of waters, that is, the Lachlan River.

Potential impacts associated with the proposal are included in Table 8.

Table 8 Potential impacts – Aboriginal Heritage

Design Change	Construction Impacts	Operational Impacts
Excavation of a smaller settlement lagoon footprint. Increased overall construction footprint including earthworks to accommodate a loop road, and ancillary infrastructure.	Impacts to ground through excavation.	Potential for vehicles / foot traffic to stray off-track and impact on PAD site not assessed in ADD. No impacts provided strict adherence to mitigation measures
Construction of a temporary clean water diversion bund	Impacts to ground through excavation.	Potential for vehicles / foot traffic to stray off-track and impact on PAD site not assessed in ADD. No impacts provided strict adherence to mitigation measures

4.3.3 Environmental Safeguards – Aboriginal Heritage

The Aboriginal Heritage safeguards and management measures from the Project REF have been reviewed and are considered to be relevant for the revised Proposal outlined herein and must be applied to these additional works accordingly. Additional safeguards and management measures for Aboriginal Heritage considerations have been identified below, as per the recommendations from the ADD:

- All land and ground disturbance activities must be confined to within the study area, as this will eliminate the risk of harm to Aboriginal objects in adjacent landforms. Should the parameters of the proposal extend beyond the assessed areas identified in Appendix C, then further archaeological assessment may be required before works can proceed.
- All staff and contractors involved in the proposed work should be made aware of the legislative protection requirements for all Aboriginal sites and objects.
- All staff and visitors should be inducted to site to ensure they are aware of the possible presence of sensitive Aboriginal heritage items located within the vicinity of the work site, and the protective measures that should remain in place throughout the works.
- Should unanticipated archaeological material be encountered during site works, all work must cease and an archaeologist contacted to make an assessment of the find. Further archaeological assessment and Aboriginal community consultation may be required prior to the recommencement of works. Any objects confirmed to be Aboriginal in origin must be reported to Heritage NSW.
- If during works, Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the *Unanticipated Finds Protocol* (See Appendix 2 of ADD) should be followed.
- If any human remains are found, all works should stop immediately, the site should be secured and NSW police contacted immediately.

- Inductions for work crews should include a cultural heritage awareness procedure to ensure they recognise Aboriginal artefacts (see Appendix 3 of ADD) and are aware of the legislative protection of Aboriginal objects under the *National Parks and Wildlife Act 1974* and the contents of the Unanticipated Finds Protocol
- The information presented within the ADD meets the requirements of the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales. It should be retained as shelf documentation for five years as it may be used to support a defence against prosecution in the event of unanticipated harm to Aboriginal objects.
- All recommendations and safeguards noted in Appendix C are to be read and followed.

4.4 Traffic and Transport

4.4.1 Existing Environment

The site is located adjacent to The Escort Way; a main arterial link managed by TfNSW connecting the towns of Forbes and Eugowra. The speed limit of the road in the vicinity of the proposed works is 100 km/hour. The proposed changes to the access point to the PTP involves relocating the entry / exit point approximately 150 m to the southeast of the originally proposed location, and the addition of a loop road around the lagoons to allow for safe and efficient vehicle access internally.

4.4.2 Potential Traffic and Transport Impacts

It is not anticipated that the proposed change to the access point and internal access will have additional construction impacts. The construction access point and upgrade to the existing access point have been assessed as separate REFs (see TEF, 2023). Operationally, the provision of a loop road around the lagoons will increase safety and efficiency for vehicles accessing the site, including both light vehicles and heavy vehicles. The flood risk and impact assessment (Appendix D) identified that the proposed works resulted in a flood level increase to the adjacent road (The Escort Way) of up to 120mm during temporary works and up to 70mm for the final design for a 1% AEP event.

Potential impacts associated with the proposal are included in Table 9 below:

Table 9 Potential impacts – Traffic and Transport

Design Change	Construction Impacts	Operational Impacts
Earthworks to accommodate a loop road, and ancillary infrastructure.	Nil additional impacts.	Increased safety and efficiency within the subject site with the provision of a loop road.
Flood level increase identified in flood risk and impact assessment.	Up to 120mm for a 1% AEP event	Up to 70mm for a 1% AEP event

4.4.3 Environmental Safeguards – Traffic and Transport

The traffic and transport safeguards and management measures from the Project REF have been reviewed and are considered to be relevant for the revised Proposal outlined herein and must be applied to these additional works accordingly.

No additional safeguards for traffic and transport have been recommended as part of these works.

4.5 Environmental Planning and Assessment Regulation, 2021 Checklist

The factors which need to be taken into account when considering the environmental impact of an activity are listed in Clause 171(2) of the *Environmental Planning and Assessment Regulation 2021*. These factors have been taken into account in the Project REF when assessing the likely impacts of the Proposal on the natural and built environment, however three (3) additional factors have been added in the revised EP&A Regulation that took effect on 1st July 2022.

These are:

Table 13 Compliance with Clause 171(2) of the EP&A Regulation 2021

Environmental Factor	Will there be an impact?	Comments
(p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions	No	Construction: not on the coast Operation: not on the coast
(q) Any applicable local strategic planning statement, regional strategic plan or district management plan made under Division 3.1 of the Act	Yes	Refer to Parkes Local Strategic Planning Statement (Parkes Shire Council, 2020). The statement mentions the Integrated Water Cycle Management Plan (IWMP) to increase drought resilience in the region. The PTP project aligns with Council's strategic plan for greater water security for the region.
(r) Any other relevant environmental factors	No	Construction: no other factors have been considered other than those listed above. Operation: no other factors have been considered other than those listed above.

5 CERTIFICATION AND ASSESSOR DECLARATION

This REF addendum provides a true and fair review of the Proposal in relation to its likely effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the Proposal.

This report has been developed in accordance with the *NSW Environmental Planning and Assessment Regulation 2021* (EP&A Regulation) and the Department of Planning and Environment's Guidelines for Division 5.1 assessments (DPE Guidelines) and demonstrates how the environmental factors specified in subsection (2) clause 171 of the EP&A Regulation were taken into account when considering the likely impact of the proposed activity.

The assessment has concluded that the proposed works as described in the Project REF and REF Addendum #2, providing all proposed management measures and Safeguards are implemented, will not result in a significant impact on the environment. An Environmental Impact Statement (EIS) is not required.

The proposed works will not result in a significant impact on any declared critical habitat, threatened species, populations or ecological communities or their habitats. Therefore, a Species Impact Statement (SIS) is not required.

The proposed works are not being carried out on Commonwealth land, are unlikely to affect any Commonwealth land, or have any significant impact on any Matters of National Environmental Significance.

All proposed work contemplated as part of the Proposal will be completed under the guidance of a Construction Environmental Management Plan (CEMP) to manage and minimise potential environmental impacts, particularly ecological impacts, associated with the proposed work. Once operational, the Proposal is not expected to cause any significant environmental or community impacts.

I certify that I have reviewed and endorsed the contents of this REF addendum document, and, to the best of my knowledge, it is in accordance with the EP&A Act, the EP&A Regulation and the Guidelines approved under clause 170 of the EP&A Regulation, and the information it contains is neither false nor misleading.

Prepared by:	Reviewed and Endorsed for Certification by:
Name: Kate Farrell	Name: Emily Cotterill
Title: GIS and Environmental Consultant	Title: Director & Principal Consultant
Date: 07-Nov-2023 | 16:54 AEDT	Date: 07-Nov-2023 | 16:54 AEDT

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Determiner declaration and approval

I have reviewed this REF and determine that the Proposal will not have a significant impact on the environment and can proceed subject to the controls outlined in this REF addendum

Name: Andrew Francis

Title: Director Infrastructure

Date: 08-Nov-2023 | 09:16 AEDT

DocuSigned by: Andrew Francis 56056065B26A4FE...

6 REFERENCES

DAWE 2022 Species Profile and Threats Databases

DAWE 2022 Protected Matters Search Tool for MNES listed under the EPBC Act. http://www.environment.gov.au/epbc/protected-matters-search-tool

DPI 2022 Priority Weeds of the Central Tablelands NSW WeedWise

DPI 2022 Weeds of National Significance NSW WeedWise

DPE 2021 NSW Government Vegetation Regulatory Map https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap

DPE 2022 Bionet Wildlife Atlas Threatened species records, which holds data from a number of custodians.

Eco Logical Australia, 2021. Lachlan River Pumping Station Augmentation, pre-treatment plant and solar system – Review of Environmental Factors. Prepared for Parkes Shire Council.

Eco Logical Australia, 2022 Parkes Town Water Security Program Project 1 Aboriginal Cultural Heritage Assessment. Prepared for Parkes Shire Council

OzArk, 2022. Proposed Lachlan River Pre-treatment Plan - Aboriginal Due Diligence. Prepared for Parkes Shire Council.

Sixmaps tool, https://maps.six.nsw.gov.au/

The Environmental Factor, 2022. Lachlan River Pumping Station Augmentation, pre-treatment plant and solar system Addendum #1. Prepared for Parkes Shire Council.

The Environmental Factor, 2023. Lachlan River Precinct Access Road Upgrade Review of Environmental Factors

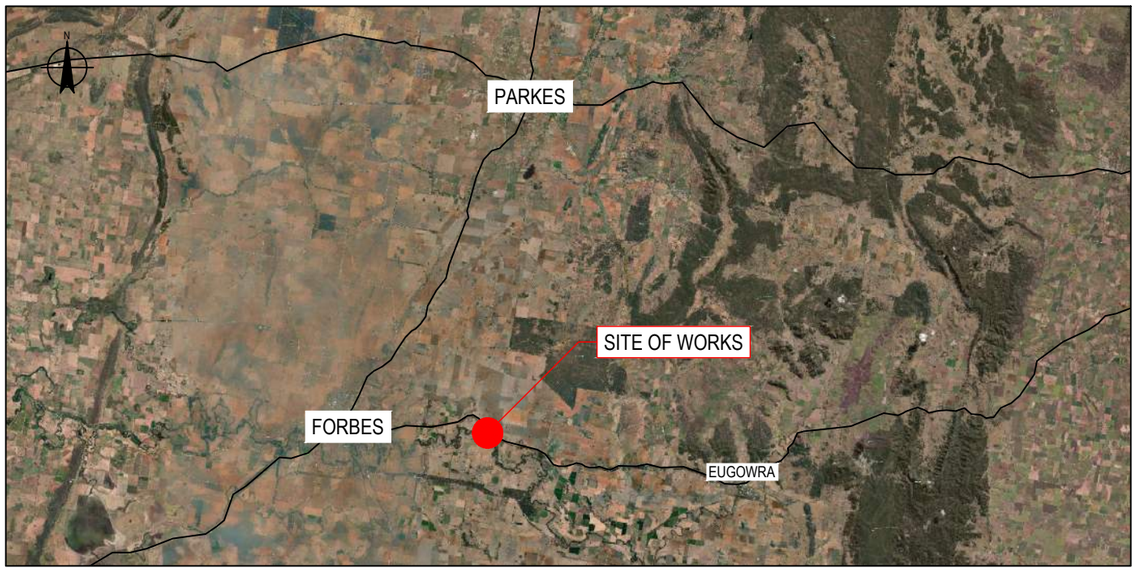
The Environmental Factor, 2023. Lachlan River Precinct Construction Access Review of Environmental Factors

7 APPENDICES

Appendix	Item
Appendix A	Updated Design Drawings
Appendix B	Geotechnical Investigation
Appendix C	Aboriginal Due Diligence Report
Appendix D	Flood Risk and Impact Assessment

Appendix A Updated Design Drawings

PARKES SHIRE COUNCIL
PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA
12598051



LOCALITY PLAN

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12598051-GHD-PWTP-LRPT-DRG-CI-00101	DETAIL PLAN - SHEET 1 OF 1
12598051-GHD-PWTP-LRPT-DRG-CI-00151	SETOUT PLAN - SHEET 1 OF 1
12598051-GHD-PWTP-LRPT-DRG-CI-00201	DETAIL SECTIONS - SHEET 1 OF 2
12598051-GHD-PWTP-LRPT-DRG-CI-00202	DETAIL SECTIONS - SHEET 2 OF 2
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12598051-GHD-PWTP-LRPT-DRG-CI-00502	LONGITUDINAL SECTIONS - MC11 - SHEET 2 OF 3
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12598051-GHD-PWTP-LRPT-DRG-CI-00802	TURN PLAN - SHEET 2 OF 2
12598051-GHD-PWTP-LRPT-DRG-CI-00901	SEDIMENT AND EROSION CONTROL NOTES - SHEET 1 OF 1
12598051-GHD-PWTP-LRPT-DRG-CI-00902	SEDIMENT AND EROSION CONTROL PLAN - SHEET 1 OF 1
12598051-GHD-PWTP-LRPT-DRG-CI-00903	SEDIMENT AND EROSION CONTROL DETAILS - SHEET 1 OF 1

Rev	Description	Checked	Approved	Date
B	DETAIL DEISIGN ISSUE	BF	NM	05.05.23
A	UNDER REVISION - FOR GHD INTERNAL USE ONLY			

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
DRAWING SET INDEX
COVER SHEET

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00001

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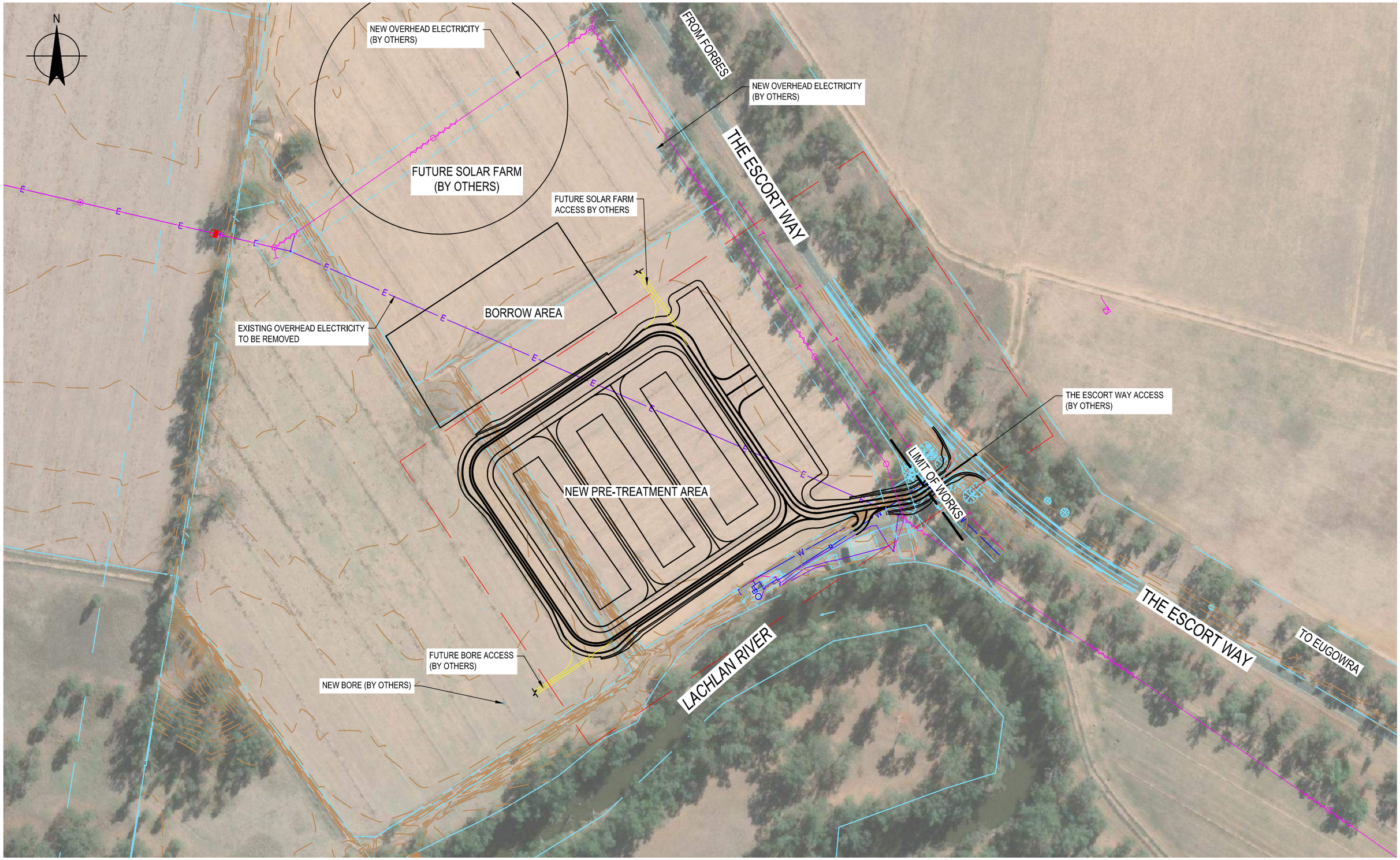

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A	UNDER REVISION - FOR GHD INTERNAL USE ONLY			

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

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PRE-TREATMENT AREA
OVERVIEW PLAN
SHEET 1 OF 1

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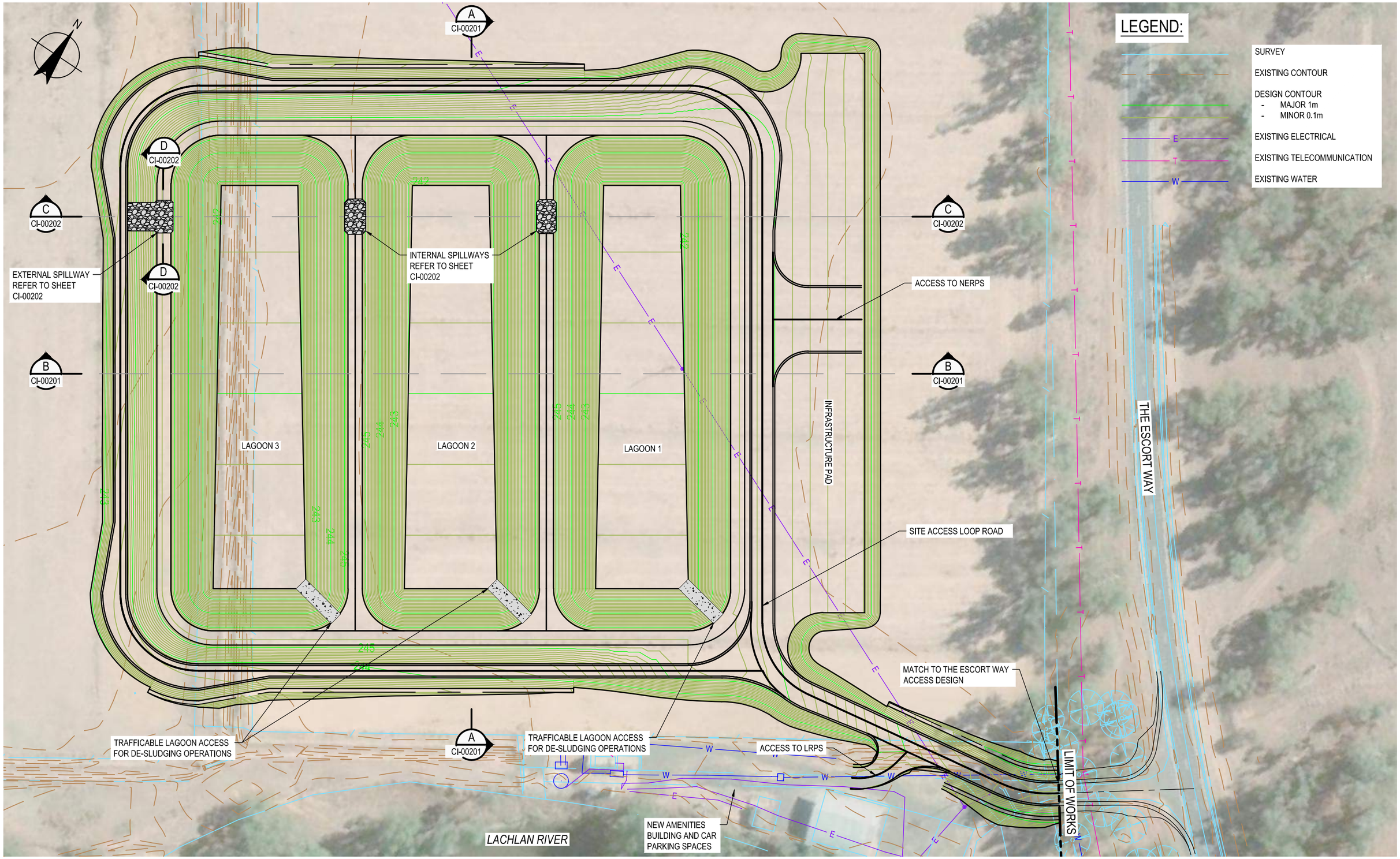

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A	CONCEPT DESIGN ISSUE	BF	NM	07.02.23

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

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DETAIL PLAN
SHEET 1 OF 1

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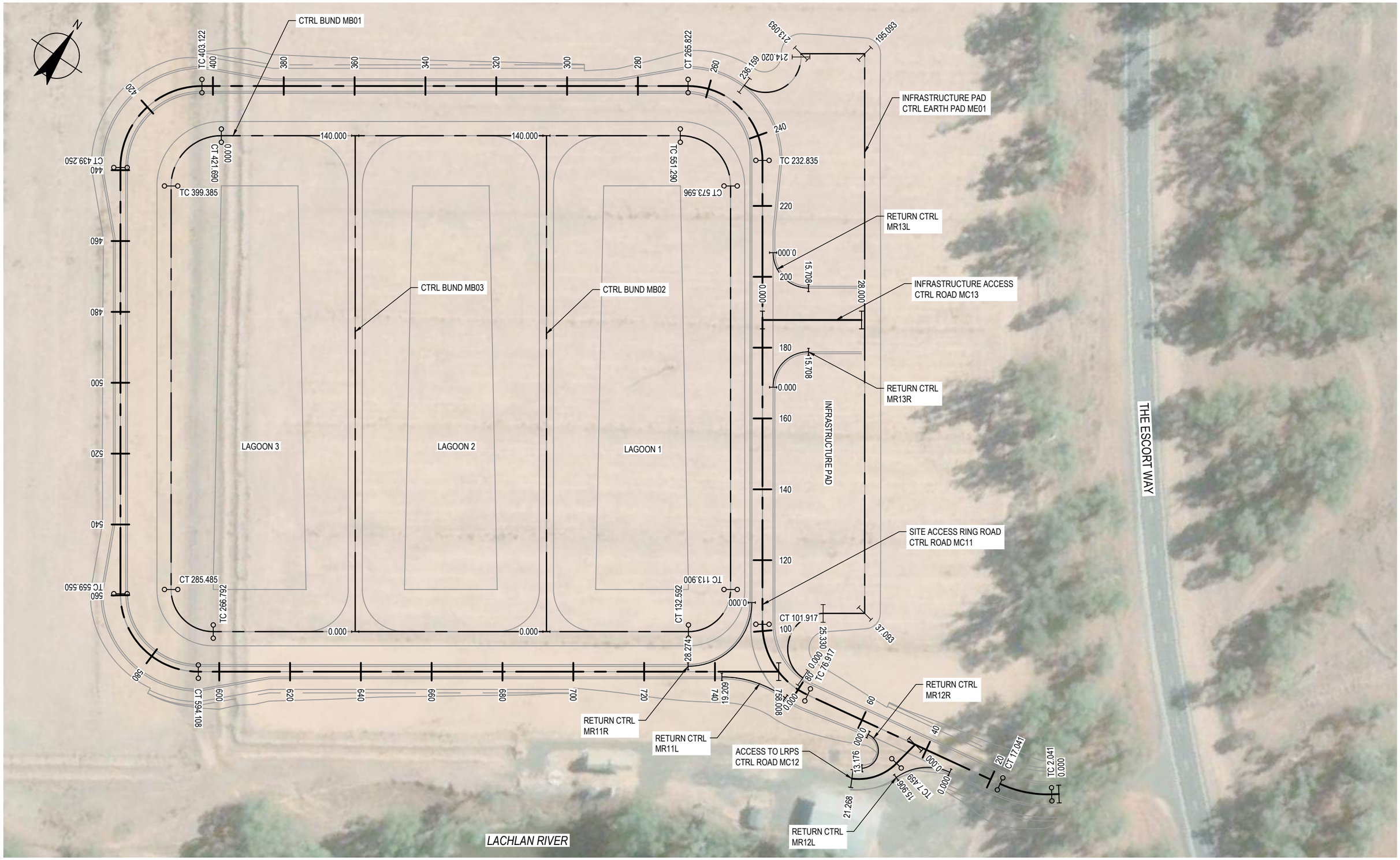

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LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
SETOUT PLAN
SHEET 1 OF 1

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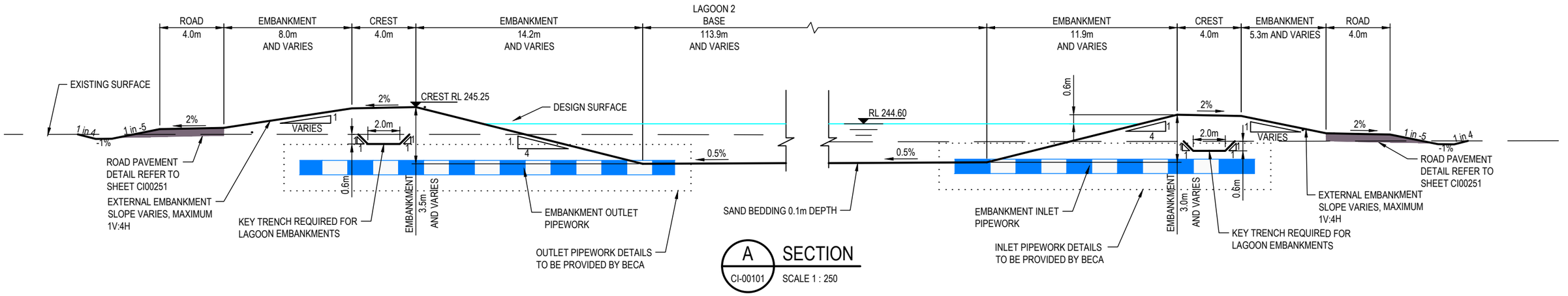

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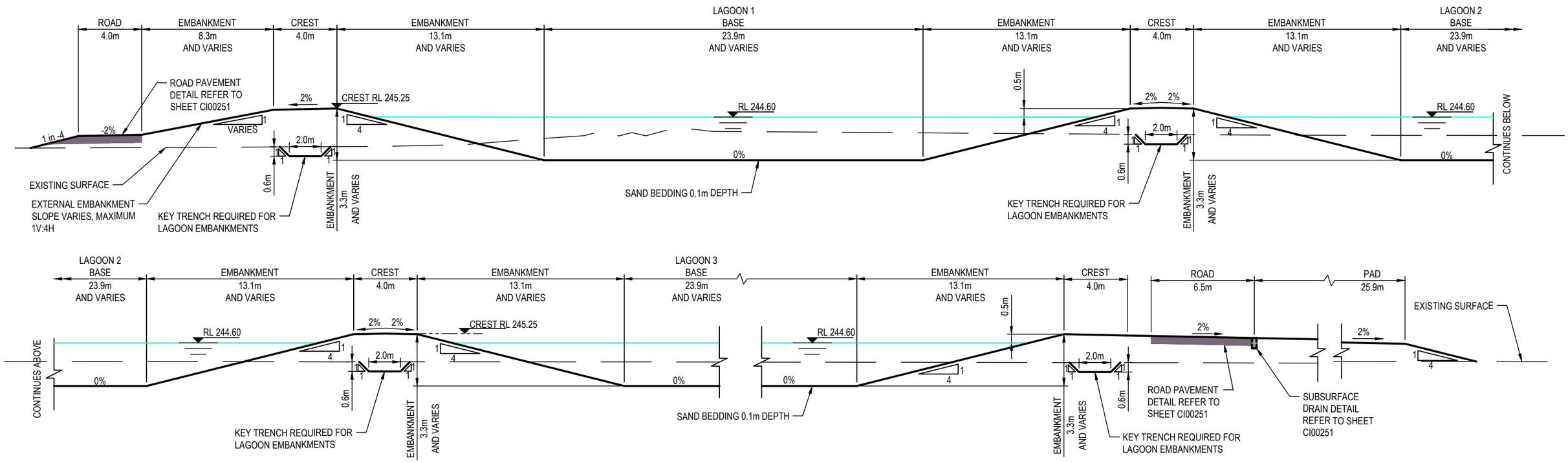

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A	CONCEPT DESIGN ISSUE	BF		NM	07.02.23

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

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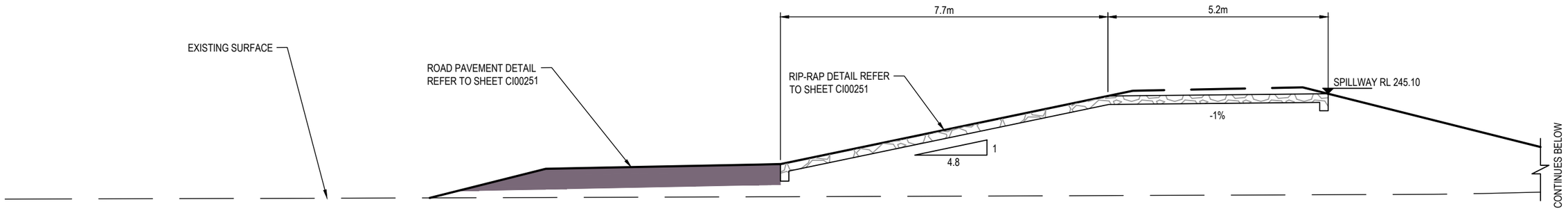
Project No. 12598051

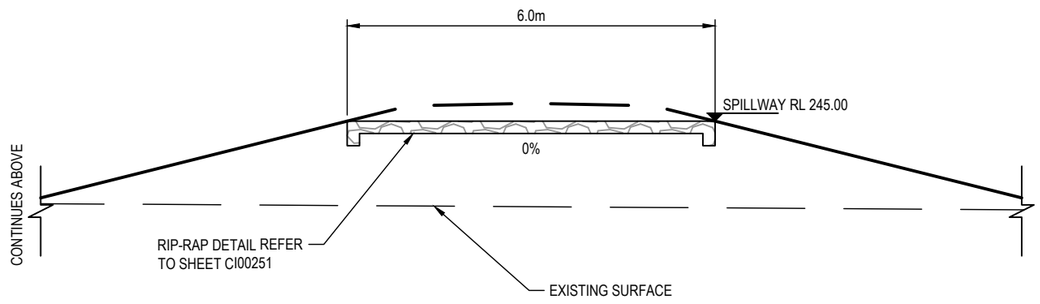
Client PARKES SHIRE COUNCIL
Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA
Status DETAIL DESIGN Status Code S4

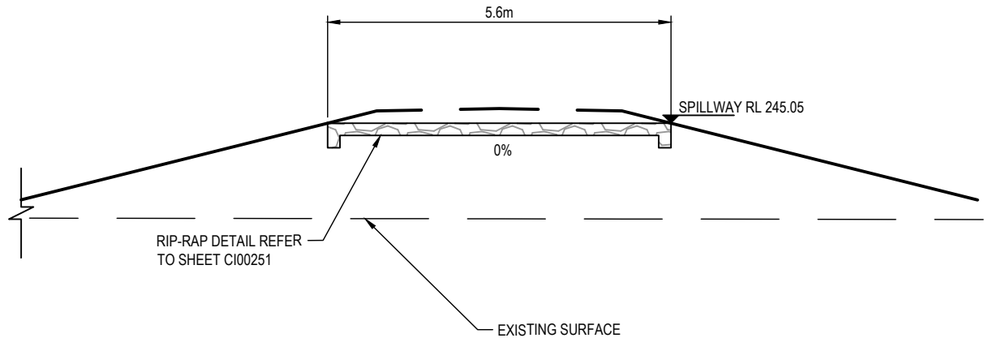
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
TYPICAL SECTIONS
SHEET 1 OF 2

Size A3
Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00201
Rev C

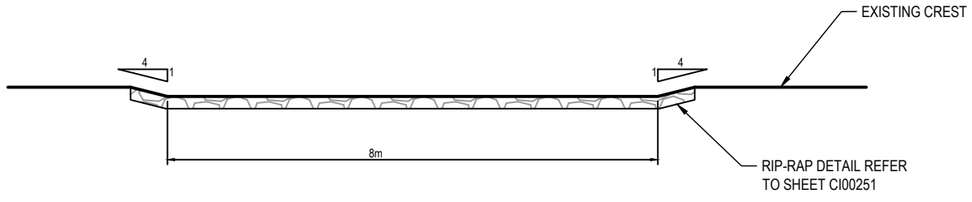
Plot Date: 8/05/2023 9:12:28 AM Plotted by: Billy Flinn
File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00200.dwg







C SECTION
CI-00101 SCALE 1 : 100



D SECTION
CI-00101 SCALE 1 : 100

Rev	Description	Checked	Approved	Date
B	DETAIL DESIGN ISSUE	BF	NM	05.05.23
A	UNDER REVISION - FOR GHD INTERNAL USE ONLY			

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

0 1 2 3m
SCALE 1:100 AT ORIGINAL SIZE

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

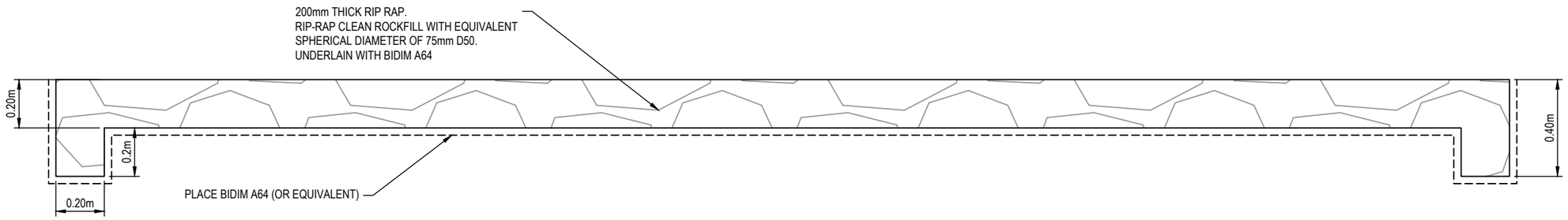
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
TYPICAL SECTIONS
SHEET 2 OF 2

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00202

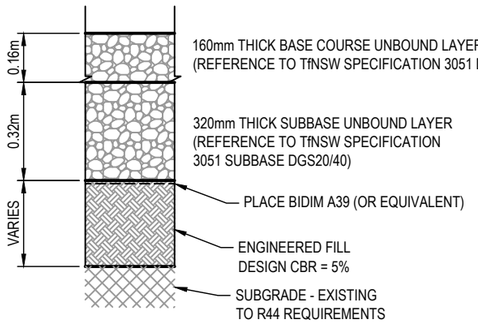
Rev B

Plot Date: 5/05/2023 5:45:39 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00200.dwg



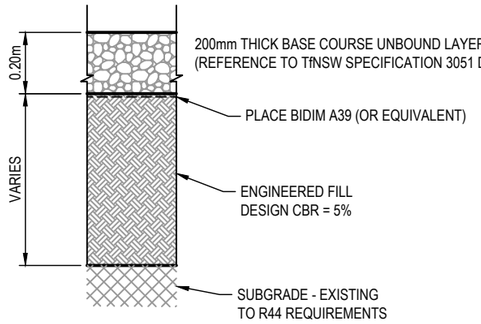
TYPICAL RIP-RAP TREATMENT

SCALE 1:20



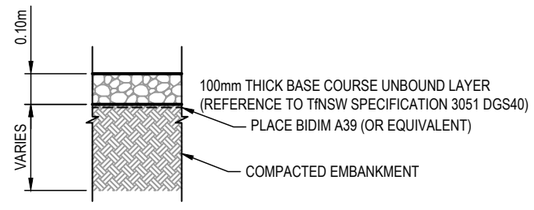
PAVEMENT TYPE 1
ACCESS ROAD

SCALE 1:20



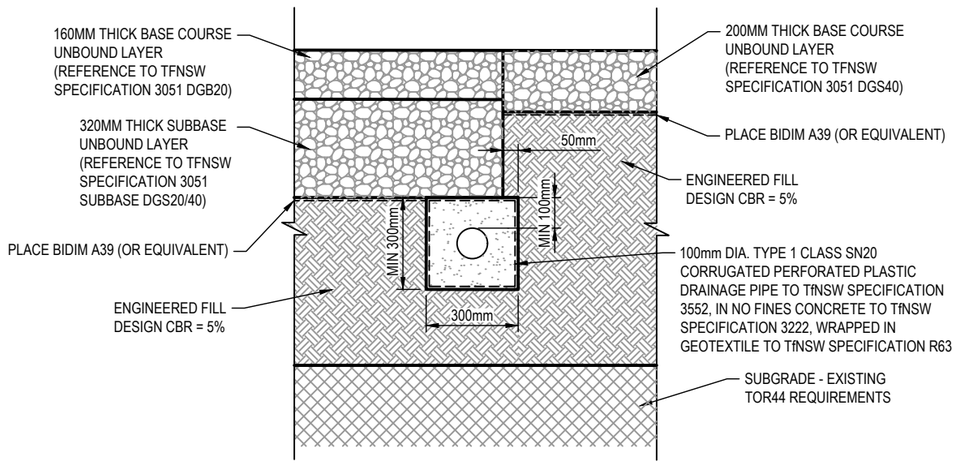
PAVEMENT TYPE 2
INFRASTRUCTURE PAD

SCALE 1:20



PAVEMENT TYPE 3
LAGOON ACCESS RAMP

SCALE 1:20



INTERFACE DETAIL
PAVEMENT TYPE 1 TO TYPE 2

SCALE 1:20

Rev	Description	Checked	Approved	Date
B	DETAIL DEISIGN ISSUE	BF	NM	05.05.23
A	UNDER REVISION - FOR GHD INTERNAL USE ONLY			

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

0 0.2 0.4 0.6m
SCALE 1:20 AT ORIGINAL SIZE

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
PAVEMENT DETAILS
SHEET 1 OF 1

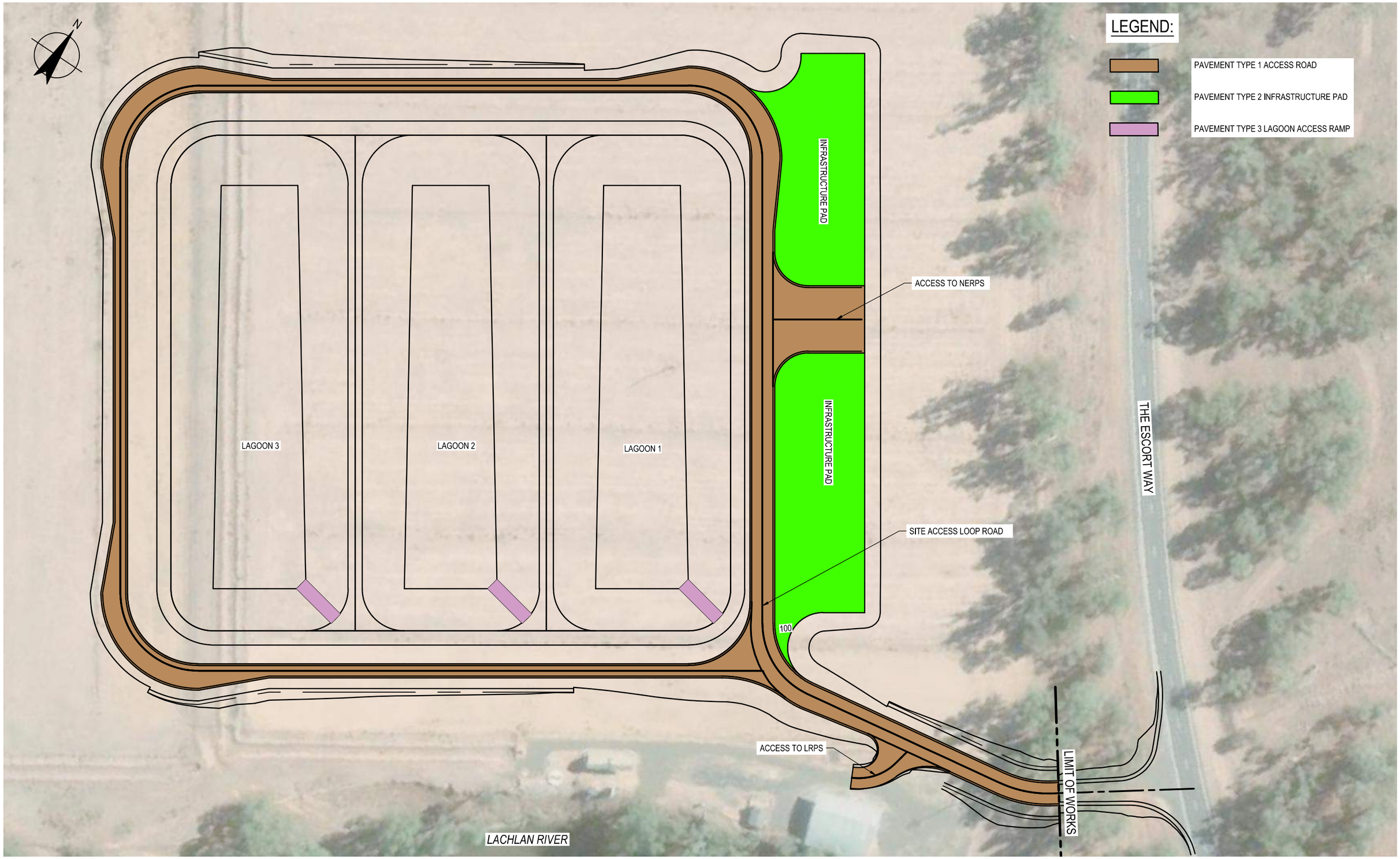
Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00251

Size A3

Rev B

Plot Date: 8/05/2023 3:12:28 PM Plotted by: Billy Flinn

File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00250.dwg



Rev	Description	Checked	Approved	Date
B	DETAIL DEISIGN ISSUE	BF	NM	05.05.23
A	UNDER REVISION - FOR GHD INTERNAL USE ONLY			

Author N.VANDERDONK Drafting Check L.SMITH
Designer B.FLINN Design Check A.SNEDDON

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

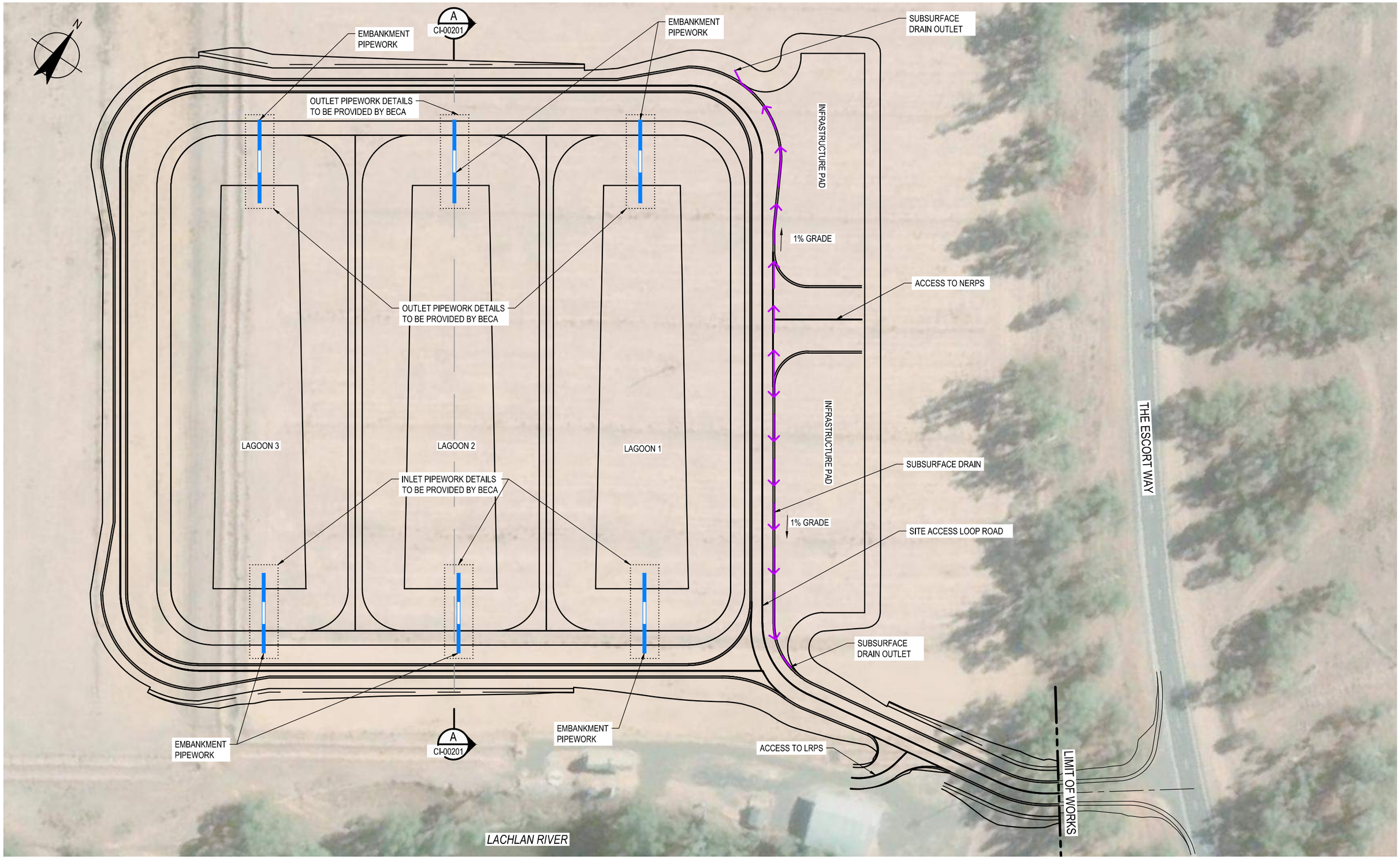
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
PAVEMENT PLAN
SHEET 1 OF 1

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00301

Rev B

Plot Date: 8/05/2023 9:41:25 AM Plotted by: Billy Flinn File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00300.dwg



Rev	Description	Checked	Approved	Date
B	DETAIL DESIGN ISSUE	BF	NM	05.05.23
A	UNDER REVISION - FOR GHD INTERNAL USE ONLY			

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

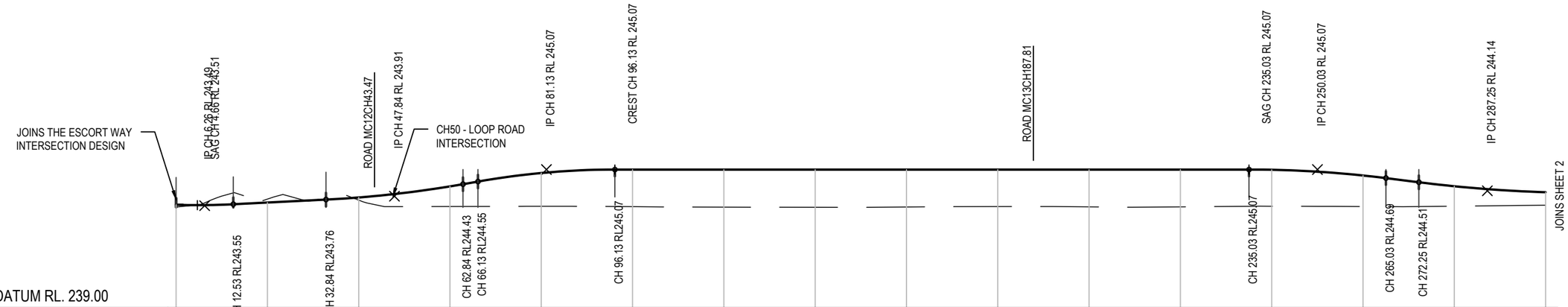
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
PIPEWORK PLAN
SHEET 1 OF 1

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00401

Size A3

Rev B

Plot Date: 8/05/2023 9:27:38 AM Plotted by: Billy Flinn File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00400.dwg



