Regional Development Assessment Panel Agenda

Meeting Date and Time: Tuesday, 30 September 2025; 9.30am
Meeting Number: RDAP/55
Meeting Venue: 140 William Street, Perth

A live stream will be available at the time of the meeting, via the following link:
RDAP/55 - 30 September 2025 - Shire of Ashburton - Shire of Narrogin

PART A – INTRODUCTION

1. Opening of Meeting, Welcome and Acknowledgement
2. Apologies
3. Noting of Minutes

PART B – SHIRE OF ASHBURTON

1. Declarations of Due Consideration
2. Disclosure of Interests
3. Form 1 DAP Applications

3.1 Unallocated Crown Land PIN 3115653 – Workforce Accommodation – DAP/25/02931

4. Form 2 DAP Applications
5. Section 31 SAT Reconsiderations

PART C – SHIRE OF NARROGIN

1. Declarations of Due Consideration
2. Disclosure of Interests
3. Form 1 DAP Applications
4. Form 2 DAP Applications
5. Section 31 SAT Reconsiderations

5.1 Lots 21, 22, 7067, 1189 Contine and Parks Road, Lots 3014, 3015, 3017, 2922, 2921, 1976 Great Southern Highway And Lots 1195, 29, 27, 7207, 6349 Wanerie Road, Narrogin – Proposed Solar and Battery Hybrid – DAP/25/02861

PART D – OTHER BUSINESS

1. State Administrative Tribunal Applications and Supreme Court Appeals
2. Meeting Closure

Please note, presentations for each item will be invited prior to the items noted on the agenda and the presentation details will be contained within the related information documentation

DAP Members
Francesca Lefante (Presiding Member)
Dale Page (Deputy Presiding Member)
Clayton Higham
President Audra Smith (Part B – Shire of Ashburton)
Cr Linton Rumble (Part B – Shire of Ashburton)
President Leigh Ballad (Part C – Shire of Narrogin)
Cr Graham Broad (Part C – Shire of Narrogin)

DAP Secretariat
Kristen Parker
Ashlee Kelly

PART A – INTRODUCTION

1. Opening of Meeting, Welcome and Acknowledgement

2. Apologies

3. Noting of Minutes

PART B – SHIRE OF ASHBURTON

1. Declarations of Due Consideration

2. Disclosure of Interests

3. Form 1 DAP Applications

3.1 Unallocated Crown Land PIN 3115653 – Workforce Accommodation – DAP/25/02931

4. Form 2 DAP Applications

Nil

5. Section 31 SAT Reconsiderations

Nil

Part B – Item 3.1 - Unallocated Crown Land PIN 3115653 – Workforce Accommodation

Form 1 – Responsible Authority Report
(Regulation 12)

DAP Name:	Regional Development Assessment Panel
Local Government Area:	Shire of Ashburton
Applicant:	RFF Pty Ltd
Owner:	Department of Planning, Lands and Heritage – Unallocated Crown Land
Value of Development:	$17 million
Responsible Authority:	Shire of Ashburton
Authorising Officer:	Joanne Sangster
LG Reference:	DA25-31
DAP File No:	DAP/25/02931
Application Received Date:	2 July 2025
Report Due Date:	17 September 2025
Application Statutory Process Timeframe:	90 Days
Attachment(s):	1. Development Plans 2. Social Impact Statement 3. Bushfire Management Plan 4. Freight Train Noise Assessment

Responsible Authority Recommendation

That the Regional Development Assessment Panel, in accordance with Clause 68 of Schedule 2 (Deemed Provisions) of the *Planning and Development (Local Planning Schemes) Regulations 2015,* and the Shire of Ashburton Local Planning Scheme No. 7, **Approves** DAP Application DAP/25/02931 for Workforce Accommodation on Unallocated Crown Land ID 3115653, incorporating the plans included as Attachment 1, subject to the conditions and advice notes set out below:

Conditions

1. This decision constitutes planning approval only and is valid for a period of 2 years from the date of approval. If the development is not substantially commenced within that period, the approval shall lapse and be of no further effect.

2. The approved development shall be in accordance with the attached approved development plans and documentation which form part of this development approval, subject to modifications required as a consequence of any condition(s) of this approval.

3. The approved development is permitted to remain on site for a period of 10 years from the date of this approval. The development shall be permanently removed from site by that date and the land restored to its pre-development condition to the satisfaction of the Local Government.

4. Prior to commencing construction, the proponent shall submit a Construction and Environmental Management Plan for approval by the Local Government, addressing the following matters. The development shall thereafter comply with that approved Plan:

    a) How materials and equipment will be delivered to and removed from the site;

    b) How materials and equipment will be stored on the site;

    c) Arrangements for complying with clearing permit conditions;

    d) Parking arrangements and facilities for users and occupants of the development;

    e) How construction and ongoing operational waste will be collected, stored, recycled and/or disposed of;

    f) How risks of wind and/or water erosion, sedimentation and dust generation will be minimised during construction and ongoing operation of the development.

5. Prior to commencing construction, the proponent shall submit a Parking and Access Plan for approval by the Local Government, addressing the following matters. The development shall thereafter comply with that approved Plan:

    a) Provision of designated bus and oversized vehicle parking bays;

    b) Provisions of Accessible Parking for people with disabilities;

    c) Dimensions and details of construction for all parking, manoeuvring areas and accessways (including pedestrian access paths);

    d) Other relevant matters as required by Clause 6.17 of the Scheme.

6. Prior to commencing operations, and subject to approval from the Local Government, the applicant shall install and commission an onsite sewerage treatment system(s) for the development, to the satisfaction of the Local Government.

7. Prior to commencing operations, the proponent shall submit to the Local Government, certification from a suitably qualified Bushfire Planning and Design (BPAD) Practitioner that the recommendations of the Western Environmental Bushfire Management Plan (BMP) dated 3 May 2025 have been implemented to the satisfaction of the practitioner and that sufficient procedures and arrangements are in place to reasonably secure ongoing compliance with the operational requirements of the BMP.

8. The development shall be constructed, operated and maintained in accordance with the BMP referenced in Condition 7 to the satisfaction of the Local Government.

9. Prior to commencing operations, the proponent shall submit to the Local Government, certification from a suitably qualified Acoustic Consultant that the recommendations of the Lloyd Geore Acoustics Freight Train Noise Assessment dated 29 April 2025 have been implemented to the satisfaction of the consultant.

10. The development shall be constructed, operated and maintained in accordance with the Noise Assessment referenced in Condition 9.

11. Prior to commencing construction, the proponent shall submit for approval by the Local Government details of the stormwater drainage design for the development, ensuring that all stormwater is contained within the development site and managed to minimise erosion. The development shall thereafter comply with the approved stormwater drainage design.

12. Prior to commencing operations, the proponent shall submit an Operational Management Plan to the Local Government for approval, addressing the matters outlined below. The development shall thereafter be operated in accordance with the approved Plan to the satisfaction of the Local Government:

    a) Overall facility management, including the implementation of operational procedures and day-to-day oversight of the village.

    b) Appointment of a qualified site manager.

    c) Transport arrangements and shift rosters/cycles for the workforce occupying the village.

    d) Health and safety management, including compliance with relevant legislation and standards.

    e) Quality assurance, including regular audits and reporting in accordance with legislative requirements.

    f) Accommodation services, including booking management, key distribution, resident communications, and general administration.

    g) Catering services, encompassing meal preparation and service, menu planning, and management of the liquor licence.

    h) Emergency preparedness and response planning.

    i) Hygiene and cleaning services, along with ongoing village maintenance.

    j) Security services to ensure resident and site safety, including perimeter fencing and access arrangements.

    k) Provision of recreational and entertainment facilities for residents.

    l) Lighting of external areas of the development.

Advice Notes

1. The proponent is advised that granting of development approval does not constitute a building permit and that an application for relevant building permits must be submitted to the Local Government and be approved before any work requiring a building permit can commence on site.

2. Relative to Condition 5, the proponent is advised that pursuant to clause 6.17.14 of Local Planning Scheme No. 7, the Local Government does not require the carparking, accessways, loading bays and vehicle turning or manoeuvring areas to be bitumen sealed and is instead prepared to accept an alternative method of surface treatment/dust suppression.

3. The proponent is advised that this development approval does not negate the requirement for any additional approvals required under separate legislation. This includes, but is not limited to, the obtaining of any required approvals from the Department of Health, the Department of Mines, Petroleum and Exploration, the Department of Water and Environmental Regulation, and Main Roads WA and consulting of Before You Dig Australia. It is the applicant's responsibility to obtain any additional approvals required before the development/use lawfully commences.

4. Onsite effluent disposal systems require approval from the Local Government's Environmental Health Services. The system must comply with the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974* and any other applicable legislation, regulations, or standards. It is recommended that the applicant engages with the Local Government early in the planning process to ensure that all design, installation, and operational requirements are met prior to commencing works.

5. The proponent is encouraged to implement measures to limit workers' exposure to nuisance and disease carrying mosquitoes. Further information on mosquito management is available from the Department of Health.

6. The proponent is encouraged to liaise with the Department of Fire and Emergency Services (DFES) to implement appropriate emergency management arrangements to address hazards other than bushfire.

7. The proponent is advised that further approvals may be required from the Local Government prior to occupancy of the development to ensure compliance with the following:

    a) All drinking water provided on site meets the health-related requirements of the Australian Drinking Water Quality Guidelines 2011.

    b) All non-drinking water systems, outlets and components are labelled and, where required, incorporate suitable backflow prevention devices in accordance with AS/NZS AS3500 – Plumbing and Drainage.

    c) Any handling of food meets the *Food Act 2008*, *Food Regulations 2009* and any relevant standards of the Australia New Zealand Food Standards Code.

d) All public access areas meet the provisions of the *Health (Miscellaneous Provisions) Act 1911*, particularly Part VI – Public Buildings and all related regulations and guidelines.

Details:

Region Scheme	N/A
Region Scheme - Zone/Reserve	N/A
Local Planning Scheme	Shire of Ashburton Local Planning Scheme No. 7
Local Planning Scheme - Reserve	Other Purpose – Infrastructure
Structure Plan/Precinct Plan	N/A
Structure Plan/Precinct Plan - Land Use Designation	N/A
Use Class and permissibility:	N/A
Lot Size:	Land ID 3115653 – 1,317.8157 Ha
Existing Land Use:	Vacant Land
State Heritage Register	No
Local Heritage	☒ N/A ☐ Heritage List ☐ Heritage Area
Design Review	☒ N/A ☐ Local Design Review Panel ☐ State Design Review Panel ☐ Other
Bushfire Prone Area	Yes
Swan River Trust Area	No

Proposal:

This application seeks development approval for the construction of a temporary Workforce Accommodation facility comprising the following:

- Siting and use of 16 trailer-mounted accommodation facilities (Fly-Camp), providing accommodation for 47 people, as a short-term accommodation solution to enable the construction of a Workforce Accommodation Facility.

- Development and use of a Workforce Accommodation Facility comprising:

  - 68 transportable buildings, providing accommodation for up to 272 people.
  - A kitchen and associated mess (dining) hall.
  - A wet mess (tavern) and associated beer garden.
  - Four laundry facilities.
  - A gym facility.
  - A recreation room.
  - Associated office, storage and ice rooms.
  - Provision of 69 car parking bays.