LEVEL DIFFERENCE CUT - / FILL +	0.10	-0.15	0.12	0.88	1.46	1.62	1.64	1.65	1.64	1.62	1.63	1.63	1.59	1.36	0.87	0.57
DESIGN SURFACE LEVEL	243.526	243.627	243.848	244.334	244.918	245.070	245.070	245.070	245.070	245.070	245.070	245.070	245.060	244.810	244.341	244.077
EXISTING SURFACE LEVEL	243.43	243.78	243.73	243.45	243.46	243.45	243.43	243.42	243.43	243.45	243.44	243.44	243.47	243.45	243.47	243.51
CHAINAGE	0.000	20.000	40.000	60.000	80.000	100.000	120.000	140.000	160.000	180.000	200.000	220.000	240.000	260.000	280.000	300.000

LONGITUDINAL SECTION - ROAD MC11

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:200

Rev	Description	Checked	Approved	Date
C	DETAIL DESIGN ISSUE	BF	NM	05.05.23
B	UNDER REVISION - FOR GHD INTERNAL USE ONLY			
A	CONCEPT DESIGN ISSUE	BF	NM	07.02.23

Author N.VANDERDONK **Drafting Check** I.SMITH
Designer B.FLINN **Design Check** A.SNEDDON

VERTICAL SCALE 1:200
AT ORIGINAL SIZE
0 2 4 6m
HORIZONTAL SCALE 1:1000
AT ORIGINAL SIZE
0 10 20 30m

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

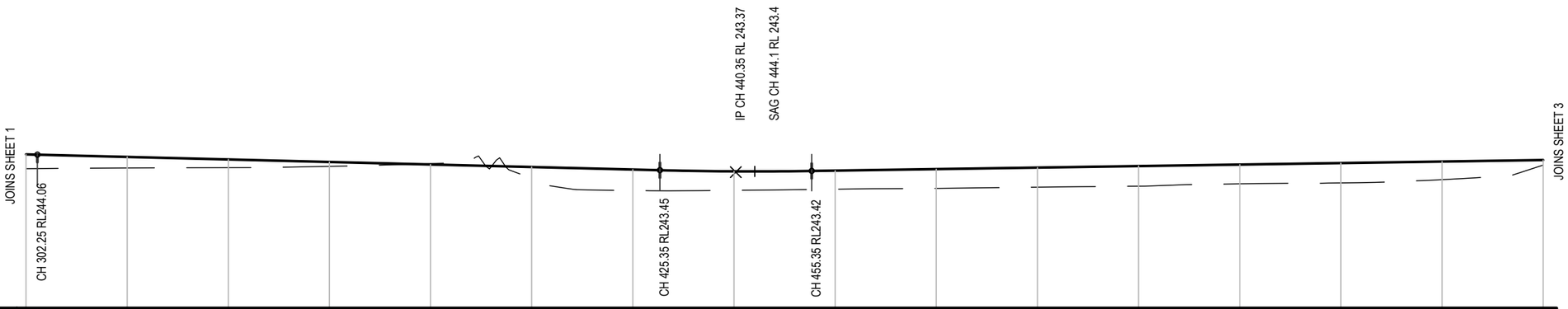
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
LONGITUDINAL SECTIONS
SHEET 1 OF 3

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00501

Rev C

Plot Date: 5/05/2023 5:45:45 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00500.dwg



DATUM RL. 238.00

VERTICAL ALIGNMENT	K=15 L=30m	L=123.11m G=-0.5%						K=37.5 L=30m	L=230.97m G=0.3%								
HORIZONTAL ALIGNMENT	L=137.30m					L=36.13m R=-23.00m		L=120.30m						L=34.56m R=-22.00m		L=163.90m	
LEVEL DIFFERENCE CUT - / FILL +	0.57	0.44	0.33	0.17	-0.03	0.46	0.83	0.75	0.73	0.76	0.77	0.79	0.76	0.79	0.72	0.20	
DESIGN SURFACE LEVEL	244.077	243.976	243.876	243.776	243.676	243.576	243.476	243.404	243.433	243.493	243.553	243.613	243.673	243.733	243.793	243.853	
EXISTING SURFACE LEVEL	243.51	243.54	243.55	243.60	243.71	243.12	242.64	242.66	242.70	242.73	242.78	242.82	242.91	242.95	243.08	243.65	
CHAINAGE	300.000	320.000	340.000	360.000	380.000	400.000	420.000	440.000	460.000	480.000	500.000	520.000	540.000	560.000	580.000	600.000	

LONGITUDINAL SECTION - ROAD MC11

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:200

Rev	Description	Checked	Approved	Date
C	DETAIL DESIGN ISSUE	BF	NM	05.05.23
B	UNDER REVISION - FOR GHD INTERNAL USE ONLY			
A	CONCEPT DESIGN ISSUE	BF	NM	07.02.23

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

VERTICAL SCALE 1:200 AT ORIGINAL SIZE
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE
0 2 4 6m
0 10 20 30m

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

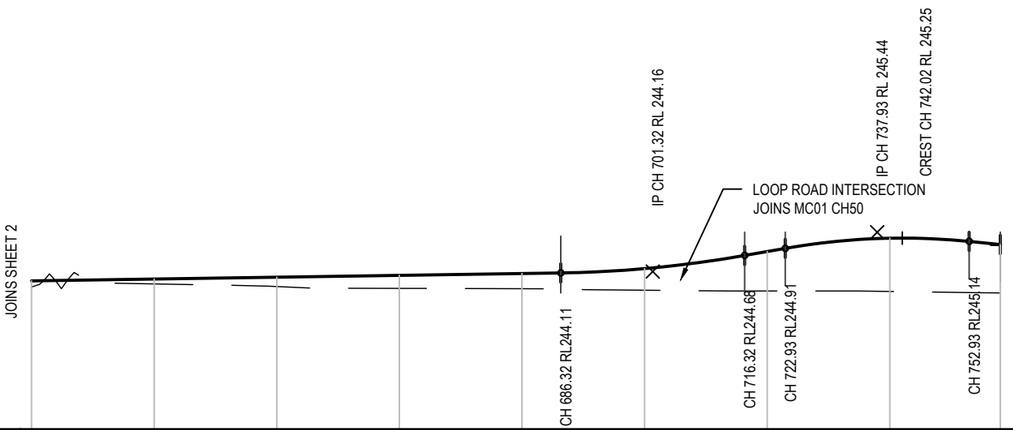
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
LONGITUDINAL SECTIONS
SHEET 2 OF 3

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00502

Rev C

Plot Date: 5/05/2023 5:45:46 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00500.dwg



DATUM RL. 239.00

VERTICAL ALIGNMENT	L=230.97m G=0.3%				K=9.38 L=30m	L=6.61m G=3.5%	K=5.45 L=30m	L=5.07m G=-2%
HORIZONTAL ALIGNMENT	L=163.90m							
LEVEL DIFFERENCE CUT - / FILL +	0.20	0.16	0.31	0.42	0.50	0.70	1.29	1.74	1.58
DESIGN SURFACE LEVEL	243.853	243.913	243.973	244.033	244.093	244.253	244.811	245.244	245.037
EXISTING SURFACE LEVEL	243.65	243.76	243.67	243.61	243.60	243.55	243.52	243.51	243.46
CHAINAGE	600.000	620.000	640.000	660.000	680.000	700.000	720.000	740.000	758.008

LONGITUDINAL SECTION - ROAD MC11

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:200

Rev	Description	Checked	Approved	Date
C	DETAIL DESIGN ISSUE	BF	NM	05.05.23
B	UNDER REVISION - FOR GHD INTERNAL USE ONLY			
A	CONCEPT DESIGN ISSUE	BF	NM	07.02.23

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

VERTICAL SCALE 1:200 AT ORIGINAL SIZE
HORIZONTAL SCALE 1:1000 AT ORIGINAL SIZE
0 2 4 6m
0 10 20 30m

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

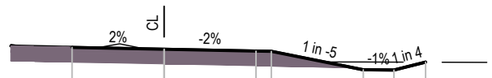
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
LONGITUDINAL SECTIONS
SHEET 3 OF 3

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00503

Rev C

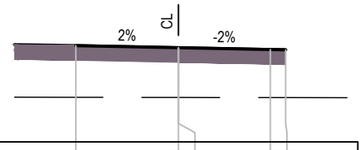
Plot Date: 5/05/2023 5:45:46 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00500.dwg



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.908		243.848	243.848	243.788	243.778	243.178	243.168	243.426		
LEVEL DIFFERENCE CUT - / FILL +	0.16		0.12	0.12	0.35	0.34	-0.25	-0.26	0.00		
EXISTING SURFACE LEVEL	243.75		243.73	243.73	243.44	243.44	243.43	243.43	243.43		
OFFSET FROM CONTROL LINE	-3.000		0.000	0.000	3.000	3.500	6.500	7.500	8.531		

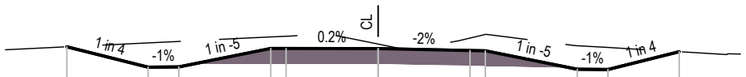
CH 40



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	245.137		245.070	245.070	245.010	245.000					
LEVEL DIFFERENCE CUT - / FILL +	1.68		1.62	1.62	1.57	1.56					
EXISTING SURFACE LEVEL	243.45		243.45	243.45	243.44	243.44					
OFFSET FROM CONTROL LINE	-3.346		0.000	0.000	3.000	3.500					

CH 100



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.687	243.023	243.033	243.633	243.632	243.627	243.627	243.567	243.557	242.957	242.947	243.527
LEVEL DIFFERENCE CUT - / FILL +	0.00	-0.79	-0.83	-0.37	-0.40	-0.15	-0.15	-0.41	-0.53	-0.77	-0.72	0.00
EXISTING SURFACE LEVEL	243.69	243.82	243.86	244.01	244.03	243.78	243.78	243.97	244.09	243.72	243.66	243.53
OFFSET FROM CONTROL LINE	-10.155	-7.500	-6.500	-3.500	-3.000	0.000	0.000	3.000	3.500	6.500	7.500	9.822

CH 20

DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.503	245.008	244.998	244.918	244.918	244.858	244.848	243.441			
LEVEL DIFFERENCE CUT - / FILL +	0.00	1.53	1.52	1.46	1.46	1.40	1.39	0.00			
EXISTING SURFACE LEVEL	243.50	243.48	243.48	243.46	243.46	243.46	243.45	243.44			
OFFSET FROM CONTROL LINE	-10.519	-4.500	-4.000	0.000	0.000	3.000	3.500	9.128			

CH 80

DATUM R.L. 241.00

DESIGN SURFACE LEVEL	243.028	242.811	242.821	243.421	243.436	243.526	243.436	243.421	242.821	242.811	243.207
LEVEL DIFFERENCE CUT - / FILL +	0.00	-0.23	-0.22	0.28	0.28	0.10	0.11	0.14	-0.36	-0.38	0.00
EXISTING SURFACE LEVEL	243.03	243.04	243.04	243.14	243.16	243.43	243.32	243.28	243.18	243.19	243.21
OFFSET FROM CONTROL LINE	-8.367	-7.500	-6.500	-3.500	-3.000	0.000	3.000	3.500	6.500	7.500	9.081

CH 0

DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.539	244.407	244.397	244.334	244.334	244.274	244.264	243.438			
LEVEL DIFFERENCE CUT - / FILL +	0.00	0.95	0.94	0.88	0.88	0.83	0.82	0.00			
EXISTING SURFACE LEVEL	243.54	243.46	243.46	243.45	243.45	243.45	243.45	243.44			
OFFSET FROM CONTROL LINE	-7.124	-3.654	-3.154	0.000	0.000	3.000	3.500	6.804			

CH 60

Rev	Description	Checked	Approved	Date
C	DETAIL DESIGN ISSUE	BF	NM	05.05.23
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A	CONCEPT DESIGN ISSUE	BF	NM	07.02.23

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

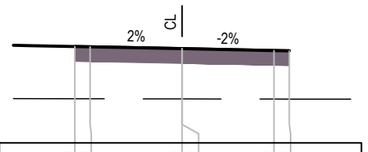
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
ROAD CROSS SECTIONS
SHEET 1 OF 5

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00601

Rev C

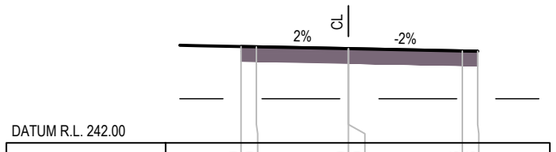
Plot Date: 5/05/2023 5:45:55 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00600.dwg



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	245.140	245.130	245.070	245.070	245.010	245.000		
LEVEL DIFFERENCE CUT - / FILL +	1.70	1.69	1.64	1.64	1.58	1.57		
EXISTING SURFACE LEVEL	243.44	243.44	243.43	243.43	243.43	243.43		
OFFSET FROM CONTROL LINE	-3.500	-3.000	0.000	0.000	3.000	3.500		

CH 160



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	245.140	245.130	245.070	245.070	244.996	244.986		
LEVEL DIFFERENCE CUT - / FILL +	1.70	1.69	1.63	1.63	1.56	1.55		
EXISTING SURFACE LEVEL	243.44	243.44	243.44	243.44	243.44	243.44		
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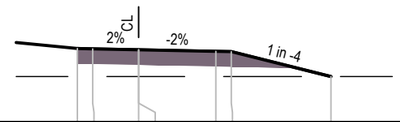
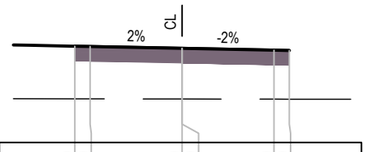
CH 220



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	244.381	244.371	244.341	244.341	244.290	244.280	243.467	
LEVEL DIFFERENCE CUT - / FILL +	0.91	0.90	0.87	0.87	0.82	0.81	0.00	
EXISTING SURFACE LEVEL	243.47	243.47	243.47	243.47	243.47	243.47	243.47	
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	2.519	3.019	6.273	

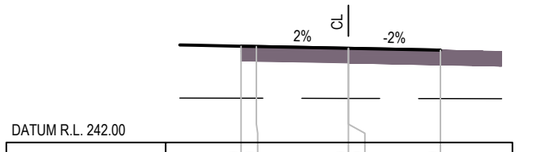
CH 280



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	245.140	245.130	245.070	245.070	245.010	245.000		
LEVEL DIFFERENCE CUT - / FILL +	1.72	1.71	1.65	1.65	1.60	1.59		
EXISTING SURFACE LEVEL	243.42	243.42	243.42	243.42	243.41	243.41		
OFFSET FROM CONTROL LINE	-3.500	-3.000	0.000	0.000	3.000	3.500		

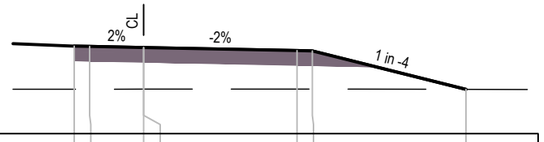
CH 140



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	245.140	245.130	245.070	245.070	245.010			
LEVEL DIFFERENCE CUT - / FILL +	1.69	1.69	1.63	1.63	1.58			
EXISTING SURFACE LEVEL	243.45	243.44	243.44	243.44	243.43			
OFFSET FROM CONTROL LINE	-3.500	-3.000	0.000	0.000	3.000			

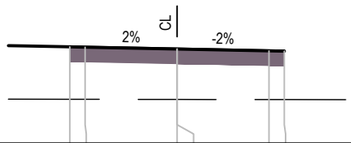
CH 200



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	244.855	244.845	244.810	244.810	244.710	244.700	243.446	
LEVEL DIFFERENCE CUT - / FILL +	1.40	1.39	1.36	1.36	1.26	1.25	0.00	
EXISTING SURFACE LEVEL	243.45	243.45	243.45	243.45	243.45	243.45	243.45	
OFFSET FROM CONTROL LINE	-2.265	-1.765	0.000	0.000	5.000	5.500	10.515	

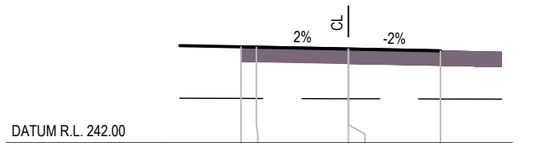
CH 260



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	245.140	245.130	245.070	245.070	245.010	245.000		
LEVEL DIFFERENCE CUT - / FILL +	1.71	1.70	1.64	1.64	1.59	1.58		
EXISTING SURFACE LEVEL	243.43	243.43	243.43	243.43	243.42	243.42		
OFFSET FROM CONTROL LINE	-3.500	-3.000	0.000	0.000	3.000	3.500		

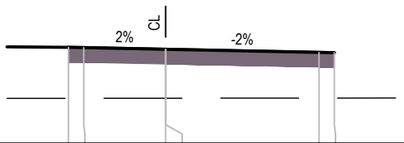
CH 120



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	245.140	245.130	245.070	245.070	245.010			
LEVEL DIFFERENCE CUT - / FILL +	1.68	1.67	1.62	1.62	1.57			
EXISTING SURFACE LEVEL	243.46	243.46	243.45	243.45	243.44			
OFFSET FROM CONTROL LINE	-3.500	-3.000	0.000	0.000	3.000			

CH 180



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	245.123	245.113	245.060	245.060	244.960	244.950		
LEVEL DIFFERENCE CUT - / FILL +	1.66	1.65	1.59	1.59	1.49	1.48		
EXISTING SURFACE LEVEL	243.46	243.46	243.47	243.47	243.47	243.47		
OFFSET FROM CONTROL LINE	-3.174	-2.674	0.000	0.000	5.000	5.500		

CH 240

Rev	Description	Checked	Approved	Date
C	DETAIL DESIGN ISSUE	BF	NM	05.05.23
B	UNDER REVISION - FOR GHD INTERNAL USE ONLY			
A	CONCEPT DESIGN ISSUE	BF	NM	07.02.23

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

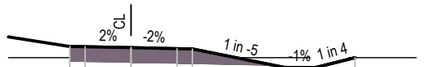
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
ROAD CROSS SECTIONS
SHEET 2 OF 5

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00602

Rev C

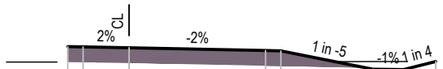
Plot Date: 5/05/2023 5:45:56 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00600.dwg



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.916	243.906	243.876	243.876	243.846	243.836	243.236	243.226	243.552
LEVEL DIFFERENCE CUT - / FILL +	0.37	0.36	0.33	0.33	0.29	0.28	-0.32	-0.33	0.00
EXISTING SURFACE LEVEL	243.55	243.55	243.55	243.55	243.55	243.55	243.55	243.55	243.55
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.500	2.000	5.000	6.000	7.305

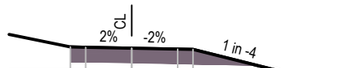
CH 340



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.616	243.606	243.576	243.576	243.487	243.477	242.877	242.867	243.129
LEVEL DIFFERENCE CUT - / FILL +	0.50	0.49	0.46	0.46	0.36	0.35	-0.25	-0.26	0.00
EXISTING SURFACE LEVEL	243.11	243.11	243.12	243.12	243.12	243.12	243.13	243.13	243.13
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	4.454	4.954	7.954	8.954	10.001

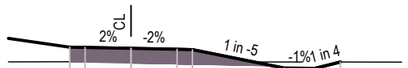
CH 400



DATUM R.L. 241.00

DESIGN SURFACE LEVEL	243.473	243.463	243.433	243.433	243.403	243.393	242.682
LEVEL DIFFERENCE CUT - / FILL +	0.77	0.76	0.73	0.73	0.71	0.70	0.00
EXISTING SURFACE LEVEL	242.71	242.70	242.70	242.70	242.69	242.69	242.68
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.500	2.000	4.842

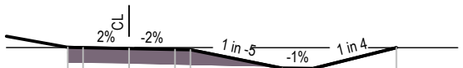
CH 460



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	244.016	244.006	243.976	243.976	243.946	243.936	243.336	243.326	243.532
LEVEL DIFFERENCE CUT - / FILL +	0.48	0.47	0.44	0.44	0.41	0.40	-0.20	-0.21	0.00
EXISTING SURFACE LEVEL	243.54	243.54	243.54	243.54	243.54	243.54	243.53	243.53	243.53
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.500	2.000	5.000	6.000	6.827

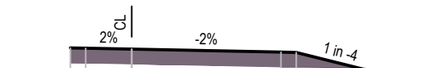
CH 320



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.716	243.706	243.676	243.676	243.646	243.636	243.036	243.026	243.706
LEVEL DIFFERENCE CUT - / FILL +	0.01	-0.00	-0.03	-0.03	-0.06	-0.07	-0.67	-0.68	0.00
EXISTING SURFACE LEVEL	243.71	243.71	243.71	243.71	243.71	243.71	243.71	243.71	243.71
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.500	2.000	5.000	6.000	8.720

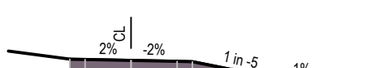
CH 380



DATUM R.L. 241.00

DESIGN SURFACE LEVEL	243.444	243.434	243.404	243.404	243.307	243.297	242.621
LEVEL DIFFERENCE CUT - / FILL +	0.78	0.77	0.75	0.75	0.67	0.66	0.00
EXISTING SURFACE LEVEL	242.66	242.66	242.66	242.66	242.63	242.63	242.62
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	4.869	5.369	8.074

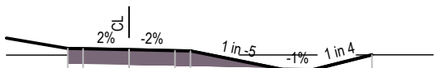
CH 440



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	244.117	244.107	244.077	244.077	244.047	244.037	243.437	243.427	243.504
LEVEL DIFFERENCE CUT - / FILL +	0.61	0.60	0.57	0.57	0.54	0.53	-0.07	-0.08	0.00
EXISTING SURFACE LEVEL	243.51	243.51	243.51	243.51	243.51	243.51	243.51	243.50	243.50
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.500	2.000	5.000	6.000	6.307

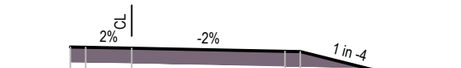
CH 300



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.816	243.806	243.776	243.776	243.746	243.736	243.136	243.126	243.606
LEVEL DIFFERENCE CUT - / FILL +	0.22	0.20	0.17	0.17	0.14	0.13	-0.47	-0.48	0.00
EXISTING SURFACE LEVEL	243.60	243.60	243.60	243.60	243.60	243.60	243.60	243.61	243.61
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.500	2.000	5.000	6.000	7.922

CH 360



DATUM R.L. 241.00

DESIGN SURFACE LEVEL	243.516	243.506	243.476	243.376	243.366	242.607
LEVEL DIFFERENCE CUT - / FILL +	0.86	0.85	0.83	0.75	0.75	0.00
EXISTING SURFACE LEVEL	242.65	242.65	242.64	242.62	242.62	242.61
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	5.000	5.500	8.537

CH 420

Rev	Description	Checked	Approved	Date
C	DETAIL DESIGN ISSUE	BF	NM	05.05.23
B	UNDER REVISION - FOR GHD INTERNAL USE ONLY			
A	CONCEPT DESIGN ISSUE	BF	NM	07.02.23

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

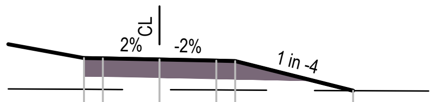
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
ROAD CROSS SECTIONS
SHEET 3 OF 5

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00603

Rev C

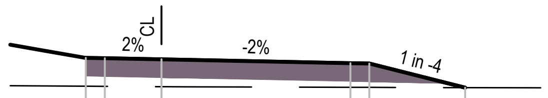
Plot Date: 5/05/2023 5:45:58 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00600.dwg



DATUM R.L. 241.00

DESIGN SURFACE LEVEL	243.653	243.643	243.613	243.613	243.583	243.573	242.793
LEVEL DIFFERENCE CUT - / FILL +	0.82	0.82	0.79	0.79	0.77	0.76	0.00
EXISTING SURFACE LEVEL	242.83	242.83	242.82	242.82	242.81	242.81	242.79
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.500	2.000	5.120

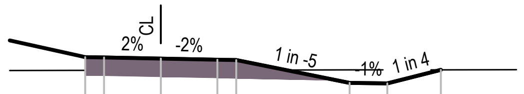
CH 520



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.833	243.823	243.793	243.793	243.693	243.683	243.049
LEVEL DIFFERENCE CUT - / FILL +	0.75	0.74	0.72	0.72	0.63	0.63	0.00
EXISTING SURFACE LEVEL	243.09	243.08	243.08	243.08	243.06	243.06	243.05
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	5.000	5.500	8.034

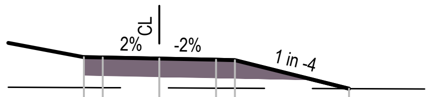
CH 580



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	244.013	244.003	243.973	243.973	243.943	243.933	243.333	243.323	243.678
LEVEL DIFFERENCE CUT - / FILL +	0.35	0.34	0.31	0.31	0.27	0.26	-0.34	-0.35	0.00
EXISTING SURFACE LEVEL	243.66	243.67	243.67	243.67	243.67	243.67	243.67	243.68	243.68
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.500	2.000	5.000	6.000	7.419

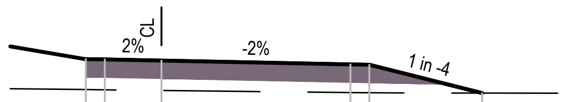
CH 640



DATUM R.L. 241.00

DESIGN SURFACE LEVEL	243.593	243.583	243.553	243.553	243.523	243.513	242.757
LEVEL DIFFERENCE CUT - / FILL +	0.81	0.80	0.77	0.77	0.75	0.74	0.00
EXISTING SURFACE LEVEL	242.79	242.79	242.78	242.78	242.77	242.77	242.76
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.500	2.000	5.024

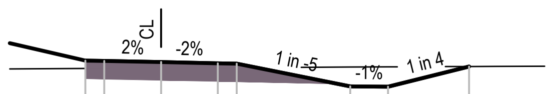
CH 500



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.773	243.763	243.733	243.633	243.623	242.878
LEVEL DIFFERENCE CUT - / FILL +	0.80	0.80	0.79	0.74	0.74	0.00
EXISTING SURFACE LEVEL	242.97	242.96	242.95	242.89	242.89	242.88
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	5.000	5.500	8.481

CH 560



DATUM R.L. 242.00

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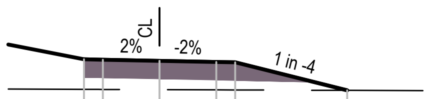
LEVEL DIFFERENCE CUT - / FILL +	0.21	0.20	0.16	0.16	0.12	0.11	-0.51	-0.52	0.00
EXISTING SURFACE LEVEL	243.74	243.75	243.76	243.76	243.76	243.77	243.78	243.79	243.80
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.500	2.000	5.000	6.000	8.141

CH 620



DATUM R.L. 241.00

DESIGN SURFACE LEVEL	243.533	243.523	243.493	243.493	243.463	243.453	242.712
LEVEL DIFFERENCE CUT - / FILL +	0.79	0.79	0.76	0.76	0.74	0.73	0.00
EXISTING SURFACE LEVEL	242.74	242.74	242.73	242.73	242.72	242.72	242.71
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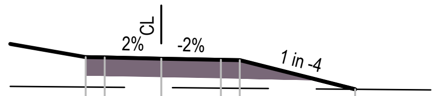
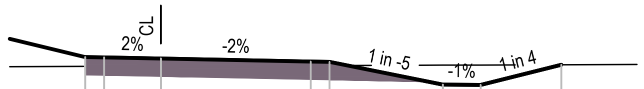
CH 480



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.713	243.703	243.673	243.673	243.641	243.631	242.867
LEVEL DIFFERENCE CUT - / FILL +	0.79	0.78	0.76	0.76	0.74	0.74	0.00
EXISTING SURFACE LEVEL	242.93	242.92	242.91	242.91	242.90	242.89	242.87
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	1.579	2.079	5.135

CH 540



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	243.893	243.883	243.853	243.853	243.774	243.764	243.164	243.154	243.688
LEVEL DIFFERENCE CUT - / FILL +	0.25	0.24	0.20	0.20	0.11	0.10	-0.51	-0.53	0.00
EXISTING SURFACE LEVEL	243.65	243.65	243.65	243.65	243.67	243.67	243.68	243.68	243.69
OFFSET FROM CONTROL LINE	-2.000	-1.500	0.000	0.000	3.969	4.469	7.469	8.469	10.606

CH 600

Rev	Description	Checked	Approved	Date
B	DETAIL DEISIGN ISSUE	BF	NM	05.05.23
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Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

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SCALE 1:200 AT ORIGINAL SIZE

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

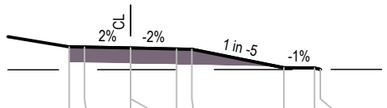
Status DETAIL DESIGN Status Code S4

Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
ROAD CROSS SECTIONS
SHEET 4 OF 5

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00604 Rev B

Plot Date: 5/05/2023 5:45:59 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00600.dwg



DATUM R.L. 242.00

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LEVEL DIFFERENCE CUT - / FILL +	0.75	0.74		0.70	0.70		0.67	0.66		0.06	0.05	0.00
EXISTING SURFACE LEVEL	243.55	243.55		243.55	243.55		243.55	243.55		243.55	243.55	243.55
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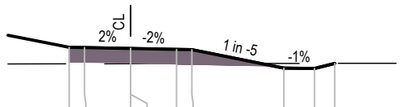
CH 700



DATUM R.L. 242.00

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LEVEL DIFFERENCE CUT - / FILL +	0.54	0.53		0.50	0.50		0.46	0.45		-0.15	-0.16	0.00
EXISTING SURFACE LEVEL	243.59	243.59		243.60	243.60		243.60	243.60		243.60	243.61	243.61
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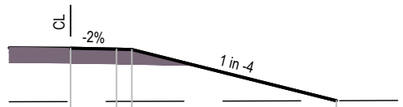
CH 680



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	245.244			245.214	245.204					243.536		
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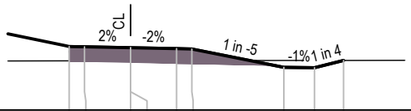
EXISTING SURFACE LEVEL	243.51			243.51	243.51					243.54		
OFFSET FROM CONTROL LINE	0.000			1.500	2.000					8.672		

CH 740



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	244.073	244.063		244.033	244.033		244.003	243.993		243.393	243.383	243.619
LEVEL DIFFERENCE CUT - / FILL +	0.47	0.46		0.42	0.42		0.39	0.38		-0.22	-0.24	0.00
EXISTING SURFACE LEVEL	243.61	243.61		243.61	243.61		243.61	243.61		243.62	243.62	243.62
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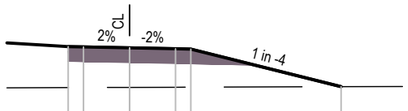
CH 660



DATUM R.L. 242.00

DESIGN SURFACE LEVEL	244.851	244.841		244.811	244.811		244.781	244.771		243.545		
LEVEL DIFFERENCE CUT - / FILL +	1.34	1.32		1.29	1.29		1.25	1.24		0.00		
EXISTING SURFACE LEVEL	243.52	243.52		243.52	243.52		243.53	243.53		243.54		
OFFSET FROM CONTROL LINE	-2.000	-1.500		0.000	0.000		1.500	2.000		6.903		

CH 720

Rev	Description	Checked	Approved	Date
B	DETAIL DEISIGN ISSUE	BF	NM	05.05.23
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Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
ROAD CROSS SECTIONS
SHEET 5 OF 5

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00605

Size A3

Rev B

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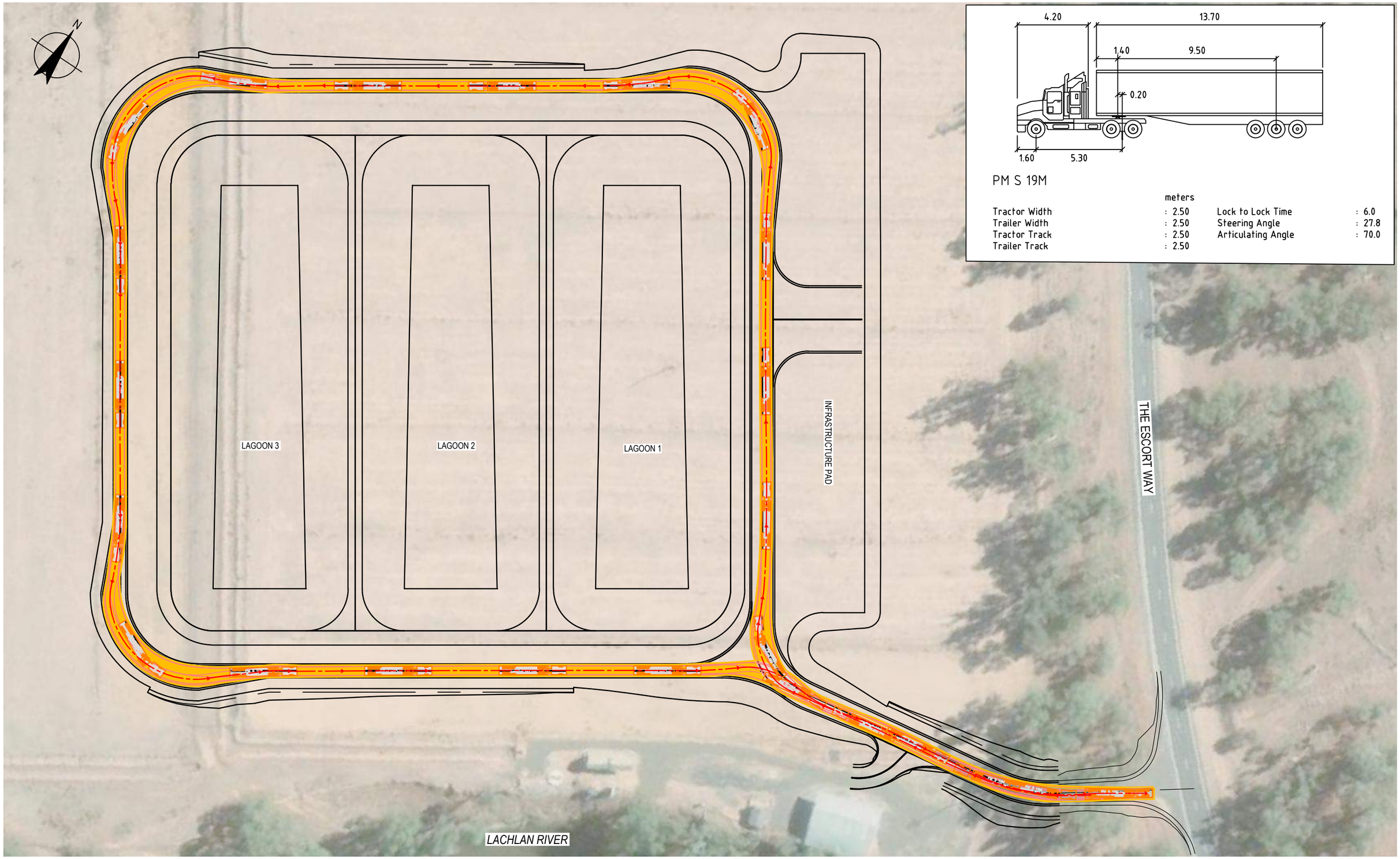

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Trailer Track	: 2.50		

Rev	Description	Checked	Approved	Date
B	DETAIL DEISIGN ISSUE	BF	NM	05.05.23
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Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

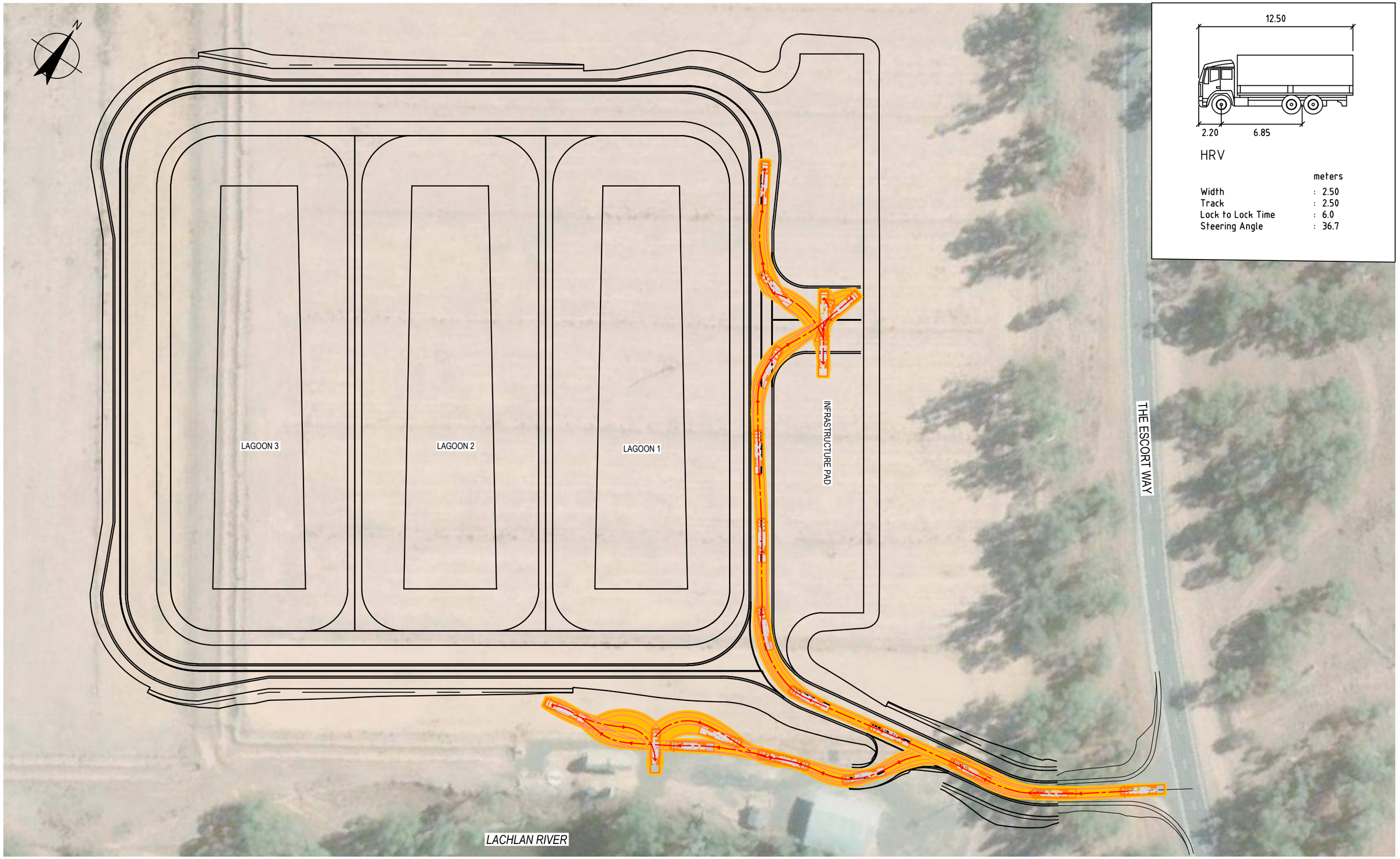
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
TURN PLAN
SHEET 1 OF 2

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00801

Size A3

Rev B

Plot Date: 8/05/2023 2:41:03 PM Plotted by: Billy Flinn File Name: C:\12d\SWdata\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00800.dwg



HRV

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Rev	Description		Checked	Approved	Date
B	DETAIL DEISIGN ISSUE	BF		NM	05.05.23
A	UNDER REVISION - FOR GHD INTERNAL USE ONLY				

Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

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SCALE 1:1000 AT ORIGINAL SIZE

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Project No. 12598051

Client PARKES SHIRE COUNCIL

Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
TURN PLAN
SHEET 2 OF 2

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00802

Size A3

Rev B

Plot Date: 8/05/2023 2:43:57 PM Plotted by: Billy Flinn File Name: C:\12d\SWdata\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00800.dwg

EROSION AND SEDIMENTATION NOTES

1. DRAWINGS ARE ISSUED AS EXAMPLE ONLY. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH THE REQUIREMENTS OF THE 'BLUE BOOK', SOILS AND CONSTRUCTION LANDCOM 2004 VOLUME 1 AND DEC VOLUME 2D AND OTHER ENVIRONMENTAL PRACTICES.

2. DETAILS ON THESE PRELIMINARY EROSION AND SEDIMENT CONTROL PLANS (ESCP'S) ARE SCHEMATIC ONLY. ADDITIONAL CONTROLS AND CHANGES TO THIS PLAN WILL BE NECESSARY DURING THE PROCESS OF IMPLEMENTATION OF THE ESCP. IN CONJUNCTION WITH THE CONSTRUCTION STAGING PLANS AND SPECIFIC ON SITE CONSTRUCTION METHODOLOGY THE CONTRACTOR SHALL PREPARE PROGRESSIVE ESCP. THE ESCP IDENTIFY THE EROSION AND SEDIMENT CONTROLS NEEDED ON SITE, BUT ARE NOT CONSTRUCTION DRAWINGS AND ARE ISSUED FOR INFORMATION ONLY. ALTERNATIVE APPROVED PRIMARY EROSION SEDIMENT CONTROLS CAN BE USED TO SUIT THE METHOD AND SEQUENCE OF CONSTRUCTION.
3. FOR EROSION AND SEDIMENTATION CONTROL PLAN SHEET ARRANGEMENT REFER TO THE SITE PLAN ON DRG CI-00903.
4. FOR EROSION AND SEDIMENT CONTROL DETAILS REFER DRG CI-00902 AND THE BLUE BOOK STANDARD DRAWING AS NOMINATED
5. REFER TO LEGEND ON THIS DRG.
6. THE SEQUENCE OF CONSTRUCTION SHALL BE AS FOLLOWS
   - 6.1. IDENTIFY LOCATION OF ALL YOUR NEW EROSION AND SEDIMENT CONTROL MEASURES.
   - 6.2. INSTALLATION OF BARRIER AND SEDIMENT FENCES.
   - 6.3. INSTALLATION OF ALL DIVERSION DRAINS AND LEVEL SPREADERS.
   - 6.4. INSTALLATION OF ALL REMAINING EROSION AND SEDIMENT CONTROLS.
   - 6.5. CLEARING OF SITE FOR CONSTRUCTION.

7. REFER TO TfNSW TYPICAL DRAWINGS R0100-01 TO R0100-12 AND THE 2008 'BLUE BOOK' TYPICAL DETAILS SD 4-1 TO SD 6-15.

8. LOCATION OF TOPSOIL STOCKPILES TO BE DETERMINED BY THE CONTRACTOR AND STABILISED IN ACCORDANCE WITH SD4.1 AND SD6.8.

9. ALL DISTURBED AND REGRADED AREAS SHALL BE REHABILITATED WITHIN 20 DAYS IN ACCORDANCE WITH REQUIREMENTS OF THE BLUE BOOK.

10. NEW OR EXISTING INFRASTRUCTURE USED TO CONVEY SITE RUNOFF DURING CONSTRUCTION SHALL BE FLUSHED CLEAN OF SEDIMENT AT COMPLETION OF THE PROJECT.

11. FIELD INSPECTIONS ARE TO BE UNDERTAKEN FOR ALL OPEN TRENCHES ON SITE TO ENSURE THAT ADEQUATE PROTECTION AGAINST EROSION IS PROVIDED AND THAT SAFETY MEASURES ARE ALSO PROVIDED IN PLACE AT THE END OF EACH DAY.

12. LOCATION OF ALL SERVICES TO BE CONFIRMED PRIOR TO COMMENCING WORK AND MANAGE THE COORDINATION OF TEMPORARY DRAINAGE AND OTHER EROSION AND SEDIMENT CONTROLS WITH THE EXISTING AND NEW UTILITIES.

13. ANY WORKS TO INSTALL UTILITIES OUTSIDE OF THE CONSTRUCTION AREAS SHOWN ON THESE PLANS ARE TO IMPLEMENT LOCAL EROSION AND SEDIMENT CONTROLS TO ENSURE ADEQUATE PROTECTION.

14. THE PROVISION OF ALL EROSION AND SEDIMENT CONTROL MEASURES REQUIRED FOR THE INSTALLATION OF ALL UTILITIES SHALL BE IN ACCORDANCE WITH VOLUME 2A 'INSTALLATION OF SERVICES" OF THE BLUE BOOK.

15. ALL EXPOSED BATTER FACES AND DIVERSION DRAINS WILL REQUIRE STABILISATION WITH HYDRAULIC MULCH AS PER TFNSW GUIDELINE FOR BATTER SURFACE STABILISATION.

16. USE WOVEN POLYPROPYLENE AND COTTON/GEOTEXTILE THREAD WITH A FLOW RATE OF 15 L/s/m^2 TO AUSTRALIAN STANDARD AS 3706.9 WHEN INSTALLING SEDIMENT FENCES.

EROSION AND SEDIMENT CONTROL LEGEND

ON-SITE WATER DIVERSION. REFER MANAGING URBAN STORMWATER (BLUE BOOK) 4TH EDITION, LANDCOM, 2004. STD DRG SD5-5/SD5-6

SEDIMENT CONTROL, FOR EXAMPLE REFER BLUE BOOK STD DRG SD6-7/ SD 6-8

CHECK DAM, REFER BLUE BOOK STD DRG SD5-4

Rev	Description	Checked	Approved	Date
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Designer B.FLINN **Design Check** A.SNEDDON

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Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

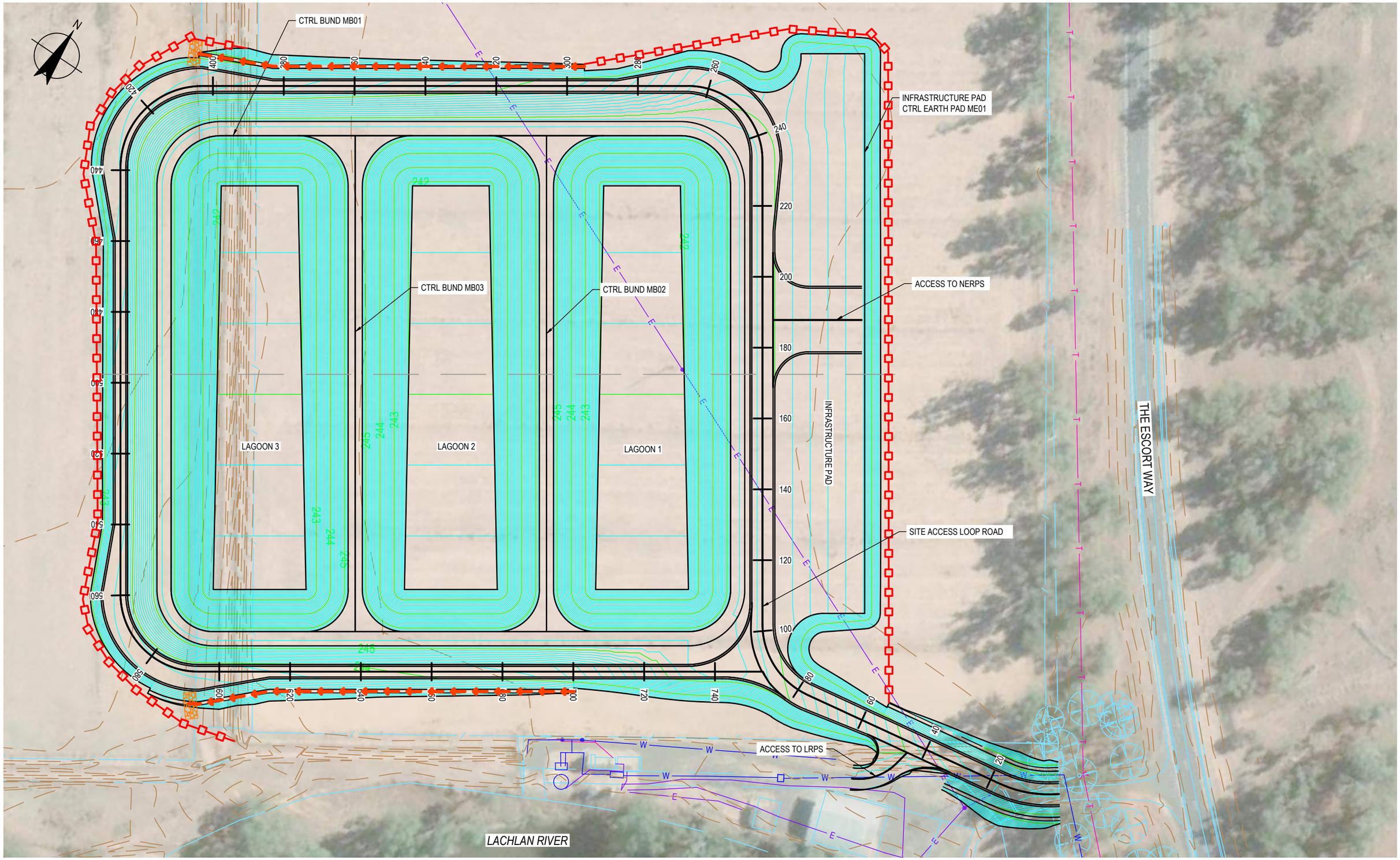
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
SEDIMENT AND EROSION
CONTROL NOTES - SHEET 1 OF 1

Size A3

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00901

Rev A

Plot Date: 5/05/2023 5:45:22 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00900.dwg



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Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

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LACHLAN RIVER PRE-TREATMENT AREA

Status DETAIL DESIGN Status Code S4

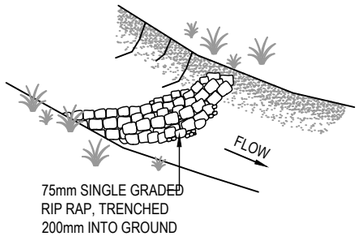
Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
SEDIMENT AND EROSION
CONTROL PLAN - SHEET 1 OF 1

Size A3

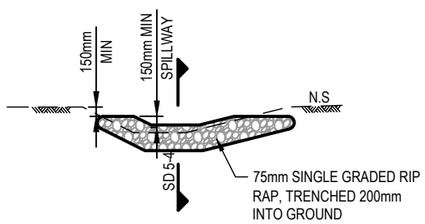
Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00902

Rev B

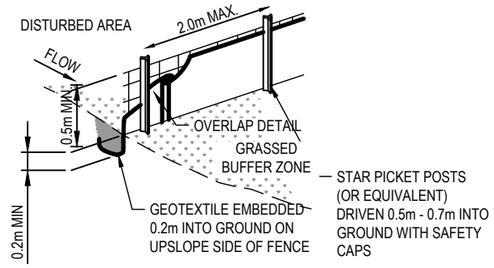
Plot Date: 5/05/2023 5:45:23 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00900.dwg



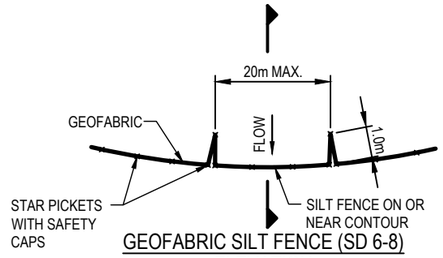
CHECK DAM (SD 5-4)
PERSPECTIVE
N.T.S.