- Personnel will be transported from their town of origin to the site by bus on a weekly basis, rather than daily.

The applicant is seeking approval for a period of 10 years to:

- Provide a short-term (approximately 4 months) accommodation solution (Fly-Camp) for the workforce (47 persons) required to construct the longer-term facility. The Fly-Camp will be demobilised following the construction of the Workforce Accommodation Facility.

- Provide a longer-term, though still temporary, accommodation solution for the renewable energy (and related infrastructure) construction workforce (257 persons), and the associated workforce facility operator (15 persons).

The proposed development will accommodate the workforce required to construct the approved Project Jinbi Solar Facility. The initial stage of the solar facility (first 75MW) is likely to be constructed over 2-3 years. This proposal allows for the workforce accommodation to remain in place for the next stage of solar development (second 75MW).

The workforce accommodation facility is designed with a structured layout to optimise functionality and ease of access. The accommodation units are arranged into clusters to provide efficient access to shared amenities while maintaining privacy for residents.

Key elements of the site layout are summarised below:

- The accommodation units are organised into multiple blocks, each comprising four-bedroom units with associated ablution facilities. Each unit provides 8m² living space per occupant, ensuring comfort and privacy.

- The camp features a centrally located amenities hub, including the dining hall, wet mess, gymnasium, and recreation room, facilitating social interaction and convenience for residents.

- Essential infrastructure, such as wastewater treatment facilities, potable water storage, and power generation units, is located on the periphery of the site to ensure operational efficiency and minimise disruption to living areas.

- A structured internal road network provides clear access to all areas of the camp, including designated parking areas for vehicles and emergency access routes.

- Open space is allocated for passive and active recreation, including shaded seating areas and a designated beer garden adjacent to the wet mess.

- The facility incorporates controlled entry points to manage site security and restrict unauthorised access, ensuring a safe and well-regulated environment for workers.

The proposed development will be managed by a full-time facility and hospitality operator engaged by YEC. The operator will be responsible for the following:

- Overall facility management, including the implementation of operational procedures and day-to-day oversight of the village.

- Appointment of a qualified site manager.
- Health and safety management, including compliance with relevant legislation and standards.
- Quality assurance, including regular audits and reporting in accordance with legislative requirements.
- Accommodation services, including booking management, key distribution, resident communications, and general administration.
- Catering services, encompassing meal preparation and service, menu planning, and management of the liquor licence.
- Waste management and disposal.
- Emergency preparedness and response planning.
- Hygiene and cleaning services, along with ongoing village maintenance.
- Security services to ensure resident and site safety.
- Provision of recreational and entertainment facilities for residents.

Background:

This application has been submitted by RFF Pty Ltd on behalf of the Yindjibarndi Energy Corporation (YEC), which has been formed to build, own and operate large-scale renewable energy projects on Yindjibarndi Ngurra (Country). YEC is a partnership between the Yindjibarndi People (through the Yiyangu Pty Ltd, which is wholly owned by the Yindjibarndi Wealth Trust) and ACEN Corporation (ACEN). The Yindjibarndi People are represented in this partnership through the Yindjibarndi Aboriginal Corporation (YAC) – an equity holder in YEC and the Registered Native Title Body Corporate (RNTBC).

The workforce accommodation facility proposed by this application is needed for construction of the Project Jinbi Solar Facility, which was approved by the Regional Development Assessment Panel on 4 December 2024 (DAP/24/02764). The approved Solar Facility comprises approximately 325,000 solar panels and related infrastructure covering almost 5.5km^2 and generating 150MW of renewable energy for consumption by Rio Tinto, in accordance with a Memorandum of Understanding (MOU) dated October 2023.

The proposed workforce accommodation is located within the approved Solar Facility development area and is located approximately 60 kilometres south of the Karratha City Centre and 180 kilometres north-west of Tom Price. Refer Figure 1: Regional Location.



Figure 1: Regional Location

The development site is located on Unallocated Crown Land (UCL) Land ID 3115653, in the north-west section of the Yindjibarndi-Ngarluma Native Title Determination Area which is subject to exclusive native title rights. The site is directly west of the Pannawonica (Robe River) Railway, and immediately east of Rio Tinto's Cape Lambert transmission line. The Millstream Chichester National Park is situated further east.

Access to the site is via the Karratha – Tom Price Road (now officially known as Manuwarra Red Dog Highway) and then via Rio Tinto private access roads adjacent to the Robe River Railway. Refer Figure 2: District Location.

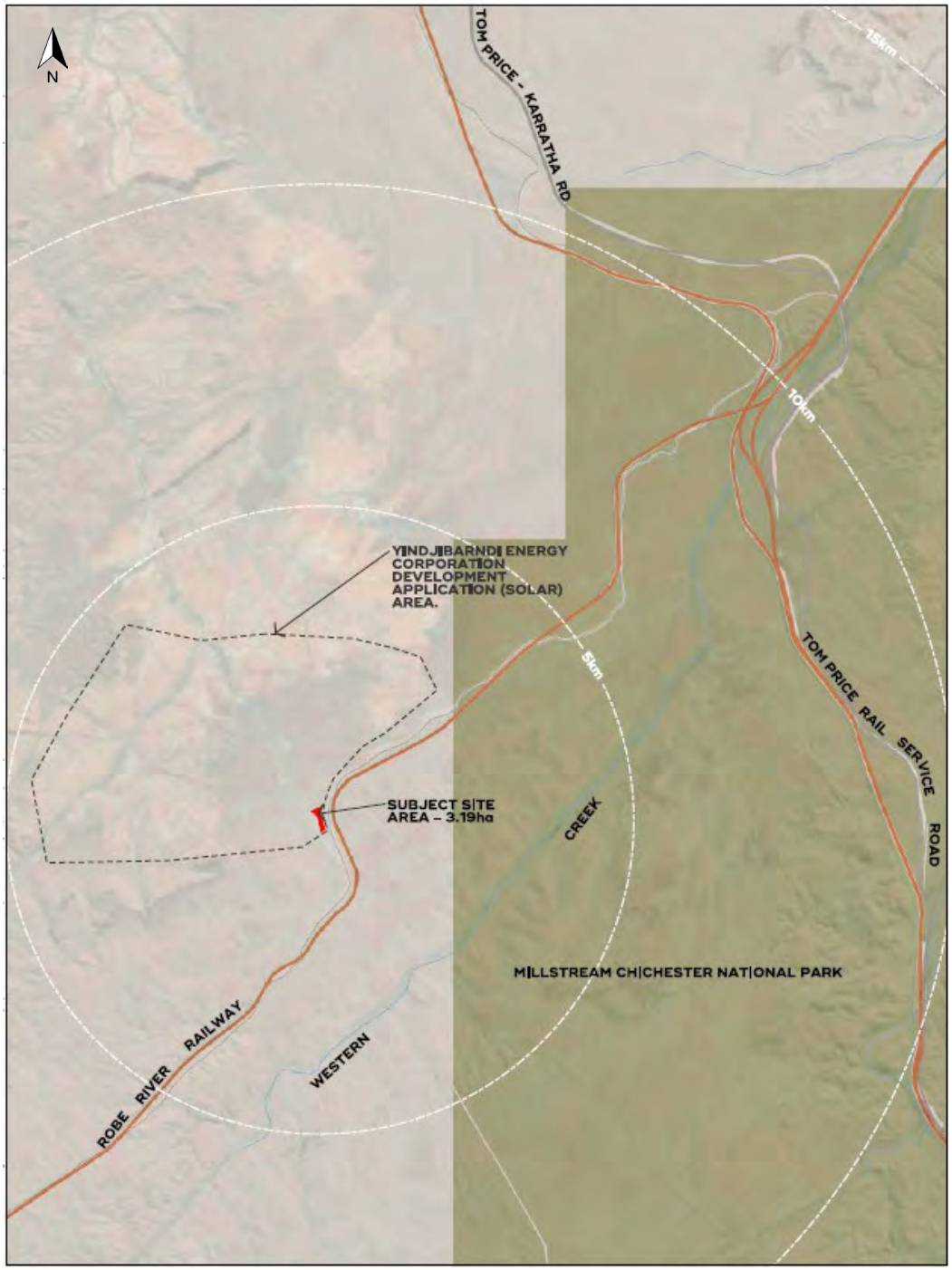


Figure 2: District Location

The development site is approximately 3.19 hectares in area, located within the approved Clearing Permit area for the Project Jinbi Solar Facility.

Legislation and Policy:

Legislation

Planning and Development Act 2005
Planning and Development (Local Planning Schemes) Regulations 2015
Planning and Development (Development Assessment Panels) Regulations 2011

Shire of Ashburton Local Planning Scheme No. 7 (LPS 7)
Draft Shire of Ashburton Local Planning Scheme No. 8 (LPS 8)

State Government Policies

Position Statement: Workforce Accommodation
State Planning Policy 3.7: Bushfire (SPP 3.7)
State Planning Policy 5.4: Road and Rail Noise (SPP 5.4)

Local Policies

Local Planning Policy 13 – Transient Workforce Accommodation
Local Planning Policy 14 – Percent for Public Art Policy
Local Planning Policy 20 – Social Impact Statement

Consultation:

Public Consultation

The application was advertised for a period of 14 days commencing on Thursday 10 July 2025 and concluding on Thursday 24 July 2025.

The Shire did not receive any public submissions on the application.

Referrals/consultation with Government/Service Agencies

The development application was referred to the following government/service agencies for comment until 18 August 2025:

- Department of Planning, Lands and Heritage (DPLH)
- Department of Water and Environment Regulation (DWER)
- Department of Health (DoH)
- Department of Local Government, Industry Regulation and Safety (LGIRS)
- Department of Mines, Petroleum and Exploration (DMPE)
- Main Roads WA (MRWA)
- Rio Tinto/Pilbara Iron

Rio Tinto requested an extension of time to respond to the proposal under Clause 66(3A) of the Deemed Provisions. The request was granted, extending Rio Tinto's comment period until 28 August 2025. Rio Tinto's response was received on 29 August 2025.

Six agency responses were received in respect of this proposal and are summarised in Table 1, with Officer Comments corresponding to each.

Where an agency was invited to provide comment on the proposal but is not listed in Table 1, that agency did not provide any response.

Table 1 – Summary of Agency Submissions

Agency Comment	Officer Comment
DPLH No objection. Based on current information held by DPLH, no approvals are required for this proposal under the *Aboriginal Heritage Act 1972* (AHA). However, DPLH notes that – 1. One of the proposed management measures comprises fencing and clear demarcation of the nearby Aboriginal site Powerline Survey 078 (ID 10937). The proponent will need to be aware that if the fencing works or any other ground disturbing activities occur within the boundary of the site by DPLH, approval will be needed under the AHA. 2. The AHA protects all Aboriginal sites in Western Australia, whether they have been evaluated and registered or not. Should a person become aware of unreported Aboriginal heritage while undertaking an activity or project, they are required to report it to DPLH and approvals may be required.	Noted. The requirement to obtain approvals and comply with all other relevant legislation is addressed by a recommended Advice Note.
DWER No objection. DWER noted that – 1. Unless otherwise approved, clearing of native vegetation must comply with approved clearing permit CPS 10494/1. 2. The proposal is subject to licencing requirements under the *Rights in Water and Irrigation Act 1914* and groundwater licence (GWL211498). 3. Stormwater design should be approved by the Shire to minimise erosion and discharge of stormwater off site. 4. The DWER has received and is currently assessing a Works Approval application for the proposed waste water treatment plant.	A Condition of approval is recommended, requiring detailed stormwater designs to be submitted to the Shire for approval.
DoH No objection. DoH noted that –	Noted. A Condition of approval and Advice Notes are recommended to address the matters raised by DoH.