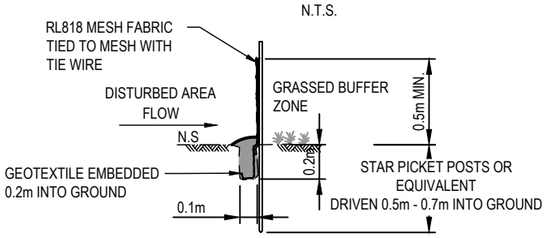
CHECK DAM (SD 5-4)
ELEVATION
N.T.S.



GEOFABRIC SILT FENCE (SD 6-8)
PERSPECTIVE
N.T.S.



GEOFABRIC SILT FENCE (SD 6-8)
ELEVATION
N.T.S.



GEOFABRIC SILT FENCE (SD 6-8)
SECTION
N.T.S.

Rev	Description	Checked	Approved	Date
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Author N.VANDERDONK Drafting Check I.SMITH
Designer B.FLINN Design Check A.SNEDDON

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Project No. 12598051

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Project PARKES WATER TREATMENT PLANT
LACHLAN RIVER PRE-TREATMENT AREA
Status DETAIL DESIGN Status Code S4

Drawing Title CIVIL WORKS
PRE-TREATMENT AREA
SEDIMENT AND EROSION
CONTROL DETAILS - SHEET 1 OF 1

Drawing No. 12598051-GHD-PWTP-LRPT-DRG-CI-00903
Size A3
Rev A

Plot Date: 5/05/2023 5:45:25 PM Plotted by: Nathan Vanderdonk File Name: C:\12d\SW\data\P-00-12D-001\22-12598051 - Parkes WTP - Lachlan River pre-treatment area_2253\CADD\AutoCAD\DRG\12598051-GHD-PWTP-LRPT-DRG-CI-00900.dwg

Appendix B Geotechnical Investigation

MACQUARIE GEOTECH

Geotechnical Investigation Report

Parkes Water Security Program

Pre-Treatment Plant, Forbes

Geotechnical Investigation

Job No.: B21615

Submitted to:

Parkes Shire Council

2 Cecile Street

Parkes NSW 2870

Attn: David Pearce

Report No.: B21615

Parkes Shire Council – Pre-Treatment Plant, Forbes

REVISION CONTROL

Revision	Date	Details	Prepared By	Reviewed By
00	04/01/2023	Draft	D. O'Donnell	D. Clarkson
01	06/11/2023	Final	D. O'Donnell	D. Clarkson

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1 INTRODUCTION

At the request of Parkes Shire Council, Macquarie Geotechnical (MG) has carried out a geotechnical investigation for the proposed Pre-treatment Plant near Forbes, NSW. The proposed works are part of the Parkes Water Security Program (PWSP). The objective of the investigation is to provide a geotechnical investigation report.

The comments and opinions expressed in this report are based on the ground conditions encountered during the site work and on the results of tests carried out in the field and in the laboratory. There may, however, be special conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report.

2 SCOPE OF INVESTIGATION

Undertake a desk study of the site to confirm the likely geological conditions of the site and to develop a geological model for the site.

Undertake Dial Before You Dig (DBYD) search.

Mobilisation of one drill rig. Drilling, logging and sampling of six boreholes as per Table 1 below.

Table 1: Borehole Scope

Hole ID	Eastings	Northings	RL (m AHD)	Depth (m)
PTP4	605661	6304827	243	4.0
PTP5	605771	6304900	246	4.0
PTP6	605707	6304755	243	4.0
PTP10	605870	6304895	248	1.0
PTP11	605792	6304829	247	8.0
PTP12	605716	6304957	246	8.0

Samples were taken at regular intervals and at every change of strata to allow for laboratory testing and returned to our NATA accredited laboratories in Bathurst and Sydney, NSW. Laboratory testing comprised the following:

- Four Atterberg Limits and Linear Shrinkage.
- Two Falling Head Permeability.
- Two Constant Head Permeability.
- Four Emerson Crumb Tests.
- One Pinhole Dispersion Test.
- Four Particle Size Distribution – Hydrometer.
- One California Bearing Ratio.
- Five Moisture Contents.

2.1 Site Description

The site is located approximately 12km east of Forbes within the Forbes Shire local government area. The site location is shown in Figure 1 below.

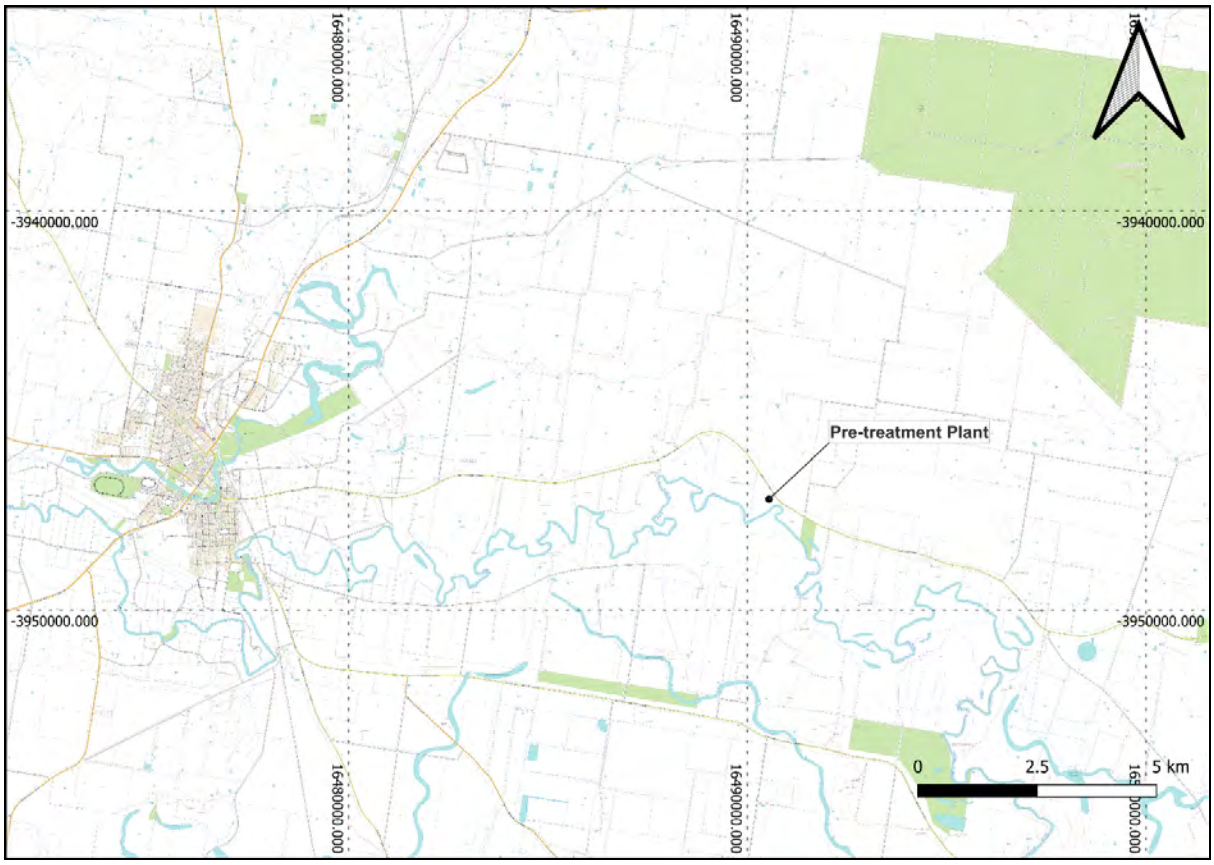

Figure 1: Site Location

2.2 Desk Study

A desk study was undertaken using readily available geological and geotechnical information and included the following:

- NSW Seamless Geology.
- ASRIS/CSIRO.
- Google Earth.
- NSW Department of Primary Industries – Groundwater Bore Data.
- Naturally Occurring Asbestos Hazard Maps.

2.3 Regional Geology

The NSW seamless geological map is shown in Figure 2 below, with NSW Groundwater Bore locations overlayed.

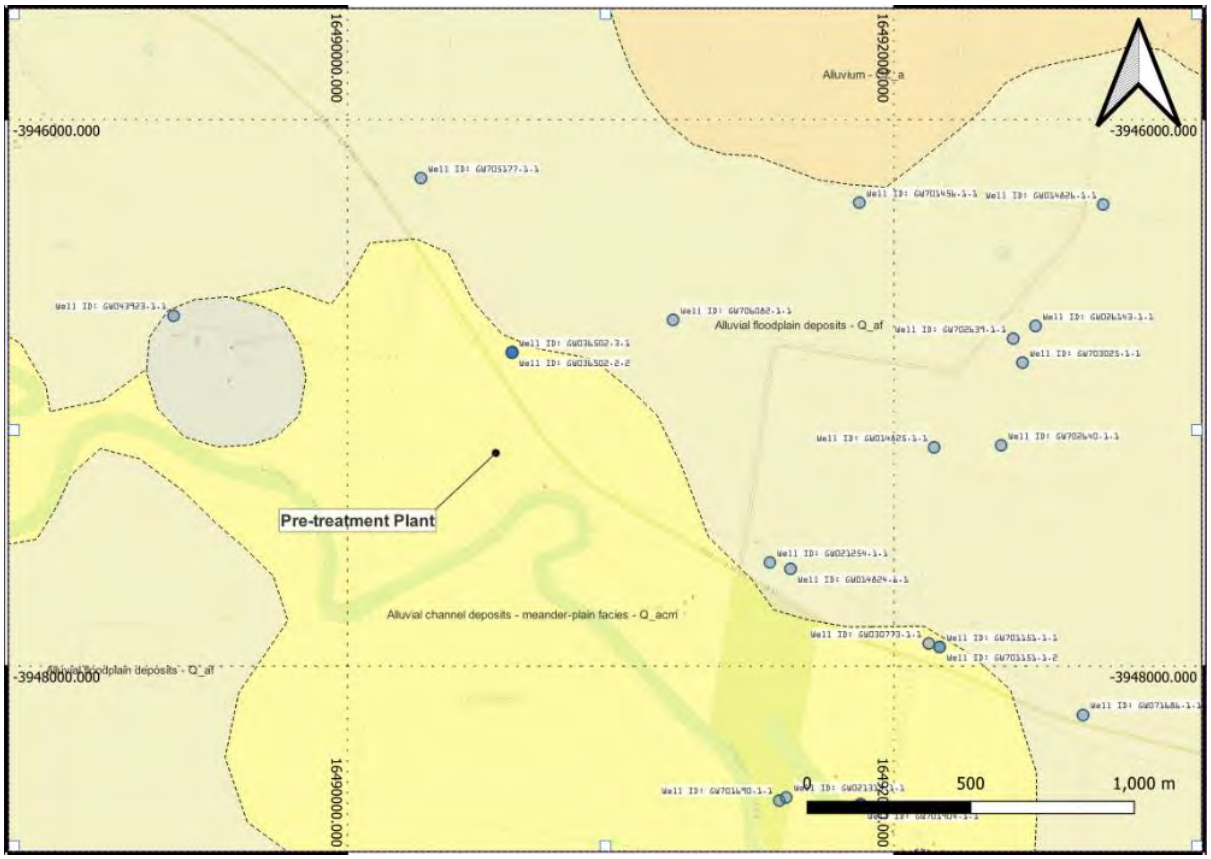

Figure 2: Seamless Geological Map Overlay

Table 2: Summary of Geology

Geological Symbol	Unit Name	Lithology
Q_acm	Alluvial channel deposits - meander-plain facies	Unconsolidated grey humic, clayey very fine-grained sand, typically overlying light brown clayey silt.

2.3.1 Groundwater Bores

The groundwater data indicates the following ground conditions:

Table 3: Groundwater Data – GW036502

Depth (m)	Drillers Description
0.00 – 3.00	Sandy Loam
3.00 – 6.00	Clay
6.00 – 9.10	Clayey Gravel
9.10 – 11.00	Clay
11.00 – 17.00	Sandy Gravel
17.00 – 19.00	Clayey Gravel

2.3.2 Acid Sulphate Maps

Reference is made to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Atlas of Australian Acid Sulphate Soils and presented in Figure 3 below:

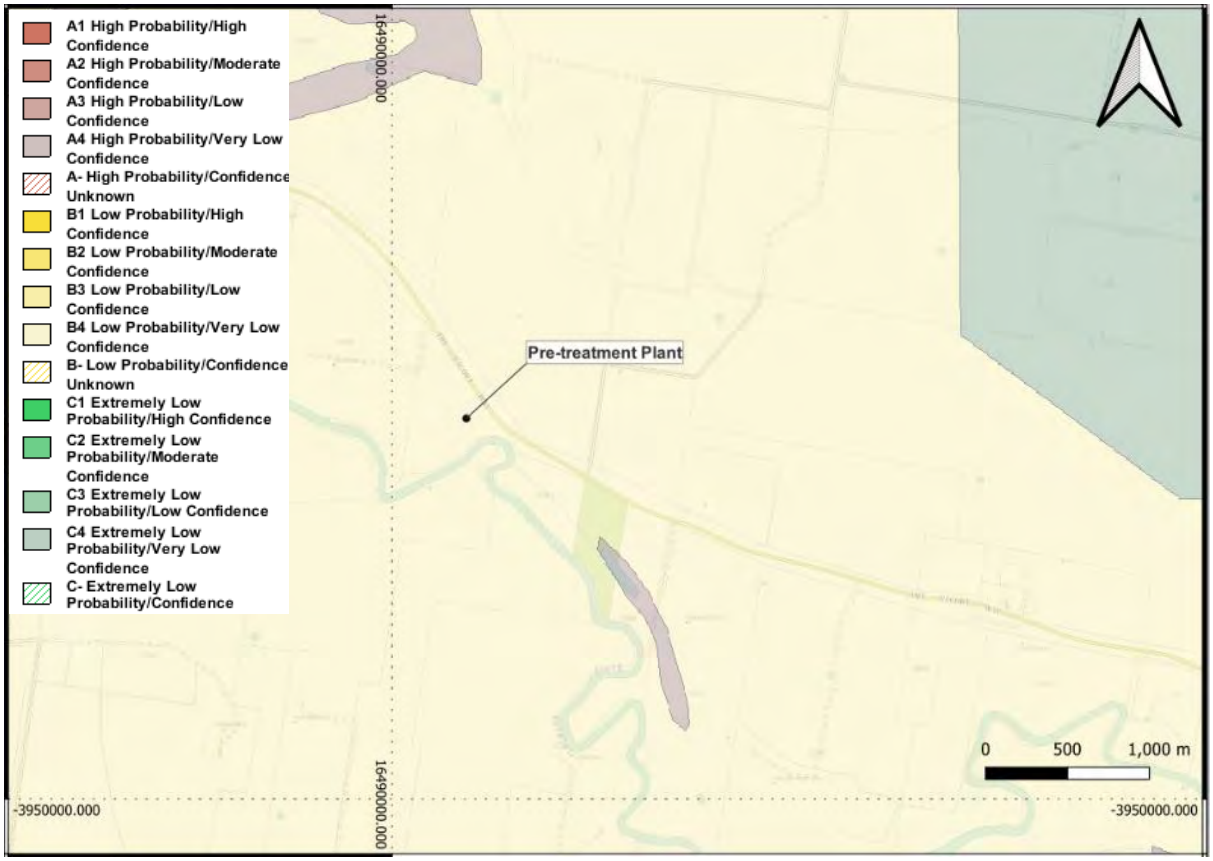

Figure 3: Acid Sulphate Risk Map

The acid sulphate risk map indicates a low probability of acid sulphate soils at the site.

2.3.3 Naturally Occurring Asbestos Maps

Reference is made to the NSW Department of Primary Industry Naturally Occurring Asbestos Hazard Maps and presented in Figure 4 below:

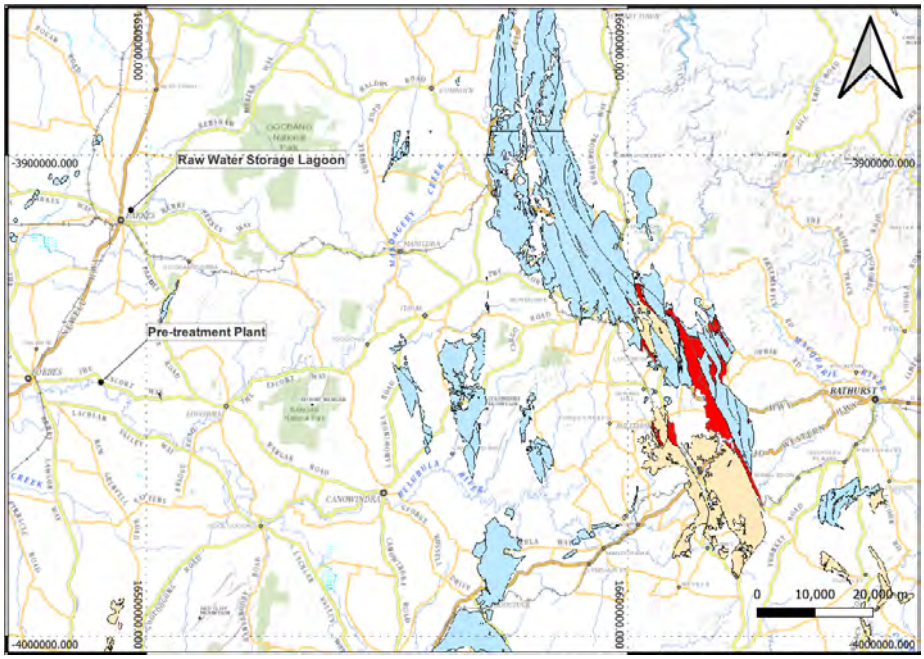

Figure 4: Naturally Occurring Asbestos Hazard Map

The Hazard Map indicates no known Naturally Occurring Asbestos (NOA) at the site.

2.3.4 Topography

The site is located in a low lying flat area with elevation ranging from 243m to 248m AHD.

Figure 5: Digital Elevation Model

2.4 Fieldwork

Fieldwork was undertaken between the 18th and 19th October 2022 by a team of Drillers and Engineering Geologist from our Bathurst office. The fieldwork was undertaken in accordance with our proposal and AS1726 Geotechnical Site Investigation.

2.4.1 Service Location

Macquarie Geotechnical obtained underground services and utility plans through 'Dial Before You Dig (DBYD)' services.

2.4.2 GPS

All test locations were surveyed using a handheld GPS with co-ordinates recorded in MGA Zone 55 format and elevations in Australian Height Datum (AHD).

2.4.3 Boreholes

The boreholes were drilled at locations nominated by Parkes Shire Council and are summarised in Table 1.

A truck mounted Christi Rig was used to drill six boreholes to depths of up to 8.00m utilising 115mm diameter solid flight augers. In-situ testing comprised of Standard Penetration Tests (SPT) and Dynamic Cone Penetrometer (DCP).

The boreholes were backfilled with arising's on completion.

Borehole logs and photographs are presented in Appendix C.

2.5 Sampling

The sampling was undertaken in general accordance with AS1289 1.2.1 and based on that defined in the proposal and considered the engineering requirements of the investigation and the nature of the materials encountered.

2.6 In Situ Testing

In-situ testing as specified by the Client or our proposal was carried out in the exploratory holes in accordance with the techniques outlined in the relevant Australian Standards and Macquarie Geotechnical Quality procedures. The results are presented on the borehole logs in Appendix C.

2.6.1 Standard Penetration Testing

Standard Penetration Tests (SPT) were carried out in the boreholes with techniques outlined in AS1289 6.3.1 in order to determine the relative density and consistency of the strata encountered. The SPT "N" value (number of blows per 300mm penetration) or the blow count / penetration were recorded for each test.

2.6.2 Dynamic Cone Penetrometer Testing

Dynamic Cone Penetrometer (DCP) testing was carried out in one of the boreholes with techniques outlined in AS1289 6.3.2 in order to determine the relative density and consistency of the strata encountered. The numbers of blows per 100mm penetration were recorded.

2.6.3 Pocket Penetrometer Testing

Pocket Penetrometer (PP) testing was carried out on SPT split spoon samples.

2.7 Laboratory Testing

The samples were returned to Macquarie Geotechnical NATA accredited laboratories for further assessment and testing. A summary of the laboratory tests is provided in Table 4 below.

Table 4: Summary of Laboratory Tests

Laboratory Test	Quantity
AS1289 3.1.1, 3.2.1, 3.3.1 Atterberg Limits	4
AS1289 3.4.1 Linear Shrinkage	4
AS 1289 6.7.2 & 2.1.1 Falling Head Permeability	2
AS 1289 6.7.3 Constant head Permeability	2
AS 1289 6.1.1 & 2.1.1 California Bearing Ratio	1
AS 1289 2.1.1 Moisture Content	5
AS 1289 3.8.1 Emerson Class Number of a Soil	4
AS1289 3.8.3 Pinhole Dispersion	1
AS1289.3.6.1 and 3.6.3 Particle Size Distribution with Hydrometer	4

3 FIELDWORK RESULTS

3.1 Borehole Summary

The subsurface conditions observed in all boreholes are broadly summarised in Table 5 below. Detailed descriptions of the strata can be found within the borehole logs provided in Appendix C.

Table 5: Borehole Summary

Unit	Name	Depth Range (m)	Maximum Thickness (m)	Material Description
1	Topsoil	0.00 – 0.10	0.10	Silty CLAY
2	Alluvial	0.10 – 8.00	7.90	Sandy Silty CLAY, Silty CLAY

3.2 Groundwater

The comments on groundwater are based on the observations made at the time of the investigation. Groundwater was encountered in boreholes PTP4, PTP11 and PTP12 at depths of 3.5m, 7.0m and 7.8m respectively.

Seasonal variation in groundwater may be encountered and shall be considered as part of the design process.

4 LABORATORY TEST RESULTS

The laboratory tests were carried out on the samples nominated by Macquarie Geotechnical. The test results are shown in Tables 6 to 8 below.

Table 6: Laboratory Test Results - Classification

Hole ID	Depth (m)	Sample Description (USCS)	Atterberg Limits			Linear Shrinkage (%)
			Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	
PTP5	3.50 – 4.00	Silty CLAY with sand	36	14	22	12.0
PTP6	2.00 – 2.50	Silty CLAY with sand*	40	18	22	12.0
PTP10	0.80 – 1.00	Silty CLAY trace sand*	45	17	28	15.0
PTP12	0.50 – 1.00	Silty CLAY trace sand*	28	15	13	11.0

Note: USCS – Unified Soil Classification System.
*Visual description.

Table 7: Laboratory Test Results – California Bearing Ratio (CBR)

Hole ID	Depth (m)	Sample Description (USCS)	California Bearing Ratio (CBR)			
			MDD (t/m^3)	OMC (%)	CBR (%)	CBR Swell (%)
PTP10	0.30 – 0.50	Silty CLAY*	1.56	23.5	0.50	-

Note: USCS – Unified Soil Classification System, MDD – Maximum Dry Density, OMC – Optimum Moisture Content.
* Visual description.

Table 8: Laboratory Test Results – Permeability and Dispersion

Hole ID	Depth (m)	Sample Description*	Falling Head Permeability (m/sec)	Constant Head Permeability (m/sec)	Emerson Class Number	Pinhole Dispersion
PTP4	1.30 – 1.50	Sandy Silty CLAY	6.0 E-10	-	-	-
PTP6	1.30 – 1.50	Silty CLAY with sand	1.0 E-10	-	-	-
PTP5	1.30 – 1.50	Silty CLAY trace sand	-	1.0 E-10	-	-
PTP10	0.80 – 1.00	Silty CLAY trace sand	-	2.0 E-10	-	-
PTP5	3.50 – 4.00	Silty CLAY with sand	-	-	2	-
PTP6	2.00 – 2.50	Silty CLAY with sand	-	-	2	-
PTP11	2.00 – 2.50	Silty CLAY with sand	-	-	2	-
PTP12	1.00 – 1.50	Silty CLAY trace sand	-	-	2	-
PTP11	0.50 – 1.00	Silty CLAY trace sand	-	-	-	ND1 Non-dispersive

Note: * Visual description.

5 GEOTECHNICAL ASSESSMENT

5.1 Site Classification

The classification of a site involves a number of geotechnical factors such as depth of bedrock, the nature and extent of subsurface soils and any specific problems (slope stability, soft soils, filling, reactivity, etc).

In accordance with AS2870 2011 the proposed development site will have an anticipated surface movement (Ys) of 50 – 60mm and is classified as “Class H1-D”.

An appropriate footing system should be designed in accordance with the above code to accommodate these anticipated movements. The possibility of additional movements, due to abnormal moisture variations, should be minimised by proper "site management" procedures.

It should be noted that this assessment is based on site conditions being represented by the natural soil profile. Any change in conditions noted during development, including cut or fill should be referred to Macquarie Geotechnical for appropriate inspection and assessment.

The above classifications, based on AS2870 which relates to construction of residential dwellings, is not technically correct for the type of structures proposed and therefore it is given as a guide only with respect to soil reactivity.

5.2 Foundations

The investigation indicates that the ground conditions generally comprised of topsoil overlying alluvial soils. Bedrock was not encountered.

5.2.1 Geotechnical Design Parameters

Based on our investigation, and our experience in this region, we recommend the following geotechnical design parameters:

Table 9: Estimated Geotechnical Engineering Parameters

Depth (m)	Soil Description	Unit Weight (KN/m³)	Angle of Friction (Degrees)		Cohesion (KPa)		Concrete to Soil Friction Angle δ (degrees)
			Drained ϕ'	Undrained ϕ	Drained c'	Undrained Cu	
Varying Depth	Silty CLAY - Firm	18	21	0	0	25	16
	Silty CLAY - Stiff	19	26	0	0	50	20
	Silty CLAY - Very Stiff	19	29	0	0	100	23
	Silty CLAY - Hard	20	32	0	0	200	25

Table 10: Shallow Footing Bearing Pressures

Depth (m)	Soil Description	Allowable Bearing Pressure (KPa)	Ultimate Bearing Pressure (KPa)	Modulus of Subgrade Reaction (MN/m³)
Varying Depth	Silty CLAY - Firm	40	120	5
	Silty CLAY - Stiff	85	255	10
	Silty CLAY - Very Stiff	170	510	20
	Silty CLAY - Hard	340	1020	40

Note: Preliminary design parameters to be confirmed by a detailed design analysis.

5.3 Foundation Settlements

For foundations bearing on the natural soils (alluvial soils) total and differential settlements are expected to be less than 25mm provided that the allowable bearing capacities are not exceeded.

5.4 Soil Dispersion

Based on the laboratory test results the soils were generally dispersive.

5.5 Structure Foundations

5.5.1 Pad and Strip Foundations

If it is proposed to use pad or strip foundations on fill material, then the existing topsoil should be stripped down to natural soils including all soft, organic or moisture affected materials. The exposed subgrade should then be rolled and compacted to a minimum dry density ratio of 98% relative to standard compaction at a moisture ratio of 60-90% of the optimum moisture content. The prepared subgrade shall then be proof rolled to identify any soft spots to remedy it. Stripped or imported fill compling with Section 4 of AS3798 or similar standard can then be placed and compacted to 98% relative to standard compaction at a moisture ratio of 60-90% of the optimum moisture content in maximum 250mm loose thickness layers up to design level. An allowable bearing capacity of 150kPa can be assumed for the compacted fill material.

6 EXCAVATION AND STABILITY

6.1 Soil

The soils at the site comprise predominately topsoil overlying alluvial soils and should present no excavation difficulty. For temporary work conditions above groundwater level, benching or slope angles of 1V:1H is considered appropriate for the materials. For temporary work conditions below groundwater level excavation support will be required. For permanent conditions, slope angles of 1V:2H is considered appropriate.

6.2 Rock

Bedrock was not encountered in the boreholes.

7 EARTHWORKS

7.1 Site Preparation

- The following scope of work is required as a minimum to prepare the site prior to filling:
- Prior to construction and placement of any fill, the proposed areas should be stripped to remove all vegetation, topsoil, uncontrolled fill, organic, root affected or other potentially deleterious material.
- Boxed-out excavations should be drained permanently to allow any infiltration from subsequent fill to escape the excavation profile.
- Where the ground slopes at more than 1V:10H (6°), the ground profile should be benched in 300mm vertical steps to create near-level platforms for filling. The platforms should be graded with a cross fall no steeper than 2% downslope to allow drainage of any infiltration to the fill and to prevent pooling of subsurface moisture.
- Following stripping, the exposed subgrade materials should be proof rolled in the presence of a suitably qualified and experienced Geotechnical Engineer to identify any wet or excessively deflecting material.
- Proof rolling should involve compacting the site with an 8-ton roller, trimming the rolled surface to level and clean finish. Where there are areas indicating excessive deflection then these may require over-excavation and backfilling with an approved select material.

7.2 Re-use of Site Material

Careful extraction and stockpile management will be required to optimise the potential volume of site won materials.

With the exception of the topsoil, the majority of the site won soil material from the cuttings is considered suitable for use as general fill material. If the material is proposed to be used as engineered fill within the permanent works then some blending of the material with coarser particle sizes may be required to comply with Specification grading requirements. Further testing of the excavated material would be required during construction to confirm specification and design acceptability requirements.

7.3 Bulk Earthworks

Subgrade preparation will generally only require removal of topsoil and compaction to 98% relative to standard compaction of the excavated subgrade material.

Slope angles of 1V:1H and 1V:2H is considered appropriate for compacted embankment fill materials in the temporary and permanent conditions respectively.

Site filling should be undertaken to the provisions of AS3798-2007: “Earthworks for Residential and Commercial Developments” or similar standard. Fill for support of structures or equipment should be placed to Level 1 inspection and testing requirements as per the standard.

7.4 Trafficability

The clay subgrades at the site have a low wet strength and poor subgrade strength. The site soils would be trafficable during dry periods. Some desiccation of exposed surfaces can be expected and large quantities of dust will be generated during dry periods under traffic. The soils will be soft and difficult to traverse following wet weather or inundation. Drying out of these soils could take several days or weeks before being able to accommodate construction traffic.

8 CONCLUSION

The findings of our report were based on our fieldwork, in-situ testing, laboratory testing and technical assessment for this site.

We trust the foregoing is sufficient for your present purposes, and if you have any questions please contact the undersigned.

Declan O'Donnell
Engineering Geologist
BSc (Geology) (Hons)

David Clarkson
Senior Geotechnical Engineer
BEng MSc MIEAust

Attached: Limitations of Geotechnical Site Investigation
References: Australian Standard 1726 – 2017 Geotechnical Site Investigations

LIMITATIONS OF GEOTECHNICAL SITE INVESTIGATION

Scope of Services

This report has been prepared for the Client in accordance with the Services Engagement Form (SEF), between the Client and Macquarie Geotechnical.

Reliance on Data

Macquarie Geotechnical has relied upon data and other information provided by the Client and other individuals. Macquarie Geotechnical has not verified the accuracy or completeness of the data, except as otherwise stated in the report. Recommendations in the report are based on the data.

Macquarie Geotechnical will not be liable in relation to incorrect recommendations should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed.

Geotechnical Investigation

Findings of Geotechnical Investigations are based extensively on judgment and experience. Geotechnical reports are prepared to meet the specific needs of individual clients. This report was prepared expressly for the Client and expressly for the Clients purposes.

This report is based on a subsurface investigation, which was designed for project-specific factors. Unless further geotechnical advice is obtained this report cannot be applied to an adjacent site nor can it be used when the nature of any proposed development is changed.

Limitations of Site investigation

As a result of the limited number of sub-surface excavations or boreholes there is the possibility that variations may occur between test locations. The investigation undertaken is an estimate of the general profile of the subsurface conditions. The data derived from the investigation and laboratory testing are extrapolated across the site to form a geological model. This geological model infers the subsurface conditions and their likely behavior with regard to the proposed development.

The actual conditions at the site might differ from those inferred to exist.

No subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

Time Dependence

This report is based on conditions, which existed at the time of subsurface exploration. Construction operations at or adjacent to the site, and natural events such as floods, or groundwater fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report.

Macquarie Geotechnical should be kept appraised of any such events, and should be consulted for further geotechnical advice if any changes are noted.

Avoid Misinterpretation

A geotechnical engineer or engineering geologist should be retained to work with other design professionals explaining relevant geotechnical findings and in reviewing the adequacy of their plans and specifications relative to geotechnical issues.

No part of this report should be separated from the Final Report.

Sub-surface Logs

Sub-surface logs are developed by geoscientific professionals based upon their interpretation of field logs and laboratory evaluation of field samples. These logs should not under any circumstances be redrawn for inclusion in any drawings.

Geotechnical Involvement During Construction

During construction, excavation frequently exposes subsurface conditions. Geotechnical consultants should be retained through the construction stage, to identify variations if they are exposed.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendations and should make their own enquiries and obtain independent advice in relation to such matters

Macquarie Geotechnical assumes no responsibility and will not be liable to any other person or organisations for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisations arising from matters dealt with or conclusions expressed in the report.

Other limitations

Macquarie Geotechnical will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

Other Information

For further information reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by the Institution of Engineers Australia, 1987.

Appendix A – Geotechnical Explanatory Notes

MACQUARIE GEOTECH

Geotechnical Explanatory Notes

Soil Description

In engineering terms soil includes every type of uncemented or partially cemented inorganic material found in the ground. In practice, if the material can be remoulded by hand in its field condition or in water it is described as a soil. The dominant soil constituent is given in capital letters, with secondary textures in lower case. The dominant feature is assessed from the Unified Soil Classification system and a soil symbol is used to define a soil layer as follows:

UNIFIED SOIL CLASSIFICATION

The appropriate symbols are selected on the result of visual examination, field tests and available laboratory tests, such as, sieve analysis, liquid limit and plasticity index.

USC Symbol	Description
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel
SW	Well graded sand
SP	Poorly graded sand
SM	Silty sand
SC	Clayey sand
ML	Silt of low plasticity
CL	Clay of low plasticity
OL	Organic soil of low plasticity
MH	Silt of high plasticity
CH	Clay of high plasticity
OH	Organic soil of high plasticity
Pt	Peaty Soil

MOISTURE CONDITION

Dry – Cohesive soils are friable or powdery
Cohesionless soil grains are free-running

Moist – Soil feels cool, darkened in colour
Cohesive soils can be moulded
Cohesionless soil grains tend to adhere

Wet – Cohesive soils usually weakened
Free water forms on hands when handling

For cohesive soils the following codes may also be used:

MC>PL Moisture Content greater than the Plastic Limit.
MC~PL Moisture Content near the Plastic Limit.
MC<PL Moisture Content less than the Plastic Limit.

PLASTICITY

The potential for soil to undergo change in volume with moisture change is assessed from its degree of plasticity. The classification of the degree of plasticity in terms of the Liquid Limit (LL) is as follows:

Description of Plasticity	LL (%)
Low	<35
Medium	35 to 50
High	>50

COHESIVE SOILS – CONSISTENCY

The consistency of a cohesive soil is defined by descriptive terminology such as very soft, soft, firm, stiff, very stiff and hard. These terms are assessed by the shear strength of the soil as observed visually, by the pocket penetrometer values and by resistance to deformation to hand moulding.

A Pocket Penetrometer may be used in the field or the laboratory to provide approximate assessment of unconfined compressive strength of cohesive soils. The values are recorded in kPa, as follows:

Strength	Symbol	Pocket Penetrometer Reading (kPa)
Very Soft	VS	< 25
Soft	S	20 to 50
Firm	F	50 to 100
Stiff	St	100 to 200
Very Stiff	VSt	200 to 400
Hard	H	> 400

MACQUARIE GEOTECH

COHESIONLESS SOILS – RELATIVE DENSITY

Relative density terms such as very loose, loose, medium, dense and very dense are used to describe silty and sandy material, and these are usually based on resistance to drilling penetration or the Standard Penetration Test (SPT) 'N' values. Other condition terms, such as friable, powdery or crumbly may also be used.

The Standard Penetration Test (SPT) is carried out in accordance with AS 1289, 6.3.1. For completed tests the number of blows required to drive the split spoon sampler 300 mm are recorded as the N value. For incomplete tests the number of blows and the penetration beyond the seating depth of 150 mm are recorded. If the 150 mm seating penetration is not achieved the number of blows to achieve the measured penetration is recorded. SPT correlations may be subject to corrections for overburden pressure and equipment type.

Term	Symbol	Density Index	N Value (blows/0.3 m)
Very Loose	VL	0 to 15	0 to 4
Loose	L	15 to 35	4 to 10
Medium Dense	MD	35 to 65	10 to 30
Dense	D	65 to 85	30 to 50
Very Dense	VD	>85	>50

COHESIONLESS SOILS PARTICLE SIZE DESCRIPTIVE TERMS

Name	Subdivision	Size
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	19 mm to 63 mm
	medium	6.7 mm to 19 mm
	fine	2.36 mm to 6.7 mm
Sand	coarse	600 μm to 2.36 mm
	medium	210 μm to 600 μm
	fine	75 μm to 210 μm

Rock Description

The rock is described with strength and weathering symbols as shown below. Other features such as bedding and dip angle are given.

ROCK QUALITY

The fracture spacing is shown where applicable and the Rock Quality Designation (RQD) or Total Core Recovery (TCR) is given where:

$$\text{RQD (\%)} = \frac{\text{Sum of Axial lengths of core > 100mm long}}{\text{total length considered}}$$

$$\text{TCR (\%)} = \frac{\text{length of core recovered}}{\text{length of core run}}$$

ROCK STRENGTH

Rock strength is described using AS1726 and ISRM – Commission on Standardisation of Laboratory and Field Tests, "Suggested method of determining the Uniaxial Compressive Strength of Rock materials and the Point Load Index", as follows:

Term	Symbol	Point Load Index $Is_{(50)}$ (MPa)
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1
High	H	1 to 3
Very High	VH	3 to 10
Extremely High	EH	>10

ROCK MATERIAL WEATHERING

Rock weathering is described using the following abbreviation and definitions used in AS1726:

Abbreviation	Term
RS	Residual soil
XW	Extremely weathered
DW	Distinctly weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
FR	Fresh

MACQUARIE GEOTECH

DEFECT SPACING/BEDDING THICKNESS

Measured at right angles to defects of same set or bedding.

Term	Defect Spacing	Bedding
Extremely closely spaced	<6 mm	Thinly Laminated
	6 to 20 mm	Laminated
Very closely spaced	20 to 60 mm	Very Thin
Closely spaced	0.06 to 0.2 m	Thin
Moderately widely spaced	0.2 to 0.6 m	Medium
Widely spaced	0.6 to 2 m	Thick
Very widely spaced	>2 m	Very Thick

DEFECT DESCRIPTION

Type:	Description
B	Bedding
F	Fault
C	Cleavage
J	Joint
S	Shear Zone
D	Drill break

Planarity/Roughness:

Class	Description
I	rough or irregular, stepped
II	smooth, stepped
III	slickensided, stepped
IV	rough or irregular, undulating
V	smooth, undulating
VI	slickensided, undulating
VII	rough or irregular, planar
VIII	smooth, planar
IX	slickensided, planar

The inclination if defects are measured from perpendicular to the core axis.

WATER


Water level at date shown


Partial water loss


Water inflow


Complete water loss

Groundwater not observed: The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.

Groundwater not encountered: The borehole/test pit was dry soon after excavation, however groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

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Graphic Symbols for Soils and Rocks

Typical symbols for soils and rocks are as follows. Combinations of these symbols may be used to indicated mixed materials such as clayey sand.

Soil Symbols

Main components


CLAY - CL


CLAY - CH


SAND


GRAVEL


BOULDERS / COBBLES


TOPSOIL


SILT

Minor Components


Clayey


Silty


Sandy


Gravelly

Other


FILL


BITUMEN


CONCRETE

Rock Symbols

Sedimentary Rocks


SANDSTONE


SILTSTONE


CLAYSTONE, MUDSTONE


SHALE


LAMINITE


ASPHALT


LIMESTONE


CONGLOMERATE

Igneous Rocks


GRANITE


BASALT


UNDIFFERENTIATED IGNEOUS

Metamorphic Rocks


SLATE, PHYLLITE, SCHIST


GNEISS

QUARTZITE

MACQUARIE GEOTECH

Engineering Classification of Shales and Sandstones in the Sydney Region – A Summary Guide

The Sydney Rock Class classification system is based on rock strength, defect spacing and allowable seams as set out below. All three factors must be satisfied.

CLASSIFICATION FOR SANDSTONE

Class	Uniaxial Compressive Strength (MPa)	Defect Spacing (mm)	Allowable Seams (%)
I	>24	>600	<1.5
II	>12	>600	<3
III	>7	>200	<5
IV	>2	>60	<10
V	>1	N.A.	N.A.

CLASSIFICATION FOR SHALE

Class	Uniaxial Compressive Strength (MPa)	Defect Spacing (mm)	Allowable Seams (%)
I	>16	>600	<2
II	>7	>200	<4
III	>2	>60	<8
IV	>1	>20	<25
V	>1	N.A.	N.A.

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UNIAXIAL COMPRESSIVE STRENGTH (UCS)

For expedience in field/construction situations the uniaxial (unconfined) compressive strength of the rock is often inferred, or assessed using the point load strength index (Is_{50}) test (AS 4133.4.1 – 1993). For Sydney Basin sedimentary rocks the uniaxial compressive strength is typically about 20 x (Is_{50}) but the multiplier may range from about 10 to 30 depending on the rock type and characteristics. In the absence of UCS tests, the assigned Sydney Rock Class classification may therefore include rock strengths outside the nominated UCS range.

DEFECT SPACING

The terms relate to spacing of natural fractures in NMLC, NQ and HQ diamond drill cores and have the following definitions:

Defect Spacing (mm)	Terms Used to Describe Defect Spacing[1]
>2000	Very widely spaced
600 – 2000	Widely spaced
200 – 600	Moderately spaced
60 – 200	Closely spaced
20 – 60	Very closely spaced
<20	Extremely closely spaced

[1]After ISO/CD14689 and ISRM.

ALLOWABLE SEAMS

Seams include clay, fragmented, highly weathered or similar zones, usually sub-parallel to the loaded surface. The limits suggested in the tables relate to a defined zone of influence. For pad footings, the zone of influence is defined as 1.5 times the least footing dimension. For socketed footings, the zone includes the length of the socket plus a further depth equal to the width of the footing. For tunnel or excavation assessment purposes the defects are assessed over a length of core of similar characteristics.

Source: Based on Pells et al (1978), as revised by Pells et al (1998).
Pells, P.J.N, Mostyn, G. and Walker, B.F. – Foundations on Sandstone and Shale in the Sydney Region. Australian Geomechanics Journal, No 33 Part 3, December 1998.

MACQUARIE GEOTECH

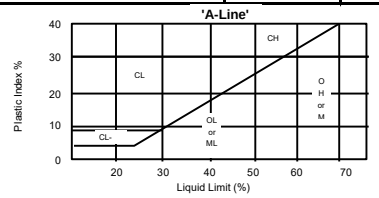
Summary of Soil Logging Procedures

Coarse Material: grain size - colour - particle shape - secondary components - minor constituents - moisture condition - relative density - origin - additional observations.

Fine Material: plasticity - colour - secondary components - minor constituents - moisture w.r.t. plasticity - consistency - origin - additional observations.

Guide to the Description, Identification and Classification of Soils

Major Divisions				SYMBOL	Typical Names
> 200mm	BOULDERS				
60 to 200mm	COBBLES				
COARSE GRAINED SOILS	More than 65% by dry mass less than 63mm is greater that 0.075mm	GRAVEL	More than 50% of coarse fraction > 2.36mm	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.
		Gravelly Soils		GM	Silty gravels, gravel-sand-silt mixtures.
				GC	Clayey gravels, gravel-sand-clay mixtures
		SANDS	More than 50% of coarse fraction < 2.36mm	SW	Well-graded sands, gravelly sands, little or no fines.
				SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
		Sandy Soils		SM	Silty sands, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	More than 35% by dry mass less than 60mm is less than 0.076mm	Liquid Limit < 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
				OL	Organic silts and organic silty clays of low plasticity.
		Liquid Limit > 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				Pt	Peat and other highly organic soils.



Grain sizes			
Gravel		Sand	
Coarse -	63 to 19mm	Coarse -	2.36 to 0.6mm
Medium -	19 to 6.7 mm	Medium -	0.6 to 0.21mm
Fine -	6.7 to 2.36mm	Fine -	0.21 to 0.075mm

GEOLOGICAL ORIGIN:-

Fill - artificial soils / deposits
Alluvial - soils deposited by the action of water
Aeolian - soils deposited by the action of wind
Topsoil - soils supporting plant life containing significant organic content
Residual - soils derived from insitu weathering of parent rock.
Colluvial - transported debris usually unsorted, loose and deposited

Field Identification of Fine Grained Soils - Silt or Clay?

Dry Strength - Allow the soil to dry completely and then test its strength by breaking and crumbling between the fingers.
High dry strength - Clays; Very slight dry strength - Silts.

Toughness Test - the soil is rolled by hand into a thread about 3mm in diameter. The thread is then folded and re-rolled repeatedly until it has dried sufficiently to break into lumps. In this condition inorganic clays are fairly stiff and tough while inorganic silts produce a weak and often soft thread which may be difficult to form and readily breaks and crumbles.

Dilatancy Test - Add sufficient water to the soil, held in the palm of the hand, to make it soft but not sticky. Shake horizontally, striking vigorously against the other hand several times. Dilatancy is indicated by the appearance of a shiny film on the surface of the soil. If the soil is then squeezed or pressed with the fingers, the surface becomes dull as the soil stiffens and eventually crumbles. These reactions are pronounced only for predominantly silt size material. Plastic clays give no reaction.

Descriptive Terms for Material Portions

COARSE GRAINED SOILS		FINE GRAINED SOILS	
% Fines	*Term/Modifier*	*% Coarse*	*Term/Modifier*
≤ 5	Omit, or use "trace"	≤ 15	Omit, or use "trace"
> 5, ≤ 12	"with clay/silt" as applicable	> 15, ≤ 30	"with sand/gravel" as applicable
> 12	Prefix soil as "silty/clayey"	> 30	Prefix as "sandy/gravelly"

Moisture Condition

for non-cohesive soils:

Dry -	runs freely through fingers.
Moist -	does not run freely but no free water visible on soil surface.
Wet -	free water visible on soil surface.

for cohesive soils:

MC > PL	Moisture content estimated to be greater than the plastic limit.
MC ~ PL	Moisture content estimated to be approximately equal to the plastic limit. The soil can be moulded
MC < PL	Moisture content estimated to be less than the plastic limit. The soil is hard and friable, or powdery.