Agency Comment	Officer Comment
1. Drinking water and non-drinking water must meet all relevant Water Quality Guidelines and Australian Standards. 2. Wastewater disposal must comply with relevant legislation and policy and an application will need to be submitted for Shire approval to construct or install a Sewage Treatment system. 3. The proponent should implement measures to workers' exposure to nuisance and disease carrying mosquitoes. 4. Consideration should be given to the health and wellbeing of employees by mitigating the noise impacts of any nearby industrial development or noise-generating activity (such as the freight rail line). 5. The site has not been classified or recorded as a contaminated site, but the proponent should still carry out due diligence to ensure compliance with the *Contaminated Sites Act 2003*. 6. The proponent is encouraged to liaise with relevant State Agencies such as DFES to implement an appropriate Emergency Management Plan in the event of an emergency.	
DMPE No objection.	Noted.
Rio Tinto No objection. Rio Tinto noted it is still negotiating resolution of the following matters with YEC – 1. Finalisation of access deeds between Yiyangu Pty Ltd (YPL) and both Hamersley Iron and Robe River. 2. Execution of a Renewable Power Purchase Agreement. Rio Tinto also advised the project still requires internal and external approvals under its *Iron Ore (Hamersley Range) Agreement Act 1963* (WA).	Noted. The matters raised by Rio Tinto are commercial considerations between the proponent and Rio Tinto entities and/or have otherwise been addressed by recommended Advice Notes.

Planning Assessment:

Shire of Ashburton Local Planning Scheme No. 7

Aims of the Scheme

The proposed workforce accommodation has been assessed against the relevant aims of LPS 7 (clause 1.6), as described in Table 2 below.

Table 2 – Aims of LPS 7

Scheme Aims	Assessment
(a) To facilitate development that responds to the character and amenity, geographical context and environmental constraints of the Shire and its urban and rural areas	The proposed workforce accommodation appropriately responds to the character, amenity, geographical context and environmental constraints of the site.
(d) To respond to potential strategic industry and resource development.	The proposed development is necessary for the construction of the Project Jinbi Solar Facility which will generate renewable energy to assist in reducing carbon emissions from the resource sector.

Development on Reserved Land

The proposed development is situated on land reserved for Other Purpose – Infrastructure under the Shire's LPS 7 (refer Figure 3). This reservation comprises a 1km wide corridor for the Rio Tinto Robe River railway. The corridor also contains the key access roads that will service the development.

Land surrounding the development site to the north, south and west is reserved for Public Purposes – Water and Drainage under LPS 7, while land further to the east, comprising the Millstream Chichester National Park, is reserved for Conservation, Recreation and Natural Landscape.

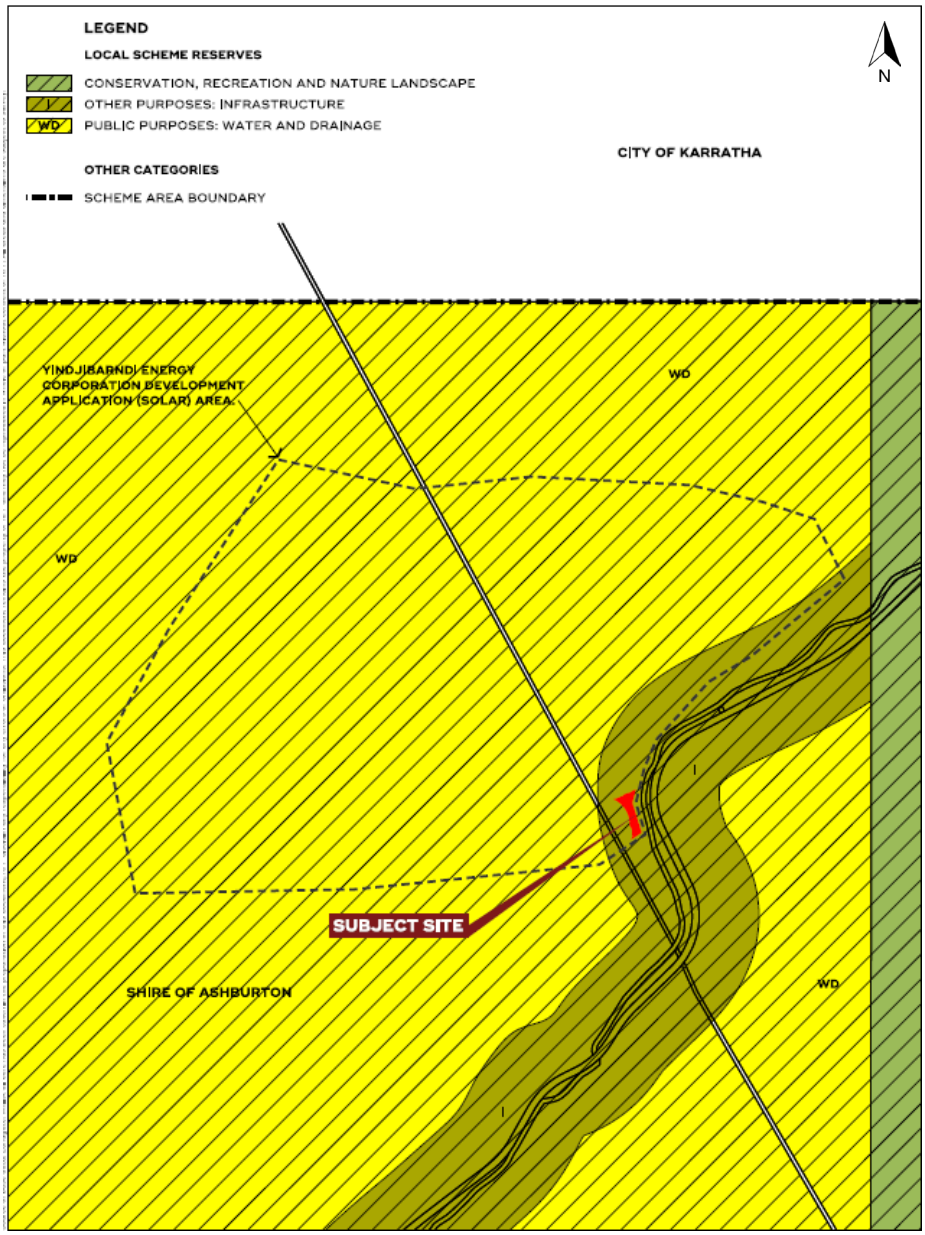


Figure 3: LPS 7 Map

When considering an application for development on reserved land, clause 3.2.2 of LPS 7 requires the decision maker to have regard to the ultimate purpose of the reserve. However, LPS 7 does not specify a purpose or objective for the Other Purpose – Infrastructure reserve. That said, it is evident this reserve is intended to accommodate essential infrastructure that supports strategic and regionally significant developments. Given the proposed workforce accommodation is critical enabling infrastructure for the Project Jinbi Renewable Energy Facility, this proposal aligns with the reserve's intent.

To further consider the appropriateness of the proposed development in the context of this reserve, the Shire referred the application for comment to Rio Tinto. This referral also satisfied the requirements of clause 3.2.7 of LPS 7 (consultation with other relevant authorities for development on reserved land).

Rio Tinto's submission is summarised in Table 1 earlier and raises no objection to this proposal. As such, the proposal is compatible with the Other Purpose – Infrastructure reserve.

Vehicle Parking and Access

Appendix 8 of LPS 7 requires the following minimum number of parking bays for transient workforce accommodation –

- Two bays per every three sleeping units, plus one oversized vehicle parking bay per every 10 sleeping units (minimum two bays); and

- At the Local Government's discretion, the provision of additional oversized vehicle bays.

The term "sleeping unit" is not defined in LPS 7 but is regarded as the self-contained room provided for each worker. In this instance, the proposed development comprises 68 transportable buildings each with four self-contained rooms or "sleeping units" – equating to a total of 272 units. On this basis and according to Appendix 8 of LPS 7, the proposed development requires a minimum of 182 car parking bays and 28 oversized vehicle bays (rounded up from 181.33 and 27.2 respectively).

This application proposes only 69 car parking bays at the northern edge of the development site and no designated oversized vehicle parking bays, representing an overall shortfall of 141 bays compared to the requirements of Appendix 8.

The proponent's justification for this variation is that personnel will be transported from their town of origin to the site by bus on a weekly basis, thus minimising the need for workers to drive to and from site in their own vehicles. However, if that does occur, then sufficient parking bays are proposed to allow one parking bay per each of the 68 transportable accommodation buildings.

Clause 6.17.5 of LPS 7 allows the decision maker to reduce the number of parking bays from those stipulated in Appendix 8 if it is satisfied the circumstances of the development justify such action and there will not be any resultant lowering of safety standards.

In this instance, the proposed variation to the Scheme's parking standards is supported because –

- The number of bays proposed is considered suitable for the 'bus-in/bus-out' workforce;

- Ample space is available on site for additional or overflow parking in the event it is needed; and

- The development is remote from any townsite and the number of parking bays proposed is not expected to adversely impact the operation of the development, of the amenity of the district.

Notwithstanding, a condition of approval has been recommended (condition 5) requiring a Parking and Access Plan to be submitted for the Shire's approval to provide oversized vehicle bays, accessible parking for people with disabilities, details and

dimensions for all parking areas and accessways, and satisfy other relevant requirements of clause 6.17.

Clause 6.17.13 of LPS 7 requires all carparking, accessways, loading bays and vehicle turning or manoeuvring areas to be sealed, kerbed, marked and drained. However, in accordance with clause 6.17.14 the decision-maker can permit an alternative method of surface treatment/dust suppression if it is satisfied the development characteristics or the area of bitumen required, would be either impractical or unduly expensive and the alternative would serve the same function without lessening the standards of health and safety.

In this instance, given the temporary nature of this development, its remoteness and the limited (weekly) bus movements to and from the site, bitumen sealing the vehicle parking and access areas is not considered necessary. This has been addressed through recommended Condition 5 and Advice Note 2,

Landscaping, Screening and Vegetation

Clause 6.19 of LPS 7, requires landscaping to be provided for all development except residential development involving two dwellings or less. However, no internal landscaping is proposed for this development as the entire site will be cleared in accordance with the approved Clearing Permit for bushfire asset protection.

The decision-maker can waive or vary the landscaping requirements (and other development requirements) of LPS 7 in accordance with clauses 6.1.1 – 6.1.3 (inclusive) having regard to following:

- The impact of the variation on other owners or occupiers in the locality;
- The matters to be considered under clause 5.9 of LPS 7; and
- Providing that the variation will not have an adverse effect upon the occupiers or users of the development, the inhabitants of the locality or the likely future development of the locality.

In this instance, the absence of landscaping is supported and it is not considered necessary to require landscaping given the development's is remoteness, temporary nature, and location in an arid environment that would impact landscaping survival rates.

<u>Shire of Ashburton Draft Local Planning Scheme No. 8</u>

The Shire of Ashburton's Draft Local Planning Scheme No. 8 (LPS 8) has been advertised for public comment (closing at the end of July 2025) and is a 'seriously entertained planning proposal', with the Scheme due to be considered by Council for final adoption in November 2025.

Under LPS 8, the development site is proposed to retain its existing Other Purposes – Infrastructure reservation. The proposed development is compatible with that reserve as stated earlier in respect of LPS 7.

Local Planning Policy 13 – Transient Workforce Accommodation (LPP 13)

The proposed transient workforce accommodation largely complies with all relevant provisions of the Shire's requirements of LPP 13 with the exception of those discussed in Table 3 below.

Table 3 – LPP 13 Assessment

Summary of Clause	Assessment
3.9 Landscaping must be provided within the development.	No landscaping is proposed for this development. See earlier discussion in respect of clause 6.19 of LPS 7.
3.10 Uniform boundary fencing must be installed around the property/development, such as post and wire.	This is addressed by a recommended condition of approval (Condition 12 – Operation Management Plan).
3.15 The proponent must provide rubbish disposal services for the development.	This is addressed by recommended conditions of approval (Condition 4 – Construction and Environmental Management Plan, and Condition 12 – Operational Management Plan).
3.16 Appropriate lighting must be provided for the development.	This is addressed by a recommended condition of approval (Condition 12 – Operation Management Plan).

Local Planning Policy 14 – Percent for Public Art Policy (LPP 14)

LPP 14 is not applicable to this application, because the proposed development is temporary, remote and only needed to facilitate construction of the approved Project Jinbi Solar Facility.

The Solar Facility itself was not deemed to be an eligible project under clause 3.2.1 of LPP 14 and was consequently approved without the need for any Public Art or Percent for Art contribution.

It therefore stands to reason that the proposed temporary workforce accommodation village needed to construct the Solar Facility would also not be regarded as an eligible project for the purpose of this Policy.

Local Planning Policy 20 – Social Impact Statement (LPP 20)

LPP 20 does not require a Social Impact Assessment (SIS) for this type of development. However, the applicant has voluntarily submitted a SIS for the proposal, outlining the potential social impacts and opportunities associated with the development. A copy of the SIS is included as Attachment 2 and identifies:

- Key areas of social influence, including nearby communities such as Ngurrawaana, Roebourne, and Karratha.

- Factors such as workforce movements, community engagement, and cultural heritage protection.

- The project's potential positive social impacts through job creation, economic opportunities for Indigenous communities, and contributions to local businesses.

- Potential challenges, including pressures on housing demand and community services, along with mitigation strategies like utilising local workforce resources and engaging local suppliers.

Position Statement: Workforce Accommodation

The WAPC's position statement on Workforce Accommodation encourages workforce accommodation to be provided in established towns where practicable, to facilitate their ongoing sustainability.

The position statement also states that workforce accommodation should be consistent with local planning strategies and schemes, except where the *Mining Act 1978* and State Agreement Acts prevail.

The proposal is consistent with these principles.

State Planning Policy 3.7: Bushfire (SPP 3.7)

The subject site is located within a designated bushfire prone area and, as such, a Bushfire Management Plan (BMP) has been submitted in accordance with the requirements of SPP 3.7. A copy of the BMP is included as Attachment 3.

Sections 4 and 5 of the BMP include recommended actions to appropriately manage the bushfire risk for this development, as summarised below –

Developer responsibilities (prior to occupancy):

- Ensure the entirety of the subject site is either non-vegetated, or contains low-threat, maintained vegetation, managed to APZ standards.
- Provide firefighting water tanks in accordance with Section 4.2 and Figure 6.
- Construct proposed accommodation buildings to BAL-12.5 construction standards in AS 3959: 2018.

Camp operator responsibilities (ongoing):

- Maintain the entirety of the subject site as either non-vegetated areas, or low-threat, maintained vegetation, managed to APZ standards.
- Review and update the Additional Bushfire Management Strategies in Section 4.3 on an annual basis, through consultation with the Camp Emergency Management Team.

Conditions of approval have been recommended to ensure the development complies with the obligations of the BMP (Conditions 7 and 8).

State Planning Policy 5.4: Rail and Road Noise (SPP 5.4)

Sixteen of the proposed accommodation modules are located within 200m of the freight railway line, and will be exposed to higher levels of rail noise. A Freight Train Noise Assessment has therefore been submitted for this development in accordance with SPP 5.4 (refer Attachment 4).

Section 5 of the Noise Assessment identifies various construction requirements to ameliorate freight rail noise impacts on the affected accommodation modules.

Conditions of approval have been recommended to ensure the development complies with the recommendations of the Noise Assessment (Conditions 9 and 10).

Clause 67 Matters for Consideration

The development has been assessed against relevant matters for consideration in clause 67 of the Deemed Provisions, as set out in Table 4 below.

Table 4 – Assessment of Matters for Consideration (Deemed Provisions)

Matters for Consideration	**Assessment**
(a) The aims and provisions of this Scheme and any other local planning scheme operating within the Scheme area.	The proposed development aligns with the aims and provisions of the Shire of Ashburton Local Planning Scheme No. 7.
(b) The requirements of orderly and proper planning including any proposed local planning scheme or amendment that has been advertised or any other proposed planning instrument that the local government is seriously considering adopting or approving.	The development, subject to compliance with the recommended conditions, satisfies the principles of orderly and proper planning and relevant provisions of the local planning framework.
(c) Any approved State planning policy.	The development complies with relevant SPPs as described earlier in this report.
(e) Any policy of the Commission.	The development aligns with the WAPC's Position Statement on Workforce Accommodation.
(fa) Any local planning strategy for this Scheme endorsed by the Commission.	The development is consistent with the Shire of Ashburton Local Planning Strategy as it supports investment in renewable energy projects, provides sustainable alternative sources of electricity generation, and enhances economic diversification and environmental stewardship.

Matters for Consideration	Assessment
(j) In the case of land reserved under this Scheme, the objectives for the reserve and the additional and permitted uses identified in this Scheme for the reserve.	The development is compatible with the Other Purpose – Infrastructure reserve over the land under LPS 7 and Draft LPS 8.
(l) The effect of the proposal on the cultural heritage significance of the area in which the development is located.	The project is being delivered in partnership with the Yindjibarndi People through Yindjibarndi Energy Corporation. The development supports the cultural and economic aspirations of the Yindjibarndi community who have been actively involved in the cultural heritage surveys and identification of avoidance sites that were incorporated into the site constraints.
(n) The amenity of the locality including the following — (i) environmental impacts of the development; (ii) the character of the locality; (iii) social impacts of the development.	The proposed development is temporary, remote, will be constructed within an area subject of an approved Clearing Permit, and will not adversely affect the environmental features or character of locality, but will facilitate an important regional renewable energy project to support decarbonisation in the resource sector. Additionally, the proponent has voluntarily provided a Social Impact Statement that identifies various social and economic benefits of the project.
(o) The likely effect of the development on the natural environment or water resources and any means that are proposed to protect or to mitigate impacts.	The development is supported by an existing clearing permit which includes a range of conditions that minimise the impact of clearing native vegetation. The development is carefully designed to avoid and therefore minimise the impact of water courses, which also serves to protect the infrastructure from flood risk. The development is not located within a water resource area.
(p) Whether adequate provision has been made for the landscaping of the land to which the application relates and whether any trees or other vegetation on the land should be preserved.	Landscaping will be retained elsewhere on the broader subject land, although no landscaping is proposed within the workforce accommodation development itself.

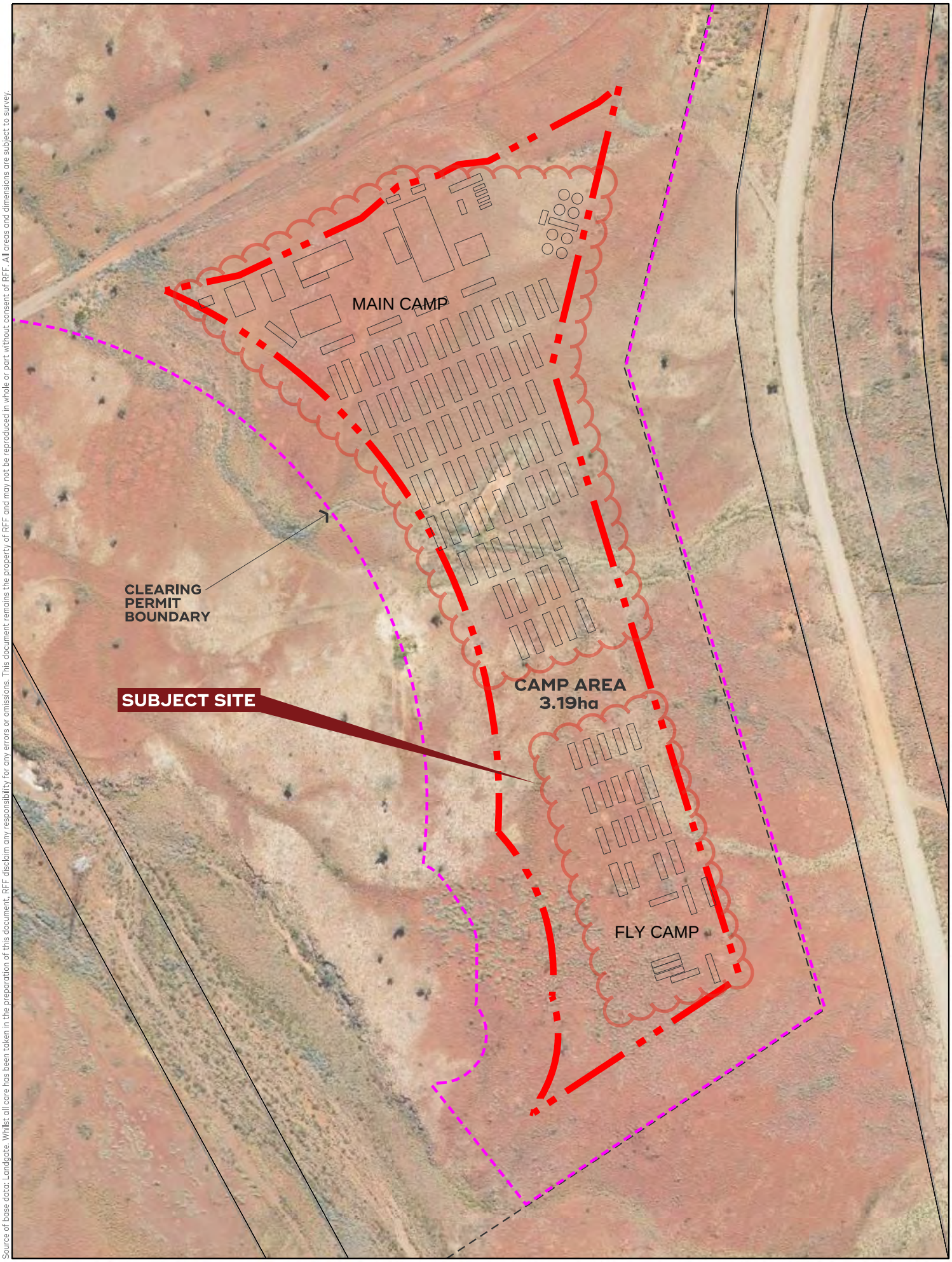
Matters for Consideration	Assessment
(q) The suitability of the land for the development taking into account the possible risk of flooding, tidal inundation, subsidence, landslip, bushfire, soil erosion, land degradation or any other risk.	The development is subject to compliance with the submitted Bushfire Management Plan and other conditions relating to construction, operation, and drainage and erosion management.
(r) The suitability of the land for the development taking into account the possible risk to human health or safety.	The subject site is both suitable for and capable of accommodating the proposed development, which is also conveniently located adjacent to the Project Jinbi Solar Facility for which the temporary construction workforce accommodation is needed.
(s) The adequacy of — (i) the proposed means of access to and egress from the site; and (ii) arrangements for the loading, unloading, manoeuvring and parking of vehicles.	The development proposes to utilise existing Rio Tinto private access roads that are connected to Manuwarra Red Dog Highway. A Parking and Access Plan is to be submitted and approved as a condition of approval.
(t) The amount of traffic likely to be generated by the development, particularly in relation to the capacity of the road system in the locality and the probable effect on traffic flow and safety.	Workers occupying the proposed development will be transported to and from the site via bus from their towns each week, generating fewer vehicle trips than was originally contemplated by the Project Jinbi Solar Facility development approval, which was premised on multiple daily worker trips (bus and car) to and from Karratha.