The plastic limit (PL) is defined as the moisture content (percentage) at which the soil crumbles when rolled into threads of 3mm dia.

Consistency - For Clays & Silts

Description	*UCS(kPa)*	*Field guide to consistency*
Very soft	< 25	Exudes between the fingers when squeezed in hand
Soft	25 - 50	Can be moulded by light finger pressure
Firm	50 - 100	Can be moulded by strong finger pressure
Stiff	100 - 200	Cannot be moulded by fingers. Can be indented by thumb.
Very stiff	200 - 400	Can be indented by thumb nail
Hard	> 400	Can be indented with difficulty by thumb nail
Friable	-	Crumbles or powders when scraped by thumbnail

Relative Density for Gravels and Sands

Description	*SPT "N" Value*	*Density Index (ID) Range %*
Very loose	0 - 4	< 15
Loose	4 - 10	15 - 35
Medium dense	10 - 30	35 - 65
Dense	30 - 50	65 - 85
Very dense	> 50	> 85

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Summary of Rock Logging Procedures

Description order: constituents - rock name - grain size - colour - weathering - strength - minor constituents - additional observations.
- minor constituents - moisture w.r.t. plasticity - consistency - origin - additional observations.

Definition - Sedimentary Rock

Conglomerate	more than 50% of the rock consists of gravel (>2mm) sized fragments
Sandstone	more than 50% of the rock consists of sand (0.06 to 2mm) sized grains
Siltstone	more than 50% of the rock consists of silt sized granular particles and the rock is not laminated
Claystone	more than 50% of the rock consists of clay or mica material and the rock is not laminated
Shale	more than 50% of the rock consists of clay or silt sized particles and the rock is laminated

Weathering

Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a change in volume but the soil has not significantly transported.
Extremely Weathered	EW	Rock is weathered to such an extent that it has 'soil' properties; ie. it either disintegrates or can be remoulded, in water.
Distinctly Weathered	DW	**Highly Weathered (HW)** - Rock is wholly discoloured and rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals **Moderately Weathered (MW)** - The whole of the rock is discoloured, usually by iron staining and bleaching. Shows little or no change in rock strength.
Slightly Weathered	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition or staining.

Stratification

thinly laminated	<6mm	medium bedded	0.2 - 0.6m
laminated	6 - 20mm	thickly bedded	0.6 - 2m
very thinly bedded	20 - 60mm	very thickly bedded	>2m
thinly bedded	60mm - 0.2m		

Discontinuities

order of description: depth - type - orientation - spacing - roughness / planarity - thickness - coating

	Type	Class	Roughness/Planarity	Class	Roughness/Planarity
B	Bedding	I	rough or irregular, stepped	VI	slickensided, undulating
F	Fault	II	smooth, stepped	VII	rough or irregular, planar
C	Cleavage	III	slickensided, stepped	VIII	smooth, planar
J	Joint	IV	rough or irregular, undulating	IX	slickensided, planar
S	Shear Zone	V	smooth, undulating		
D	Drill break				

Rock Strength

Term		Is (50)	Field Guide
		0.03	
Very low	VL		Material crumbles under firm blows with sharp end of pick; can be peeled with knive. Pieces up to 30mm thick can be broken by finger pressure.
		0.1	
Low	L		A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
		0.3	
Medium	M		A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.
		1	
High	H		A piece of core 150 mm long x 50 mm dia. core cannot be broken by unaided hands, can be slightly scratched or scored with knife.
		3	
Very High	VH		A piece of core 150 mm long x 50 mm dia. May be broken readily with hand held hammer. Cannot be scratched with pen knife.
		10	
Extremely High	EH		A piece of core 150 mm long x 50 mm dia. Is difficult to break with hand held hammer. Rings when struck with a hammer.

* - rock strength defined by point load strength (Is 50) in direction normal to bedding

Degree of fracturing

fragmented	The core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter
highly fractured	Core lengths are generally less than 20mm - 40mm with occasional fragments.
fractured	Core lengths are mainly 30mm - 100mm with occasional shorter and longer lengths
slightly fractured	Core lengths are generally 300mm - 1000mm with occasional longer sections and shorter sections of 100mm -- 300mm.
unbroken	The core does not contain any fracture.

- spacing of all types of natural fractures, but not artificial breaks, in cored bores.

The fracture spacing is shown where applicable and the Rock Quality Designation is given by: RQD (%) = sum of unbroken core pieces 100 mm or longer

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Appendix B – Site Plan

148.135 148.136 148.137 148.138 148.139 148.140

-33.389 -33.390 -33.391 -33.392

PTP12 PTP5 PTP10 PTP4 PTP11 PTP6

N

Legend

B21615- Boreholes

MACQUARIE GEOTECH	Client: Parkes Shire Council			0 30 60 90 120 Metres - Scale 1:1200	JOB NO B21615
	Project: Forbes WTP				
	Location: Forbes, NSW			Vertical to Horizontal Scale 1 : 1 Co-ordinate Reference System - EPSG: 4326 WGS: 84	Macquarie Geotechnical Ltd Geotechnical Investigation Locality Map
3 Watt Drive, Bathurst NSW 2795 P: 02 6332 2011 F: 02 6334 4213 E: macgeo@macgeo.com.au	Drawn: D. Onyeaka	Checked: C. Green	01/11/2022		Drawing Number: B21615 - Rev0

MACQUARIE GEOTECH

Appendix C – Borehole Logs

MACQUARIE GEOTECH

Borehole No.
PTP4
Page 1 of 2

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	18/10/2022
Project Name:	Parkes BBRF	Completed:	18/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605661.0 m E 6304827.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	243.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information									Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T				D 0.10-0.50 m					NA	TOPSOIL Silty CLAY trace sand: low plasticity, dark brown; sand fine grained.	NA	NA		TOPSOIL
									CL-CI	Silty CLAY trace sand: low to medium plasticity, orange brown; sand fine grained.				0.00: hole position moved 20m north
				D 0.50-1.00 m					CL-CI	Silty CLAY trace sand: low to medium plasticity, brown; sand fine grained.				ALLUVIAL SOIL
						242.0	1							
									CL	Sandy Silty CLAY: low plasticity, orange; sand fine to coarse grained.		St		
				B 1.30-1.50 m x2 SPT 1.50-1.95 m 9,7,7 N=14							w<PL			
				D 2.00-2.50 m		241.0	2							
				D 2.50-3.00 m										
				SPT 3.00-3.45 m 1,2,2 N=4		240.0	3					F		
				D 3.50-4.00 m							w~PL to w>PL			
			18/10/22 10:00, seepage			239.0	4			Hole Terminated at 4.00 m Target depth				
						238.0	5							

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	18/10/2022
Project Name:	Parkes BBRF	Completed:	18/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605661.0 m E 6304827.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	243.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

PTP4 Depth Range: 1.50 - 1.95 m

PTP4 Depth Range: 3.00 - 3.45 m

MACQUARIE GEOTECH

Borehole No.
PTP5
Page 1 of 2

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	18/10/2022
Project Name:	Parkes BBRF	Completed:	18/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605771.0 m E 6304900.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	246.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information									Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T			Not Observed	D 0.10-0.50 m					NA	TOPSOIL Silty CLAY: low to medium plasticity, dark brown; with rootlets <5mm.	NA	NA		TOPSOIL
									CL-CI	Silty CLAY trace sand: low to medium plasticity, orange red, brown; sand fine grained.				ALLUVIAL SOIL
				D 0.50-1.00 m					CL-CI	Silty CLAY trace sand: low to medium plasticity, pale orange, brown; sand fine grained.				
						245.0	1							
				D 1.30-1.50 m										
				SPT 1.50-1.95 m 4,8,9 N=17					CI-CH	Silty CLAY trace sand: medium to high plasticity, orange, mottled grey; sand fine grained.				
				D 2.00-2.50 m		244.0	2				w<PL	VSt		
				D 2.50-3.00 m										
				SPT 3.00-3.45 m 2,6,12 N=18		243.0	3							
				D 3.50-4.00 m										
						242.0	4			Hole Terminated at 4.00 m Target depth				
						241.0	5							

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

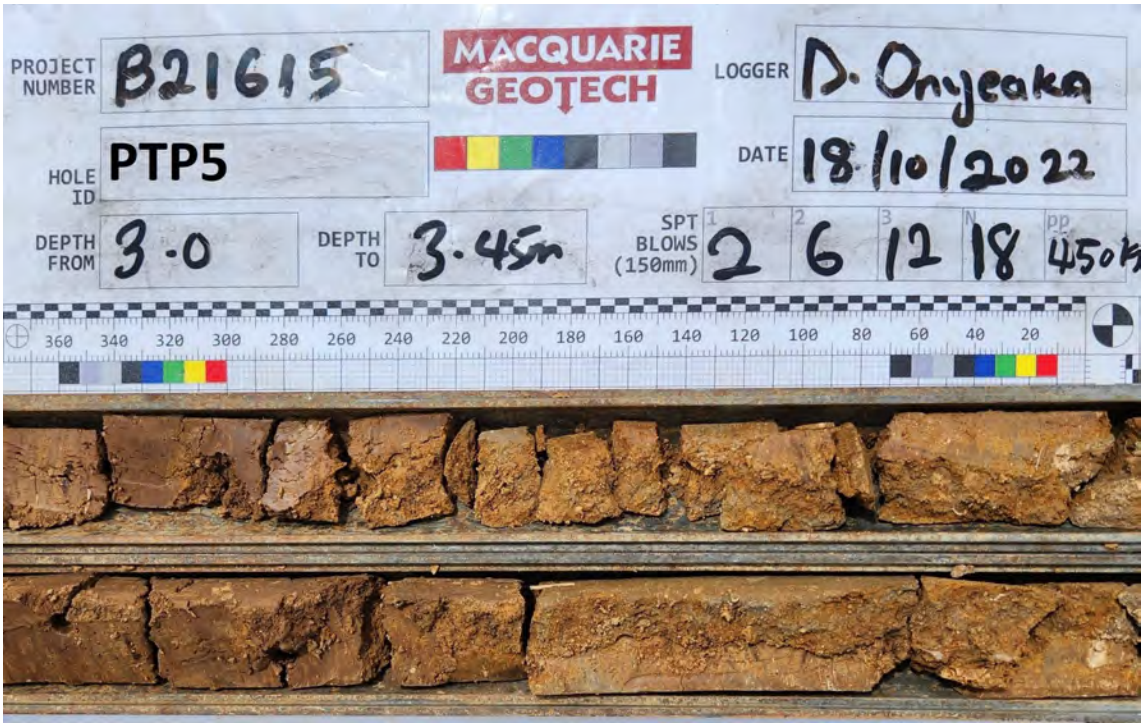
Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	18/10/2022
Project Name:	Parkes BBRF	Completed:	18/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605771.0 m E 6304900.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	246.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

PTP5 Depth Range: 1.50 - 1.95 m



PTP5 Depth Range: 3.00 - 3.45 m

MACQUARIE GEOTECH

Borehole No.
PTP6
Page 1 of 2

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	18/10/2022
Project Name:	Parkes BBRF	Completed:	18/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605707.0 m E 6304755.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	243.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information									Soil Description			Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T		Not Observed		D 0.10-0.50 m		242.0	1		NA	TOPSOIL Silty CLAY trace sand: low plasticity, dark brown; sand fine grained; with roots <5mm.	NA	NA		TOPSOIL
									CL	Silty CLAY trace sand: low plasticity, orange, brown; sand fine grained.				ALLUVIAL SOIL
				D 0.50-1.00 m					CL-CI	Silty CLAY trace sand: low to medium plasticity, orange brown; sand fine grained.				
				D 1.30-1.50 m SPT 1.50-1.95 m 10,13,18 N=31		241.0	2		CI-CH	Silty CLAY with sand: medium to high plasticity, orange brown; sand fine grained.		H	×	1.70: PP Samp =450 kPa
				D 2.00-2.50 m										
				D 2.50-3.00 m							w<PL			
				SPT 3.00-3.45 m 5,6,10 N=16		240.0	3					VSt	×	3.20: PP Samp =350 kPa
				D 3.50-4.00 m		239.0	4			Hole Terminated at 4.00 m Target depth				
						238.0	5							

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	18/10/2022
Project Name:	Parkes BBRF	Completed:	18/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605707.0 m E 6304755.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	243.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

PTP6 Depth Range: 1.50 - 1.95 m

PTP6 Depth Range: 3.00 - 3.45 m

MACQUARIE GEOTECH

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	18/10/2022
Project Name:	Parkes BBRF	Completed:	18/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Position:	605870.0 m E 6304895.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	248.00 m		
Hole Diameter:	250 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information | **Soil Description** | **Observations**

Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	DCP Blows/100mm	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T			Not Observed			248.0	0.0		NA	TOPSOIL Silty CLAY: low plasticity, Dark brown; with rootlets <1mm.	NA	NA			TOPSOIL
							0.1		CL	Silty CLAY: low plasticity, Dark brown.		St			ALLUVIAL SOIL
				B 0.30-0.50 m X2											
							0.5		CL-CI	Silty CLAY trace sand: low to medium plasticity, Orange brown and brown; sand fine grained.	w<PL	VSt			
				B 0.80-1.00 m X2											
						247.0	1.0			Hole Terminated at 1.00 m Target depth					

Method
AS - Auger Screwing
RR - Rock Roller
WB - Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

MACQUARIE GEOTECH

Borehole No.
PTP11
Page 1 of 5

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	19/10/2022
Project Name:	Parkes BBRF	Completed:	19/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605792.0 m E 6304829.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	247.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information									Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T				D 0.10-0.50 m					NA	TOPSOIL	NA	NA		TOPSOIL
									CI	Silty CLAY trace sand: low to medium plasticity, dark brown; sand fine grained; with rootlets <5mm.				ALLUVIAL SOIL
				D 0.50-1.00 m						Silty CLAY trace sand: medium plasticity, orange brown; sand fine grained.				
				D 1.00-1.50 m		246.0	1							
				SPT 1.50-1.95 m 5,7,9 N=16					CI-CH	Silty CLAY with sand: medium to high plasticity, orange, brown, grey; sand fine grained.			×	1.70: PP Samp =280 kPa
				D 2.00-2.50 m		245.0	2							
				D 2.50-3.00 m										
				SPT 3.00-3.45 m 8,12,13 N=25		244.0	3				w<PL	VSt	×	3.20: PP Samp =450 kPa
				D 3.50-4.00 m					CI	Silty CLAY with sand trace gravel: medium plasticity, pale orange, grey; sand fine to medium grained; gravel fine to coarse grained, sub-angular to angular; trace organics.				
				D 4.00-4.50 m		243.0	4							
				SPT 4.50-4.95 m 4,8,12 N=20									×	4.70: PP Samp =400 kPa
				D 5.00-5.50 m		242.0	5		CL-CI	Sandy Silty CLAY: low to medium plasticity, orange, grey; sand fine to coarse grained.				
				D 5.50-6.00 m										

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

MACQUARIE GEOTECH

Borehole No.
PTP11
Page 2 of 5

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	19/10/2022
Project Name:	Parkes BBRF	Completed:	19/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605792.0 m E 6304829.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	247.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information								Soil Description			Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density / Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T			19/10/22 16:00	SPT 6.00-6.45 m 7,12,15 N=27					CL-CI	Sandy Silty CLAY: low to medium plasticity, orange, grey; sand fine to coarse grained. *(continued)*		VSt	ALLUVIAL SOIL 6.20: PP Samp =350 kPa
				D 6.50-7.00 m					CL-CI	Sandy Silty CLAY trace gravel: low to medium plasticity, pale orange brown, grey; sand fine to coarse grained; gravel fine to coarse grained, sub-angular to angular.	w<PL	H	
				D 7.00-7.50 m		240.0	7						
				SPT 7.50-7.95 m 15,21,24 N=45					CL-CI	Silty CLAY trace gravel: low to medium plasticity, orange, grey; gravel fine to coarse grained, sub-angular to angular; trace organics.			
						239.0	8			Hole Terminated at 8.00 m Target depth			
						238.0	9						
						237.0	10						
						236.0	11						

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	19/10/2022
Project Name:	Parkes BBRF	Completed:	19/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605792.0 m E 6304829.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	247.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

PTP11 Depth Range: 1.50 - 1.95 m

PTP11 Depth Range: 3.00 - 3.45 m

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	19/10/2022
Project Name:	Parkes BBRF	Completed:	19/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605792.0 m E 6304829.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	247.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

PTP11 Depth Range: 4.50 - 4.95 m

PTP11 Depth Range: 6.00 - 6.45 m

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	19/10/2022
Project Name:	Parkes BBRF	Completed:	19/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605792.0 m E 6304829.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	247.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

PTP11 Depth Range: 7.50 - 7.95 m

MACQUARIE GEOTECH

Borehole No.
PTP12
Page 1 of 5

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	19/10/2022
Project Name:	Parkes BBRF	Completed:	19/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605716.0 m E 6304957.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	246.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information									Soil Description			Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density / Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T		C		D 0.10-0.50 m					NA		NA	NA	TOPSOIL
									CL-CI	TOPSOIL Silty CLAY trace sand: low plasticity, dark brown; sand fine to medium grained; with rootlets <5mm.			ALLUVIAL SOIL
				D 0.50-1.00 m						Silty CLAY trace sand: low to medium plasticity, orange brown; sand fine to medium grained.			
				D 1.00-1.50 m		245.0	1					St	
				SPT 1.50-1.95 m 2,3,6 N=9					CI-CH	Silty CLAY trace sand: medium to high plasticity, orange brown; sand fine to medium graned.			1.70: PP Samp =310 kPa
				D 2.00-2.50 m		244.0	2						
				D 2.50-3.00 m									
				SPT 3.00-3.45 m 4,7,11 N=18		243.0	3				w<PL		3.20: PP Samp =520 kPa
				D 3.50-4.00 m					CI-CH	Silty CLAY trace gravel trace sand: medium to high plasticity, orange brown, grey; gravel fine to coarse grained, sub-angular to angular; sand fine grained.			
				D 4.00-4.50 m		242.0	4					VSt	
				SPT 4.50-4.95 m 5,6,11 N=17									4.70: PP Samp =470 kPa
				D 5.00-5.50 m		241.0	5		CI-CH	Sandy Silty CLAY trace gravel: medium to high plasticity, orange, grey; sand fine to coarse grained; gravel fine to coarse grained, sub-angular to angular.			
				D 5.50-6.00 m									

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very Soft
S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
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Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

MACQUARIE GEOTECH

Borehole No.
PTP12
Page 2 of 5

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	19/10/2022
Project Name:	Parkes BBRF	Completed:	19/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605716.0 m E 6304957.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	246.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

Drilling Information							Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency Relative Density / Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
AD/T			19/10/22 13:00	SPT 6.00-6.45 m 7,11,17 N=28					CL-CI	Sandy Silty CLAY: low to medium plasticity, orange, grey; sand fine to coarse grained.		VSt	ALLUVIAL SOIL
				D 6.50-7.00 m									6.20: PP Samp =250 kPa
									CL	Sandy Silty CLAY: low plasticity, orange, grey; sand fine to coarse grained.			
				D 7.00-7.50 m		239.0	7				w<PL	H	
				SPT 7.50-7.95 m 13,14,23 N=37									7.70: PP Samp =110 kPa
						238.0	8			Hole Terminated at 8.00 m Target depth			
						237.0	9						
						236.0	10						
						235.0	11						

Method
AS - Auger Screwing
RR - Rock Roller
WB- Washbore

Penetration
No resistance ranging to refusal

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test

Moisture Condition
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M - Moist
W - Wet

Consistency/Relative Density
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S - Soft
F - Firm
VSt - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Support
C - Casing

Graphic Log/Core Loss
Core recovered (hatching indicates material)
Core loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
< PL
= PL
< PL

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	19/10/2022
Project Name:	Parkes BBRF	Completed:	19/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605716.0 m E 6304957.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	246.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

PTP12 Depth Range: 1.50 - 1.95 m

PTP12 Depth Range: 3.00 - 3.45 m

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	19/10/2022
Project Name:	Parkes BBRF	Completed:	19/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605716.0 m E 6304957.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	246.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

PTP12 Depth Range: 4.50 - 4.95 m

PTP12 Depth Range: 6.00 - 6.45 m

Engineering Log - Borehole

Project No.: B21615

Client:	Parkes Shire Council	Commenced:	19/10/2022
Project Name:	Parkes BBRF	Completed:	19/10/2022
Hole Location:	Pre-treatment Plant - Forbes	Logged By:	D.Onyeaka
Hole Coordinates:	605716.0 m E 6304957.0 m N MGA94 Zone 55	Checked By:	D.O'Donnell

Drill Model and Mounting:	Christie	Inclination:	-90°	RL Surface:	246.00 m		
Hole Diameter:	115 mm	Bearing:		Datum:	AHD	Operator:	K. Christiansen

PTP12 Depth Range: 7.50 - 7.95 m

Appendix D – Laboratoty Test Results

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-26**
Issue Number: 1
Date Issued: 21/11/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 947
Sample Number: BTH-947A
Date Sampled: 18/10/2022
Dates Tested: 24/10/2022 - 14/11/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **PTP6 (BH04) 1.30-1.50m**
Lot No: **B21615-PSC-BBRF**

Falling Head Permeability (AS 1289 6.7.2 & 2.1.1)		Min	Max
Coefficient of Permeability (m/sec)	$1x10^{-10}$		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.78		
Optimum Moisture Content (%)	17.0		
Field Moisture Content (%)	17.2		
Sieve for Oversize (mm)	19.0		
Oversize Material (%)	0.0		
Laboratory Density Ratio (%)	99.9		
Laboratory Moisture Ratio (%)	99.0		
Surcharges and Pressure Applied	-		

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-26**
Issue Number: 1
Date Issued: 21/11/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 947
Sample Number: BTH-947B
Date Sampled: 18/10/2022
Dates Tested: 24/10/2022 - 21/11/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **PTP4 (BH03) 1.30-1.50m**
Lot No: **B21615-PSC-BBRF**

Falling Head Permeability (AS 1289 6.7.2 & 2.1.1)		Min	Max
Coefficient of Permeability (m/sec)	$6x10^{-10}$		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Maximum Dry Density (t/m^3)	1.84		
Optimum Moisture Content (%)	12.5		
Field Moisture Content (%)	9.7		
Sieve for Oversize (mm)	19.0		
Oversize Material (%)	0.0		
Laboratory Density Ratio (%)	99.7		
Laboratory Moisture Ratio (%)	99.0		
Surcharges and Pressure Applied	-		

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-26**
Issue Number: 1
Date Issued: 21/11/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 947
Sample Number: BTH-947D
Date Sampled: 18/10/2022
Dates Tested: 24/10/2022 - 15/11/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **PTP10 (BH01) 0.30-0.50m**
Lot No: **B21615-PSC-BBRF**

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**0.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Material Source Records		
Maximum Dry Density (t/m^3)	1.56		
Optimum Moisture Content (%)	23.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Moisture Content at Placement (%)	23.5		
Moisture Content Top 30mm (%)	23.3		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	69.6		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
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Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-26**
Issue Number: 1
Date Issued: 21/11/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 947
Sample Number: BTH-947E
Date Sampled: 18/10/2022
Dates Tested: 24/10/2022 - 14/11/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **PTP10 (BH01) 0.80-1.00m**
Lot No: **B21615-PSC-BBRF**

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	45		
Plastic Limit (%)	17		
Plasticity Index (%)	**28**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**15.0**		
Cracking Crumbling Curling	Curling		

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-26**
Issue Number: 1
Date Issued: 21/11/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 947
Sample Number: BTH-947H
Date Sampled: 19/10/2022
Dates Tested: 24/10/2022 - 09/11/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **PTP11 (BH05) 2.00-2.50m**
Lot No: **B21615-PSC-BBRF**

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	-		
Nature of Water	DISTILLED		
Temperature of Water (^{o}C)	18		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	16.2

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-26**
Issue Number: 1
Date Issued: 21/11/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 947
Sample Number: BTH-947I
Date Sampled: 19/10/2022
Dates Tested: 24/10/2022 - 14/11/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **PTP12 (BH06) 0.50-1.00m**
Lot No: **B21615-PSC-BBRF**

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	28		
Plastic Limit (%)	15		
Plasticity Index (%)	**13**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**11.0**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	20.4

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-26**
Issue Number: 1
Date Issued: 21/11/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 947
Sample Number: BTH-947J
Date Sampled: 19/10/2022
Dates Tested: 24/10/2022 - 09/11/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **PTP12 (BH06) 1.00-1.50m**
Lot No: **B21615-PSC-BBRF**

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	-		
Nature of Water	DISTILLED		
Temperature of Water (^{o}C)	18		

Material Test Report

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Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number:	**B22068-26**
Issue Number:	1
Date Issued:	21/11/2022
Client:	Macquarie Geotechnical
	3 Watt Drive, Bathurst NSW 2795
Contact:	John Boyle
Project Number:	B22068
Project Name:	GEO/Drillers - Bathurst Laboratory Testing
Work Request:	947
Sample Number:	BTH-947K
Date Sampled:	19/10/2022
Dates Tested:	24/10/2022 - 01/11/2022
Sampling Method:	Sampled by Client
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**PTP12 (BH06) 4.00-4.50m**
Lot No:	**B21615-PSC-BBRF**

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	20.2

Material Test Report

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3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

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Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-26**
Issue Number: 1
Date Issued: 21/11/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 947
Sample Number: BTH-947L
Date Sampled: 17/10/2022
Dates Tested: 24/10/2022 - 14/11/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **PTP5 (BH02) 3.50-4.00m**
Lot No: **B21615-PSC-BBRF**

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	36		
Plastic Limit (%)	14		
Plasticity Index (%)	**22**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.0**		
Cracking Crumbling Curling	Cracking		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	-		
Nature of Water	DISTILLED		
Temperature of Water (^{o}C)	18		

Material Test Report

Macquarie Geotechnical Pty Ltd
Bathurst Laboratory
3 Watt Drive Bathurst NSW 2795
Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number:	**B22068-26**
Issue Number:	1
Date Issued:	21/11/2022
Client:	Macquarie Geotechnical
	3 Watt Drive, Bathurst NSW 2795
Contact:	John Boyle
Project Number:	B22068
Project Name:	GEO/Drillers - Bathurst Laboratory Testing
Work Request:	947
Sample Number:	BTH-947M
Date Sampled:	17/10/2022
Dates Tested:	24/10/2022 - 01/11/2022
Sampling Method:	Sampled by Client
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Sample Location:	**PTP5 (BH02) 2.00-2.50m**
Lot No:	**B21615-PSC-BBRF**

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	

Material Test Report

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Bathurst Laboratory
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Phone: (02) 6332 2011
Email: macgeo@macgeo.com.au

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Approved Signatory: Barry Froebel
Laboratory Manager
NATA Accredited Laboratory Number: 14874

Report Number: **B22068-26**
Issue Number: 1
Date Issued: 21/11/2022
Client: Macquarie Geotechnical
3 Watt Drive, Bathurst NSW 2795
Contact: John Boyle
Project Number: B22068
Project Name: GEO/Drillers - Bathurst Laboratory Testing
Work Request: 947
Sample Number: BTH-947N
Date Sampled: 18/10/2022
Dates Tested: 24/10/2022 - 14/11/2022
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Sample Location: **PTP6 (BH04) 2.00-2.50m**
Lot No: **B21615-PSC-BBRF**

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	40		
Plastic Limit (%)	18		
Plasticity Index (%)	**22**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.0**		
Cracking Crumbling Curling	Curling		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	-		
Nature of Water	DISTILLED		
Temperature of Water (^{o}C)	18		

MOISTURE CONTENT TEST REPORT

Client	Parkes Shire Council	**Job #**	S22105-1
Address	Parkes NSW 2870	**Report #**	S81543-MC
Project	B21615-Parkes Shire Council-BBRF		

Test Procedure

- ☑ AS 1289 2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method).
- ☐ AS4133 1.1.1 Determination of the moisture content of rock - Oven drying method (standard method)
- ☐ RMS T120 Moisture content of road construction materials (Standard method)
- ☐ RMS T262 Determination of moisture content of aggregates (Standard method)

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 18/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 17/11/2022

Sample #	Source	Sample Description	Moisture Content %
S81543	PTP5 BH02 2.00-2.50m	Silty CLAY with Sand	**16.0**

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

18/11/2022

Date:

Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

Permeability of Soil - Constant Head Method Using a Flexible Wall Permeameter Report

Client	Parkes Shire Council	**Source**	PTP5 BH02 1.30-1.50m
Address	Parkes NSW 2870	**Sample Description**	Silty CLAY
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S81539-TP
Job No	S22105-1	**Lab No**	S81539 (BTH-947C)

Test Procedure	AS 1289 6.7.3 Determination of permeability of soil-Constant head method using a flexible wall permeameter		
Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	18/10/2022
Preparation	Prepared in accordance with the test method	**Date Tested**	22/11/2022

Test Details	
Specimen Type	Remoulded
Remoulding Details	100% of SMDD at 100% of SOMC
Tested Portion	-9.5 mm
Permeant Type	Sydney Tap Water

Specimen Details	
Percent Retained on 37.5 mm Sieve (%)	0
Maximum Dry Density (t/m^3)	1.68
Optimum Moisture Content (%)	21.2
Test Moisture Content (%)	21.2
Moisture Ratio (%)	100.0
Test Dry Density (t/m^3)	1.68
Density Ratio (%)	100.0
Specimen Length (mm)	70.2
Specimen Diameter (mm)	70.3
Length to Diameter Ratio	1.0

Test Data	
Confining Pressure (kPa)	550
Back Pressure (kPa)	500
Mean Effective Stress (kPa)	50
Coefficient of Permeability k(20) (m/second)	**1E-10**

Notes

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Authorised Signatory: Date:

22/11/2022

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14 Carter St
Lidcombe NSW 2141

Permeability of Soil - Constant Head Method Using a Flexible Wall Permeameter Report

Client	Parkes Shire Council	**Source**	PTP10 BH01 0.80-1.00m
Address	Parkes NSW 2870	**Sample Description**	Silty CLAY
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S81540-TP
Job No	S22105-1	**Lab No**	S81540 (BTH-947E)

Test Procedure	AS 1289 6.7.3 Determination of permeability of soil-Constant head method using a flexible wall permeameter		
Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	18/10/2022
Preparation	Prepared in accordance with the test method	**Date Tested**	22/11/2022

Test Details	
Specimen Type	Remoulded
Remoulding Details	100% of SMDD at 100% of SOMC
Tested Portion	-9.5 mm
Permeant Type	Sydney Tap Water

Specimen Details	
Percent Retained on 37.5 mm Sieve (%)	0
Maximum Dry Density (t/m^3)	1.66
Optimum Moisture Content (%)	25.1
Test Moisture Content (%)	25.1
Moisture Ratio (%)	100.0
Test Dry Density (t/m^3)	1.66
Density Ratio (%)	100.0
Specimen Length (mm)	70.2
Specimen Diameter (mm)	70.2
Length to Diameter Ratio	1.0

Test Data	
Confining Pressure (kPa)	550
Back Pressure (kPa)	500
Mean Effective Stress (kPa)	50
Coefficient of Permeability k(20) (m/second)	**2E-10**

Notes

NATA Accredited Laboratory Number: 14874

Authorised Signatory: Chris Lloyd

Date: 22/11/2022

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14 Carter St
Lidcombe NSW 2141

Pinhole Dispersion Classification Report

Client	Parkes Shire Council	**Source**	PTP11 BH05 0.50-1.00m
Address	Parkes NSW 2870	**Sample Description**	Silty CLAY
Project	B21615-Parkes Shire Council-BBRF	**Report No.**	S81541-PH
Job No.	S22105-1	**Sample No.**	S81541 (BTH-947F)

Test Procedure ☑ AS1289 3.8.3 Soil classification tests - Dispersion - Determination of pinhole dispersion classification of a soil

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 18/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 22/11/2022

Pinhole Dispersion Results

Pinhole Dispersion Classification	**ND1 Non-dispersive**
Final Rate of Flow through specimen (ml/s)	3.39
Natural Moisture Content (%)	18.9
Test Moisture Content (%)	14.2
Test Wet Density (t/m^3)	2.091
Time Sample Cured in Soil Specimen Cylinder (Hours)	24
Method of Moisture Determination for Remoulding	Plastic Limit
Source of Water	Distilled
Hole Reformed at 50mm Head (Yes / No)	Yes

Notes

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

23/11/2022

Date:

Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

Particle Size Distribution with Hydrometer Report

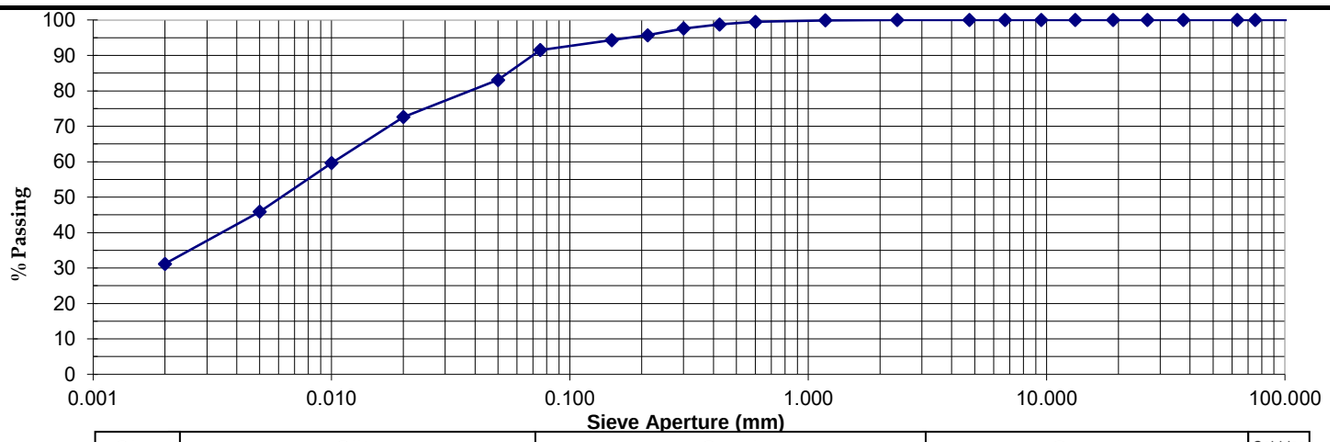
Client	Parkes Shire Council	**Source**	PTP11 BH05 1.00-1.50m
Address	Parkes NSW 2870	**Sample Description**	Silty CLAY, trace of Sand
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S81542-HYD
Job No	S22105-1	**Lab No**	S81542 (BTH-947G)

Test Procedure AS1289.3.6.3 Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer

AS1289.3.6.1 Determination of particle size distribution of a soil standard method sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 18/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 17/11/2022



Clay	Silt	Sand	Gravel	Cobbles

Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	-		1.180	100	
75	-		0.600	99	
63	-		0.425	99	
37.5	-		0.300	98	
26.5	-		0.212	96	
19.0	-		0.150	94	
13.2	-		0.075	91	
9.5	-		0.050	83	
6.7	-		0.020	73	
4.75	-		0.010	60	
2.36	100		0.005	46	
			0.002	31	

Loss in Pre-treatment of Material (%):	0	Particle Density (t/m^3):	2.65
Method of Dispersion:	Sodium Hexametaphosphate / Sodium Carbonate	Assumed	
Method of Preparation:	As received from natural state	Hydrometer Type:	ASTM E100

Notes

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Chris Lloyd

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Lidcombe NSW 2141

Particle Size Distribution with Hydrometer Report

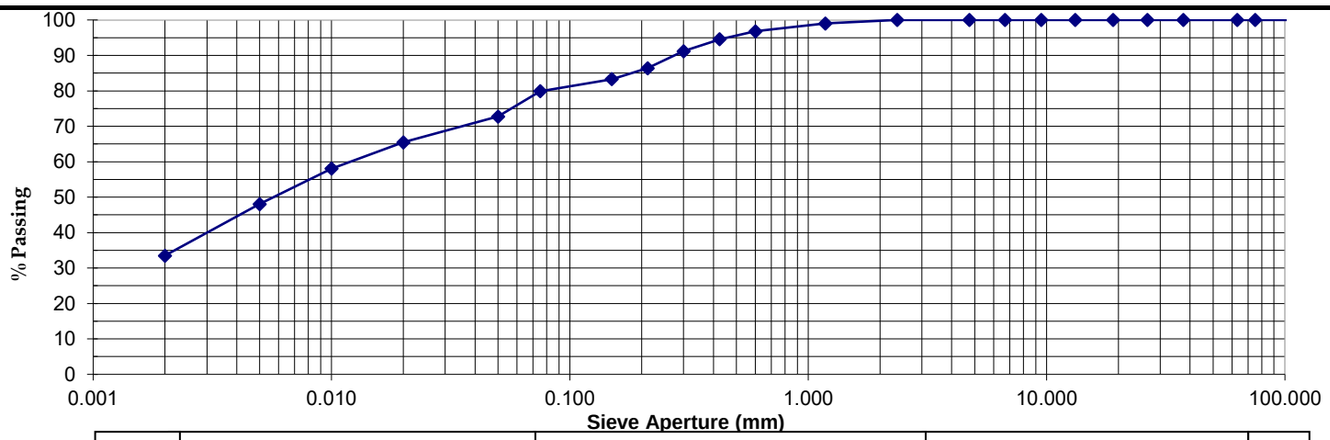
Client	Parkes Shire Council	**Source**	PTP5 BH02 2.00-2.50m
Address	Parkes NSW 2870	**Sample Description**	Silty CLAY with Sand
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S81543-HYD
Job No	S22105-1	**Lab No**	S81543 (BTH-947M)

Test Procedure AS1289.3.6.3 Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer

AS1289.3.6.1 Determination of particle size distribution of a soil standard method sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 18/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 17/11/2022



Clay	Silt	Sand	Gravel	Cobbles

Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	-		1.180	99	
75	-		0.600	97	
63	-		0.425	95	
37.5	-		0.300	91	
26.5	-		0.212	86	
19.0	-		0.150	83	
13.2	-		0.075	80	
9.5	-		0.050	73	
6.7	-		0.020	65	
4.75	-		0.010	58	
2.36	100		0.005	48	
			0.002	34	

Loss in Pre-treatment of Material (%):	0	Particle Density (t/m^3):	2.65
Method of Dispersion:	Sodium Hexametaphosphate / Sodium Carbonate	Assumed	
Method of Preparation:	As received from natural state	Hydrometer Type:	ASTM E100

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Lidcombe NSW 2141

Particle Size Distribution with Hydrometer Report

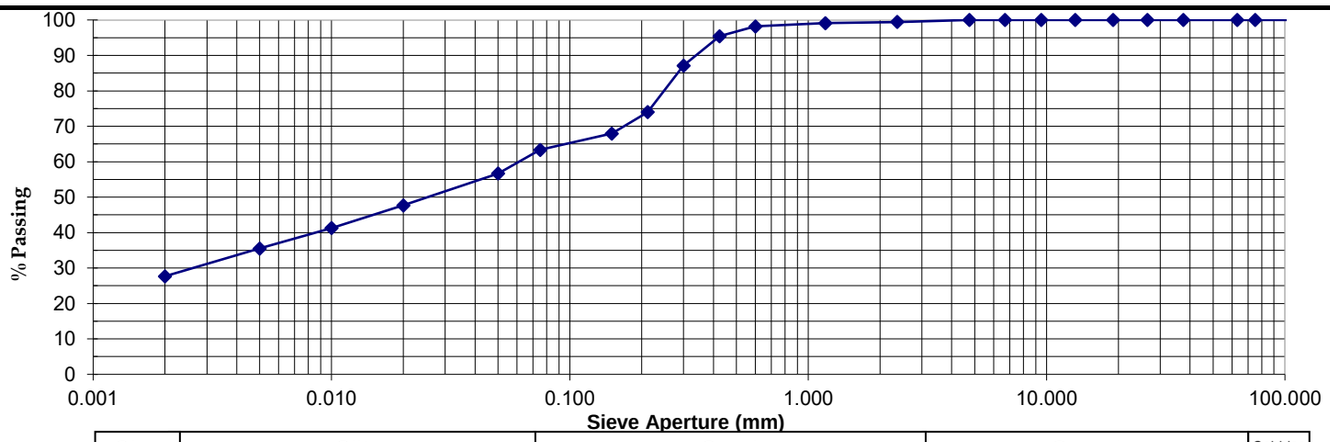
Client	Parkes Shire Council	**Source**	PTP11 BH05 5.50-6.00m
Address	Parkes NSW 2870	**Sample Description**	Silty Sandy CLAY, trace of Gravel
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S81544-HYD
Job No	S22105-1	**Lab No**	S81544 (BTH-947O)

Test Procedure AS1289.3.6.3 Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer

AS1289.3.6.1 Determination of particle size distribution of a soil standard method sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 18/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 17/11/2022



Clay	Silt	Sand	Gravel	Cobbles

Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	-		1.180	99	
75	-		0.600	98	
63	-		0.425	95	
37.5	-		0.300	87	
26.5	-		0.212	74	
19.0	-		0.150	68	
13.2	-		0.075	63	
9.5	-		0.050	57	
6.7	-		0.020	48	
4.75	100		0.010	41	
2.36	99		0.005	36	
			0.002	28	

Loss in Pre-treatment of Material (%):	0	Particle Density (t/m^3):	2.65
Method of Dispersion:	Sodium Hexametaphosphate / Sodium Carbonate	Assumed	
Method of Preparation:	As received from natural state	Hydrometer Type:	ASTM E100

Notes

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Authorised Signatory: Date:

18/11/2022

Chris Lloyd

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Lidcombe NSW 2141

Particle Size Distribution with Hydrometer Report

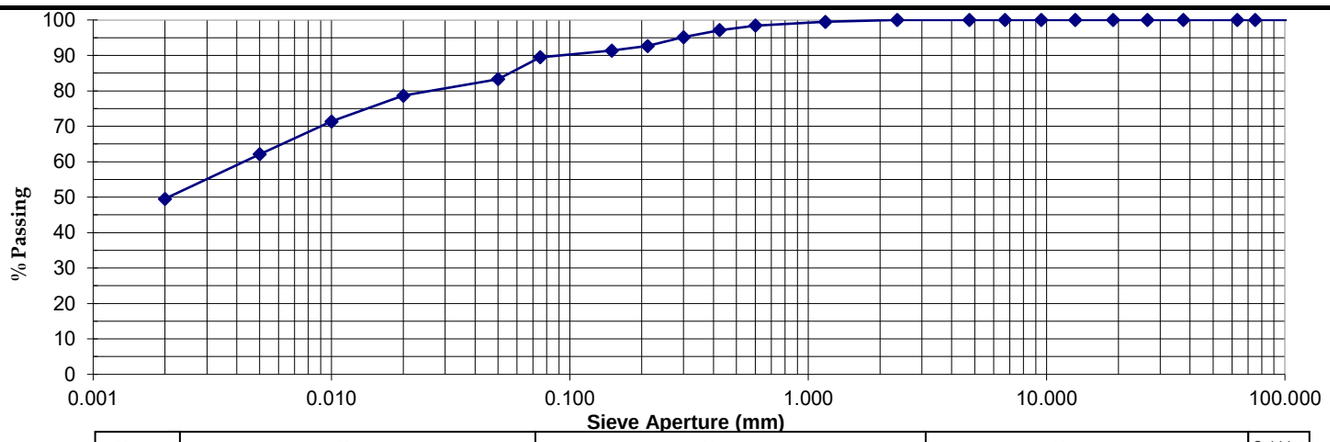
Client	Parkes Shire Council	**Source**	PTP12 BH06 3.50-4.00m
Address	Parkes NSW 2870	**Sample Description**	Silty CLAY, trace of Sand
Project	B21615-Parkes Shire Council-BBRF	**Report No**	S81545-HYD
Job No	S22105-1	**Lab No**	S81545 (BTH-947P)

Test Procedure AS1289.3.6.3 Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer

AS1289.3.6.1 Determination of particle size distribution of a soil standard method sieving

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** 18/10/2022

Preparation Prepared in accordance with the test method **Date Tested** 17/11/2022



Clay	Silt	Sand	Gravel	Cobbles

Sieve Aperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	-		1.180	99	
75	-		0.600	98	
63	-		0.425	97	
37.5	-		0.300	95	
26.5	-		0.212	93	
19.0	-		0.150	91	
13.2	-		0.075	89	
9.5	-		0.050	83	
6.7	-		0.020	79	
4.75	-		0.010	71	
2.36	100		0.005	62	
			0.002	50	

Loss in Pre-treatment of Material (%):	0	Particle Density (t/m^3):	2.65
Method of Dispersion:	Sodium Hexametaphosphate / Sodium Carbonate	Assumed	
Method of Preparation:	As received from natural state	Hydrometer Type:	ASTM E100

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory: Date:

18/11/2022

Chris Lloyd

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Macquarie Geotechnical

14 Carter St
Lidcombe NSW 2141

Appendix C Aboriginal Due Diligence Report

View of the study area during the visual inspection.

ABORIGINAL DUE DILIGENCE ASSESSMENT REPORT

PROPOSED LACHLAN RIVER PRE-TREATMENT PLANT

FORBES NSW

NOVEMBER 2022

Report prepared by

OzArk Environment & Heritage

for Parkes Shire Council

OzArk
Environment & Heritage

145 Wingewarra St
(PO Box 2069)
Dubbo NSW 2830

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DOCUMENT CONTROLS

Proponent	Parkes Shire Council
Document Description	Aboriginal Due Diligence Report: Proposed Lachlan River Pre-Treatment Plant
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Clients\Parkes Shire Council\Parkes BBRF Archaeological TFF August 2022\Forbes Report	3531

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Final V3: Final document	V3.0 final 21/11/22
Prepared for	Prepared by
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Acknowledgement

OzArk acknowledge the traditional custodians of the area on which this assessment took place and pay respect to their beliefs, cultural heritage, and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the Elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

EXECUTIVE SUMMARY

OzArk Environment & Heritage (OzArk) has been engaged by the Parkes Shire Council (PSC) to complete an Aboriginal heritage due diligence assessment for the proposed construction of a Pre-Treatment Plant, east of Forbes adjacent to the Lachlan River. The proposed works are part of the Building Better Regions Fund for regional NSW and will be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*.

The study area is situated on a flat, cleared paddock approximately 14 kilometres east of Forbes, NSW. The proposed Pre-Treatment Plant (PTP) will be situated directly adjacent to the Lachlan River. There is one previously recorded Aboriginal site (Lachlan River PSC OS1 with PAD, AHIMS ID# 43-3-0108) located at the south of the study area.

The visual inspection of the study area was completed by OzArk archaeologists Harrison Rochford and Jordan Henshaw on 28 September 2022. Rob Clegg, Peter Clegg and Mick Dunn of the Wiradjuri Council of Elders assisted with the inspection.

Part of the study area was the subject of an Aboriginal Heritage Impact Permit (AHIP) in early 2015, under which a salvage program removed observable Aboriginal objects from the site Lachlan River PSC OS1 with PAD. Consequently only a portion of this site remains valid within the PTP study area. Inspection of this site area, and the study area as a whole, has concluded that the ground surface has been heavily impacted by decades of agricultural activities and the construction of water management infrastructure. Further, OzArk have relied on test excavation results covering this landform, adjacent to the study area, that indicated no sub-surface Aboriginal objects were present (Ecological 2022). As a result, it is assessed that there is a low likelihood for intact subsurface archaeological deposits to be present within the study area.

The undertaking of the due diligence process resulted in the conclusion that the proposed works will have an impact on the ground surface, however, no Aboriginal objects or intact archaeological deposits will be harmed by the proposal. This moves the proposal to the following outcome:

> *AHIP application not necessary. Proceed with caution. If any Aboriginal objects are found, stop work, and notify Heritage NSW (02) 98738500 (heritagemailbox@environment.nsw.gov.au). If human remains are found, stop work, secure the site, and notify NSW Police and Heritage NSW.*

To ensure the greatest possible protection to the area's Aboriginal cultural heritage values, the following recommendations are made:

1) The proposed work may proceed without further archaeological investigation under the following conditions:

    a) All land and ground disturbance activities must be confined to within the study area, as this will eliminate the risk of harm to Aboriginal objects in adjacent

landforms. Should the parameters of the proposal extend beyond the assessed areas, then further archaeological assessment may be required.

b) All staff and contractors involved in the proposed work should be made aware of the legislative protection requirements for all Aboriginal sites and objects.