Conclusion:

The proposed workforce accommodation has been assessed against and complies with (or can be conditioned to comply with) all relevant provisions of the Shire of Ashburton local planning framework, State Planning Policies and WAPC Position Statement on Workforce Accommodation.

The development will not adversely impact any other property or landowner nor the character and amenity of the locality. The development is temporary and will exist on site for only 10 years, to accommodate the construction workforce needed to deliver the approved Project Jinbi Solar Facility.

It is recommended that the Regional Development Assessment Panel approves the development application, subject to the recommended conditions and advice notes, which will ensure compliance with relevant statutes and standards, and that the impacts and operations of the development are effectively managed.



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J487-5-003.dgn / 28 APRIL 2025

RFF

SITE PLAN

DEVELOPMENT APPLICATION
JINBI CAMP

FIGURE 3



ZONE LEGENDS	
NAME	ZONE COLOUR
EXISTING TRACKS	RED
ACCESS ROADS	TEAL
LEASE BOUNDARY	GREEN
30M OFFSET FROM BOUNDARY	BLUE DASHED
CLEARANCE PERMIT	PINK
HERITAGE ZONE	BROWN
RING ROAD	ORANGE
ASSET PROTECTION ZONE	

REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	CLIENT
		K	14.03.25	RE–ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		J	18.03.25	RE–ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		I	18.03.25	RE–ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		H	13.03.25	RE–ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		G	26.02.25	RE–ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		F	25.02.25	RE–ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		E	19.02.25	RE–ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
.	.	–	26.11.24	COMMENCED	BM	CM	AC	OM	RK	OM	

$FILE$ $TIME$ $DATE$

Rapid Exploration Pty Ltd Trading as Rapid Camps

Rapid Camps

Yindjibarndi Energy

NORTH

PROJECT NUMBER: 29

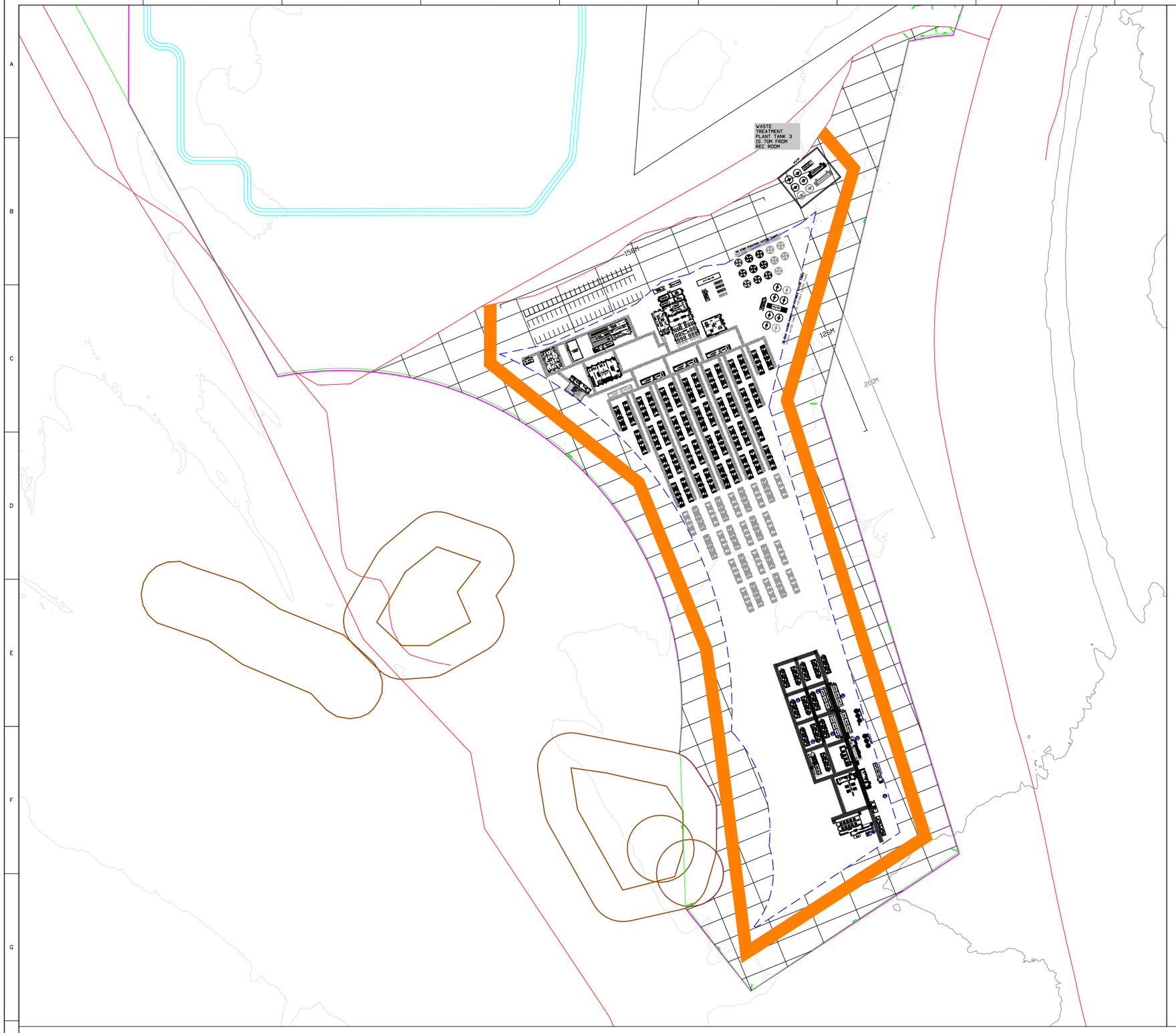
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VENDOR/DESIGNER DRG No. 029–DWG–AR–002 — REV: K

Yindjibarndi Energy

JINBI–WORKER CAMP 172 PERSON CAMP
(EXPANSION SHOWN UP TO 272 PERSON CAMP
RAPID CAMPS
CAMP SATELLITE OVERVIEW LAYOUT

A1 — SCALE: NTS — DRG No: 029–DWG–AR–002 — REV: K



ZONE LEGENDS	
NAME	ZONE COLOUR
EXISTING TRACKS	RED
ACCESS ROADS	TEAL
LEASE BOUNDARY	GREEN
30M OFFSET FROM BOUNDARY	BLUE DASHED
CLEARANCE PERMIT	PINK
HERITAGE ZONE	BROWN
RING ROAD	ORANGE
ASSET PROTECTION ZONE	

REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	CLIENT
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		I	18.03.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		H	13.03.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		G	26.02.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		F	25.02.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		E	19.02.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
.	.	–	26.11.24	COMMENCED	BM	CM	AC	OM	RK	OM	

$FILE$ $TIME$ $DATE$

Rapid Exploration Pty Ltd Trading as Rapid Camps

Rapid Camps

Yindjibarndi Energy

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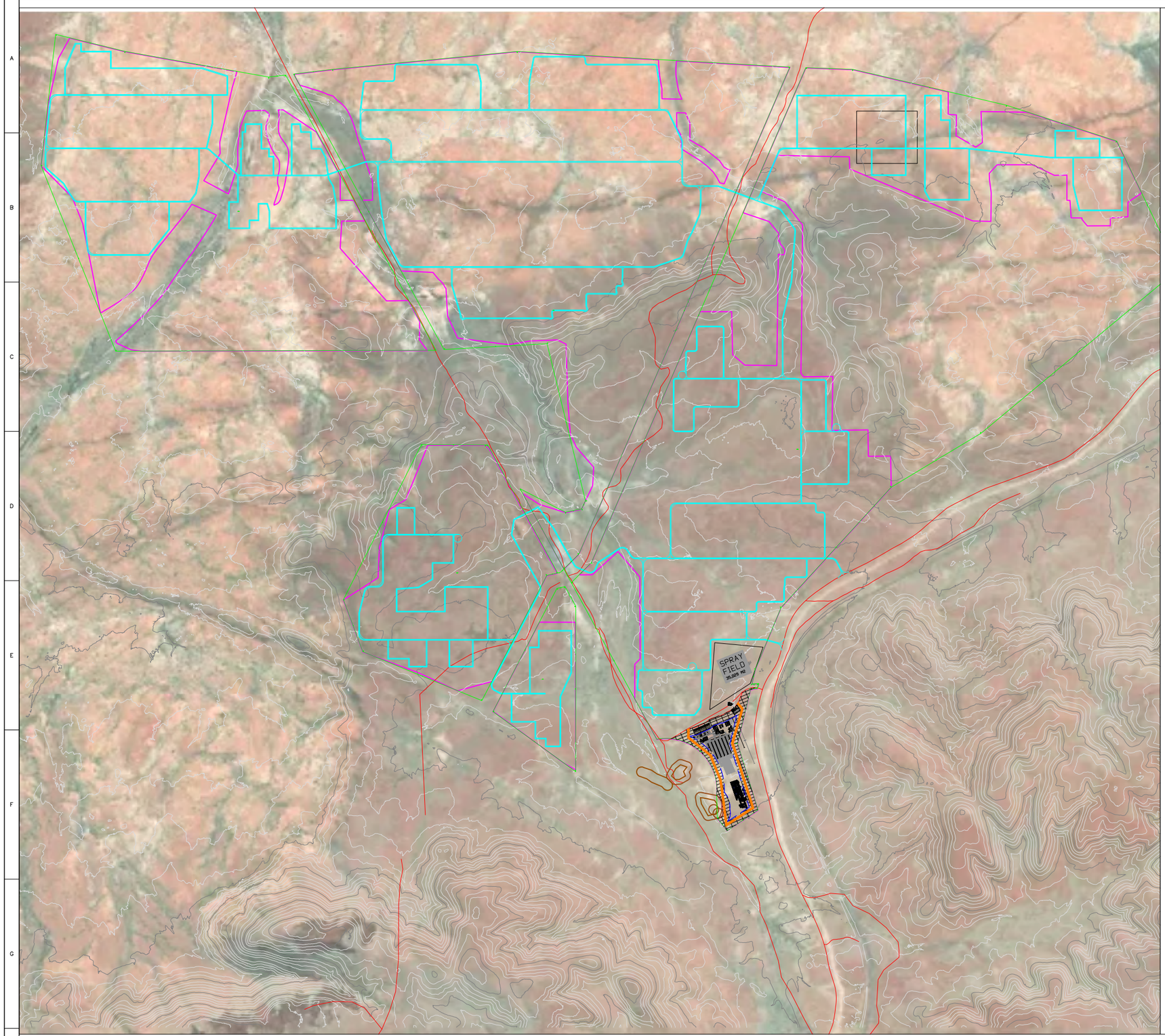
PROJECT NUMBER 29

VENDOR/DESIGNER DRG No. 029-DWG-AR-001 REV: K

Yindjibarndi Energy

JINBI-WORKER CAMP 172 PERSON CAMP
(EXPANSION SHOWN UP TO 272 PERSON CAMP
RAPID CAMPS
CAMP OVERVIEW LAYOUT

A1 SCALE NTS DRG No: 029-DWG-AR-001 REV: K



ZONE LEGENDS	
NAME	ZONE COLOUR
EXISTING TRACKS	RED
ACCESS ROADS	TEAL
LEASE BOUNDARY	GREEN
30M OFFSET FROM BOUNDARY	BLUE DASHED
CLEARANCE PERMIT	PINK
HERITAGE ZONE	BROWN
RING ROAD	ORANGE
ASSET PROTECTION ZONE	

REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	CLIENT
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		I	18.03.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		H	13.03.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		G	26.02.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
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		E	19.02.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
.	.	–	26.11.24	COMMENCED	BM	CM	AC	OM	RK	OM	

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Rapid Camps

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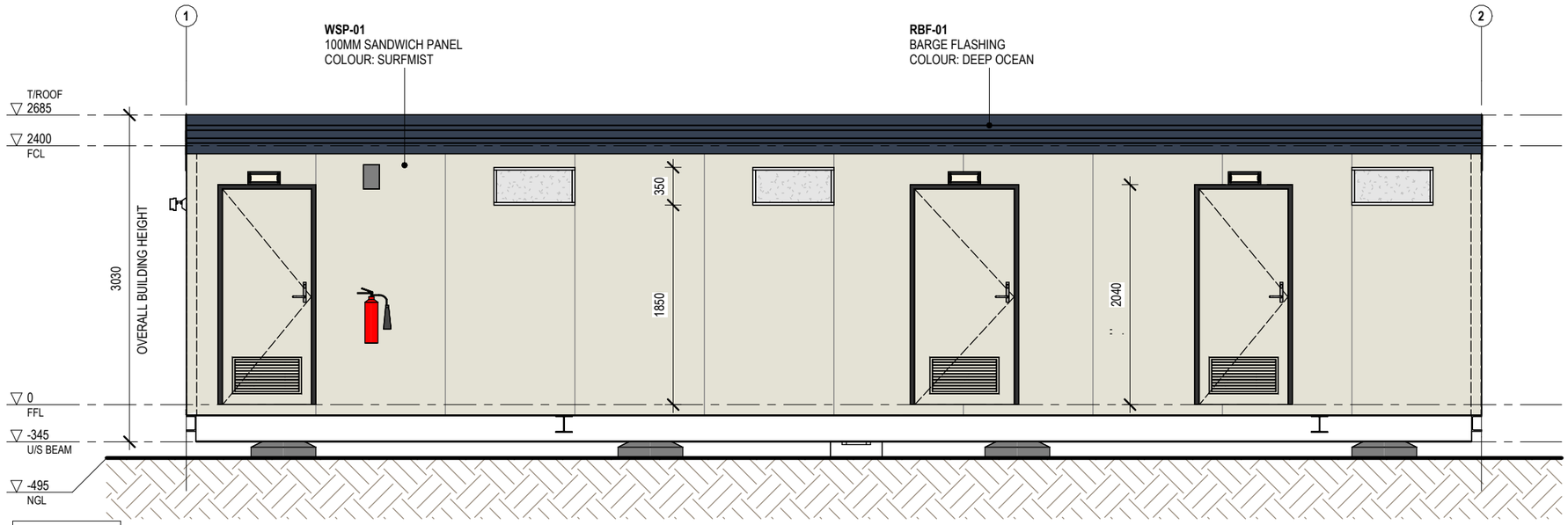
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JINBI-WORKER CAMP 172 PERSON CAMP
(EXPANSION SHOWN UP TO 272 PERSON CAMP
RAPID CAMPS
CAMP OVERVIEW LAYOUT WITH SOLAR FARMS

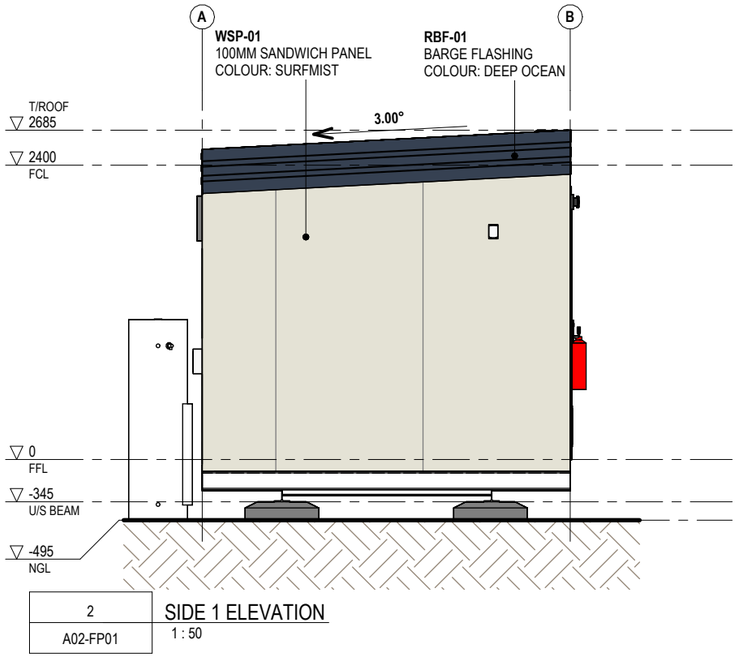
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FRONT ELEVATION
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2
A02-FP01

SIDE 1 ELEVATION
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	31/01/24	SC	KP

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PROJECT CLIENT: **FLEETWOOD CAPEX**

PROJECT: **PLANT ABLUTIONS**

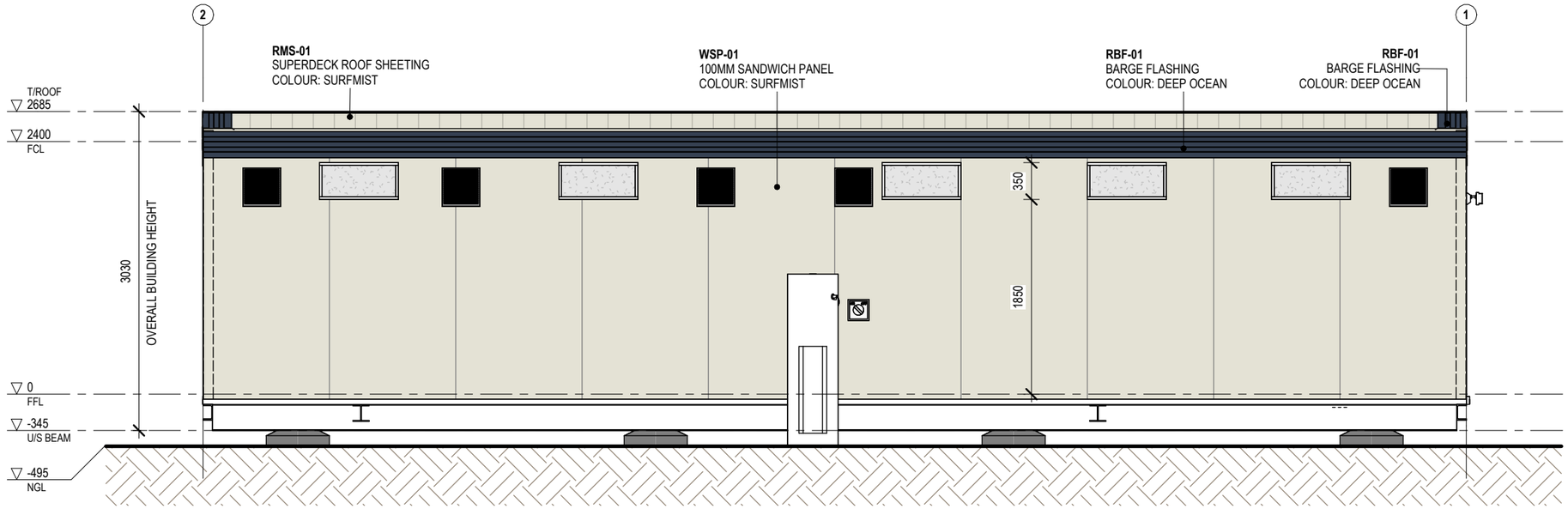
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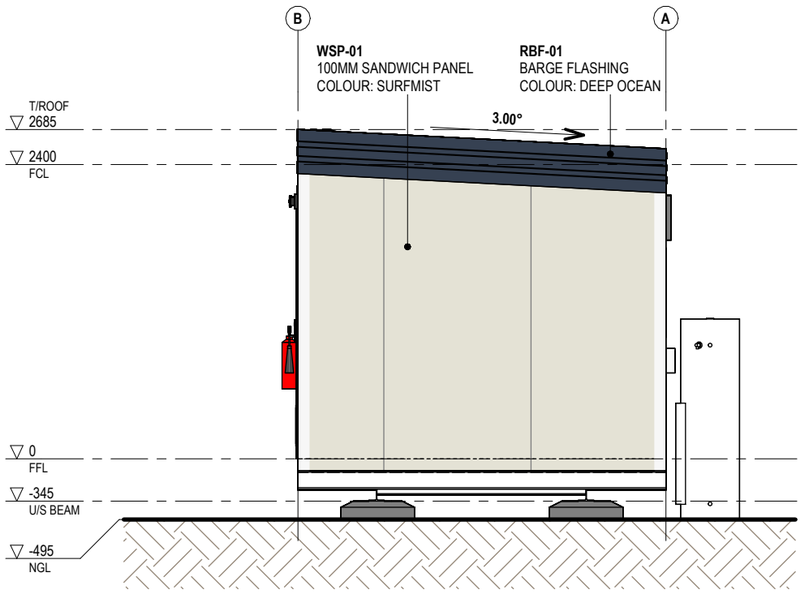
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2
A02-FP01