2) OzArk must issue a site card update for Lachlan River PSC OS1 with PAD (AHIMS ID# 43-3-0108) documenting the results of this assessment and revising the site extent as shown in **Section 2.5**.

3) This assessment has concluded that there is a low likelihood that the proposed work will adversely harm Aboriginal cultural heritage items or sites. If during works, however, Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the *Unanticipated Finds Protocol* (**Appendix 2**) should be followed.

4) Inductions for work crews should include a cultural heritage awareness procedure to ensure they recognise Aboriginal artefacts (see **Appendix 3**) and are aware of the legislative protection of Aboriginal objects under the *National Parks and Wildlife Act 1974* and the contents of the *Unanticipated Finds Protocol.*

5) The information presented here meets the requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. It should be retained as shelf documentation for five years as it may be used to support a defence against prosecution in the event of unanticipated harm to Aboriginal objects.

CONTENTS

FIGURES

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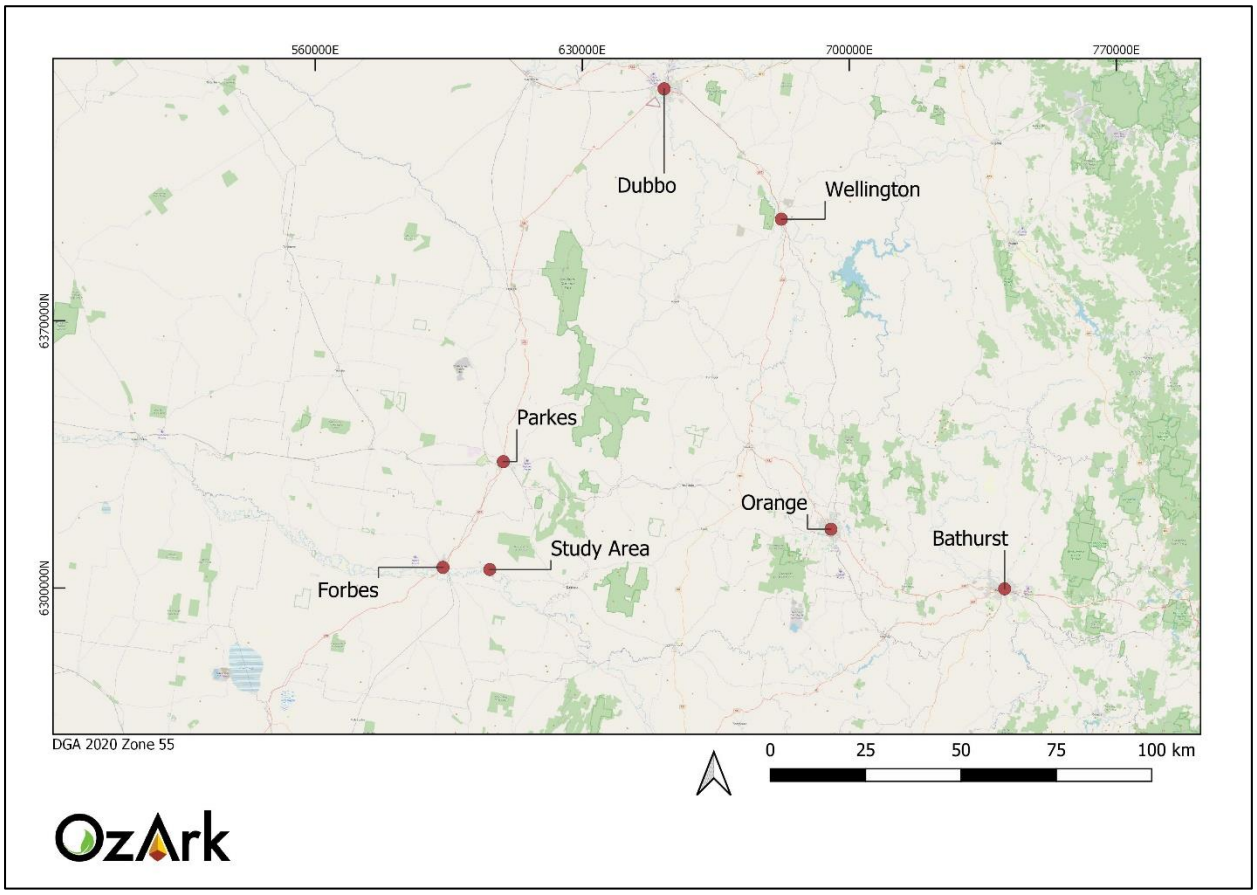
PLATES

1 INTRODUCTION

1.1 BRIEF DESCRIPTION OF THE PROPOSAL

OzArk Environment & Heritage (OzArk) has been engaged by Parkes Shire Council (the proponent) to complete an Aboriginal heritage due diligence assessment for the construction of the proposed Lachlan River Pre-Treatment Plant (the proposal). The proposal is in the Forbes Shire Council Local Government Area (LGA) **(Figure 1-1)**.

Figure 1-1. Map showing the location of the proposal.

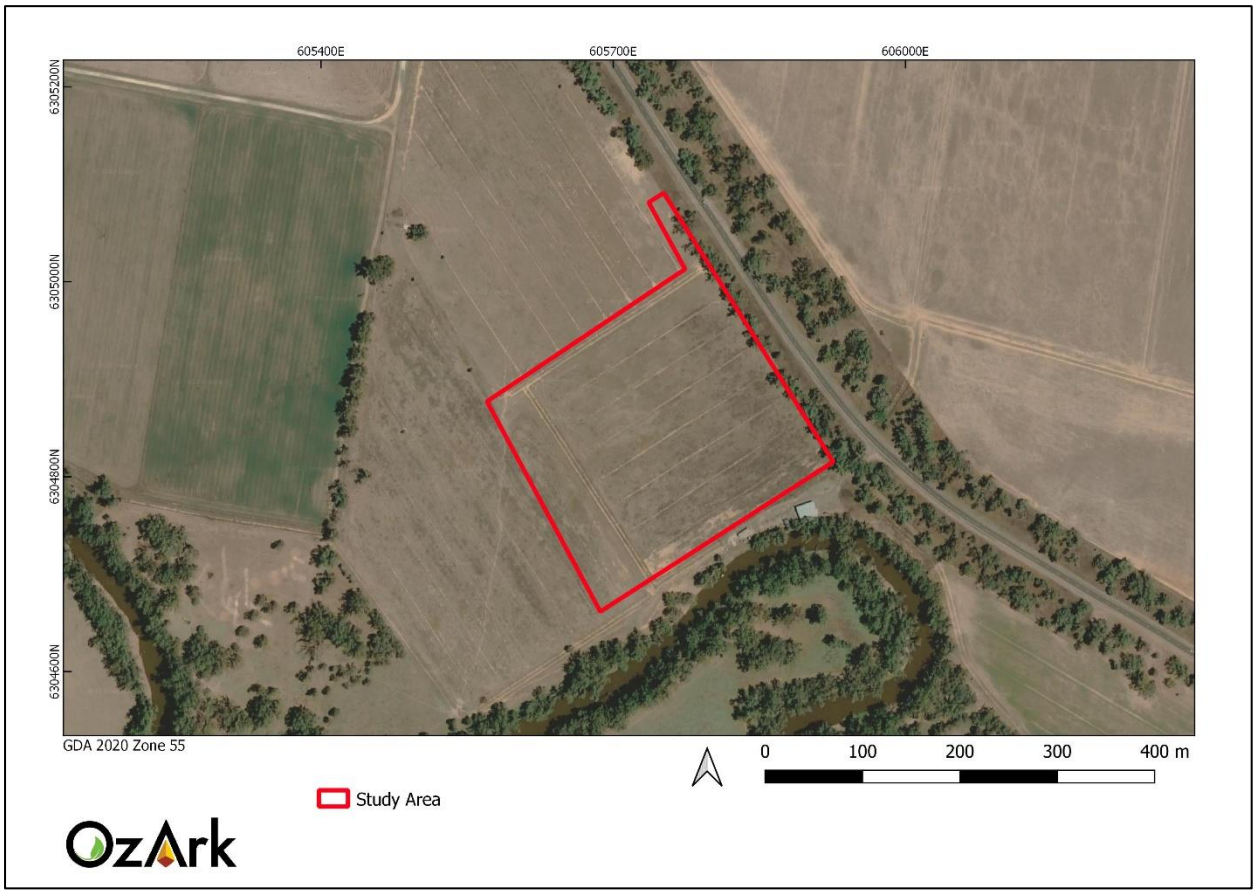


1.2 STUDY AREA

The study area is located approximately 14 kilometres (km) east of Forbes in the Central West region of NSW. The proposed Pre-Treatment Plant (PTP) will be situated in a cleared paddock adjacent to the Lachlan River. The study area is on a flat landform that has been used for moderate intensity agriculture.

The study area is shown on **Figure 1-2**.

Figure 1-2. Aerial showing the study area.

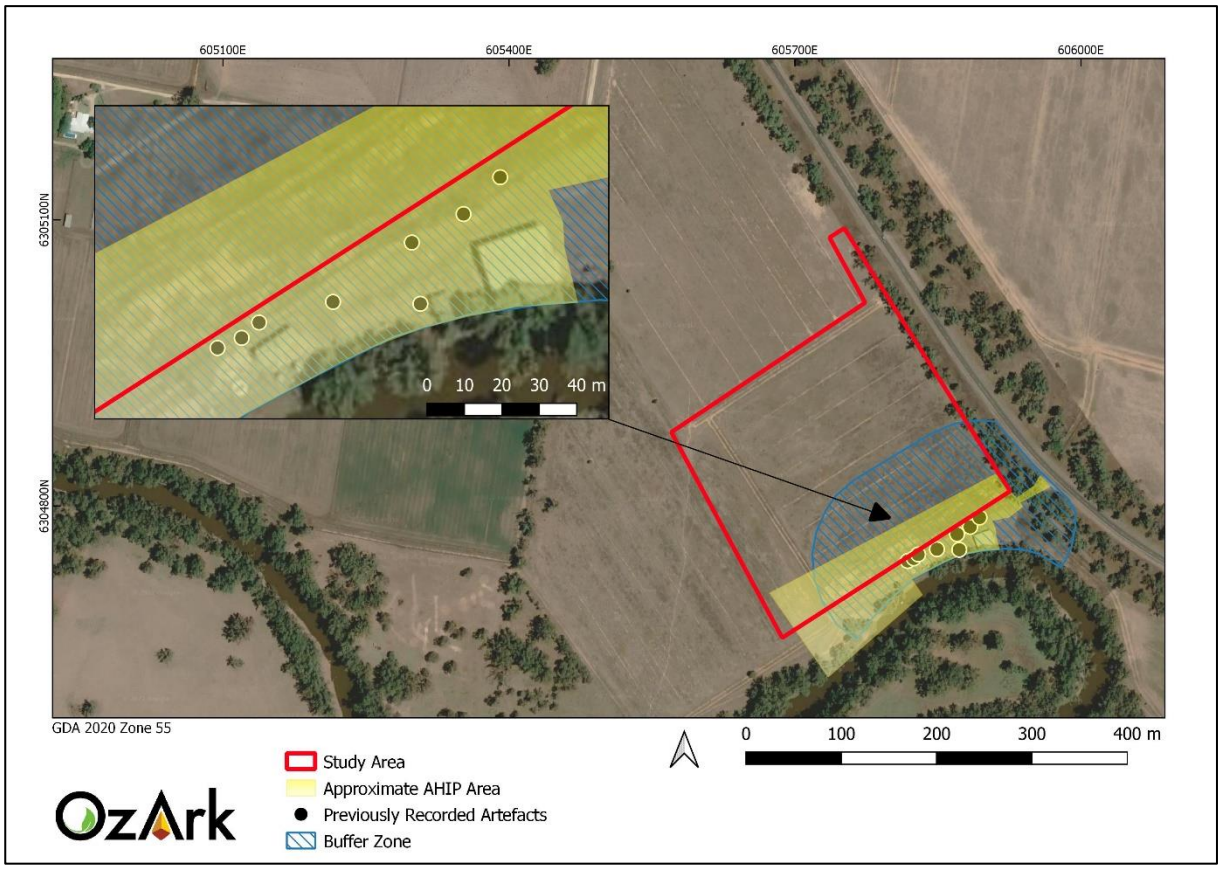


1.3 BACKGROUND

The location of the proposal has been subject to several heritage assessments for the Parkes Shire Council (PSC) since 2001. An Aboriginal heritage assessment was conducted by OzArk in 2015 to the south of the current study area, adjacent to the Lachlan River. This assessment recorded one low-density artefact scatter along the terrace landform of the Lachlan River. The site, PSC Pump Station OS1 with PAD (AHIMS ID# 43-3-0108) is approximately 200 metres (m) by 100 m.

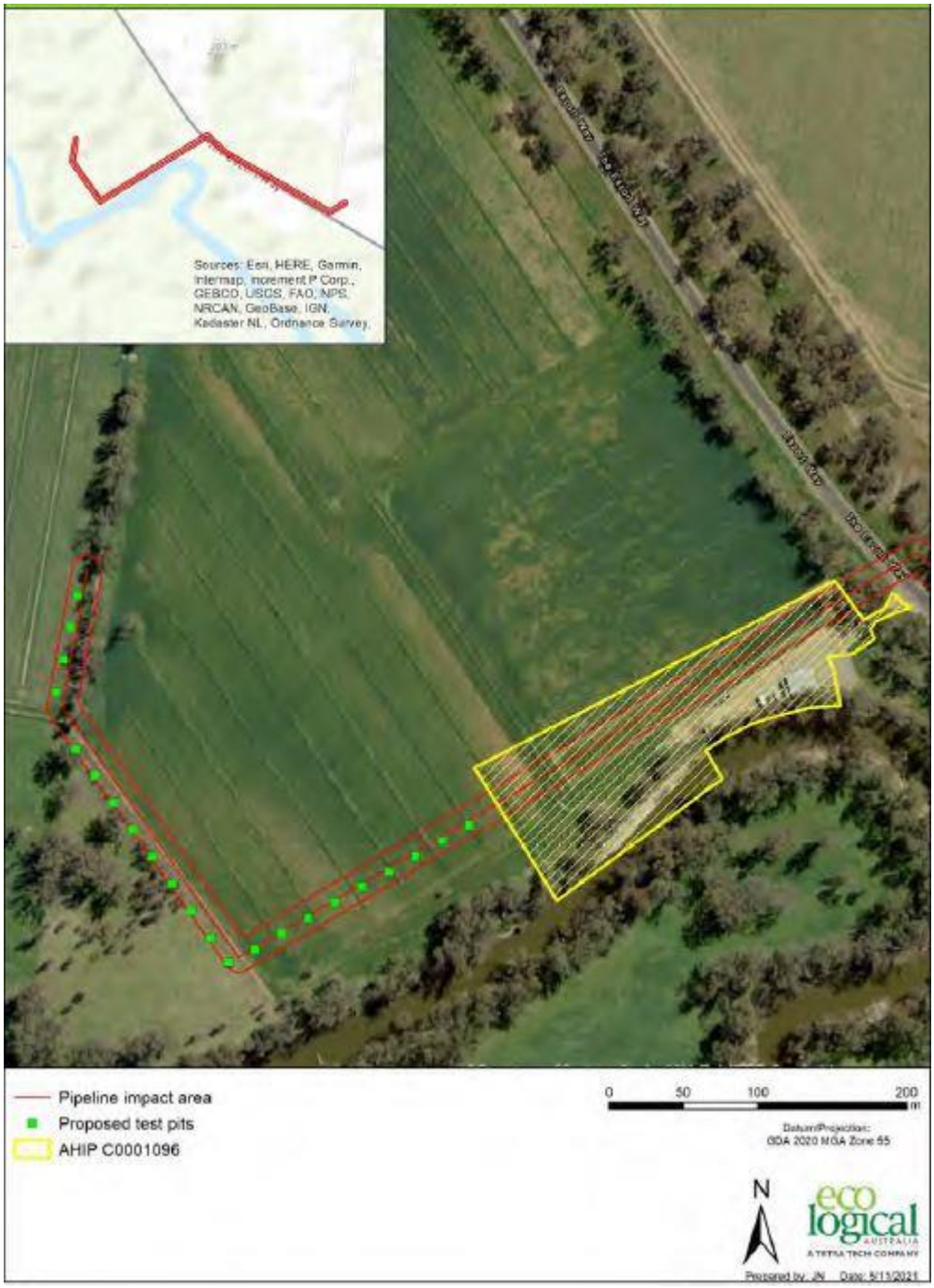
It was recommended that PSC apply for an Aboriginal Heritage Impact Permit (AHIP) before any work could begin (OzArk 2015: 45). An AHIP (C0001096) was issued to the Parkes Shire Council in April 2015. The approximate AHIP area and the site extent are shown on (**Figure 1-3**). The artefact scatter has since been salvaged. All surface artefacts were collected with the assistance of the Peak Hill Local Aboriginal Land Council (LALC). This AHIP remains active until 2025 and partially overlaps the study area.

Figure 1-3. Showing AHIP Area and Buffer Zone overlap with study area.



Since the AHIP was issued, another heritage assessment was conducted late 2021 for the proposed construction of a 9 km water pipeline by PSC (Ecological 2022). The pipeline extends across the southern boundary of the study area, and transects the AHIP area (**Figure** 1-4). The assessment included a test excavation program that completed 24 test pits. The test excavation program did not record any Aboriginal objects (**Plate 1**).

Figure 1-4. Proposed pipeline alignment and approximate test pit locations (Ecological 2022).



1.4 ASSESSMENT APPROACH

Aboriginal cultural heritage

The desktop and visual inspection component for the study area follows the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (due diligence; DECCW 2010). The field inspection followed the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (OEH 2011).

2 ABORIGINAL DUE DILIGENCE ASSESSMENT

2.1 INTRODUCTION

Section 57 of the National Parks and Wildlife Regulation 2019 (NPW Regulation) made under the *National Parks and Wildlife Act 1974* (NPW Act) advocates a due diligence process to determining likely impacts on Aboriginal objects. Carrying out due diligence provides a defence to the offence of harming Aboriginal objects and is an important step in satisfying Aboriginal heritage obligations in NSW.

2.2 DEFENCES UNDER THE NPW REGULATION 2019

2.2.1 Low impact activities

The first step before application of the Due Diligence process itself is to determine whether the proposed activity is a "low impact activity" for which there is a defence in the NPW Regulation. The exemptions are listed in Section 58 of the NPW Regulation (DECCW 2010: 6).

The work proposed by the Parkes Shire Council is not considered a 'low impact activity' as earthworks will be undertaken to construct new raw water storage lagoons up to five metres deep.

2.2.2 Disturbed lands

Relevant to this process is the assessed levels of previous land-use disturbance.

The NPW Regulation Section 58 (DECCW 2010: 18) define disturbed land as follows:

> *Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable.*
>
> *Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks.*

This entire study area undergone agricultural disturbance that is clear from aerial imagery. Further, there have been disturbances along the southern boundary from the water management infrastructure located along the Lachlan River. However, as there is a previously recorded site present, further assessment is needed.

In summary, it is determined that the proposal must be assessed under the Due Diligence Code of Practice. The reasoning for this determination is set out in **Table 2-1**.

Table 2-1: Determination of whether Due Diligence Code of Practice applies.

Item	Reasoning	Answer
Is the activity to be assessed under Division 4.7 (state significant development) or Division 5.2 (state significant infrastructure) of the EP&A Act?	The proposal will be assessed under Part 5 of the EP&A Act.	No
Is the activity exempt from the NPW Act or NPW Regulation?	The proposal is not exempt under this Act or Regulation.	No
Do either or both apply: Is the activity in an Aboriginal place? Have previous investigations that meet the requirements of this Code identified Aboriginal objects?	The activity will not occur in an Aboriginal place. Although multiple Aboriginal heritage assessments have been conducted on the current study area, no previous investigations have been undertaken specifically for this proposal.	No
Is the activity a low impact one for which there is a defence in the NPW Regulation?	The proposal is not a low impact activity for which there is a defence in the NPW Regulation.	No
Is the activity occurring entirely within areas that are assessed as 'disturbed lands?'	Although the proposal is within areas of disturbance, there is also a listed site present, hence further investigation is needed.	No
Due Diligence Code of Practice assessment is required		

2.3 APPLICATION OF THE DUE DILIGENCE CODE OF PRACTICE TO THE PROPOSAL

To follow the generic due diligence process, a series of steps in a question/answer flowchart format (DECCW 2010: 10) are applied to the proposed impacts and the study area, and the responses documented.

2.3.1 Step 1

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

Yes, the proposal will impact the ground surface but will not impact culturally modified trees.

The proposal will impact the ground surface within the study area through excavation to establish water storage dams and earthworks to create dam bunds.

As no mature native vegetation is present within the study area, culturally modified trees will not be impacted by the proposal.

2.3.2 Step 2a

Are there any relevant confirmed site records or other associated landscape feature information on AHIMS?

Yes. While there are no previously recorded sites within the study area, there is a relevant site recording adjacent to the study area.

A search of the Aboriginal Heritage Information Management System (AHIMS) on 15 September 2022 was undertaken over a 10 x 10 km search area centred on the study area (GDA Zone 55

Eastings: 601000–611000, Northings 6299400–6309400). The search returned seven previously recorded Aboriginal sites within the search area; however, none are within the study area.

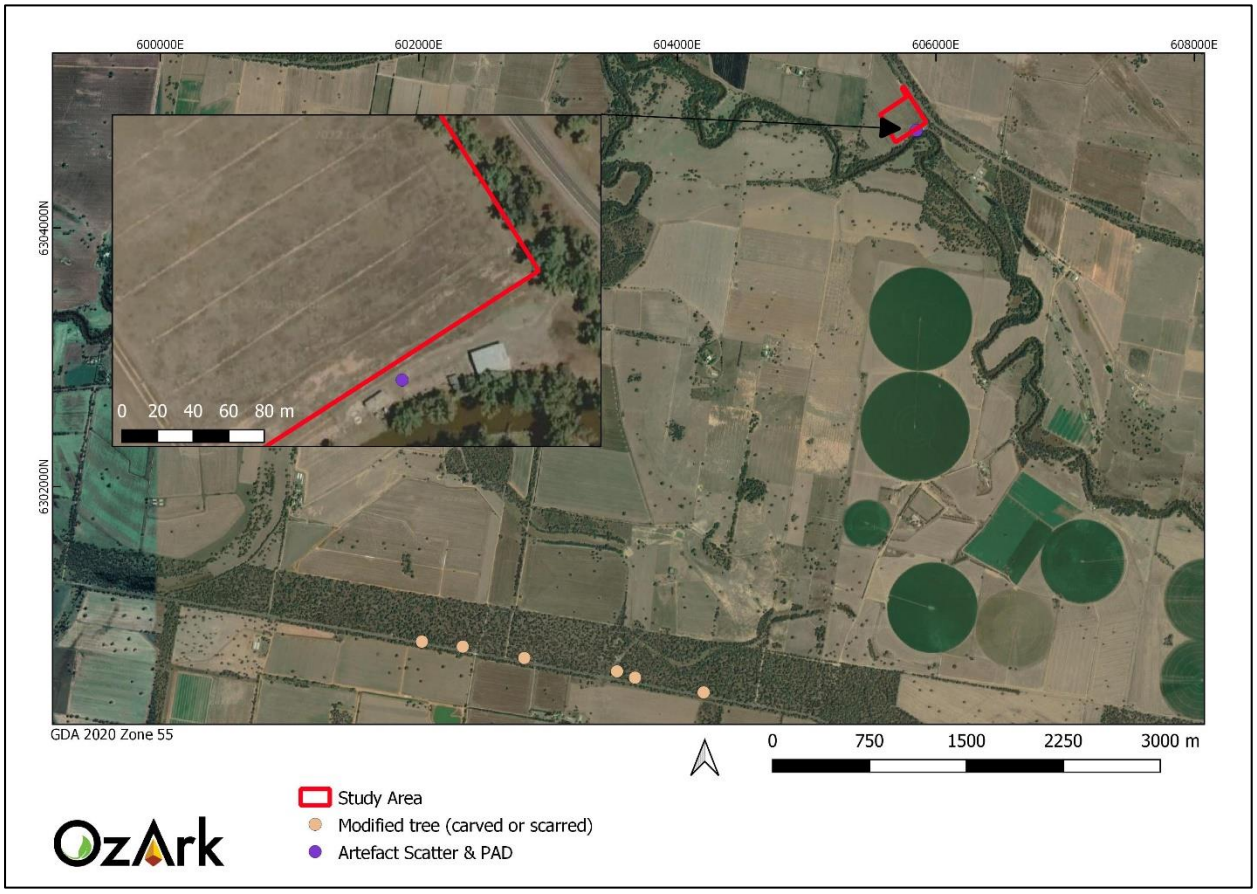
Six modified trees were identified, and one partially destroyed artefact scatter with a Potential Archaeological Deposit (PAD) is also located 10 m south of the study area. This site is discussed in further detail in **Section 2.3.6**.

Figure 2-1 shows all previously recorded sites in relation to the study area and **Table 2-2** shows the types of sites that are close to the study area.

Table 2-2: Site types and frequencies of AHIMS sites near the study area.

Site Type	Number	% Frequency
Modified tree (scarred or carved)	6	86
Artefact Scatter & PAD	1	14
Total	***7***	***100***

Figure 2-1. Previously recorded sites in relation to the study area.



The AHIMS search results indicate that culturally modified trees are the most frequently recorded Aboriginal site type within the search area (86%, n=6). The data therefore suggests that modified

trees might be a likely site type to be recorded at the study area, however, as mature native vegetation is not present within the study area, modified trees will not be recorded.

The recording of an artefact scatter and PAD adjacent to the study area suggests the study area may contain additional Aboriginal objects. This site has been partially destroyed and surface artefacts have been salvaged, however the identified PAD extends into the study area allowing archaeological potential to remain. It is noteworthy that the PAD extent was determined more as a buffer zone to the identified site than as a landform-based PAD declaration (see **Section 2.3.3.3**).

2.3.3 Step 2b

Are there any other sources of information of which a person is already aware?

Yes, there are sources of information that would indicate the presence of Aboriginal objects in the study area.

2.3.3.1 Ethnohistoric Context

The proposal is located in the centre of Wiradjuri country (Tindale 1974). The Wiradjuri tribal area extends as far north as Gilgandra, as far east as Lithgow and as far west as Hay. It is the largest tribal and linguistic group in NSW by land size and incorporates a large section of the central tablelands and central west regions of NSW (Horton 1996).

The ethnographic information recorded by colonial explorers in the region, such as Oxley and Cunningham in the early 1800s, indicates that Wiradjuri people near the Lachlan River lived in both small groups and some larger groups that comprised of up to 120 individuals. Wiradjuri people and hunted local species of kangaroo, emu, and possum as a source of food. Fishing was also utilised to sustain the population with both mussels and freshwater fish being caught by women who used moveable dams made of grasses to direct fish, making them easier to catch (Kass 2003:6).

2.3.3.2 Regional Archaeological Context

OzArk 2016

A 2016 study analysing site distribution across the central west region of NSW concluded that Aboriginal sites are more likely to be found in Channel and Floodplain landscapes (OzArk 2016). Scarred trees were found to be the most common site type within these landscapes.

Sloping landscapes were also found to contain a relatively large number of Aboriginal sites with artefacts scatters most commonly associated with this type of landscape.

The report also found a strong correlation between site location and proximity to water.

The study area is situated on the Lachlan-Bland Channels and Floodplains landscape unit (Mitchell 2002), which was categorised as a Channel and Floodplain type in the study. As the results of the OzArk study indicate that Channel and Floodplain landscapes have the highest correlation with Aboriginal site identification, this suggest an increased likelihood for sites to be present within the study area.

2.3.3.3 Local Archaeological Assessments

OzArk 2015

A 2015 study located one previously unrecorded artefact scatter and PAD adjacent to the current study area (Lachlan River PSC Pump OS1). The artefact scatter consisted of eight individual artefacts located within 50 m of each other, however none were located within the current study area. The extent of the site is approximately 200 m by 100 m and the buffered extent of the site extends into the current study area. However, the report notes that this larger area is a precautionary buffer area recorded as a PAD because the area was not accessed or assessed during the 2015 survey.

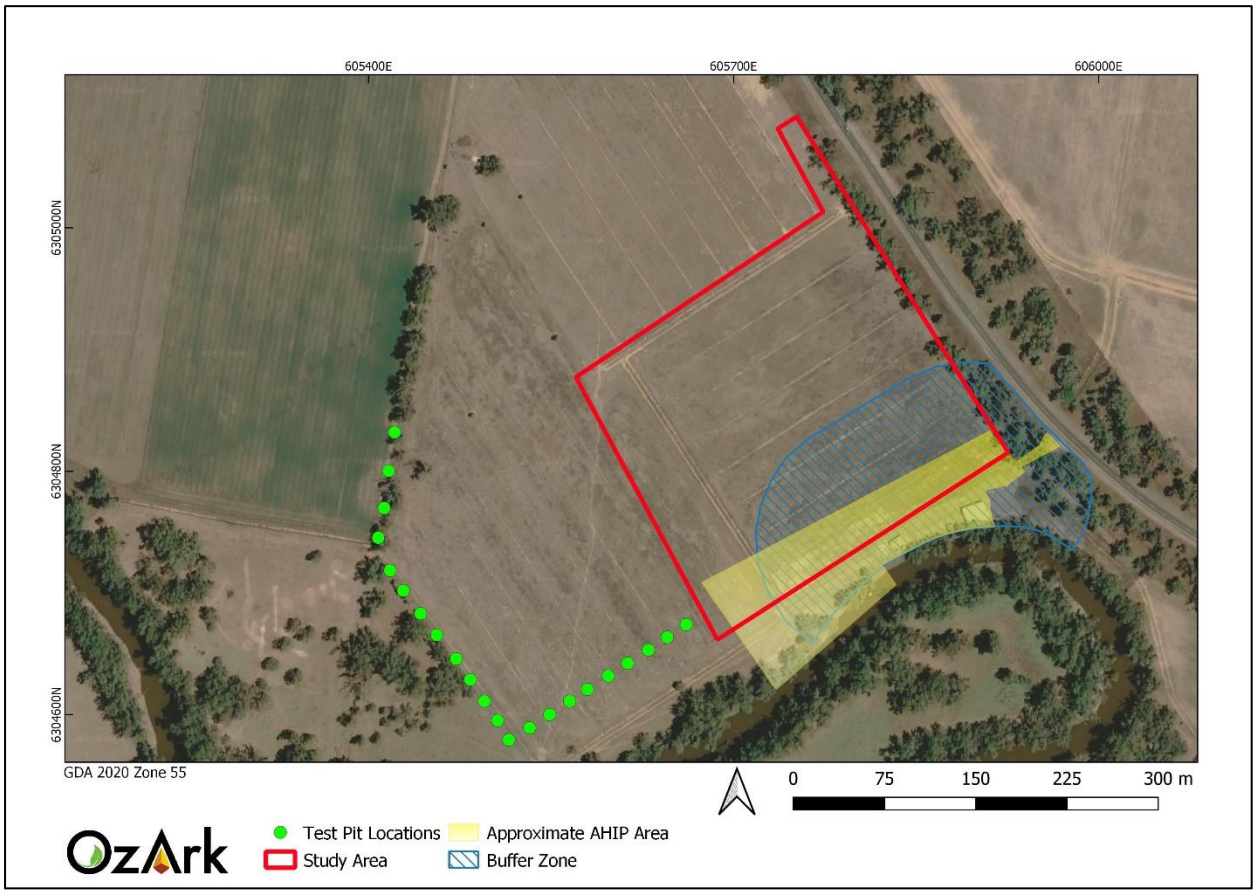
An AHIP (C0001096) was issued to allow for salvage of the site within the impact footprint of the pumping station. Both the AHIP area and the remaining valid site extent overlap with the current study area, which can be seen on **Figure 1-3**.

Ecological 2022

As part of the Parkes Town Water Security Program, Ecological assessed a 9 km pipeline easement which extends through both the current study area and the existing AHIP area. As part of this assessment, a test excavation program was completed by OnSite CHM and Wiradjuri site officers led by Rob Clegg.

A total of 24 (50 x 50 cm) test pits were excavated at 20 m intervals along the proposed alignment parallel to the Lachlan River in late 2021 (**Figure 2-2**). The test pit excavations did not record any Aboriginal artefacts. The report concluded that the results of the test excavations suggested the PAD (Lachlan River PSC Pump OS1) held no further potential for Aboriginal objects (Ecological 2022: 20).

Figure 2-2. Location of test pits relative to study area.



Implications for the study area

The ethnohistoric context of the site suggests Wiradjuri people left evidence of their use of the land though scarred trees and artefact scatters. The Lachlan River is known to have been an important resource and a feature of the cultural landscape, indicating that there is a heightened likelihood for Aboriginal sites in the south of the study area.

Previous assessments have recorded Aboriginal objects along the Lachlan River adjacent to the study area. Although the Aboriginal objects at Lachlan River PSC OS1 with PAD have been salvaged, the buffer area extends into the study area and requires visual inspection.

2.3.4 Step 2c

Are there any landscape features that are likely to indicate presence of Aboriginal objects?

Yes, portions of the study area contain landforms with identified archaeological sensitivity.

The study area consists of a floodplain landform located adjacent to the Lachlan River. The landform is a flat paddock across the entire study area. Modification to this landform can be observed at a desktop level in the form of small parallel drainage bunds, however, the overall level of disturbance that these modifications have caused is unclear. The study area is within

200 m of a major waterway which suggests an increased potential for the presence of Aboriginal sites.

The soil profile of the Lachlan-Bland Channels and Floodplains generally consists of structured red-brown texture contrast clay loams (Mitchell 2002: 92). This soil profile on an elevated terrace is likely to have been well draining and contain sought-after locations for habitation, although inundation is also possible and potentially frequent.

Vegetation across the study area would have consisted of an open woodland of white cypress pine, grey box and river red gums along the channel of the Lachlan River. The study area has been entirely cleared since colonial settlement.

2.3.5 Step 3

Can harm to Aboriginal objects or disturbance of archaeologically sensitive landscape features be avoided?

No, landforms with identified archaeological sensitivity cannot be avoided by the proposal.

The southern portion of the study area is situated on an archaeologically sensitive landform which cannot be avoided.

2.3.6 Step 4

Does a desktop assessment and visual inspection confirm that there are Aboriginal objects or that they are likely?

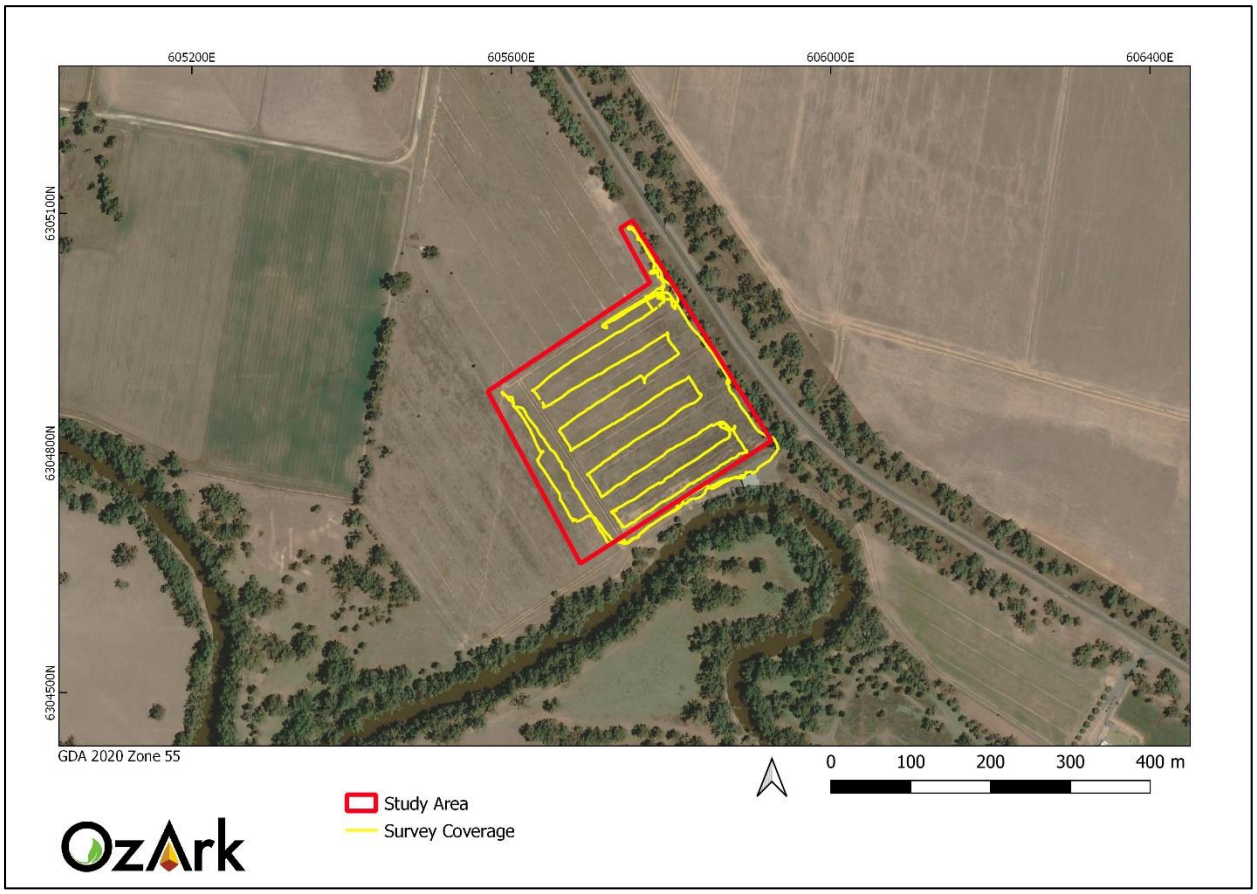
No, Aboriginal objects are not present within the study area.

The visual inspection of the study area was undertaken by OzArk archaeologists Harrison Rochford and Jordan Henshaw on 28 September 2022. The OzArk archaeologists were accompanied by Rob Clegg, Peter Clegg and Mick Dunn of the Wiradjuri Council of Elders for the duration of the inspection.

Ground Surface Visibility (GSV) was estimated at 0–10% across the study area (**Plate 2**), however all landforms were still able to be fully assessed. Some exposures were present near gates and fence lines due to vehicle tracks, offering much higher GSV (up to 80%).

The survey coverage represented on **Figure 2-3** only represents one of the five members of the visual inspection team as only one GPS was used throughout the day.

Figure 2-3: Survey coverage at the study area.



Discussion

No Aboriginal objects were identified during the visual inspection.

While desktop modelling would have accurately predicted the heightened likelihood of Aboriginal objects being present at the study area, the archaeological potential of the study area has been greatly reduced by both ground disturbance related to agricultural activity (**Plate** 3) and the salvage program associated with the AHIP in 2015.

The 2015 report that initially recorded the PAD outlines the favourable landforms which are located around the area. However, it also concludes that a range of historic impacts, surface disturbances and seasonal flooding have affected the natural landforms. The effects of flooding can be seen in terms of the recent 2022 floods (**Plate** 3)**.** Since then, a test excavation program conducted adjacent to the current study area on the same landform did not recover any Aboriginal objects (OnSite CHM 2022). In addition, the visual inspection for this assessment identified disturbances within the precautionary buffer that currently forms the site extent of Lachlan River PSC OS1 with PAD. As a result of the interplay of these factors, it was concluded that the study area has low archaeological potential.

A ‘no’ answer for Step 4, results in the following outcome (DECCW 2010):

AHIP (Aboriginal Heritage Impact Permit) *application not necessary. Proceed with caution. If any Aboriginal objects are found, stop work and notify Heritage NSW (02)9873 8500 (heritagemailbox@environment.nsw.gov.au). If human remains are found, stop work, secure the site and notify NSW Police and Heritage NSW.*

2.4 CONCLUSION

The due diligence process has resulted in the outcome that an Aboriginal Heritage Impact Permit (AHIP) is not required. The reasoning behind this determination is set out in **Table 2-3**.

Table 2-3: Due Diligence Code of Practice application.

Step	Reasoning	Answer
Step 1 Will the activity disturb the ground surface or any culturally modified trees?	The proposed works will disturb the ground surface through excavation. The proposal will not impact culturally modified trees.	Yes
If the answer to Step 1 is 'yes', proceed to Step 2		
Step 2a Are there any relevant records of Aboriginal heritage on AHIMS to indicate presence of Aboriginal objects?	AHIMS indicates that there is one site situated nearby that may extend into the study area.	Yes
Step 2b Are there other sources of information to indicate presence of Aboriginal objects?	Previously recorded site Lachlan River PSC OS1 partially extends into the study area.	Yes
Step 2c Will the activity impact landforms with archaeological sensitivity as defined by the Due Diligence Code?	Landforms with identified archaeological sensitivity are present as the study area is within 200 m of 'waters.'	Yes
If the answer to any stage of Step 2 is 'yes', proceed to Step 3		
Step 3 Can harm to Aboriginal objects listed on AHIMS or identified by other sources of information and/or can the carrying out of the activity at the relevant landscape features be avoided?	The proposal will impact landforms with archaeological sensitivity as identified in the Due Diligence Code: landforms within 200 m of 'waters.'	No
If the answer to Step 3 is 'no', a visual inspection is required. Proceed to Step 4.		
Step 4 Does the visual inspection confirm that there are Aboriginal objects or that they are likely?	The salvage undertaken in 2015 of Lachlan River PSC OS1 has collected the artefacts associated with this site from within the study area. No other objects were identified. Landforms associated with the Lachlan River PSC OS1 site that were identified as archaeologically sensitive at a desktop level were found during the inspection to have low archaeological potential due to agricultural disturbances; and further test excavations of the landform for another project recovered no Aboriginal objects	No
Conclusion		
AHIP not necessary. Proceed with caution.		

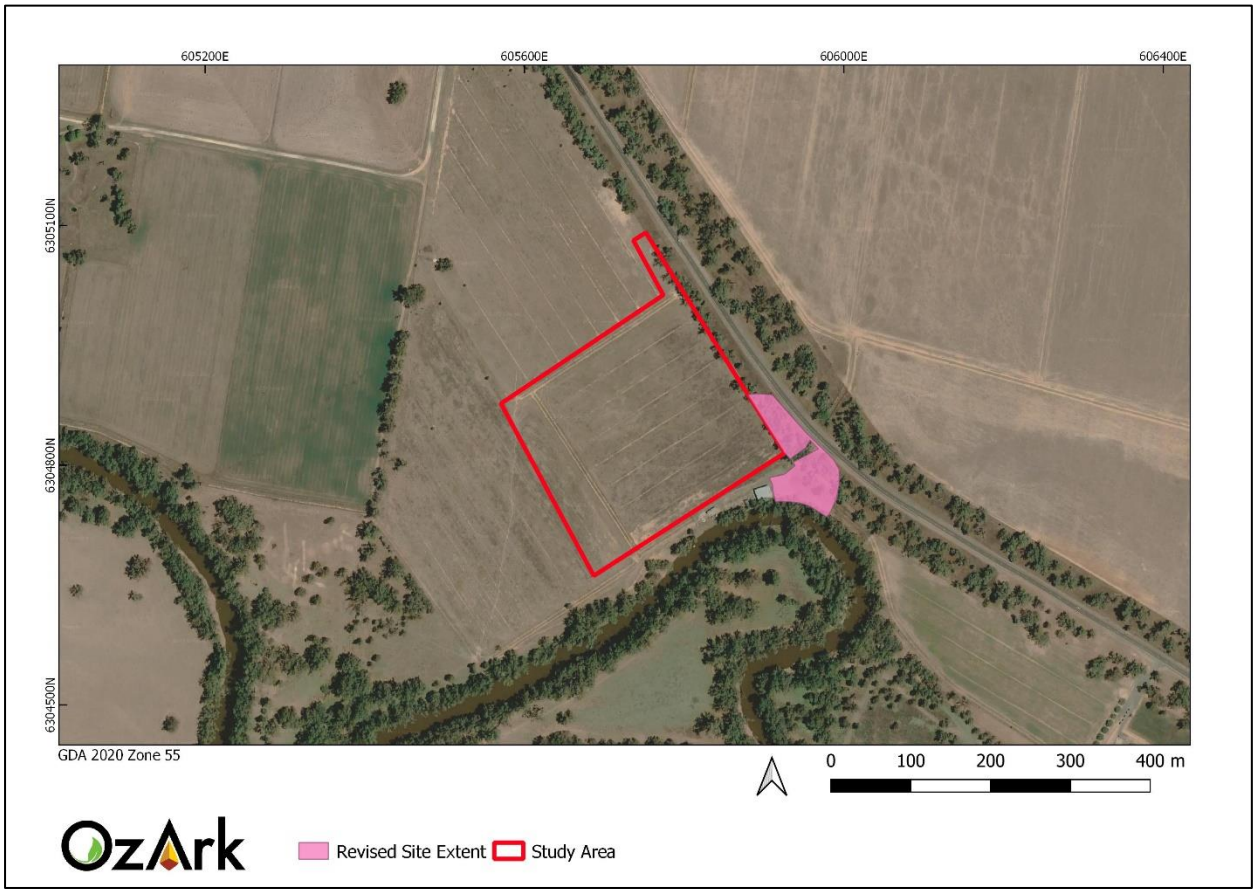
2.5 MANAGEMENT OF LACHLAN RIVER PSC OS1 WITH PAD

The assessment of the study area has determined that the original precautionary buffer recorded for Lachlan River PSC OS1 with (AHIMS site 43-3-0108) should be revised. Considering the absence of recorded artefacts during recent test excavations (OnSite CHM 2022) and the results of the current assessment, the appropriate site extent for Lachlan River PSC OS1 is confined to

areas that are not within landforms modified by agricultural disturbance or the 2015 salvage program.

The revised site extent is shown on **Figure 2-4**. This information will be provided to the AHIMS database and the site card for Lachlan River PSC OS1 with PAD will be updated.

Figure 2-4: Revised site extent of Lachlan River PSC OS1 with PAD.



3 MANAGEMENT RECOMMENDATIONS

The undertaking of the due diligence process resulted in the conclusion that the proposed works will have an impact on the ground surface, however, no Aboriginal objects or intact archaeological deposits will be harmed by the proposal. This moves the proposal to the following outcome:

> *AHIP application not necessary. Proceed with caution. If any Aboriginal objects are found, stop work, and notify Heritage NSW (02) 9873 8500 (heritagemailbox@environment.nsw.gov.au). If human remains are found, stop work, secure the site, and notify NSW Police and Heritage NSW.*

To ensure the greatest possible protection to the area's Aboriginal cultural heritage values, the following recommendations are made:

1) The proposed work may proceed within the study area without further archaeological investigation under the following conditions:
   a) All land and ground disturbance activities must be confined to within the study area, as this will eliminate the risk of harm to Aboriginal objects in adjacent landforms. Should the parameters of the proposal extend beyond the assessed areas, then further archaeological assessment may be required.
   b) All staff and contractors involved in the proposed work should be made aware of the legislative protection requirements for all Aboriginal sites and objects.
2) OzArk must issue a site card update for Lachlan River PSC OS1 with PAD (AHIMS ID# 43-3-0108) documenting the results of this assessment and revising the site extent as shown in **Section 2.5**.
3) This assessment has concluded that there is a low likelihood that the proposed work will adversely harm Aboriginal cultural heritage items or sites. If during works, however, Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the *Unanticipated Finds Protocol* (**Appendix 2**) should be followed.
4) Inductions for work crews should include a cultural heritage awareness procedure to ensure they recognise Aboriginal artefacts (see **Appendix 3**) and are aware of the legislative protection of Aboriginal objects under the NPW Act and the contents of the *Unanticipated Finds Protocol.*
5) The information presented here meets the requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. It should be retained as shelf documentation for five years as it may be used to support a defence against prosecution in the event of unanticipated harm to Aboriginal objects.

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PLATES

Plate 1: Aerial view of the test pits excavated in 2021 (OnSite CHM 2022)

Plate 2: View west across the study area showing the flat landform and low ground surface visibility, as well as plough lines.

Plate 3: Agricultural disturbance present throughout study area.

Plate 4: View east of existing Lachlan River pump station.