SIDE 2 ELEVATION
1 : 50

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PROJECT NO.:
J005076-B02

PROJECT STATUS
ISSUED FOR REVIEW

PROJECT CLIENT
FLEETWOOD CAPEX

PROJECT:
PLANT ABLUTIONS

PROJECT ADDRESS
XX

SHEET
ELEVATIONS

DRAWN **SC** | CHECKED **KP** | SCALE **1 : 50** | SIZE **A3**

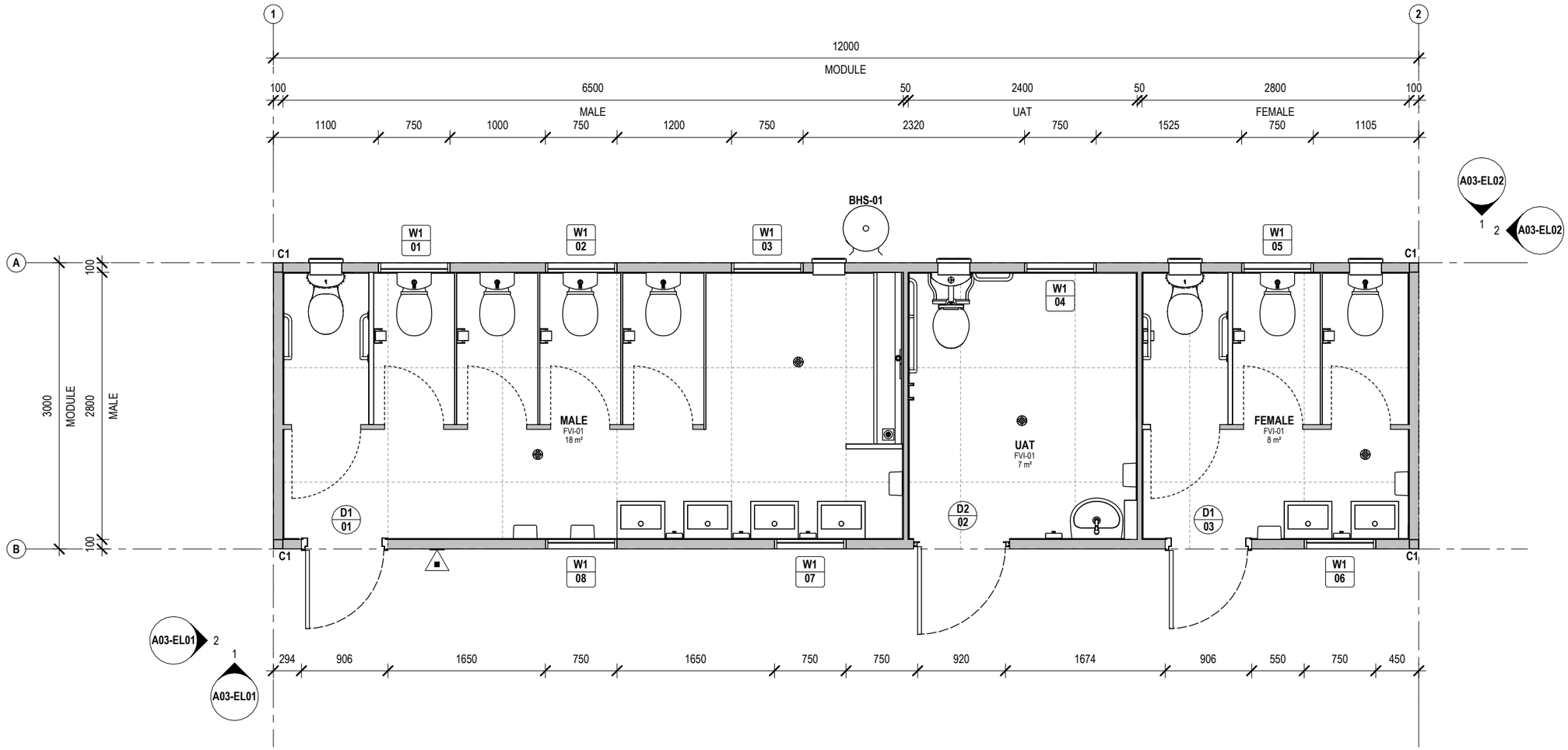
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ROOM NAME	AREA
FEMALE	8 m²
MALE	18 m²
UAT	7 m²
TOTAL	33 m²



1 FLOOR PLAN
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
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PROJECT: **PLANT ABLUTIONS**

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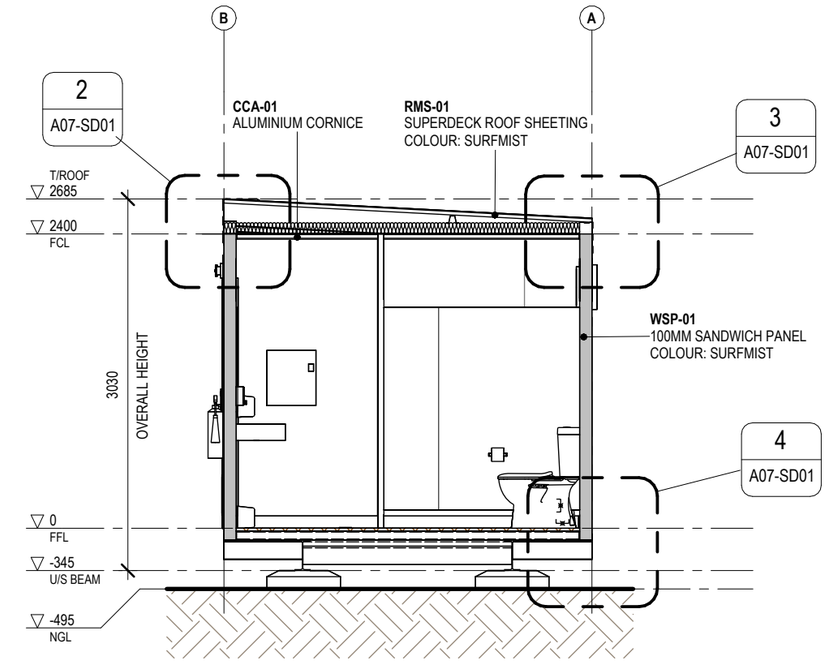
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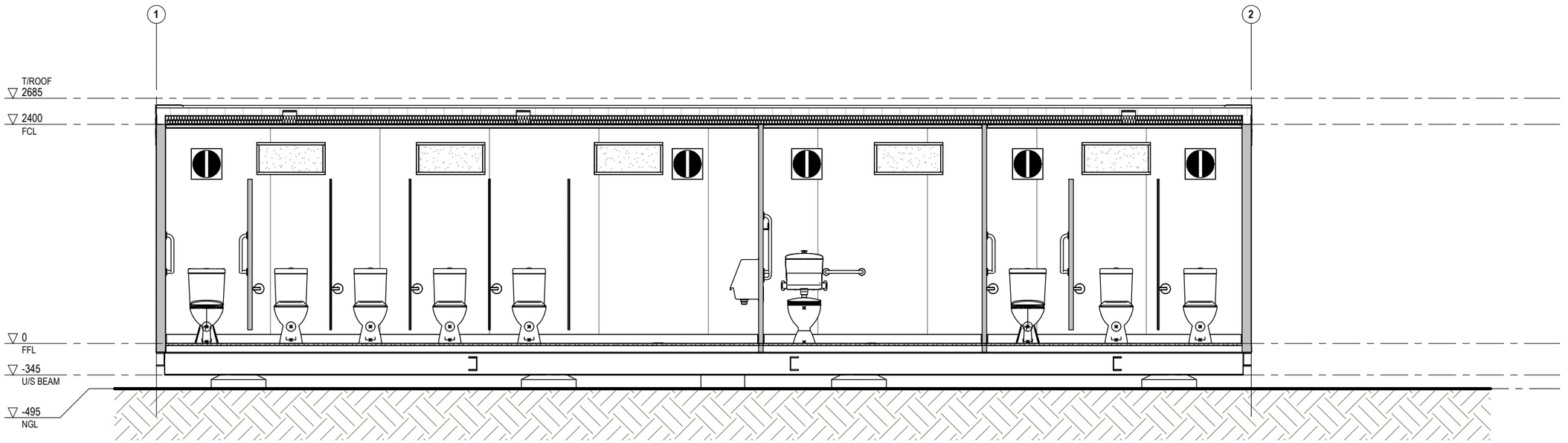
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1
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SECTION 1
1 : 50



2
A05-RP01

SECTION 2
1 : 50

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PROJECT STATUS
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PROJECT CLIENT
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PROJECT:
PLANT ABLUTIONS

PROJECT ADDRESS
XX

SHEET
SECTIONS

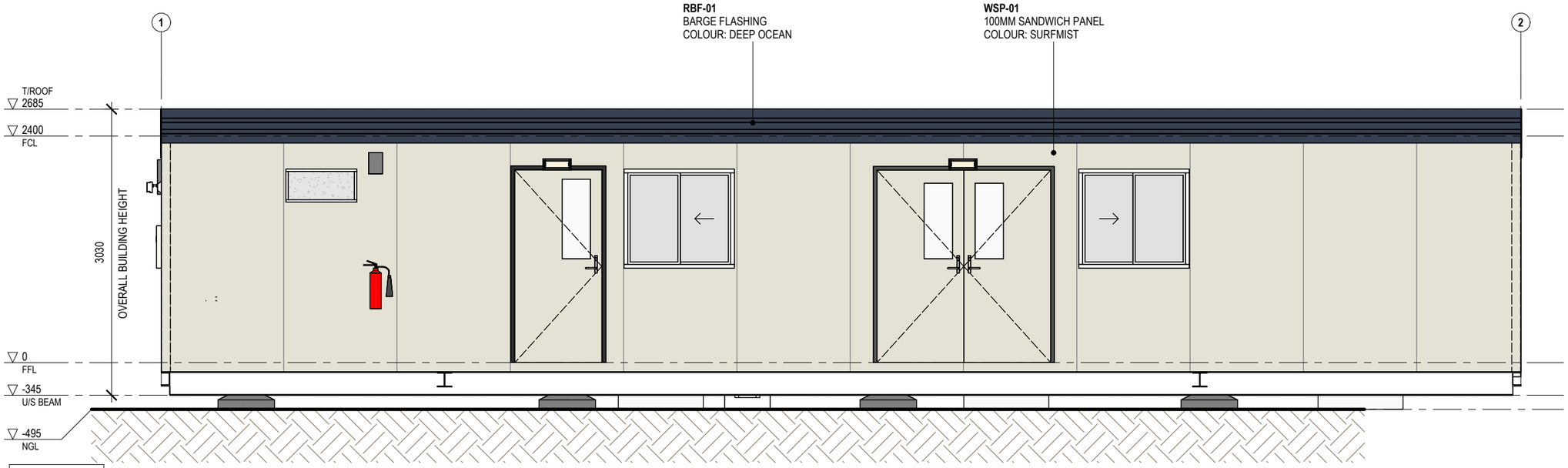
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REVISION
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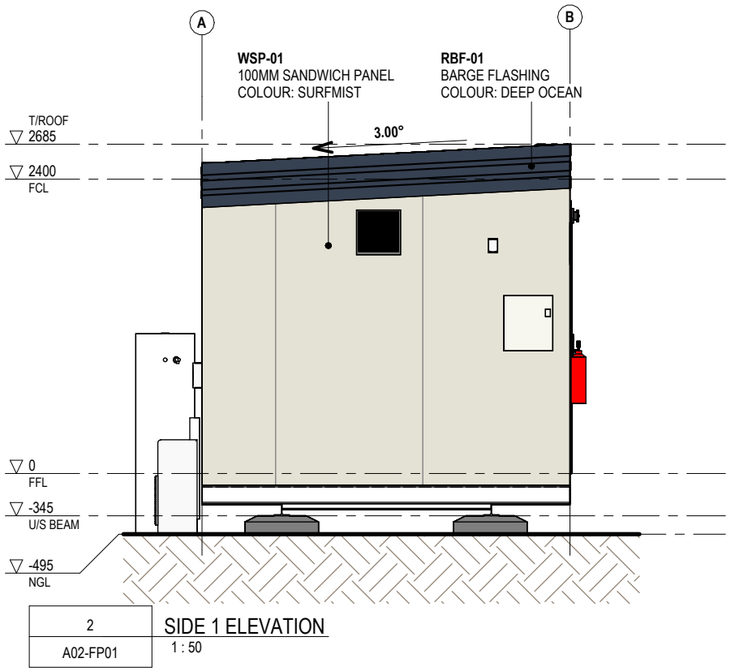
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1
A02-FP01