Plate 5: Aerial view of the study are (approximated in yellow) during the 2022 floods.

APPENDIX 1: AHIMS SEARCH RESULTS

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Forbes study site

Client Service ID : 718080

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
43-3-0108	Lachlan River PSC Pump OS1 PAD	GDA	55	605849	6304754	Open site	Partially Destroyed	Artefact : -, Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Ms.Morgan Wilcox					Permits	3844	
43-3-0107	Forbes North2	GDA	55	602023	6300801	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Mr.Larry Towney,Central Tablelands Local Land Services - Orange					Permits		
43-3-0196	LVST2	GDA	55	603672	6300522	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Eco Logical Australia Pty Ltd - Sydney - Individual users,Mr.Declan Coman					Permits		
43-3-0197	LVST1	GDA	55	604203	6300408	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Eco Logical Australia Pty Ltd - Sydney - Individual users,Mr.Declan Coman					Permits		
43-3-0198	LVST3	GDA	55	603533	6300571	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Eco Logical Australia Pty Ltd - Sydney - Individual users,Mr.Declan Coman					Permits		
43-3-0199	LVST4	GDA	55	602815	6300674	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Eco Logical Australia Pty Ltd - Sydney - Individual users,Mr.Declan Coman					Permits		
43-3-0200	LVST5	GDA	55	602339	6300762	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Eco Logical Australia Pty Ltd - Sydney - Individual users,Mr.Declan Coman					Permits		

** Site Status

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 15/09/2022 for Jodie Benton for the following area at Datum :GDA, Zone : 55, Eastings : 601000.0 - 611000.0, Northings : 6299400.0 - 6309400.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 7

This information is not guaranteed to be free from error omission. Heritage NSW and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

Page 1 of 1

APPENDIX 2: ABORIGINAL HERITAGE: UNANTICIPATED FINDS PROTOCOL

An Aboriginal artefact is anything which is the result of past Aboriginal activity. This includes stone (artefacts, rock engravings etc.), plant (culturally scarred trees) and animal (if showing signs of modification; i.e. smoothing, use). Human bone (skeletal) remains may also be uncovered while onsite.

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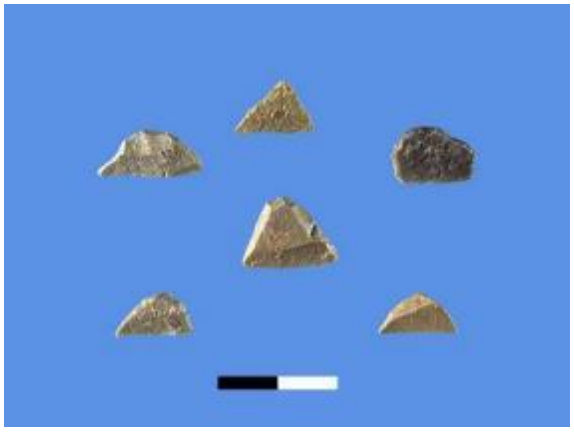
Protocol to be followed if previously unrecorded or unanticipated Aboriginal object(s) are encountered:

1. If any Aboriginal object is discovered and/or harmed in, or under the land, while undertaking the proposed development activities, the proponent must:
    a. Not further harm the object
    b. Immediately cease all work at the particular location
    c. Secure the area to avoid further harm to the Aboriginal object
    d. Notify Heritage NSW as soon as practical on (02) 9873 8500 (heritagemailbox @environment.nsw.gov.au), providing any details of the Aboriginal object and its location; and
    e. Not recommence any work at the particular location unless authorised in writing by Heritage NSW.
2. If Aboriginal burials are unexpectedly encountered during the activity, work must stop immediately, the area secured to prevent unauthorised access and NSW Police and Heritage NSW contacted.
3. Cooperate with the appropriate authorities and relevant Aboriginal community representatives to facilitate:
    a. The recording and assessment of the find(s)
    b. The fulfilment of any legal constraints arising from the find(s), including complying with Heritage NSW directions
    c. The development and implementation of appropriate management strategies, including consultation with stakeholders and the assessment of the significance of the find(s).
4. Where the find(s) are determined to be Aboriginal object(s), recommencement of work in the area of the find(s) can only occur in accordance with any consequential legal requirements and after gaining written approval from Heritage NSW (normally an Aboriginal Heritage Impact Permit).

APPENDIX 3: ABORIGINAL HERITAGE: ARTEFACT IDENTIFICATION

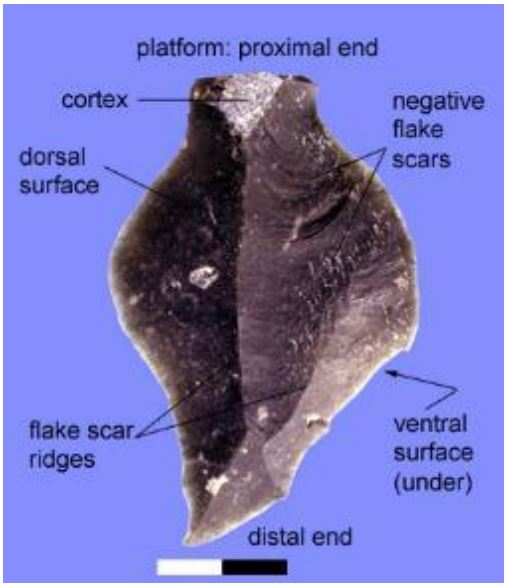
A retouched silcrete flake

A quartz flake



Microliths (scale = 1 cm)

Volcanic flakes



Flake characteristics (scale = 1 cm)

A mudstone/tuff core from which flakes have been removed

View east across the addendum study area.

ADDENDUM
ABORIGINAL HERITAGE DUE DILIGENCE ASSESSMENT REPORT

LACHLAN RIVER PRE-TREATMENT PLANT

FORBES LGA, NSW

OCTOBER 2023

Report prepared by

OzArk Environment & Heritage

for Parkes Shire Council

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DOCUMENT CONTROLS

Proponent	Parkes Shire Council
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Acknowledgement

OzArk acknowledge the traditional custodians of the area on which this assessment took place and pay respect to their beliefs, cultural heritage, and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the Elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

EXECUTIVE SUMMARY

OzArk Environment & Heritage (OzArk) has been engaged by Parkes Shire Council (PSC, the proponent) to complete an addendum Aboriginal due diligence heritage assessment for the proposed access upgrade works associated with the Lachlan River Pre-Treatment Plant (the proposal).

The addendum study area comprises approximately 16 hectares (ha) of land to the north of the proposed PTP. The addendum study area includes a cleared section of The Escort Way road corridor and a small section of a cleared, cropped paddock. OzArk (2023) assessed the southern road access route and road corridor to the Lachlan PTP area. The current report is an addendum to the 2023 assessment.

The due diligence process has resulted in the conclusion that although the proposed works will impact the ground surface, no known Aboriginal objects or archaeologically sensitive landforms will be affected.

A 'no' answer for Questions 2 a-c of the due diligence process results in the following outcome (DECCW 2010: 10):

> *AHIP (Aboriginal Heritage Impact Permit) application not necessary. Proceed with caution. If any Aboriginal objects are found, stop work, and notify Heritage NSW (02) 9873 8500 (heritagemailbox@environment.nsw.gov.au). If human remains are found, stop work, secure the site, and notify NSW Police and Heritage NSW.*

To ensure the greatest possible protection to the area's Aboriginal cultural heritage values, the following recommendations are made:

1) The proposed work may proceed without further archaeological investigation, provided that all land and ground disturbance activities must be confined to within the addendum study area.

2) This assessment has concluded that there is a low likelihood that the proposed work will adversely harm Aboriginal cultural heritage items or sites. If during works, however, Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the *Unanticipated Finds Protocol* (**Appendix 1**) should be followed.

3) Inductions for work crews should include a cultural heritage awareness procedure to ensure they recognise Aboriginal artefacts (see **Appendix 2**) and are aware of the legislative protection of Aboriginal objects under the *National Parks and Wildlife Act 1973* (NPW Act) and the contents of the *Unanticipated Finds Protocol.*

4) The information presented here meets the requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. It should be retained

as shelf documentation for five years as it may be used to support a defence against prosecution in the event of unanticipated harm to Aboriginal objects.

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FIGURES

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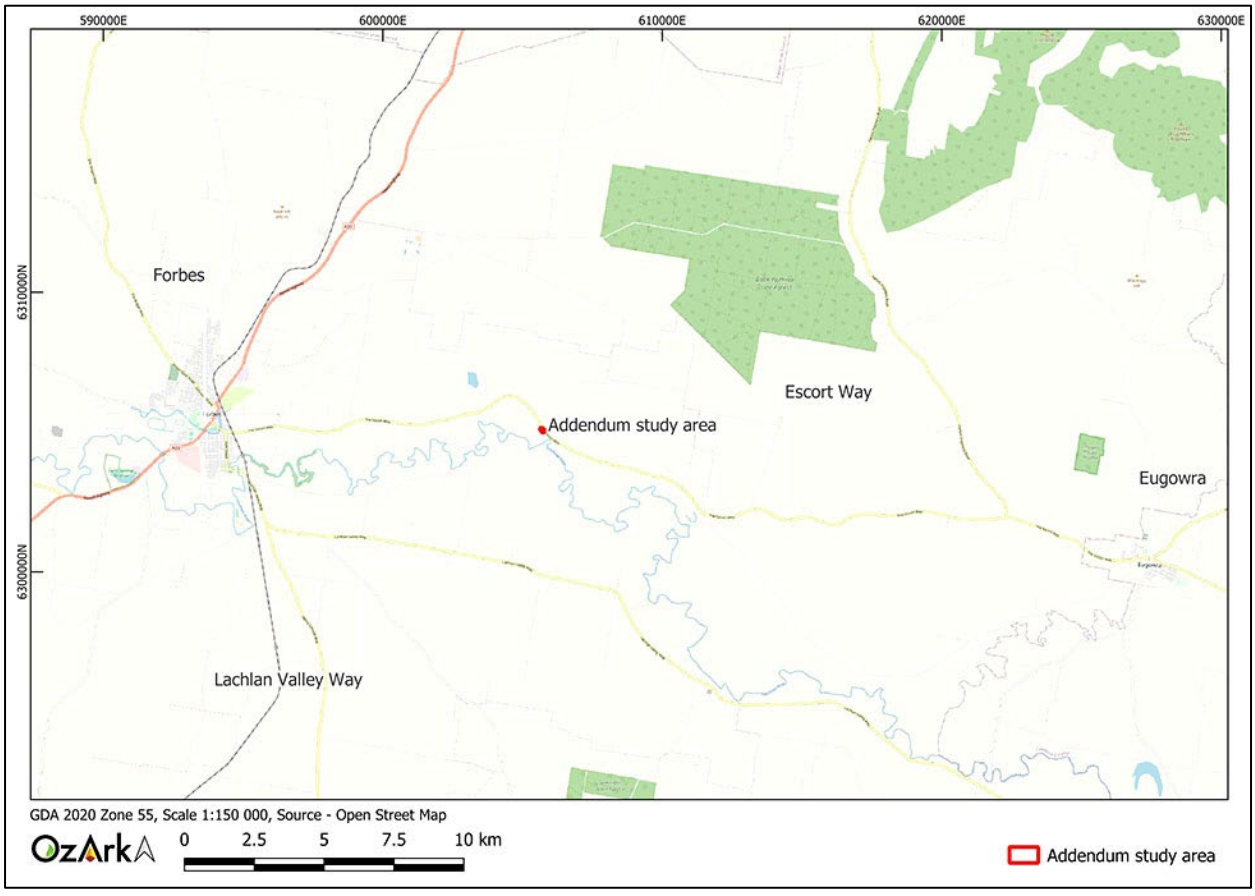
1 INTRODUCTION

1.1 BRIEF DESCRIPTION OF THE PROPOSAL

OzArk Environment & Heritage (OzArk) has been engaged by Parkes Shire Council (PSC, the proponent) to complete an addendum Aboriginal heritage due diligence assessment for the proposed access upgrade works associated with the Lachlan River Pre-Treatment Plant (the proposal). The proposal is in the Forbes Shire Local Government Area (LGA) (**Figure 1-1**).

This report is an addendum to OzArk (2023) which assessed the access route to the Lachlan River Pre-Treatment Plant (PTP). Following the completion of OzArk (2023) an additional access point at the northern end of the proposed PTP was required. This additional access point is the 'addendum study area' and is assessed in this report.

Figure 1-1. Map showing the location of the proposal.



1.2 ADDENDUM STUDY AREA

The addendum study area comprises approximately 16 hectares (ha) of land to the north of the proposed PTP. The addendum study area includes a cleared section of The Escort Way road corridor and a small section of a cleared, cropped paddock. The addendum study area in relation to the previous Due Diligence assessments (OzArk 2022 and OzArk 2023) is shown on **Figure 1-2**.

1.3 BACKGROUND

OzArk (2022) assessed the paddock to the south of the current addendum study area, where the main works for the Lachlan PTP will be completed. This assessment concluded that the previously recorded Aboriginal site PSC Pump Station OS1 with PAD (AHIMS Site 43-3-0108) did not remain valid within the 2022 study area due to the salvage that had been completed in 2015. See OzArk 2022 for more information.

OzArk (2023) assessed the road access route and road corridor to the Lachlan PTP area. One Aboriginal site was recorded during the assessment, Escort Way ST 1. The current report is an addendum to the 2023 assessment.

1.4 ASSESSMENT APPROACH

The desktop assessment of the study area follows the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (due diligence; DECCW 2010).

Figure 1-2: Aerial showing the addendum study area in relation to previous assessments.

2 ABORIGINAL DUE DILIGENCE ASSESSMENT

2.1 INTRODUCTION

Section 57 of the National Parks and Wildlife Regulation 2019 (NPW Regulation) made under the *National Parks and Wildlife Act 1974* (NPW Act) advocates a due diligence process to determining likely impacts on Aboriginal objects. Carrying out due diligence provides a defence to the offence of harming Aboriginal objects and is an important step in satisfying Aboriginal heritage obligations in NSW.

2.2 DEFENCES UNDER THE NPW REGULATION 2019

2.2.1 Low impact activities

The first step before application of the due diligence process itself is to determine whether the proposed activity is a "low impact activity" for which there is a defence in the NPW Regulation. The exemptions are listed in Section 58 of the NPW Regulation (DECCW 2010: 6).

The proposal will require excavation and disturbance of the ground surface to establish an additional access point to the proposed location of the Lachlan PTP. These activities are not defined as "low impact" activities under the NPW Regulation, so the Due Diligence process must be applied.

2.2.2 Disturbed lands

Relevant to this process is the assessed levels of previous land-use disturbance.

The NPW Regulation Section 58 (DECCW 2010: 18) define disturbed land as follows:

> *Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable.*
>
> *Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks.*

Although some sections of the study area, such as the Escort Way, could be considered 'disturbed land', the entirety of the study area has not been modified in a 'clear and observable' manner. In summary, it is determined that the proposal must be assessed under the Due Diligence Code of Practice. The reasoning for this determination is set out in **Table 2-1**.

Table 2-1: Determination of whether Due Diligence Code of Practice applies.

Item	Reasoning	Answer
Is the activity to be assessed under Division 4.7 (state significant development) or Division 5.2 (state significant infrastructure) of the EP&A Act?	The proposal will be assessed under Part 5 of the EP&A Act.	No
Is the activity exempt from the NPW Act or NPW Regulation?	The proposal is not exempt under this Act or Regulation.	No
Do either or both apply: Is the activity in an Aboriginal place? Have previous investigations that meet the requirements of this Code identified Aboriginal objects?	The activity will not occur in an Aboriginal place. No previous investigations have been undertaken for this proposal.	No
Is the activity a low impact one for which there is a defence in the NPW Regulation?	The proposal is not a low impact activity for which there is a defence in the NPW Regulation.	No
Is the activity occurring entirely within areas that are assessed as 'disturbed lands'?	The proposal is not entirely within areas of high modification.	No
Due Diligence Code of Practice assessment is required		

2.3 APPLICATION OF THE DUE DILIGENCE CODE OF PRACTICE TO THE PROPOSAL

To follow the generic due diligence process, a series of steps in a question/answer flowchart format (DECCW 2010: 10) are applied to the proposed impacts and the study area, and the responses documented.

2.3.1 Step 1

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

Yes, the proposal will impact the ground surface but will not impact culturally modified trees.

The proposal will require excavation and ground disturbance to construct the access point and track. There are no trees within the study area, so there will be no potential impacts to modified trees.

2.3.2 Step 2a

Are there any relevant confirmed site records or other associated landscape feature information on AHIMS?

No, there are no previously recorded sites within the addendum study area.

The results of the AHIMS searches including the addendum study area are summarised in OzArk (2023). There are no previously recorded AHIMS sites within the addendum study area.

2.3.3 Step 2b

Are there any other sources of information of which a person is already aware?

No, there are no other sources of information that would indicate the presence of Aboriginal objects in the addendum study area.

There are no known cultural values pertaining directly to the location of the proposed work, or any other sources of information suggesting that Aboriginal objects are likely.

Refer to Section 2.3.3 of OzArk (2023) for detailed information on the local and regional archaeological context the region, including the addendum study area.

2.3.4 Step 2c

Are there any landscape features that are likely to indicate presence of Aboriginal objects?

No, the addendum study area does not contain landforms with identified archaeological sensitivity.

The Due Diligence Code of Practice (DECCW 2010) refers to several landscape features which have higher potential to contain Aboriginal objects. These include:

- Within 200 m of waters
- Located within a sand dune system
- Located on a ridge top, ridge line or headland
- Located within 200 m below or above a cliff face
- Within 20 m of or in a cave, rock shelter, or a cave mouth

The only potentially relevant landscape feature to the addendum study area is 'waters'. However, as the Lachlan River is 275 m south of the study area at the closest point, the addendum study area is considered to not contain archaeologically sensitive landforms as defined by the Due Diligence Code.

A visual inspection of the study area is not required and did not take place, although views of the addendum study area have been provided by the proponent (**Plate 1** and **Plate 2**). These images confirm the expected landform characteristics of the addendum study area, as developed by the comprehensive assessment of the adjacent landforms by OzArk (2022) and OzArk (2023), see **Figure 1-2**.

A 'no' answer for Question 2 a-c, results in the following outcome (DECCW 2010: 10):

> *AHIP* (Aboriginal Heritage Impact Permit) *application not necessary. Proceed with caution. If any Aboriginal objects are found, stop work, and notify Heritage NSW*

(02) 9873 8500 (heritagemailbox@environment.nsw.gov.au). If human remains are found, stop work, secure the site, and notify NSW Police and Heritage NSW.

2.4 CONCLUSION

The due diligence process has resulted in the outcome that an Aboriginal Heritage Impact Permit (AHIP) is not required. The reasoning behind this determination is set out in **Table 2-2**.

Table 2-2: Due Diligence Code of Practice application.

Step	Reasoning	Answer
Step 1 Will the activity disturb the ground surface or any culturally modified trees?	The proposed works will disturb the ground surface through track construction. The proposal will not impact mature, native vegetation and therefore will not harm culturally modified trees.	Yes
If the answer to Step 1 is 'yes', proceed to Step 2		
Step 2a Are there any relevant records of Aboriginal heritage on AHIMS to indicate presence of Aboriginal objects?	AHIMS indicated that there are no Aboriginal sites within the study area.	No
Step 2b Are there other sources of information to indicate presence of Aboriginal objects?	There are no other sources of information to indicate that Aboriginal objects are likely in the study area.	No
Step 2c Will the activity impact landforms with archaeological sensitivity as defined by the Due Diligence Code?	Landforms with identified archaeological sensitivity are not present as the addendum study area is over 200 m from the Lachlan River.	No
Conclusion		
AHIP not necessary. Proceed with caution.		

3 MANAGEMENT RECOMMENDATIONS

The undertaking of the due diligence process resulted in the conclusion that the proposed works will have an impact on the ground surface, however, no Aboriginal objects or intact archaeological deposits will be harmed by the proposal. This moves the proposal to the following outcome:

> *AHIP application not necessary. Proceed with caution. If any Aboriginal objects are found, stop work, and notify Heritage NSW (02) 9873 8500 (heritagemailbox@environment.nsw.gov.au). If human remains are found, stop work, secure the site and notify NSW Police and Heritage NSW.*

To ensure the greatest possible protection to the area's Aboriginal cultural heritage values, the following recommendations are made:

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2) This assessment has concluded that there is a low likelihood that the proposed work will adversely harm Aboriginal cultural heritage items or sites. If during works, however, Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the *Unanticipated Finds Protocol* (**Appendix 1**) should be followed.
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REFERENCES

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OzArk 2023 — OzArk Environment and Heritage 2023. *Aboriginal Due Diligence Report: Additional Lachlan PTP Area.* Report to Parkes Shire Council.

PLATES

Plate 1: View east across the access between the paddock (right) and The Escort Way at the addendum study area.

Plate 2: View north at the addendum study area.

APPENDIX 1: ABORIGINAL HERITAGE: UNANTICIPATED FINDS PROTOCOL

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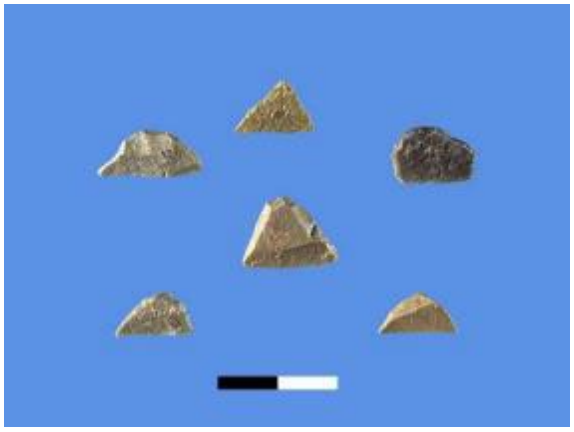
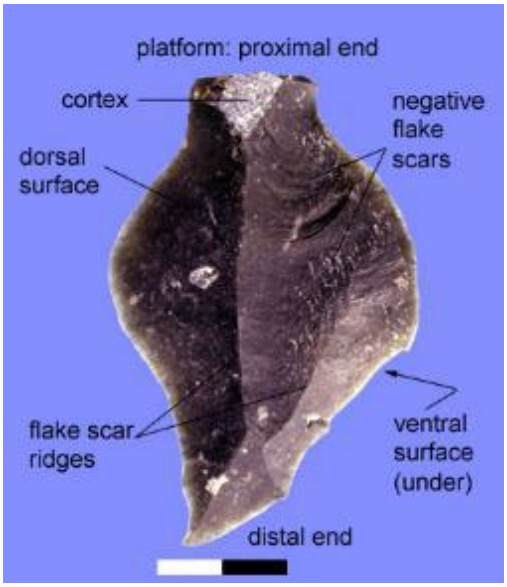


Microliths (scale = 1 cm)

Volcanic flakes



Flake characteristics (scale = 1 cm)

A mudstone/tuff core from which flakes have been removed

Appendix D Flood Risk and Impact Assessment

Lachlan River Pre-treatment lagoons

Prepared for Parkes Shire Council

May 2023
Project Number SE22026

OPPORTUNITIES THROUGH EXCELLENCE

bgeeng.com

BG&E

Contents

Document Control				
Revision	Date	Prepared	Reviewed	Approved
A	03/05/2023	Ainis Vincevicius	Ivan Varga	Ivan Varga

1. Executive Summary

Parkes Shire Council is considering the construction of a pre-treatment lagoons for water supply purposes at a property termed Tallawalla, near the banks of the Lachlan River. This property (81/DP750183) is located at The Escort Way, some 11 km east of Forbes. Parkes Shire Council has engaged BG&E to carry out a flood risk and impact assessment to determine the flood immunity of the proposed lagoons and potential flood impacts to adjacent properties as a result of changes to flood behaviour due to the presence of the proposed lagoons' bunds on the Lachlan River floodplain.

This report covers data collation and review, flood model built, results, and recommendations. Data collation and review included the design of the water treatment basin by KBR in August 2021, a plan showing proposed floodwater mitigation bund by Arndell Surveying in July 2022, a 12D model for preliminary civil works, and ELVIS LiDAR data for Forbes area.

A Tuflow 2D hydraulic was built to establish design flood behaviour along the Lachlan River floodplain near the proposed pre-treatment lagoons, and assess changes to flood behaviour post pre-treatment lagoons construction.

The outcome of the study showed that:

- The designed bund heights provide flood immunity of up to the 1% AEP flood event with some freeboard for temporary works and final design scenarios
- The proposed WTP works have no adverse flood impact on design flood levels to surrounding properties for the 1%, 5%, and 10% AEP flood events
- The proposed WTP works resulted in a flood level increase to the adjacent road (The Escort Way) of up to 120mm during temporary works and up to 70mm for the final design for a 1% AEP event.

2. Introduction

This report presents the findings and recommendations of the Parkes Surface Water Modelling Update project (Project Number SE22026), which was commissioned by Parkes Shire Council and completed by BG&E Pty Limited.

The purpose of the project was to evaluate the flood immunity of the proposed pre-treatment lagoons located on the north bank of the Lachlan River and to evaluate the flood impact on adjacent properties. Two scenarios were considered in this study: (i) the temporary works scenario during the construction of the plant, and (ii) the final design. This report documents the methodology, results, limitations, and conclusions of each of the proposed scenario runs for the 10%, 5%, and 1% AEP events. The report aims to assist Parkes Shire Council in making informed decisions about flood risk management and mitigation strategies based on the modelling outcomes.

3. Scope of works

The Parkes Lachlan River Precinct and Surface Water Management project encompassed the following aspects:

1. Site Visit: On September 20th, 2022, BG&E and staff from Parkes Shire Council conducted a site visit to familiarize themselves with the Lachlan River pumping station site and local floodplain conditions. This visit provided valuable insights into the physical characteristics of the site and helped to inform subsequent modelling activities.
2. Review of background Information: BG&E carried out a review of background information relating to the Lachlan River pre-treatment lagoons and layout. This included reviewing existing reports, plans, and data related to the site's hydrology, geology, topography, land use, infrastructure, and environmental conditions. The review aimed to identify data gaps, inconsistencies, or errors that could affect the accuracy or reliability of subsequent modelling activities.
3. Establish Riverine Flood Model: Based on design flood hydrology derived from available data sources and industry standards, BG&E established a riverine flood model for the Lachlan River precinct. The model aimed to simulate various flood scenarios based on different return periods (1%, 5% and 10% AEP) and assess their potential impacts on infrastructure, property, and people in the area. The new model performance was verified against the Forbes shire Council Flood Study (2020).
4. Earthworks Design and Flood Immunity Assessment: BG&E incorporated the design of the temporary and operational earthworks within the Lachlan River Precinct to determine the level of flood immunity provided at the pre-treatment lagoons and quantify adverse flood impact on adjacent properties as a result of the proposed works. This assessment aimed to ensure that the earthworks design was compatible with flood risk management objectives and did not increase flood risk for nearby properties.

4. Data Collation and Review

The following data has been reviewed and utilised in the establishment of the flood model:

4.1 Design of the Lachlan River pre-treatment Lagoon (KBR, August, 2021)

The provided CAD drawing contains details of the pre-treatment lagoon, including the surrounding bund height and footprint of the bunded area. The key outcome from this design is surrounding bund height and a footprint of the bunded area – which results in alteration of flood behaviour due to displaced water. Other detailed aspects of the pre-treatment plant design may not be critical for flood impact assessment. The CAD drawing provided sufficient details to undertake a flood impact assessment exercise.

4.2 12D model for preliminary civil works (GHD, 2022)

A 12d TIN model was provided for the preliminary civil works within the site by GHD (Figure 1). 3D data was incorporated into TUFLOW model as part of the design. A earth bund has been designed to provide flood immunity up to a level of 245.25m AHD which corresponded to flood immunity the 1% AEP with a nominal 500 mm freeboard above the flood level. The layout of the temporary bund is provided in Figure 1.

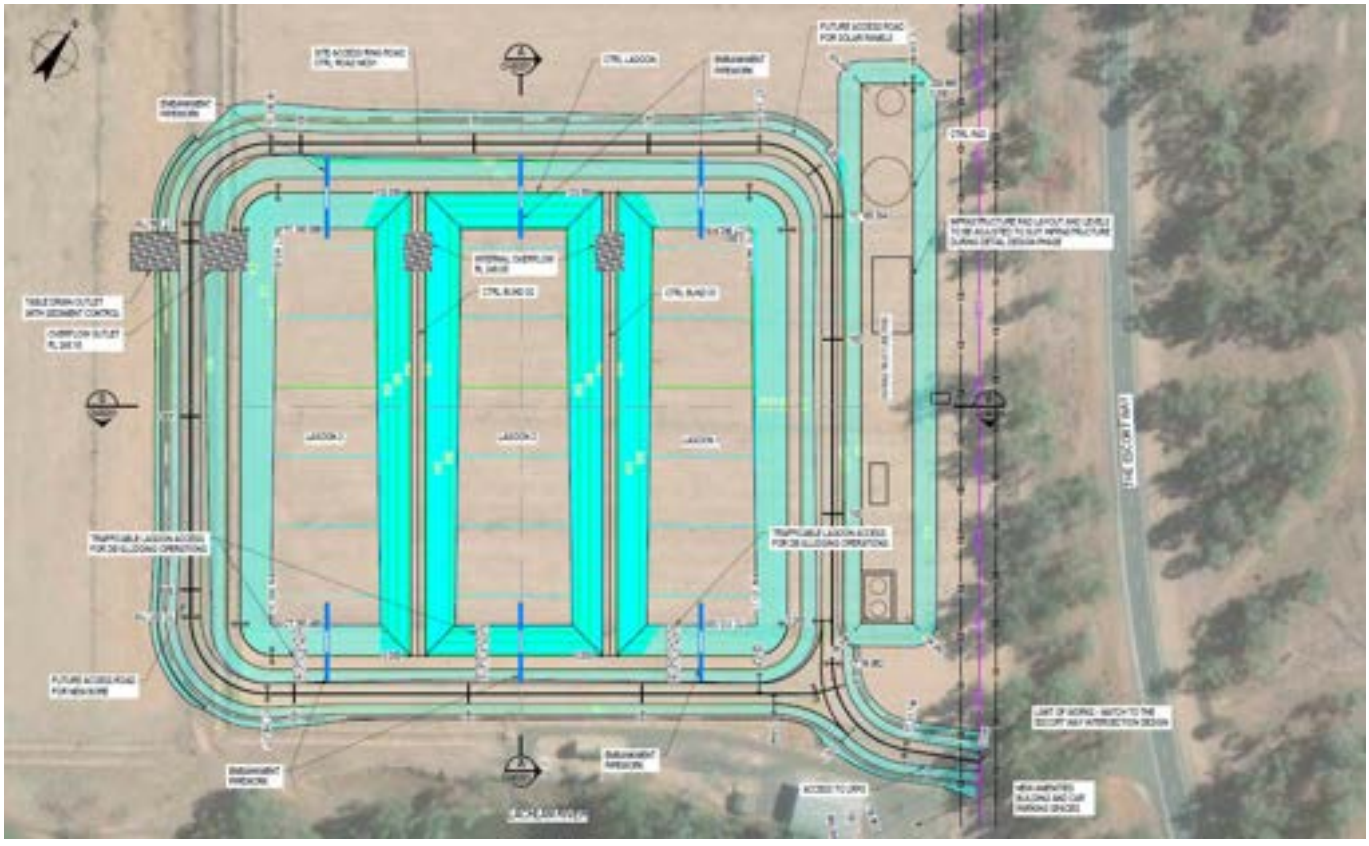


Figure 1 – Proposed flood mitigation bund around pre-treatment lagoon site

4.3 ELVIS LiDAR Data for Forbes township (ELVIS, 2022)

Spatial topographic data at 1 m resolution grid is publicly available (ELVIS) for the study area. The data was captured in 2013. This dataset contains ground surface model in ASCII grid format derived from C3 LiDAR. The data has a vertical accuracy of ±0.3 m accuracy (95% confidence interval) and ±0.8 m in horizontal accuracy.

5. Flood Model Build

This section describes the flood model build process and parameters adopted to establish the design flooding along the Lachlan River floodplain surrounding the Tallawalla properties.

5.1 Hydraulic Modelling

Hydraulic modelling was undertaken using TUFLOW. Tuflow is a 1D/2D hydrodynamic modelling software developed by BMT used in Australia and internationally to simulate complex flow behaviour in rural, urban and coastal floodplains. The flooding regime is estimated using a rectangular 2D grid with the incorporation of finer elements such as culverts, pits, pipes and narrow drainage channel in as 1D elements. The extent of the Tuflow model used in this analysis is depicted in Figure 2 as well as Figure 1 in Appendix A.

The model setup is summarised in Table 1. Adopted land use areas expressed as manning's n surface roughness values in TUFLOW model provided in Table 2.

Table 1 Tuflow Model Setup and adopted parameters.

Parameter	Comment
Tuflow version	2020-10-AE
Adopted grid cell	A 2m model grid size with 1m sub-grid-sampling
Model Extent	Refer in Figure 2. Model covers an area of approximately 2.6km^2
Inflows	Rainfall on Grid applied with a 2d_rf layer consisting of the entire model extent
Culverts	1d network elements (1d_nwk) and 2d_bc to connect to 2d domain
DEM	LiDAR from Elvis, supplemented by Survey
Downstream Boundary Conditions	Set as HQ (Head vs Flow) boundary with respect to the slope of the terrain in the area
Mannings N	Roughness of different areas were set as per Table 2
Structures	Cottons Weir and Iron Bridge
Lachlan River	LiDAR smoothed in the Lachlan River to prevent tinning effect of water in the LiDAR

Table 2 Tuflow Model Manning's n values for different land use areas.

Terrain	Manning's n
Roads/Streets	0.020
Industrial Areas	0.150
Open Space	0.050
Open Drain	0.030
Residential Areas	0.080
Medium Vegetation	0.060
Basins/Channels/Water	0.015
Grass Swales	0.035
Rock Protection	0.080

Terrain	Manning's n
WTP Buildings	0.5
Future Development	0.75

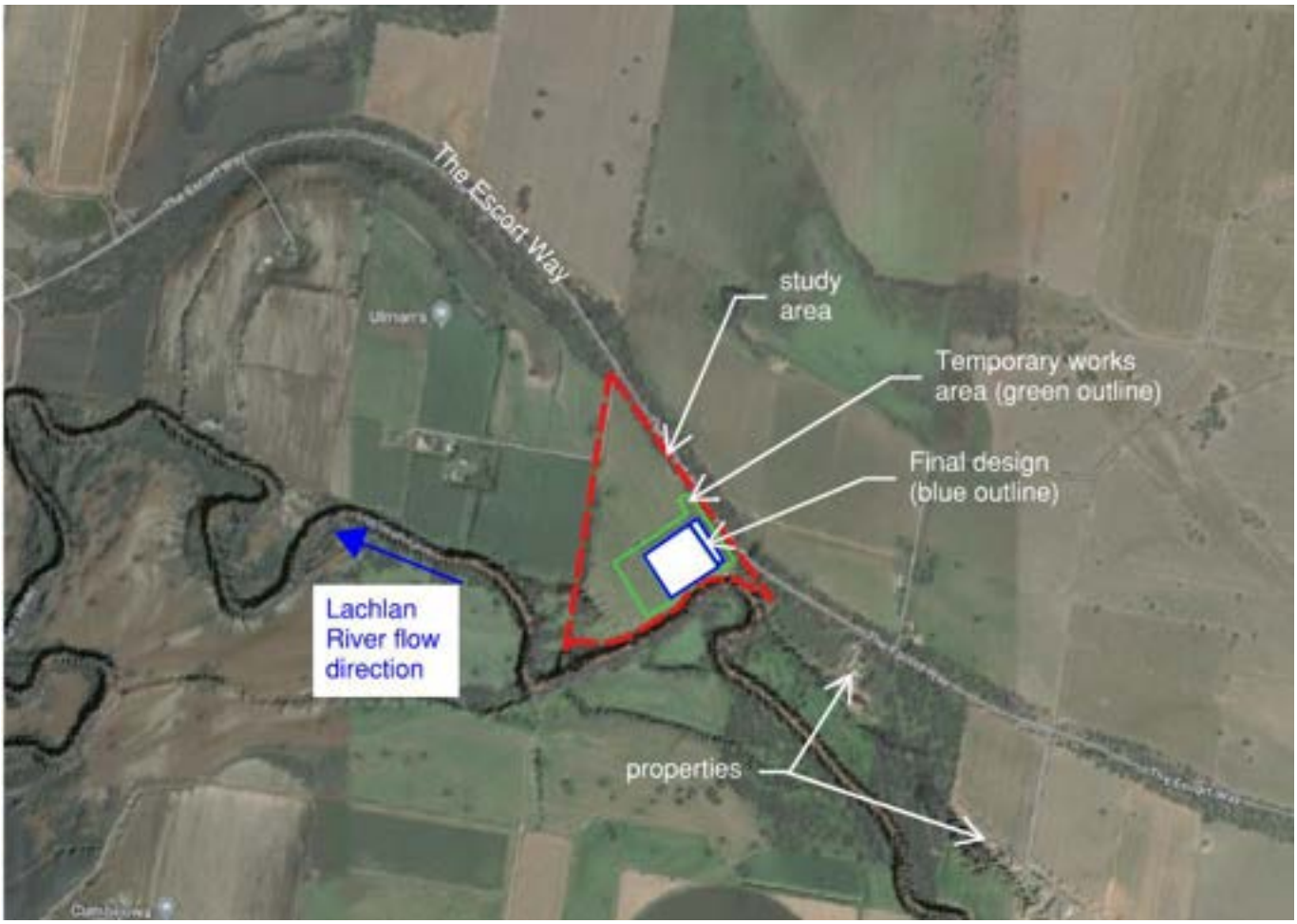


Figure 2 Tuflow model layout

5.2 Design Inflows

The design flows derived from Forbes Flood Study (2020) and have been applied at two inflow locations as seen in Figure 3 (Eugowra and Nanami). Each of the inflow peak flow values summarised in Table 3. Forbes flood study was completed recently in 2020 and it is believed that hydrology is suitable for this project. Local catchment flooding was not considered for this site as Lachlan River is dominating flood levels for the site.

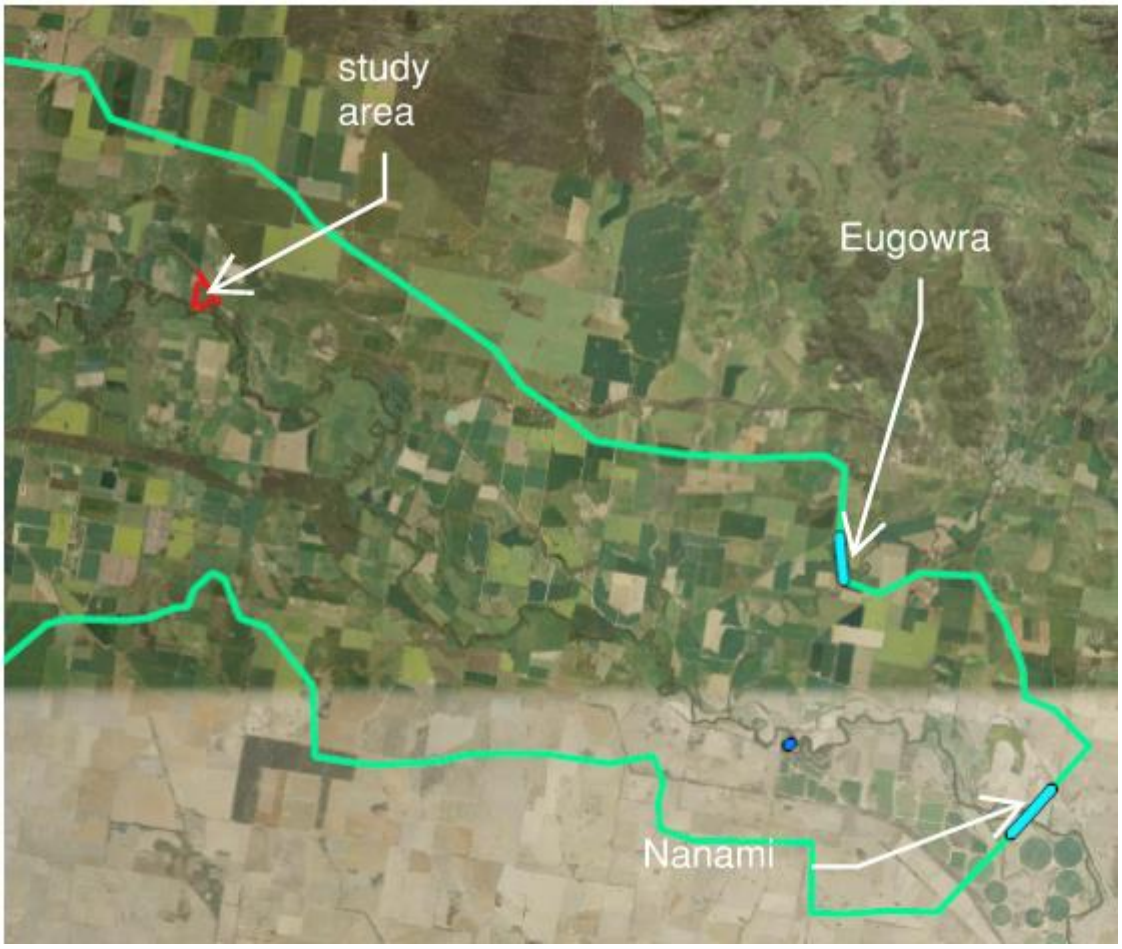


Figure 3 Tuflow model inflow locations.

Table 3 Peak flow values for modelled events.

Inflow Location	1% AEP [m^3/s]	5% AEP [m^3/s]	10% AEP [m^3/s]
Eugowra	605	410	305
Nanami	5280	1960	1190

5.3 Validation to Forbes Council Flood Study

The new model has been verified against the Forbes Council Flood Study (2020). Flood levels were compared at two gauged sites, namely Iron Bridge and Cotton's Weir, flood levels at these locations were calibrated to historical events in Forbes Council Flood Study (2020). Sensitivity analysis was conducted to Manning's n values by scaling Tuflow 2D surface Manning's n values between 0% and 50% and comparing water level changes at the two gauged sites.

It is important to note that these two gauged sites are located away from the area of interest, approximately 10.7 km for Iron Bridge and 13.8 km for Cotton's Weir as the crow flies. Calibrating the model to the nearest millimetre at these two sites would have a small advantage or increase the confidence in the calibration at the area of interest location. Therefore, only a comparison of water levels was undertaken with some sensitivity.

The existing railway embankment upstream of the gauged site is an important aspect to consider. It was discovered that this railway embankment was not modelled properly in the original TUFLOW model, and it was not enforced as a continuous embankment. The calibration exercise took place with no specific site survey of these hydraulic controls (Cotton's Weir and Iron Bridge). It was found that using the base Mannings N values and applying a baseflow through the Lachlan River the water level difference between gauged levels versus modelled were within 0 to 150mm (for the 1 to 10% AEP events), which was deemed to be an acceptable level of accuracy.

Table 4 summarises the water level comparison at the two gauged locations. Stream gauges are presented in Figure 4.

Table 4: Peak Water Level Values for Chosen Scenario – Flood Study Manning's N, Baseflow and No Railway.

Calibration Site	AEP event (AEP)	Water Levels from Flood Study [mAHD]	Modelled Water Level [mAHD]	Difference in Water Levels [m]
Iron Bridge	10%	238.57	238.42	0.15
	5%	238.58	238.47	0.11
	1%	239.07	239.07	0.00
Cottons Weir	10%	236.36	236.21	0.15
	5%	236.40	236.26	0.14
	1%	236.87	236.85	0.02

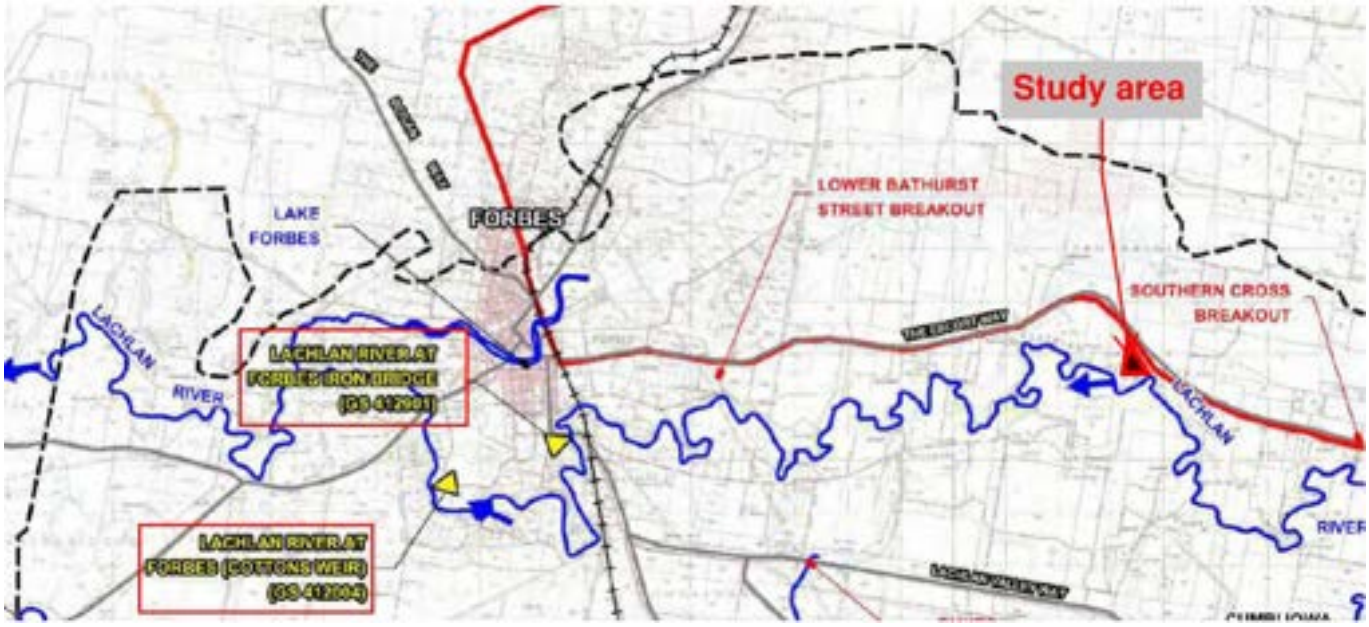


Figure 4: Stream Gauge Locations used for Validation.

5.4 Temporary works

Temporary works scenario consists of a larger footprint and a temporary bund height set at 245mAHD. This bund provides 200mm freeboard from 1% AEP flood event. It is expected that temporary works site will be active during the construction period (approximately less than 2 years). The temporary works (also called interim scenario) flood levels and outlines are presented in Figures 8 to 13 in Appendix A.

5.5 Final Design

The final design (also called Ultimate scenario) has smaller footprint area than temporary works and hence the displaces less amount of water (Figures 14-19 in Appendix A inclusively). The proposed final scenario is depicted in Figure 1.

6. Results

As described in Section 5.4 and 5.5, the two scenarios were developed to evaluate flood levels and flood impacts to surrounding locations for:

- Temporary works scenario (interim scenario); and
- Final design (Ultimate scenario).

The highest flood level around the perimeter of the site summarised in Table 5. Noting that temporary works site bund height has been set to 245mAHD and provides 200mm freeboard from 1% AEP flood level, while the design scenario bund height set to 245.25 and provides 540mm of freeboard for 1% AEP event.

Table 5 Peak flow values for modelled scenarios and design events.

Scenario	Design bund height [mAHD]	WL 1% AEP event [mAHD]	WL 5% AEP event [mAHD]	WL 10% AEP event [mAHD]
Temporary works (interim scenario)	245.00	244.75	244.09	243.89
Final (Ultimate scenario)	245.25	244.70	244.08	243.89

The flood impact mapping has been produced for both scenarios, and all events run are shown in Figures 20 to 25 in Appendix A. As expected, the temporary works scenario resulted in a larger footprint of flood impacts. If the 1% AEP event were to occur during the construction period, it would not negatively impact any of the surrounding houses.

At The Escort Way, design flood levels increase up to 120mm for the 1% AEP event for temporary works and up to 70mm for the 1% AEP event for the final scenario. Table 6 summarizes the flood level increase for The Escort Way for various scenarios and events.

Table 6: Peak flood depths and flood impacts to The Escort Way.

Scenario	1% AEP Flood depth [mm]	5% AEP Flood depth [mm]	10% AEP Flood depth [mm]	1% AEP Afflux [mm]	5% AEP Afflux [mm]	10% AEP Afflux [mm]
Baseline	1040	420	240	-	-	-
Temporary works (interim scenario)	1160	500	290	120	80	50
Final (Ultimate scenario)	1110	460	270	70	40	30

7. Conclusions and Recommendation

7.1 Conclusions

- Based on the model sensitivity and verification runs, the results are comparable to the Forbes Flood study conducted in 2020. The 1% AEP event showed no difference in water level at two gauge sites, and other modelled events resulted in lower flood levels of up to 150mm.
- The designed bund height of 245m for the temporary works scenario and 245.25mAHD for the ultimate scenario provides a level of protection to the 1% AEP event with some freeboard (subject to model assumptions and limitations).
- The water level difference mapping indicated that there is no increase in flood levels for the surrounding properties for the events of 1%, 5%, and 10% AEP.
- The water level difference mapping showed that design flood levels increase at The Escort Way due to the proposed infrastructure (up to 120mm during temporary works and up to 70mm for the final design for 1% AEP). However, the road is already inundated at various location along its alignment. The local increase in flood levels has no adverse impact on the existing immunity of The Escort Way. The relative minor increases to flood levels have no adverse impact on potential evacuation process that local authorities may carry out in the event of a major flood.

8. References

Lyall&Associates. (May 2020). *Forbes Flood Study Review*. Forbes Shire Council.

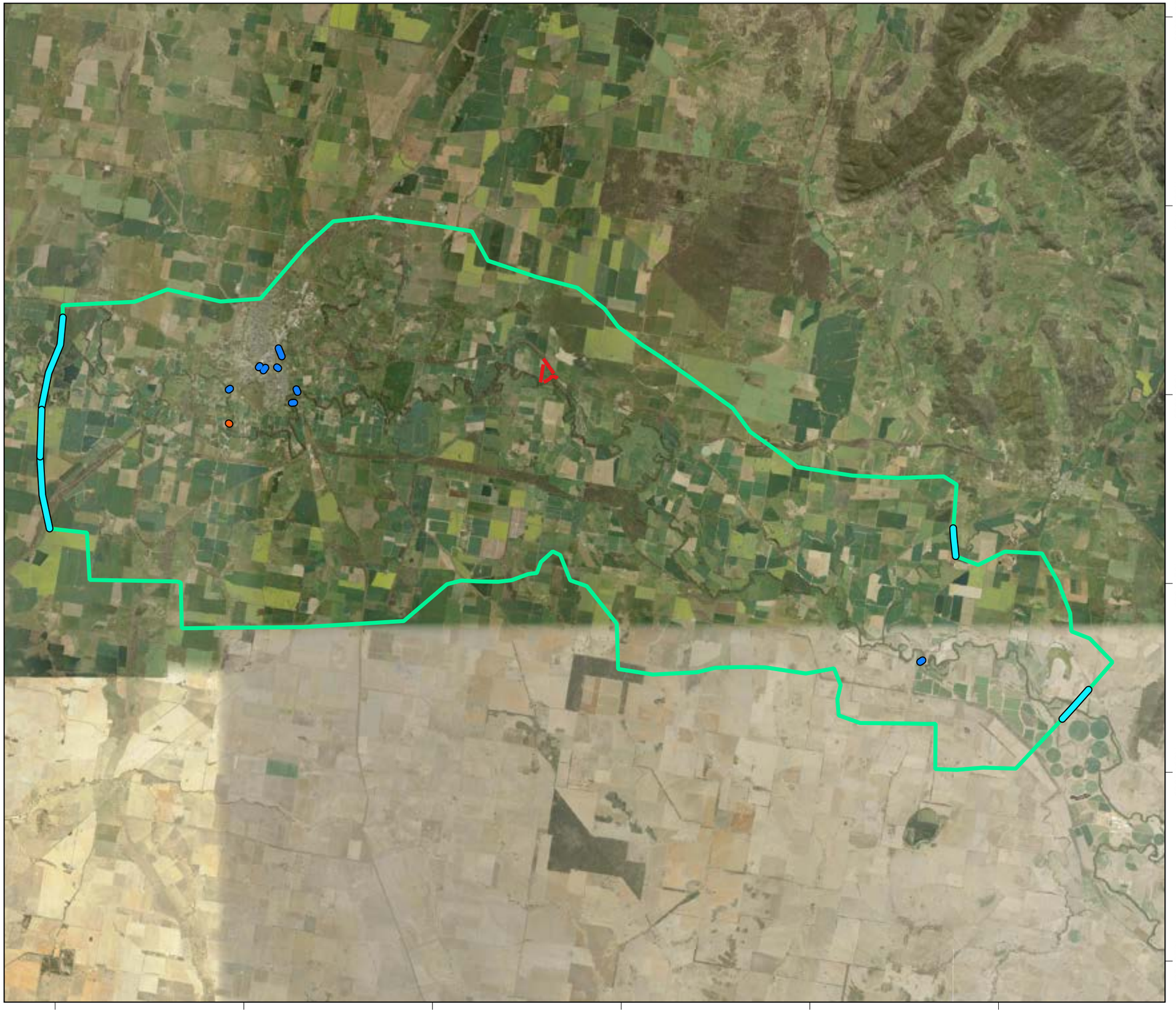
Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors). (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation.* Commonwealth of Australia.

DFSI Spatial. (May 2015). *Elevation data products specification and description. Source Airbourne Light Detecting and Ranging (LiDAR).* NSW Spatial Services.

ELVIS. (2020, June 25). *Elevation and Depth - Foundation Spatial Data*. Retrieved from https://elevation.fsdf.org.au/

Appendices

Appendix A - Figures



Legend

- Study Area
- Inflows and Outflows
- Bridges
- Cottons Weir
- Model Extent

0 2,000 4,000 6,000 8,000 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

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CLIENT: Parkes Shire Council

SE22026 Lachlan River Pre-Treatment Lagoons

Figure 1
Model Setup

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

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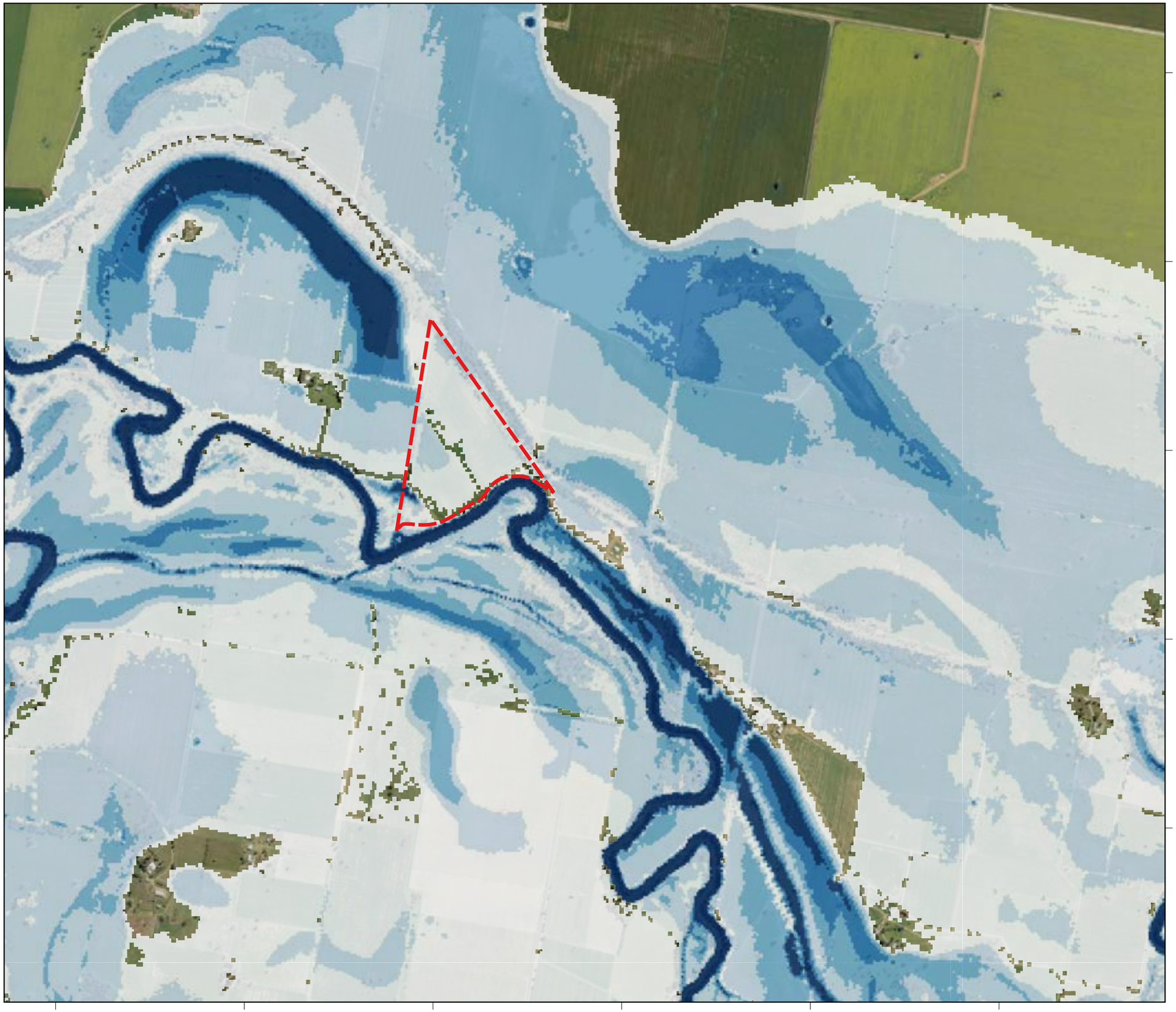

Legend

- Study Area

Flood Depth (m)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

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Figure 2
Existing Scenario - Flood Depth 10% AEP

DATUM GDA 2020 MGA Zone 55

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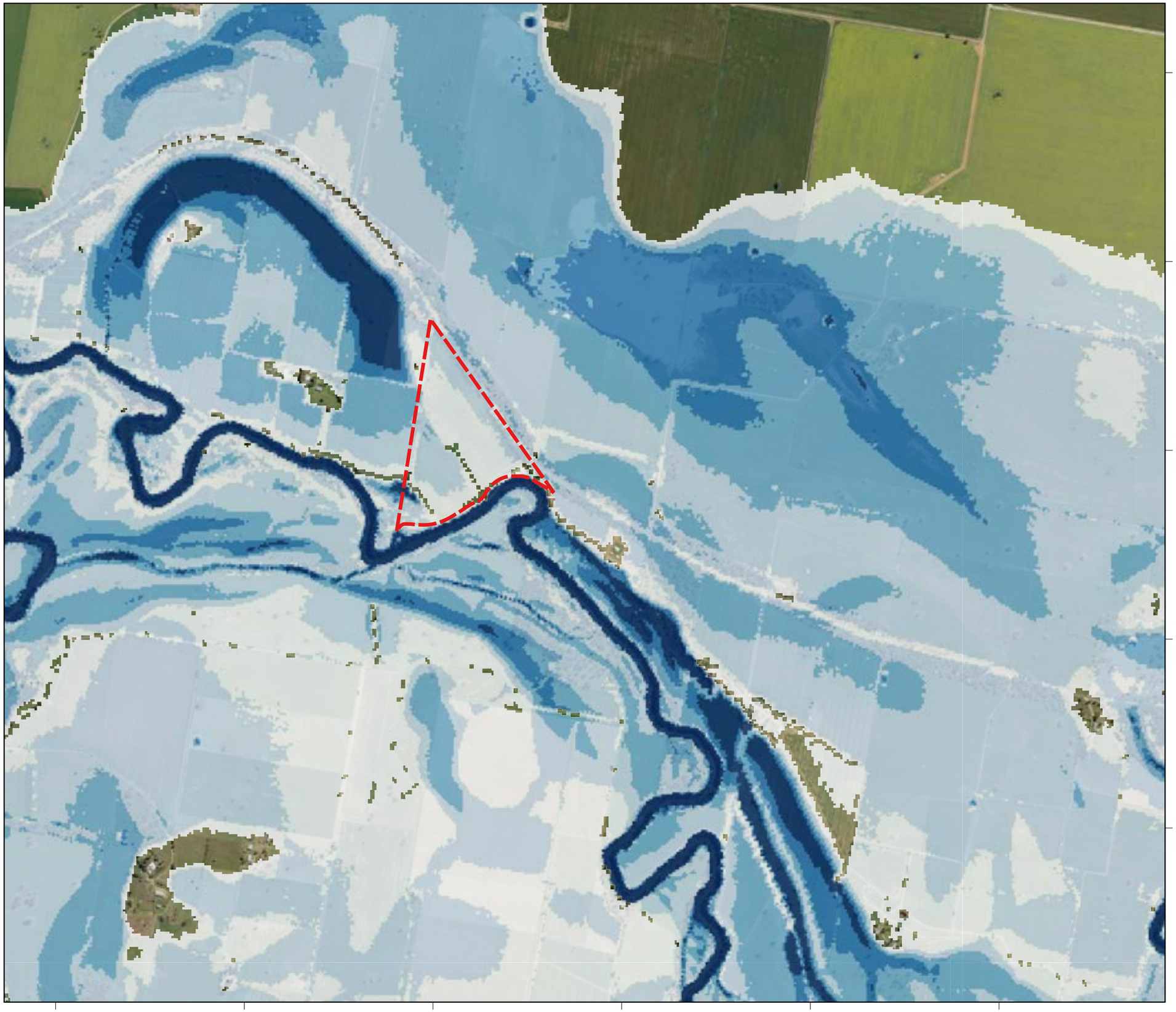
Aerial Imagery Source: Sixmaps



Legend

- Study Area

Flood Depth (m)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

0 200 400 600 800 m

N

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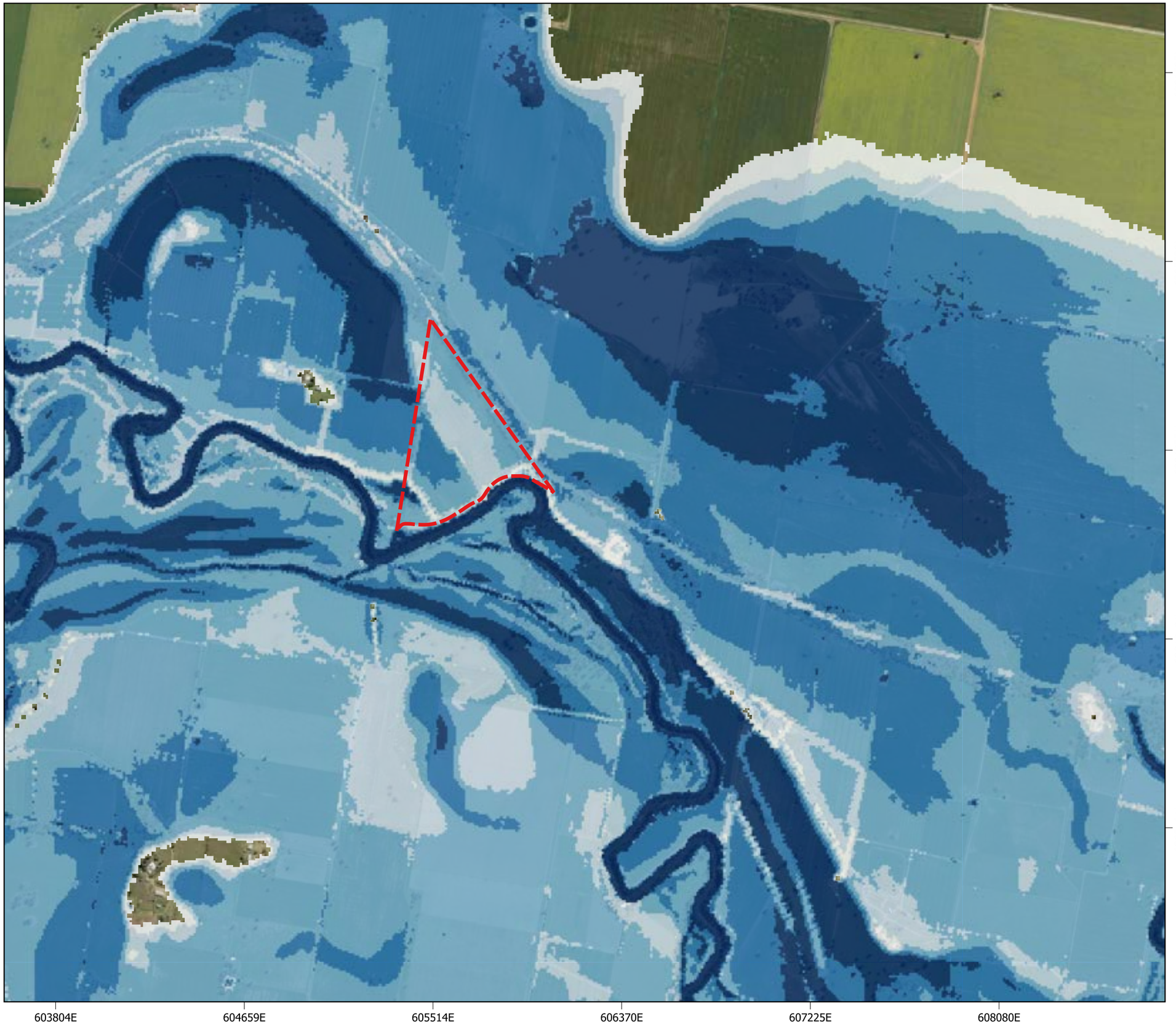
Figure 3
Existing Scenario - Flood Depth 5% AEP

DATUM GDA 2020 MGA Zone 55

||bgesydfs03|Projects|BGE|SYD|SE22026 PARKES SURFACE WATER MODELLING UPDATE|100 DRAW|100.4 Water|GIS|Wor|Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas

Aerial Imagery Source: Sixmaps



Legend

- Study Area

Flood Depth (m)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

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Figure 4
Existing Scenario - Flood Depth 1% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

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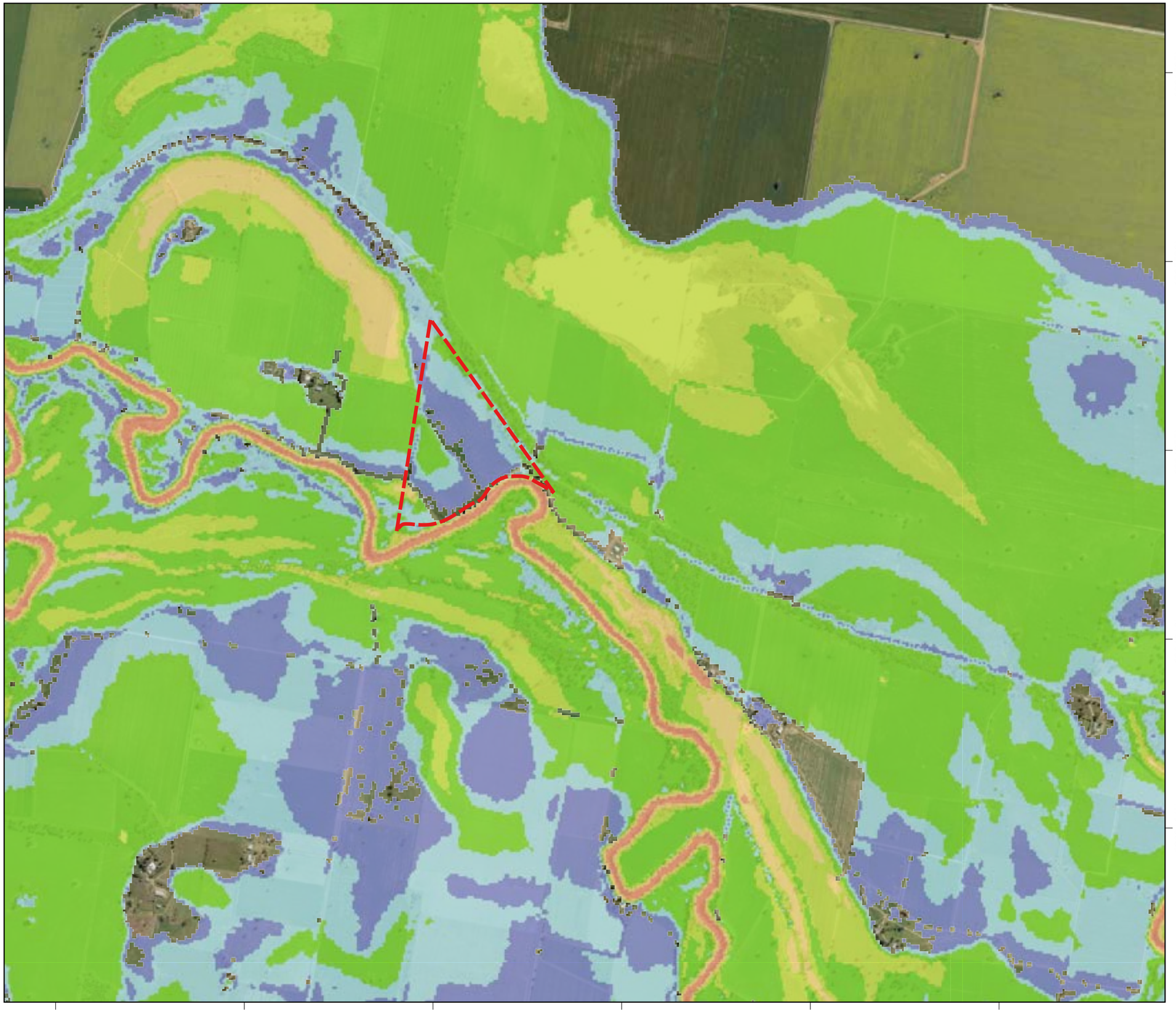

Legend

- Study Area

Flood Hazard

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles
- H3: Unsafe for vehicles, children and the elderly
- H4: Unsafe for vehicles and people
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6: Unsafe for vehicles and people All building types considered vulnerable to failure

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

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Figure 5
Existing Scenario - Flood Hazard 10% AEP

DATUM GDA 2020 MGA Zone 55

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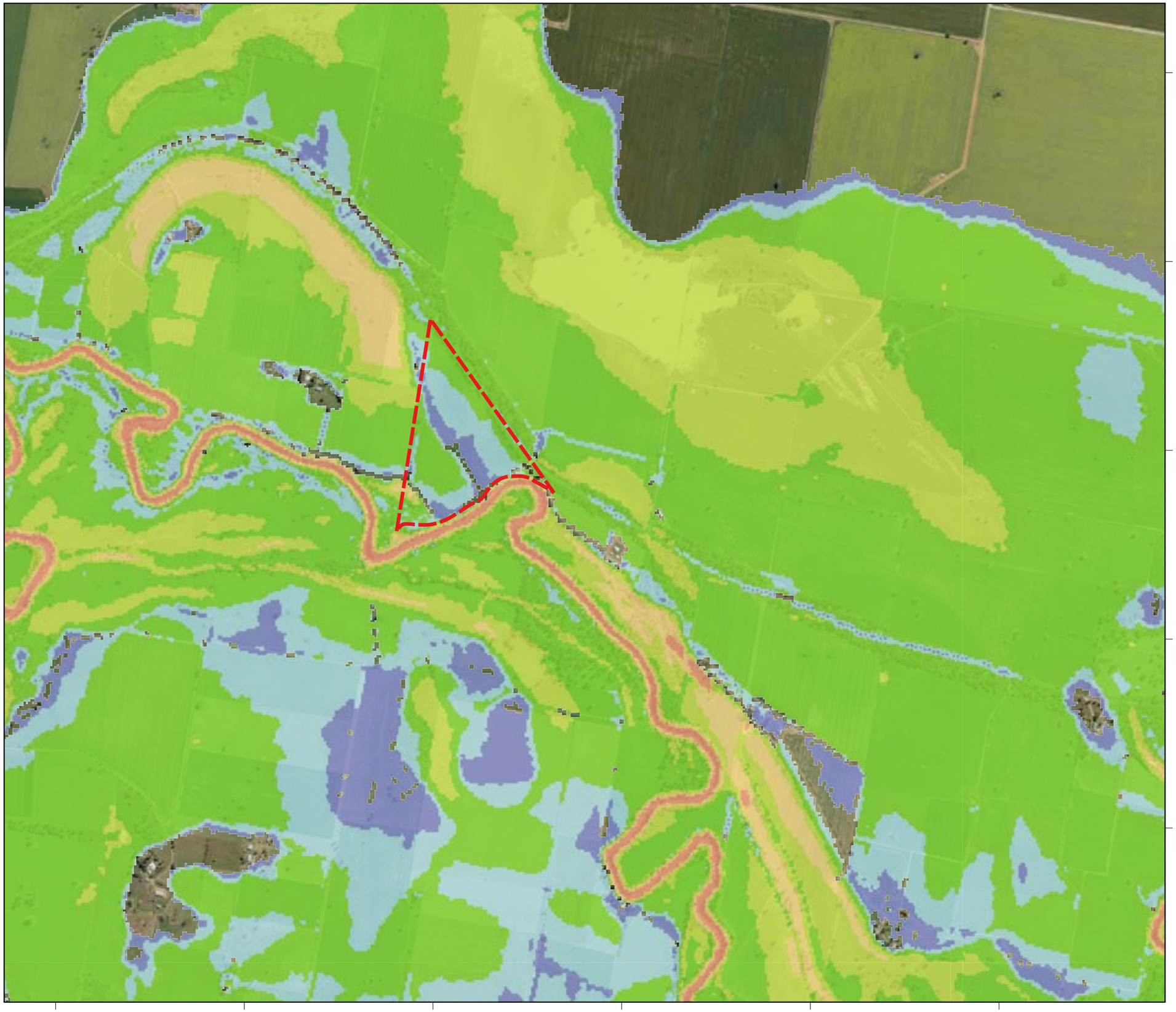
Aerial Imagery Source: Sixmaps



Legend

- Study Area

Flood Hazard

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles
- H3: Unsafe for vehicles, children and the elderly
- H4: Unsafe for vehicles and people
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6: Unsafe for vehicles and people All building types considered vulnerable to failure

0 200 400 600 800 m

N

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APPROVED: IV

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SE22026 Lachlan River Pre-Treatment Lagoons

Figure 6
Existing Scenario - Flood Hazard 5% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

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Legend

- Study Area

Flood Hazard

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles
- H3: Unsafe for vehicles, children and the elderly
- H4: Unsafe for vehicles and people
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6: Unsafe for vehicles and people All building types considered vulnerable to failure

0 200 400 600 800 m

N

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APPROVED: IV

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SE22026 Lachlan River Pre-Treatment Lagoons

Figure 7
Existing Scenario - Flood Hazard 1% AEP

DATUM GDA 2020 MGA Zone 55

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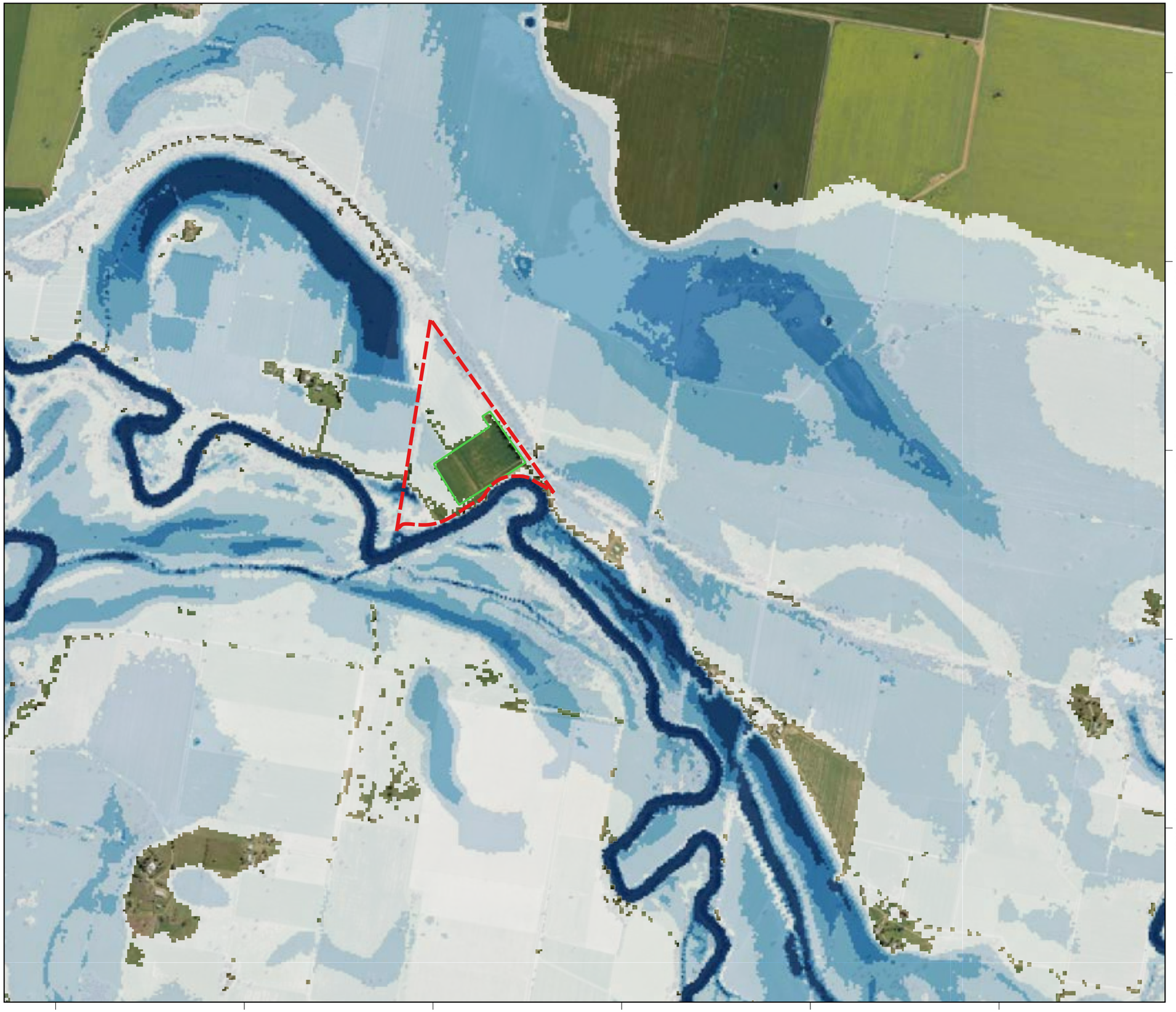
Aerial Imagery Source: Sixmaps



Legend

- Study Area
- Interim Works Site Bund

Flood Depth (m)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

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PROJECT: Lachlan River Pre-Treatment Lagoons
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SE22026 Lachlan River Pre-Treatment Lagoons

Figure 8
Interim Scenario - Flood Depth 10% AEP

DATUM GDA 2020 MGA Zone 55

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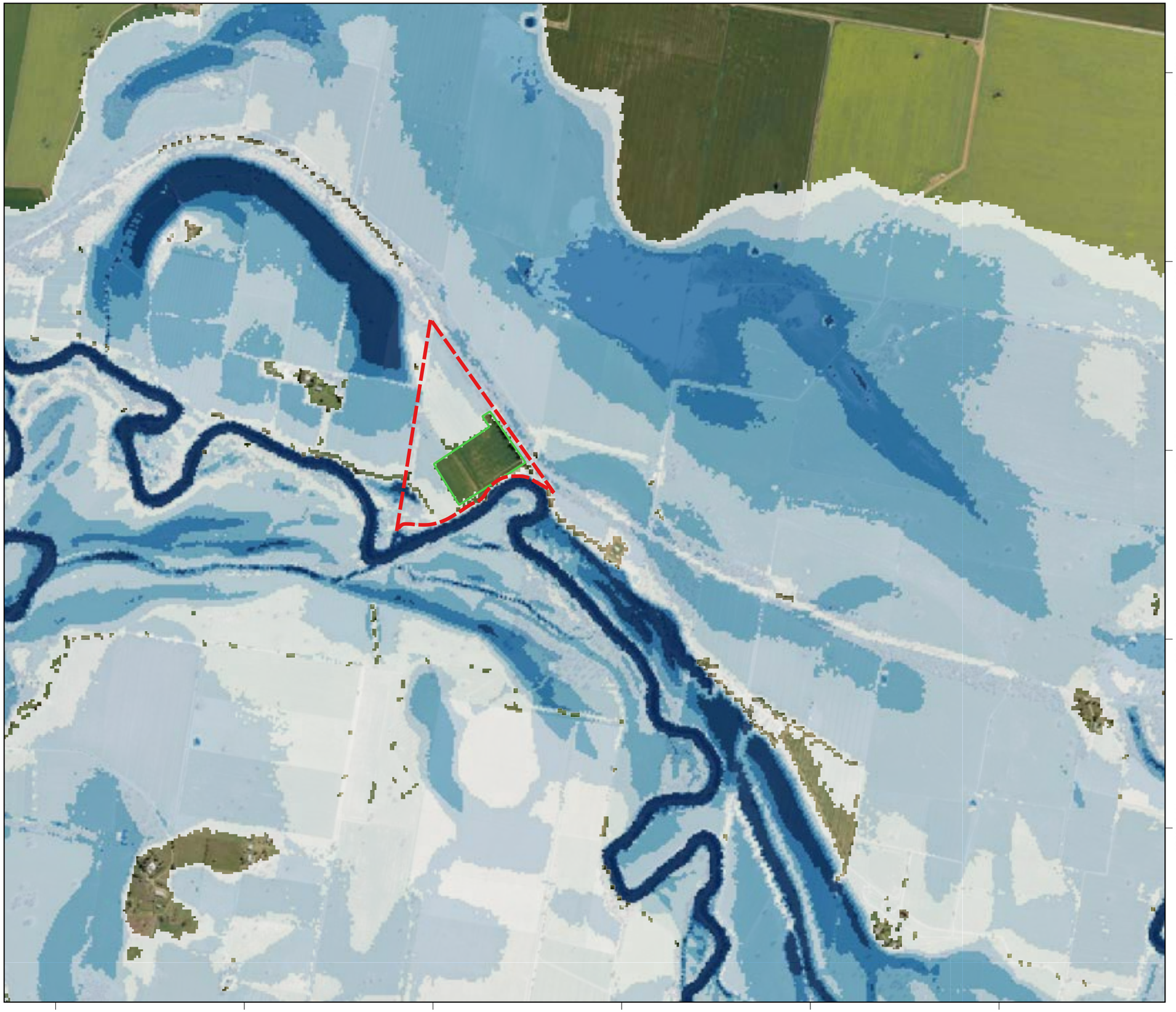
Aerial Imagery Source: Sixmaps



Legend

- Study Area
- Interim Works Site Bund

Flood Depth (m)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

0 200 400 600 800 m

N

DRAWN: SM
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APPROVED: IV

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PROJECT: Lachlan River Pre-Treatment Lagoons
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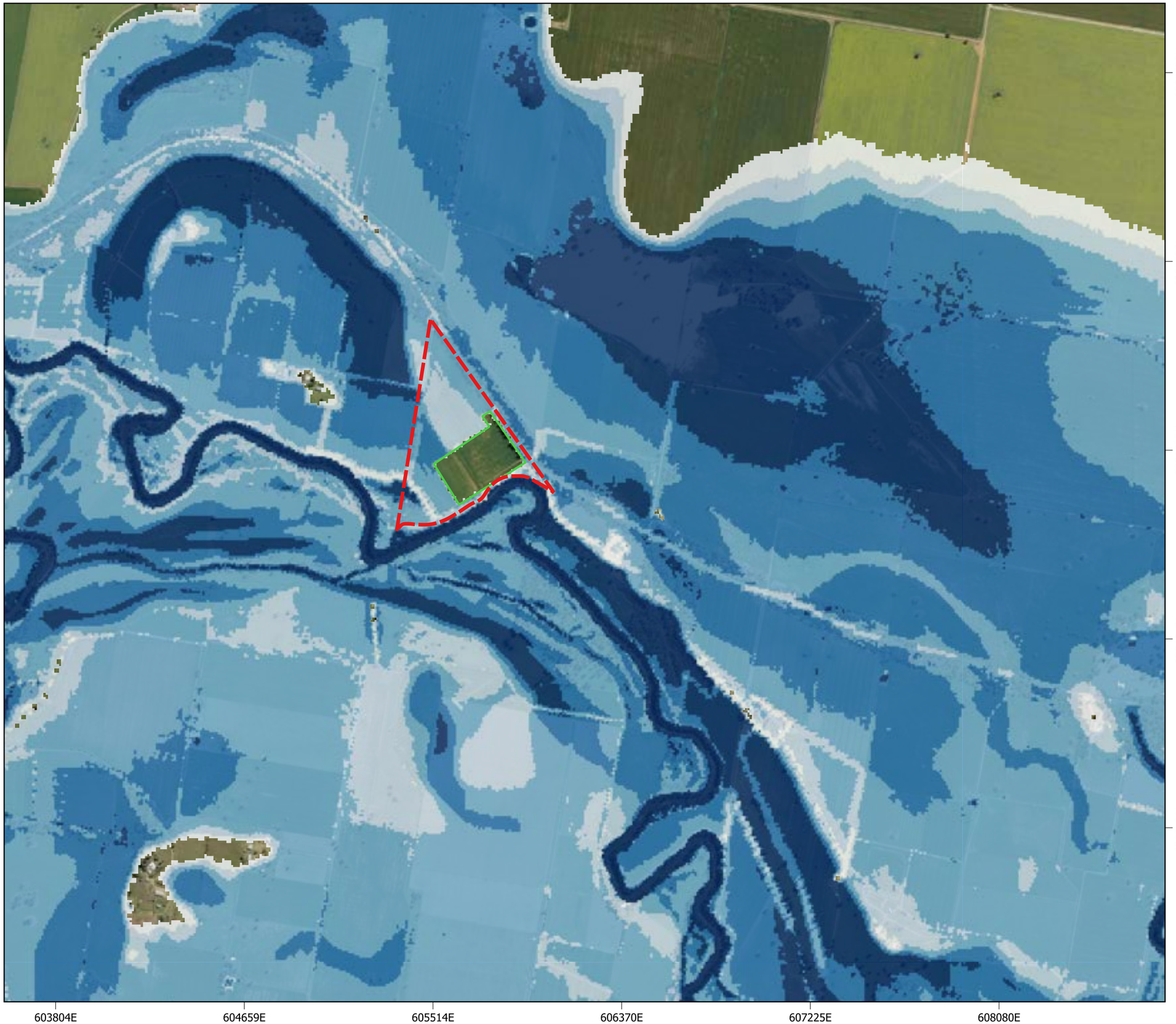
SE22026 Lachlan River Pre-Treatment Lagoons

Figure 9
Interim Scenario - Flood Depth 5% AEP

DATUM GDA 2020 MGA Zone 55

||bgesydfs03|Projects|BGE|SYD|SE22026 PARKES SURFACE WATER MODELLING UPDATE|100 DRAW|100.4 Water|GIS|Wor|Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas

Aerial Imagery Source: Sixmaps



Legend

- Study Area
- Interim Works Site Bund

Flood Depth (m)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

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PROJECT: Lachlan River Pre-Treatment Lagoons
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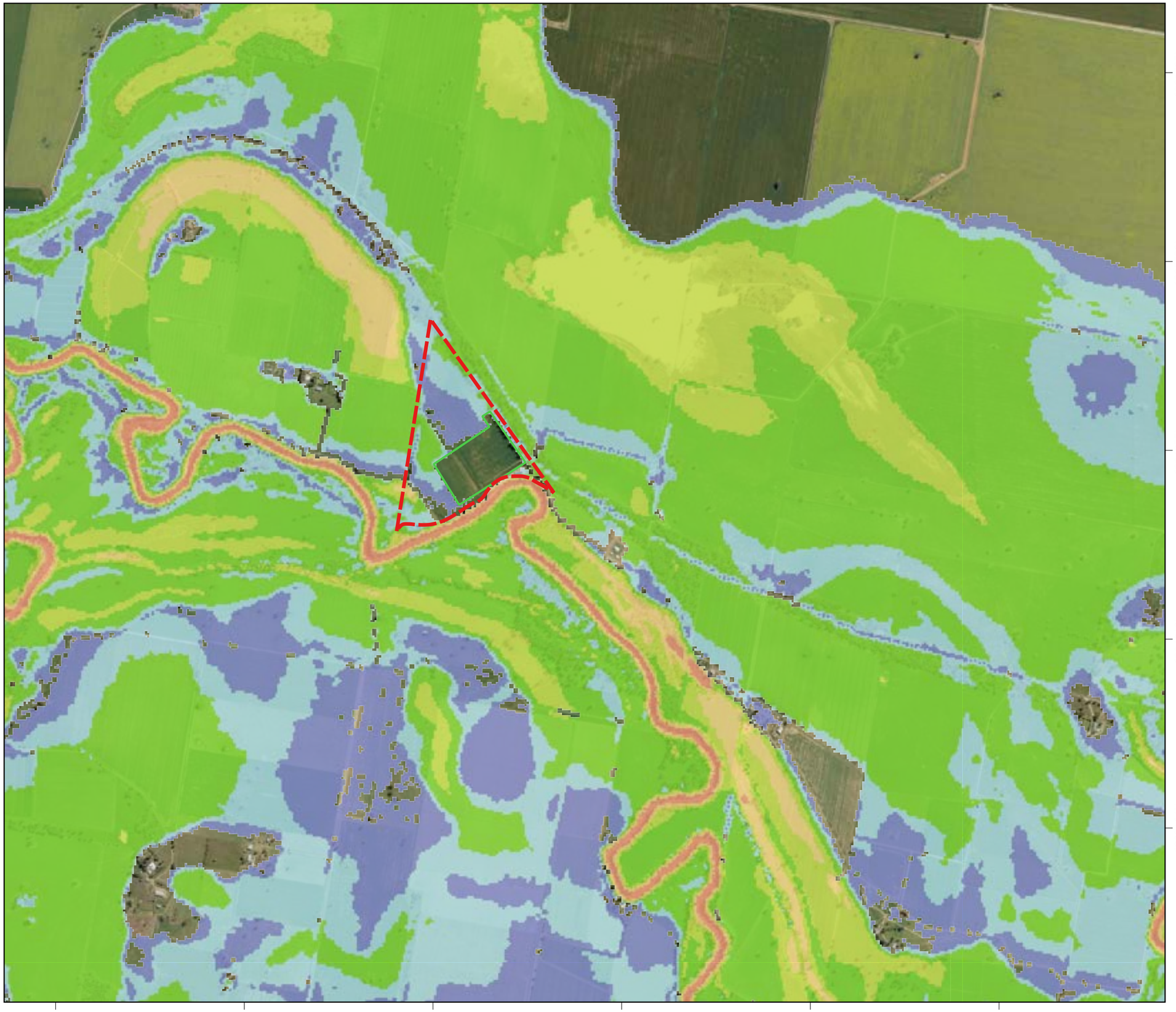
SE22026 Lachlan River Pre-Treatment Lagoons

Figure 10
Interim Scenario - Flood Depth 1% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps



Legend

- Study Area
- Interim Works Site Bund

Flood Hazard

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles
- H3: Unsafe for vehicles, children and the elderly
- H4: Unsafe for vehicles and people
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6: Unsafe for vehicles and people All building types considered vulnerable to failure

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

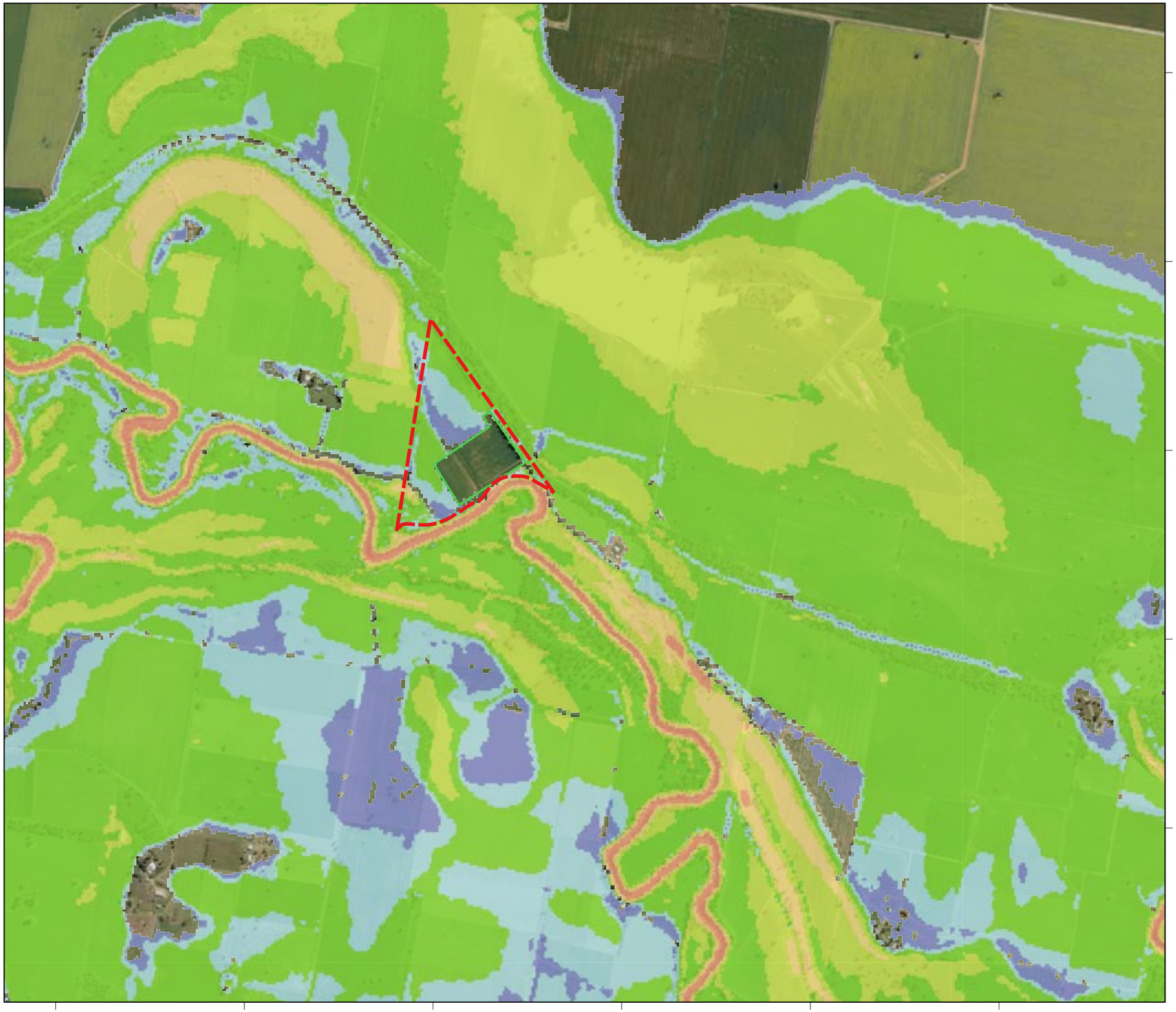
SE22026 Lachlan River Pre-Treatment Lagoons

Figure 11
Interim Scenario - Flood Hazard 10% AEP

DATUM GDA 2020 MGA Zone 55

\\bgesydfs03\Projects\BGE\SYD\SE22026 PARKES SURFACE WATER MODELLING UPDATE\100 DRAW\100.4 Water\GIS\Wor\Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas

Aerial Imagery Source: Sixmaps



Legend

- Study Area
- Interim Works Site Bund

Flood Hazard

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles
- H3: Unsafe for vehicles, children and the elderly
- H4: Unsafe for vehicles and people
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6: Unsafe for vehicles and people All building types considered vulnerable to failure

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

SE22026 Lachlan River Pre-Treatment Lagoons

Figure 12
Interim Scenario - Flood Hazard 5% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

\\bgesydfs03\Projects\BGE\SYD\SE22026 PARKES SURFACE WATER MODELLING UPDATE\100 DRAW\100.4 Water\GIS\Wor\Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas

6306585N
6305730N
6304875N
6304019N
6303164N

603804E
604659E
605514E
606370E
607225E
608080E

Legend

- Study Area
- Interim Works Site Bund

Flood Hazard

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles
- H3: Unsafe for vehicles, children and the elderly
- H4: Unsafe for vehicles and people
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6: Unsafe for vehicles and people All building types considered vulnerable to failure

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

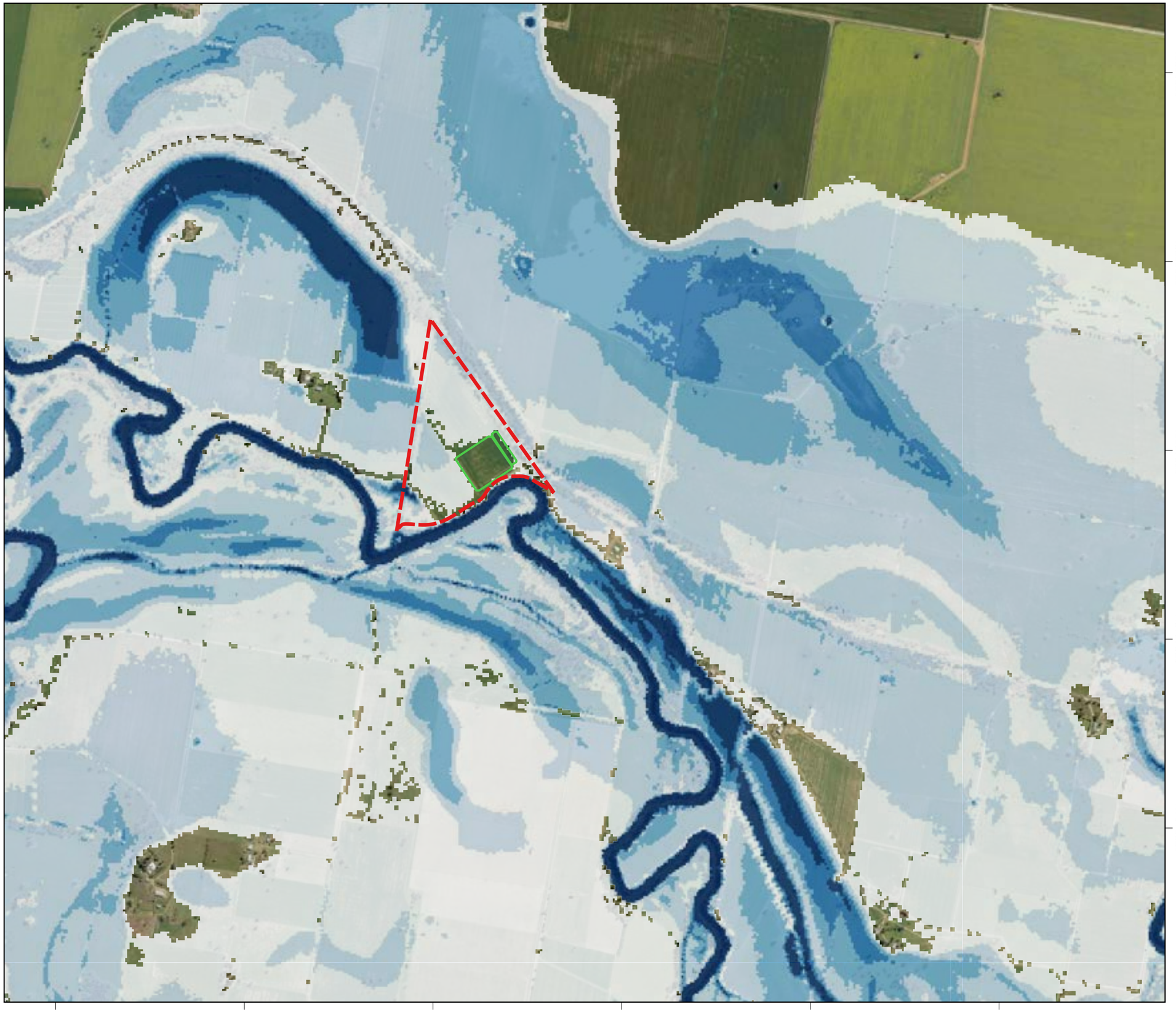
SE22026 Lachlan River Pre-Treatment Lagoons

Figure 13
Interim Scenario - Flood Hazard 1% AEP

DATUM GDA 2020 MGA Zone 55

\\bgesydfs03\Projects\BGE\SYD\SE22026 PARKES SURFACE WATER MODELLING UPDATE\100 DRAW\100.4 Water\GIS\Wor\Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas

Aerial Imagery Source: Sixmaps



Legend

- Study Area
- Ultimate Design

Flood Depth (m)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

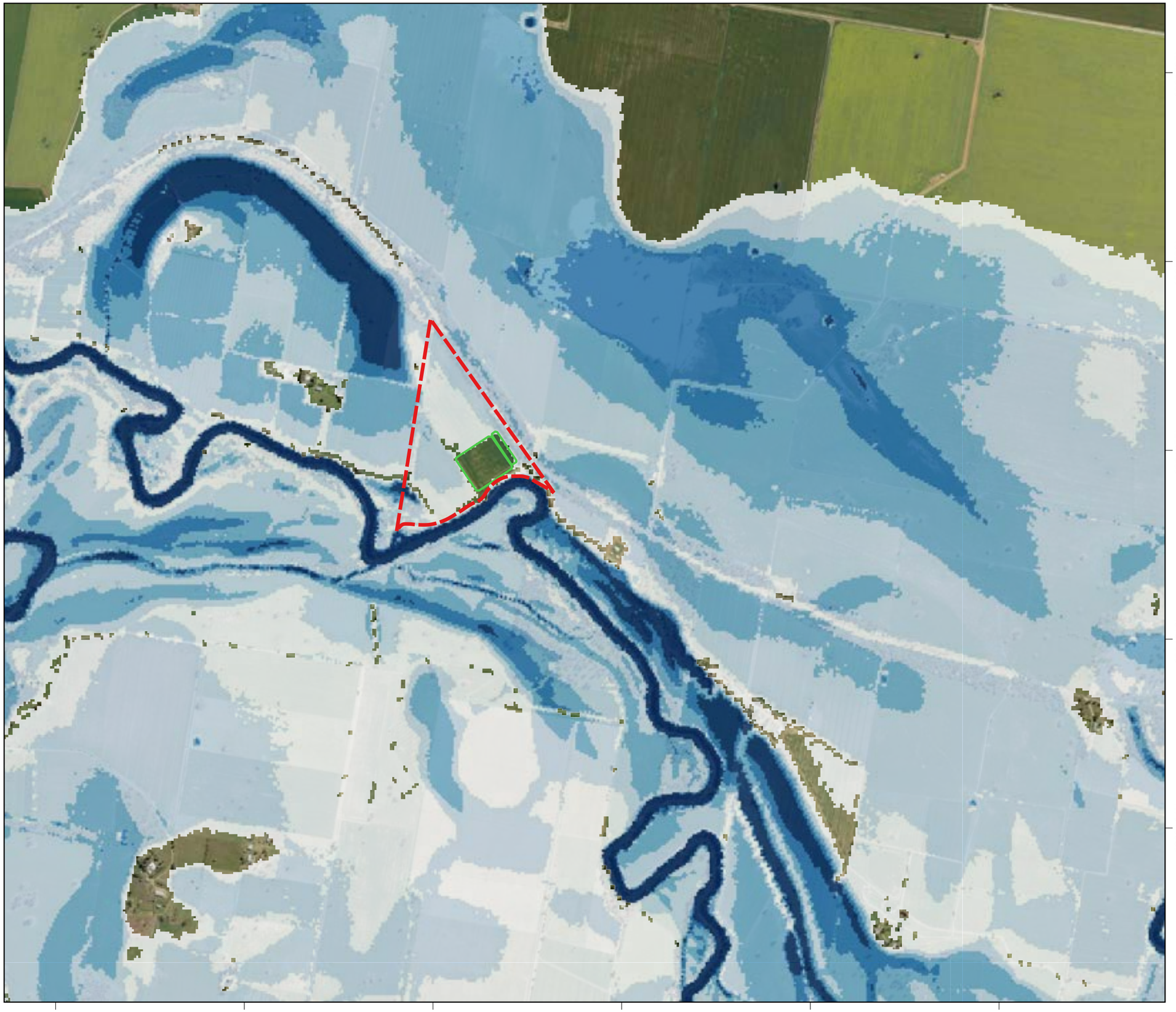
SE22026 Lachlan River Pre-Treatment Lagoons

Figure 14
Ultimate Scenario - Flood Depth 10% AEP

DATUM GDA 2020 MGA Zone 55

||bgesydfs03|Projects|BGE|SYD|SE22026 PARKES SURFACE WATER MODELLING UPDATE|100 DRAW|100.4 Water|GIS|Wor|Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas

Aerial Imagery Source: Sixmaps



Legend

- Study Area
- Ultimate Design

Flood Depth (m)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

0 200 400 600 800 m

N

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REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

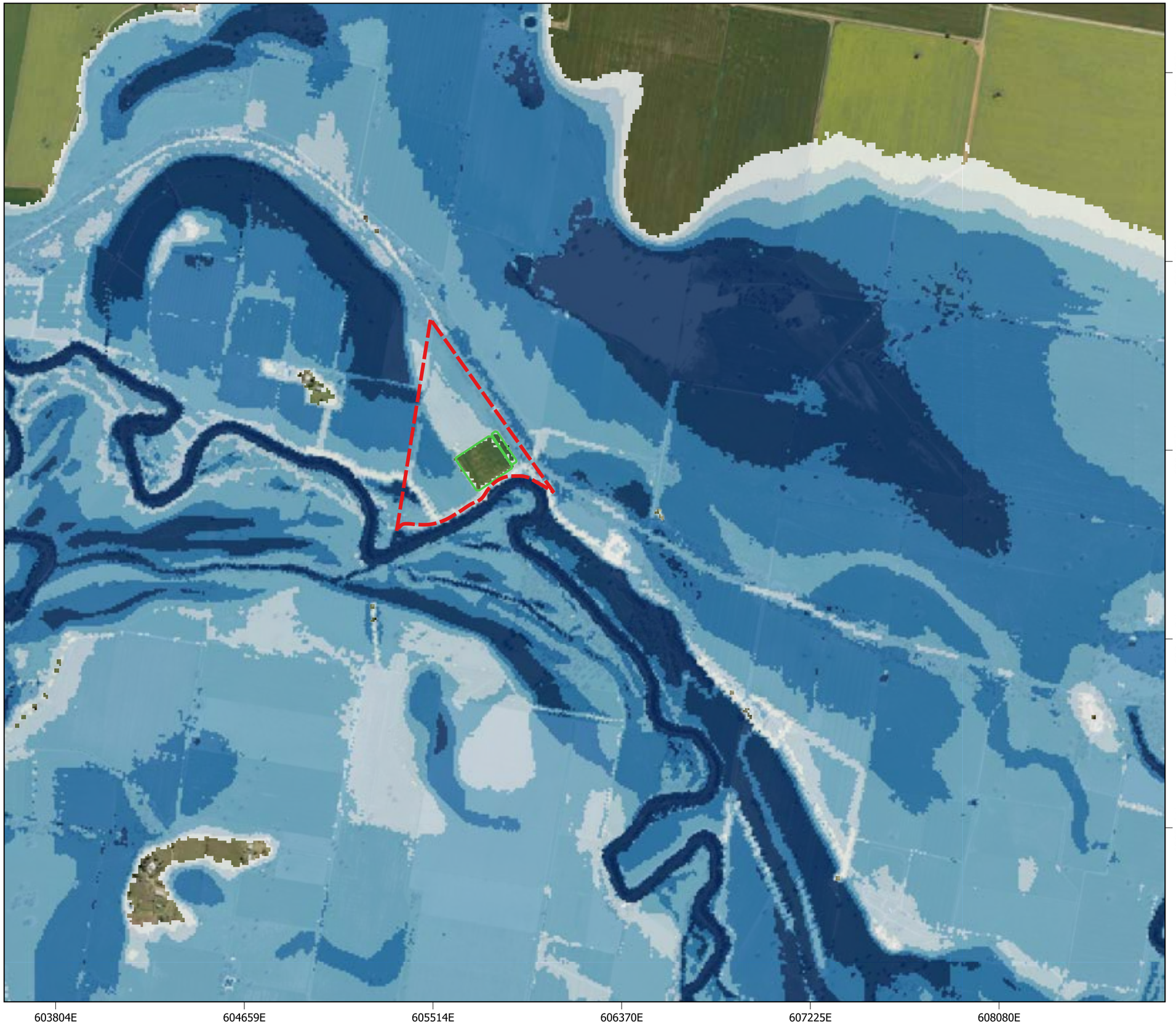
SE22026 Lachlan River Pre-Treatment Lagoons

Figure 15
Ultimate Scenario - Flood Depth 5% AEP

DATUM GDA 2020 MGA Zone 55

||bgesydfs03|Projects|BGE|SYD|SE22026 PARKES SURFACE WATER MODELLING UPDATE|100 DRAW|100.4 Water|GIS|Wor|Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas

Aerial Imagery Source: Sixmaps



Legend

- Study Area
- Ultimate Design

Flood Depth (m)

- <= 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

SE22026 Lachlan River Pre-Treatment Lagoons

Figure 16
Ultimate Scenario - Flood Depth 1% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

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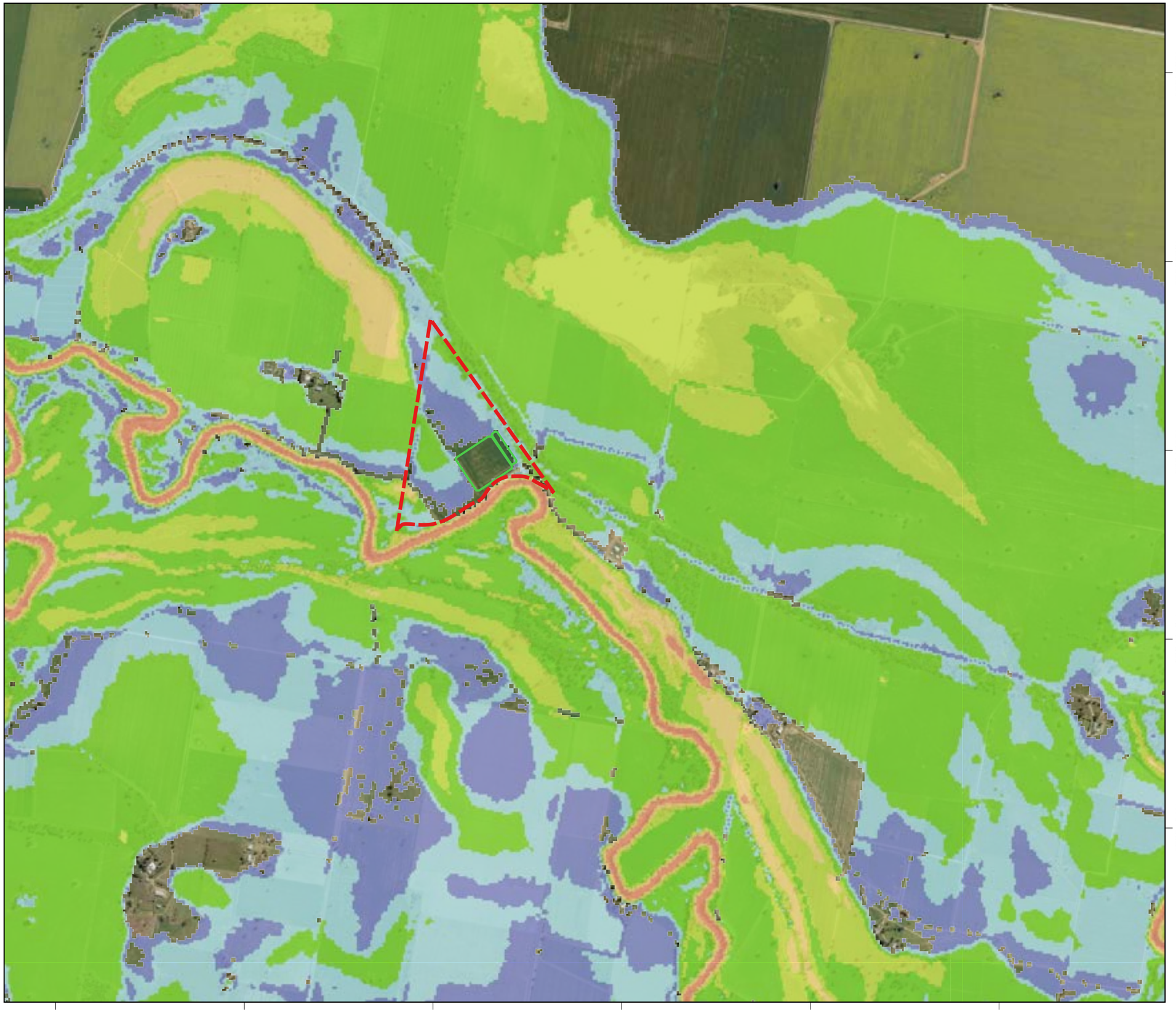


Legend

- Study Area
- Ultimate Design

Flood Hazard

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles
- H3: Unsafe for vehicles, children and the elderly
- H4: Unsafe for vehicles and people
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6: Unsafe for vehicles and people All building types considered vulnerable to failure

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

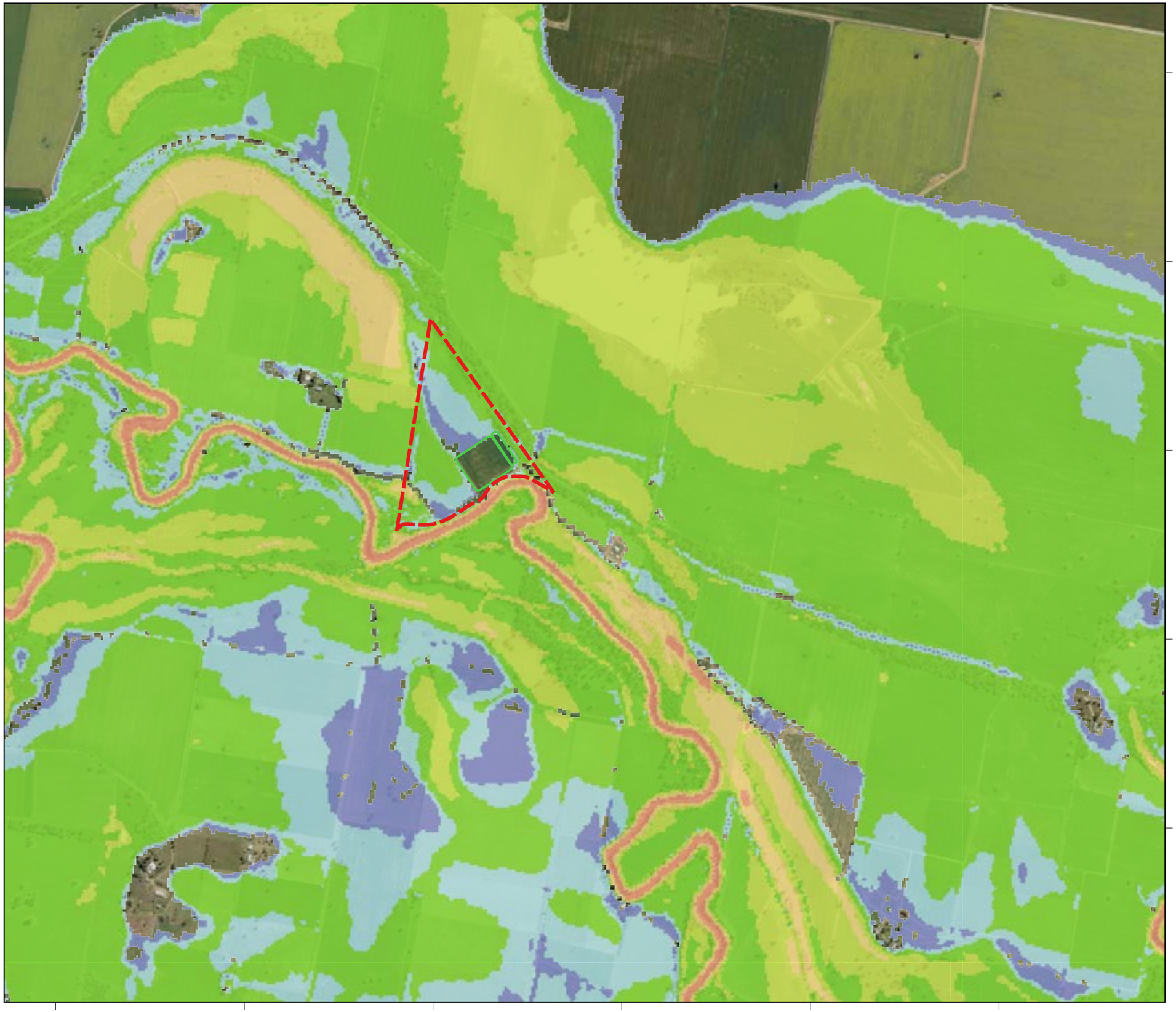
SE22026 Lachlan River Pre-Treatment Lagoons

Figure 17
Ultimate Scenario - Flood Hazard 10% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

|\bgesydfs03\Projects\BGE\SYD\SE22026 PARKES SURFACE WATER MODELLING UPDATE\100 DRAW\100.4 Water\GIS\Wor\Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas



Legend

- Study Area
- Ultimate Design

Flood Hazard

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles
- H3: Unsafe for vehicles, children and the elderly
- H4: Unsafe for vehicles and people
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6: Unsafe for vehicles and people All building types considered vulnerable to failure

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

SE22026 Lachlan River Pre-Treatment Lagoons

Figure 18
Ultimate Scenario - Flood Hazard 5% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

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Legend

- Study Area
- Ultimate Design

Flood Hazard

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles
- H3: Unsafe for vehicles, children and the elderly
- H4: Unsafe for vehicles and people
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6: Unsafe for vehicles and people All building types considered vulnerable to failure

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

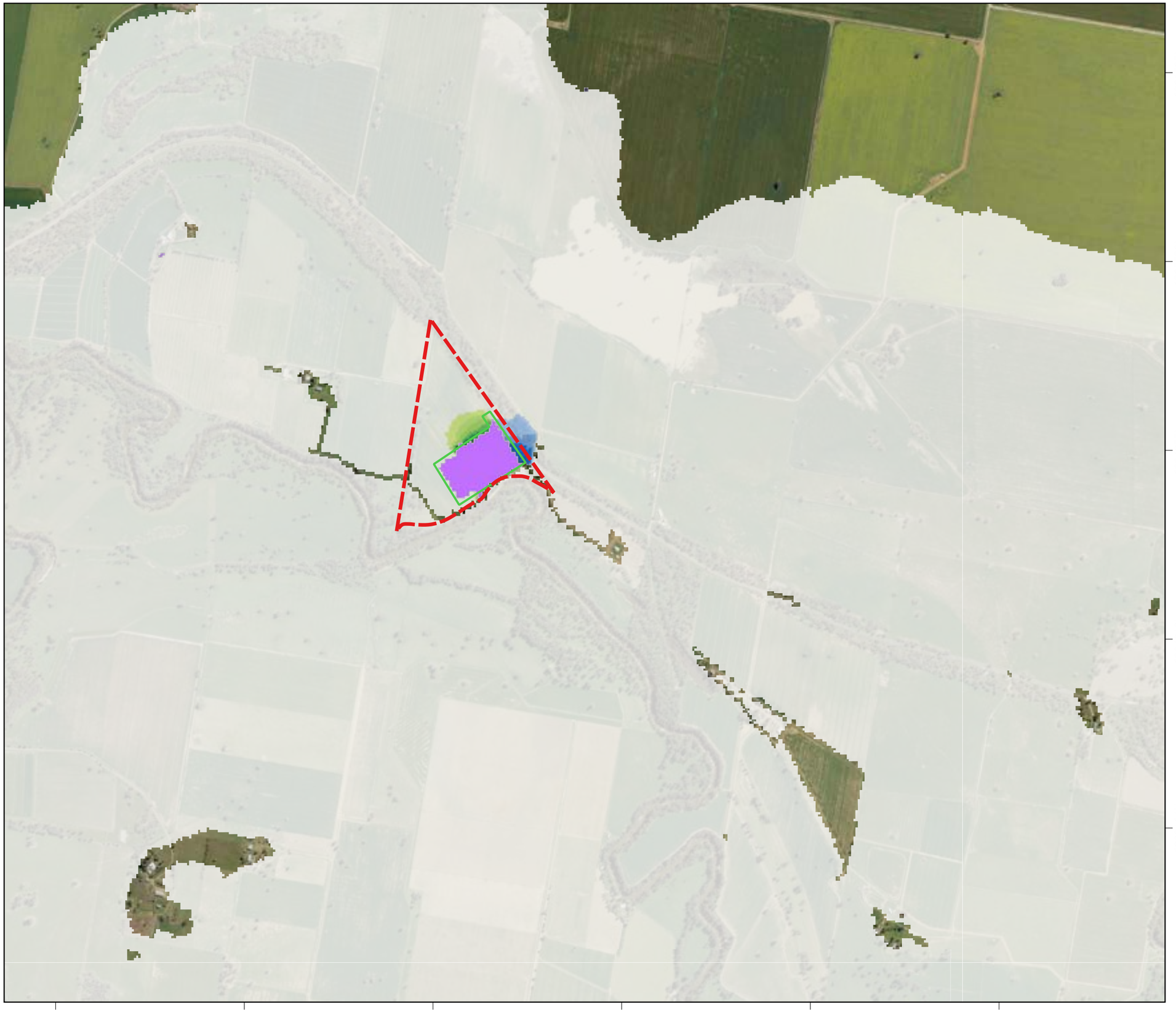
SE22026 Lachlan River Pre-Treatment Lagoons

Figure 19
Ultimate Scenario - Flood Hazard 1% AEP

DATUM GDA 2020 MGA Zone 55

\\bgesydfs03\Projects\BGE\SYD\SE22026 PARKES SURFACE WATER MODELLING UPDATE\100 DRAW\100.4 Water\GIS\Wor\Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas

Aerial Imagery Source: Sixmaps



Legend

- Study Area
- Interim Works Site Bund

Water Level Difference (cm)

- < -10
- -10 - -8
- -8 - -6
- -6 - - 4
- -4 - -3
- -3 - -2
- No change (+/- 2)
- 2 - 3
- 3 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- > 10
- Was Wet Now Dry
- Was Dry Now Wet

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

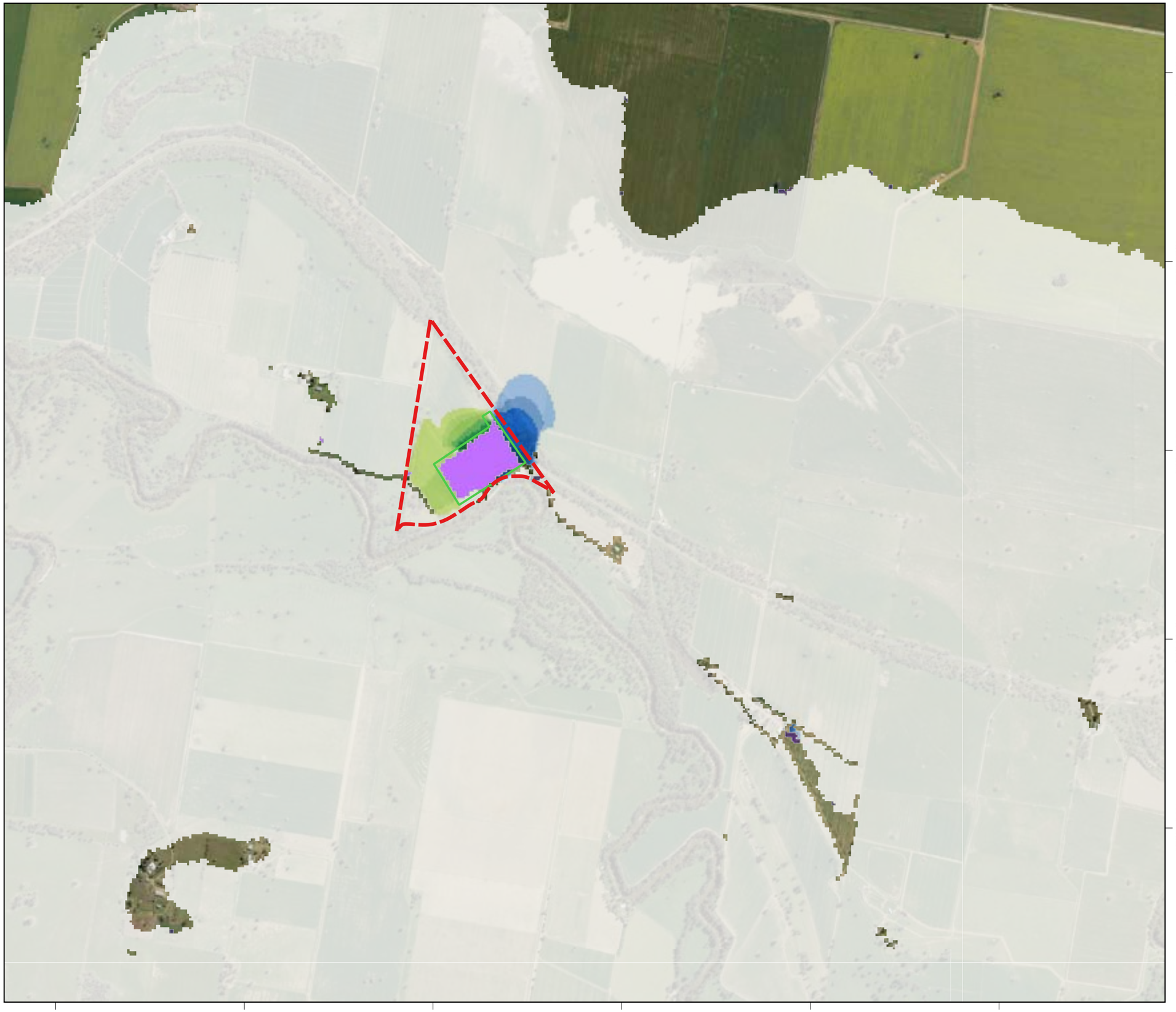
SE22026 Lachlan River Pre-Treatment Lagoons

Figure 20
Afflux Interim Scenario - 10% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

\\bgesydfs03\Projects\BGE\SYD\SE22026 PARKES SURFACE WATER MODELLING UPDATE\100 DRAW\100.4 Water\GIS\Wor\Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas



Legend

- Study Area
- Interim Works Site Bund

Water Level Difference (cm)

- < -10
- -10 - -8
- -8 - -6
- -6 - - 4
- -4 - -3
- -3 - -2
- No change (+/- 2)
- 2 - 3
- 3 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- > 10
- Was Wet Now Dry
- Was Dry Now Wet

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

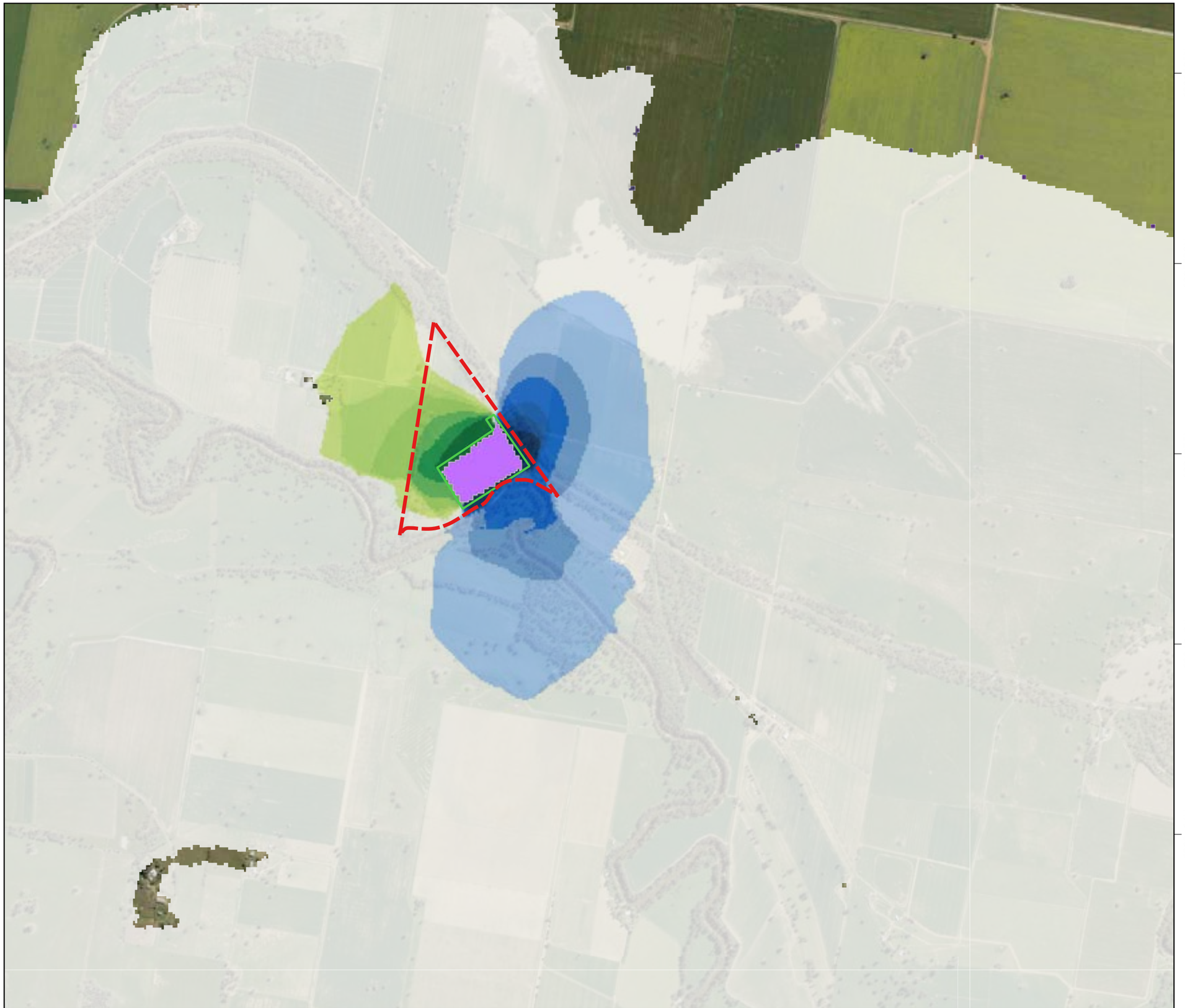
SE22026 Lachlan River Pre-Treatment Lagoons

Figure 21
Afflux Interim Scenario - 5% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

|\bgesydfs03\Projects\BGE\SYD\SE22026 PARKES SURFACE WATER MODELLING UPDATE\100 DRAW\100.4 Water\GIS\Wor\Lachlan_River_Tuflow_setup_AS.qgz | Master_Atlas



Legend

- Study Area
- Interim Works Site Bund

Water Level Difference (cm)

- < -10
- -10 - -8
- -8 - -6
- -6 - - 4
- -4 - -3
- -3 - -2
- No change (+/- 2)
- 2 - 3
- 3 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- > 10
- Was Wet Now Dry
- Was Dry Now Wet

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

SE22026 Lachlan River Pre-Treatment Lagoons

Figure 22
Afflux Interim Scenario - 1% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

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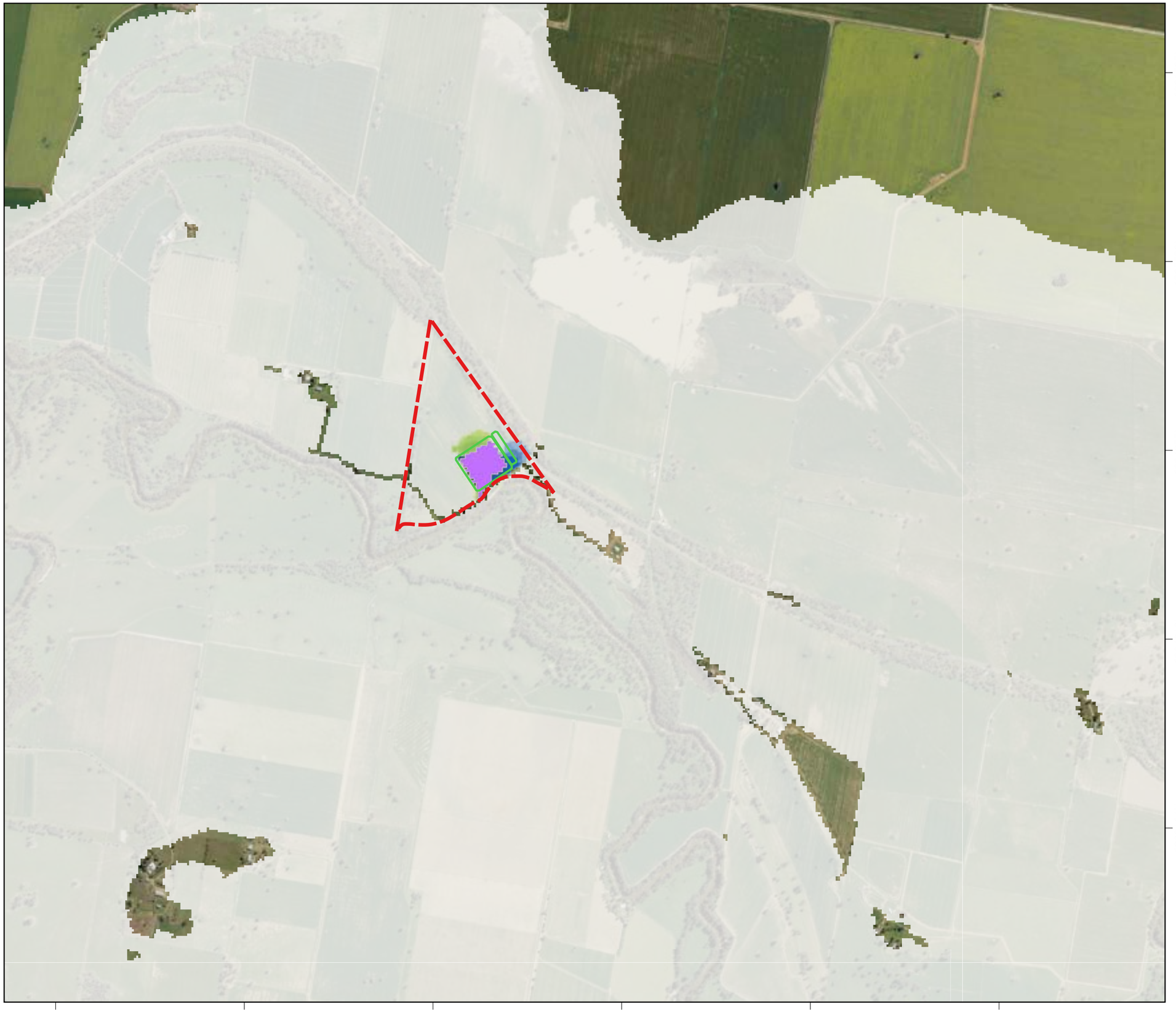

Legend

- Study Area
- Ultimate Design

Water Level Difference (cm)

- < -10
- -10 - -8
- -8 - -6
- -6 - - 4
- -4 - -3
- -3 - -2
- No change (+/- 2)
- 2 - 3
- 3 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- > 10
- Was Wet Now Dry
- Was Dry Now Wet

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

SE22026 Lachlan River Pre-Treatment Lagoons

Figure 23
Afflux Ultimate Scenario - 10% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

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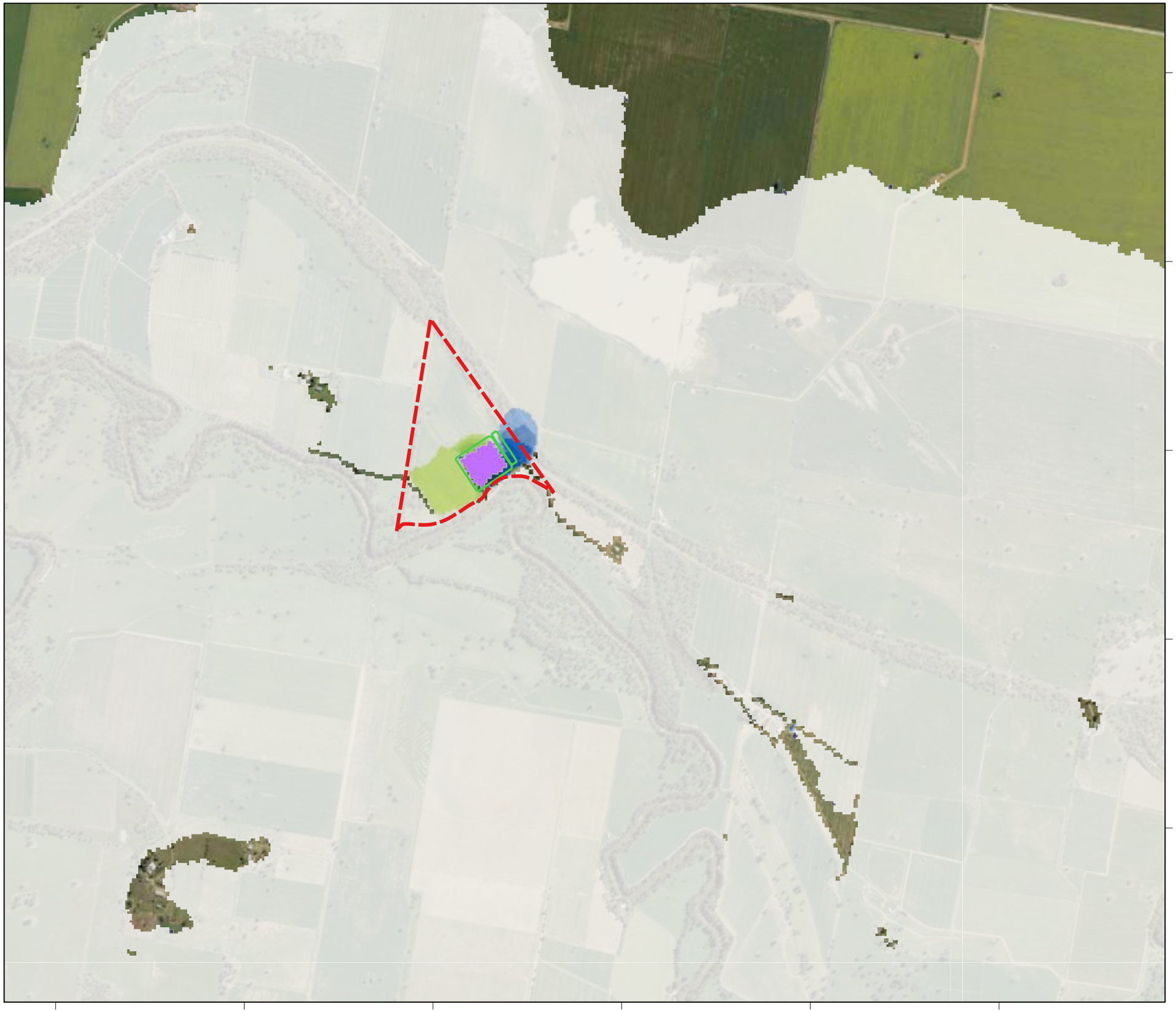

Legend

- Study Area
- Ultimate Design

Water Level Difference (cm)

- < -10
- -10 - -8
- -8 - -6
- -6 - - 4
- -4 - -3
- -3 - -2
- No change (+/- 2)
- 2 - 3
- 3 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- > 10
- Was Wet Now Dry
- Was Dry Now Wet

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

SE22026 Lachlan River Pre-Treatment Lagoons

Figure 24
Afflux Ultimate Scenario - 5% AEP

DATUM GDA 2020 MGA Zone 55

Aerial Imagery Source: Sixmaps

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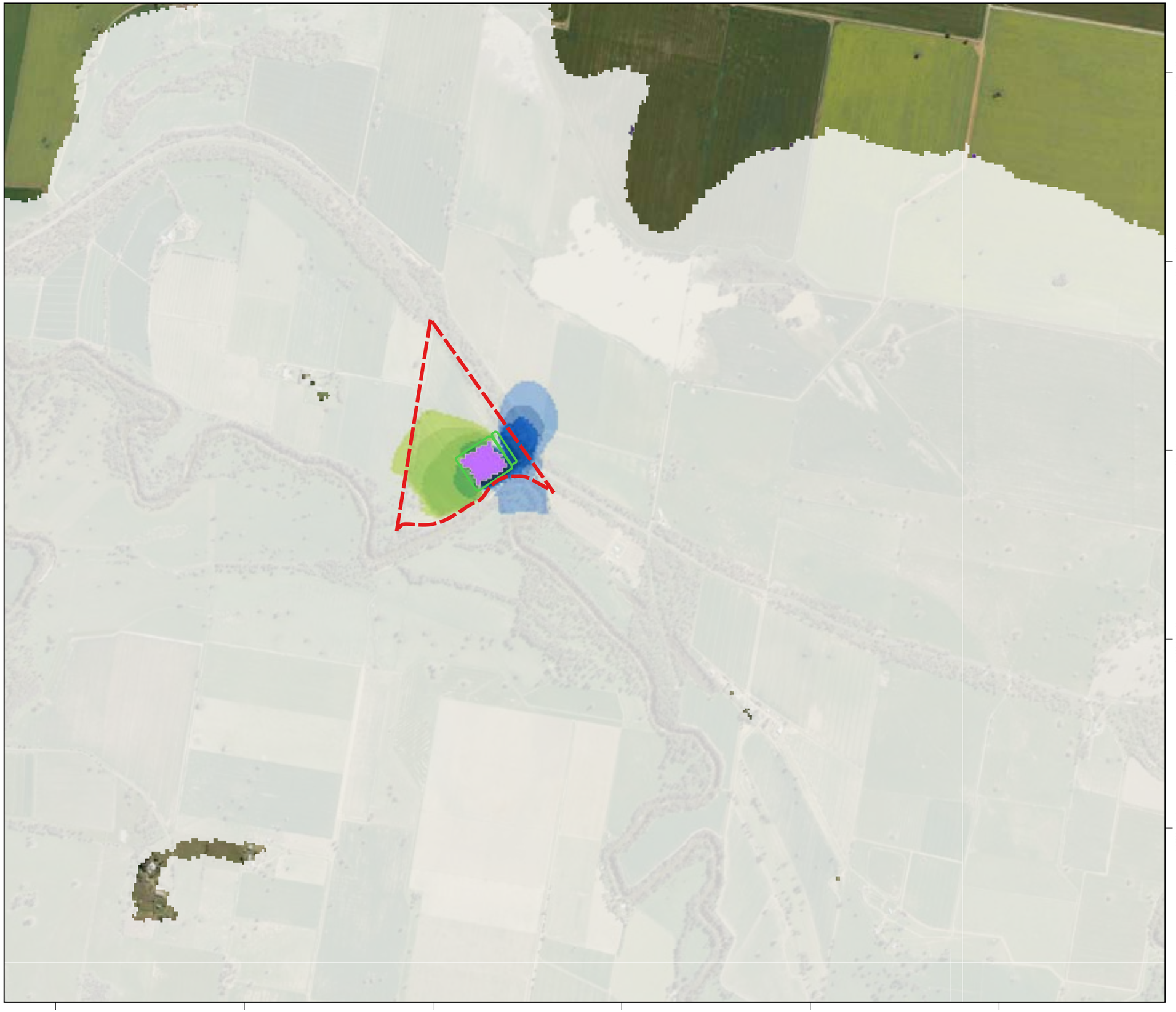

Legend

- Study Area
- Ultimate Design

Water Level Difference (cm)

- < -10
- -10 - -8
- -8 - -6
- -6 - - 4
- -4 - -3
- -3 - -2
- No change (+/- 2)
- 2 - 3
- 3 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- > 10
- Was Wet Now Dry
- Was Dry Now Wet

0 200 400 600 800 m

N

DRAWN: SM
REVIEWED: IV
APPROVED: IV

DATE: 28/3/2023
PROJECT: Lachlan River Pre-Treatment Lagoons
CLIENT: Parkes Shire Council

SE22026 Lachlan River Pre-Treatment Lagoons

Figure 25
Afflux Ultimate Scenario - 1% AEP

DATUM GDA 2020 MGA Zone 55

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Aerial Imagery Source: Sixmaps

At BG&E, we are united by a common purpose – we believe that truly great engineering takes curiosity, bravery and trust, and is the key to creating extraordinary built environments.

Our teams in Australia, New Zealand, South East Asia, the United Kingdom and the Middle East, design and deliver engineering solutions for clients in the Property, Transport, Ports and Marine, Water, Defence, Renewables and Resources sectors.

We collaborate with leading contractors, developers, architects, planners, financiers and government agencies, to create projects for today and future generations.

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