FRONT ELEVATION
1 : 50



2
A02-FP01

SIDE 1 ELEVATION
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
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PROJECT NO.: **J005076-B08**

PROJECT STATUS: **FOR SALES**

PROJECT CLIENT: **FLEETWOOD CAPEX**

PROJECT: **FIRST AID HUT**

PROJECT ADDRESS: **XX**

SHEET: **ELEVATIONS**

DRAWN	CHECKED	SCALE	SIZE
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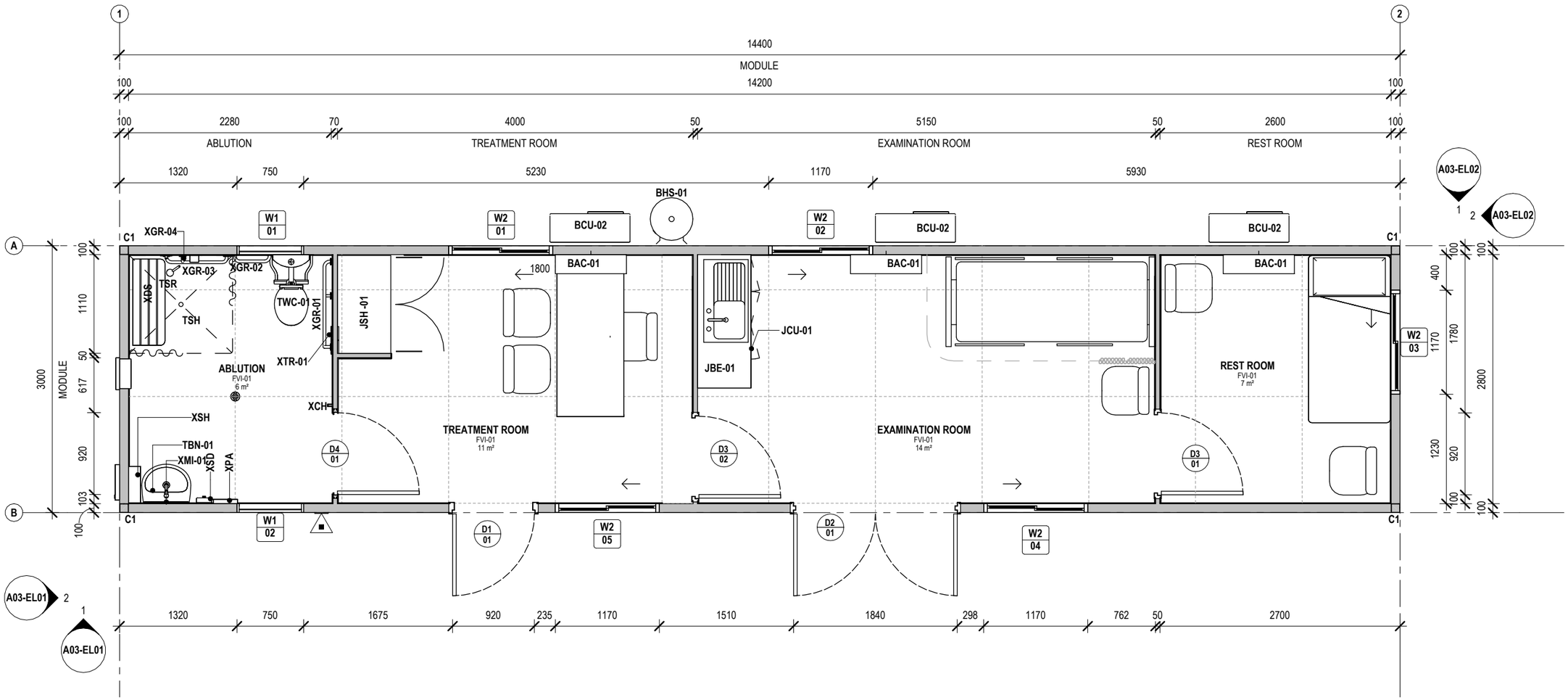
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REVISION: A

DC SIGN OFF:

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ROOM NAME	AREA
ABLUTION	6 m²
EXAMINATION ROOM	14 m²
REST ROOM	7 m²
TREATMENT ROOM	11 m²
TOTAL	39 m²



1	FLOOR PLAN
	1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	6/2/24	SC	KP

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PROJECT NO.: J005076-B08

PROJECT: FIRST AID HUT

PROJECT STATUS: FOR SALES

PROJECT CLIENT: FLEETWOOD CAPEX

PROJECT ADDRESS: XX

NORTH

SHEET: FLOOR PLAN

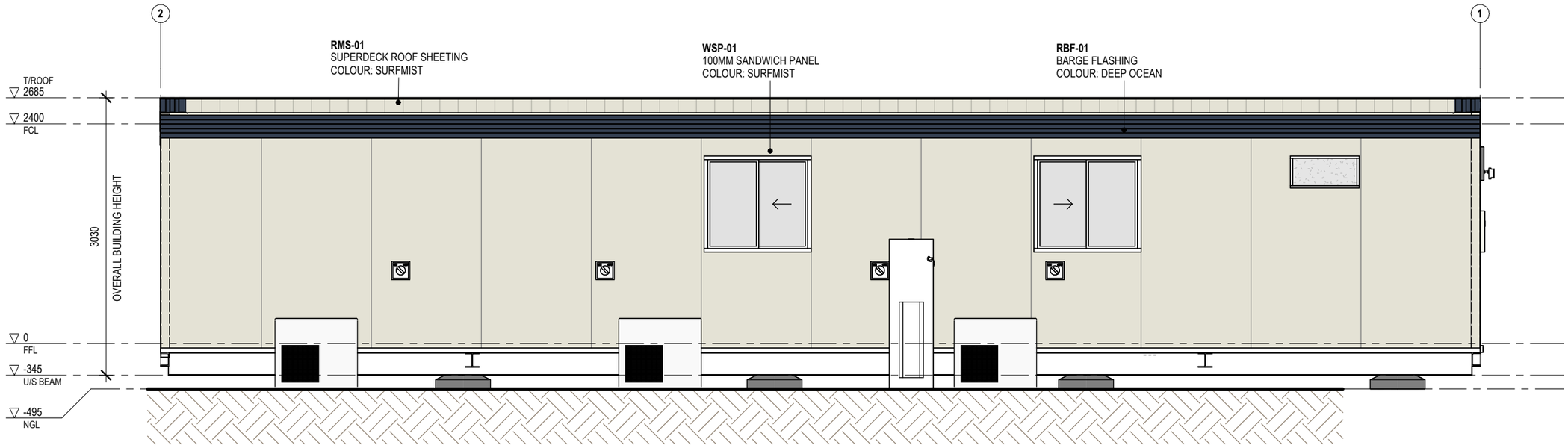
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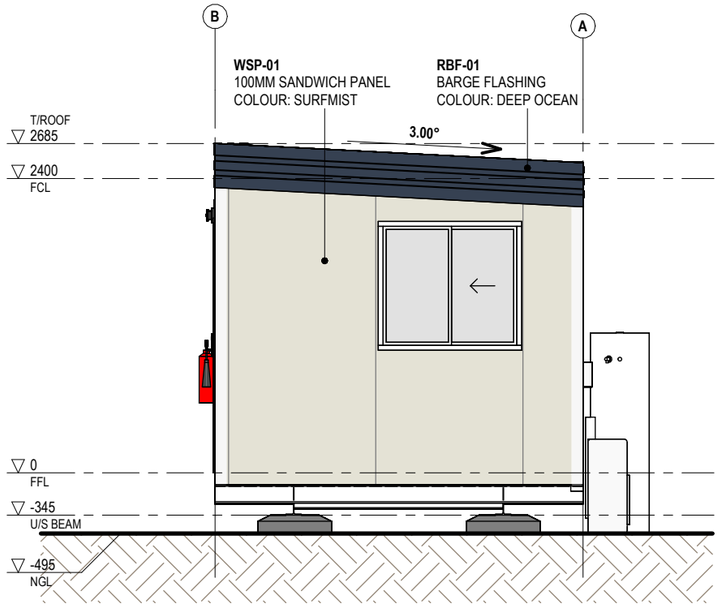
REVISION: A

DC SIGN OFF:

Autodesk Docs://J005076 - FWD CAPEX - 100P Camp Stock Build/J005076_B08_First Aid Hut_R22_SophiaCAK9M2.rvt



1 / A02-FP01 REAR ELEVATION
1 : 50



2 / A02-FP01 SIDE 2 ELEVATION
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	6/2/24	SC	KP

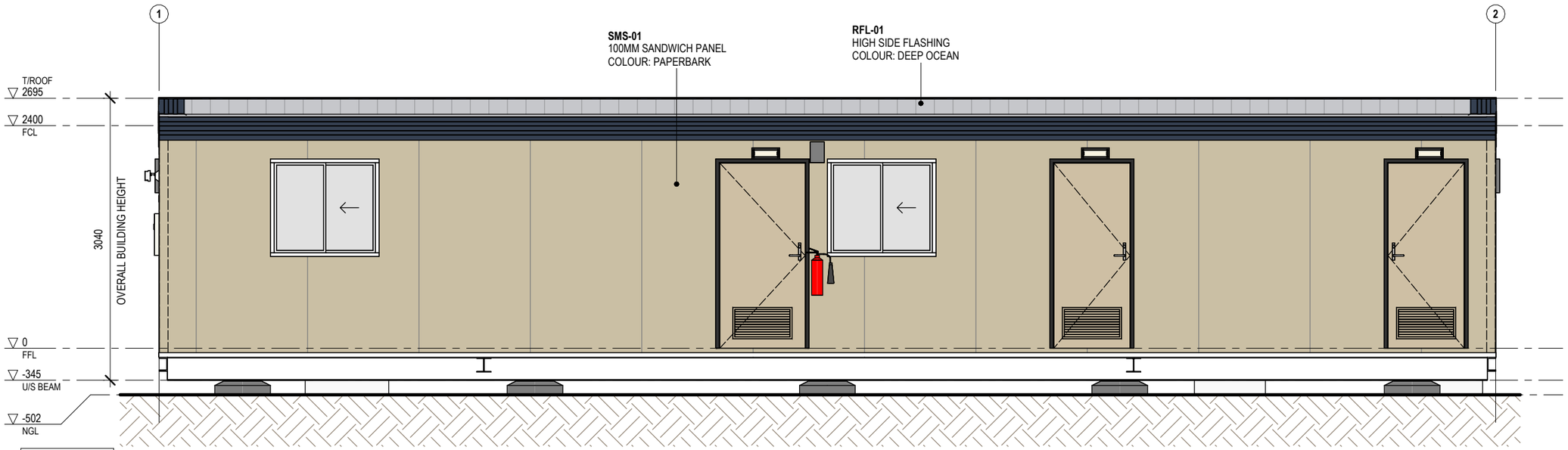
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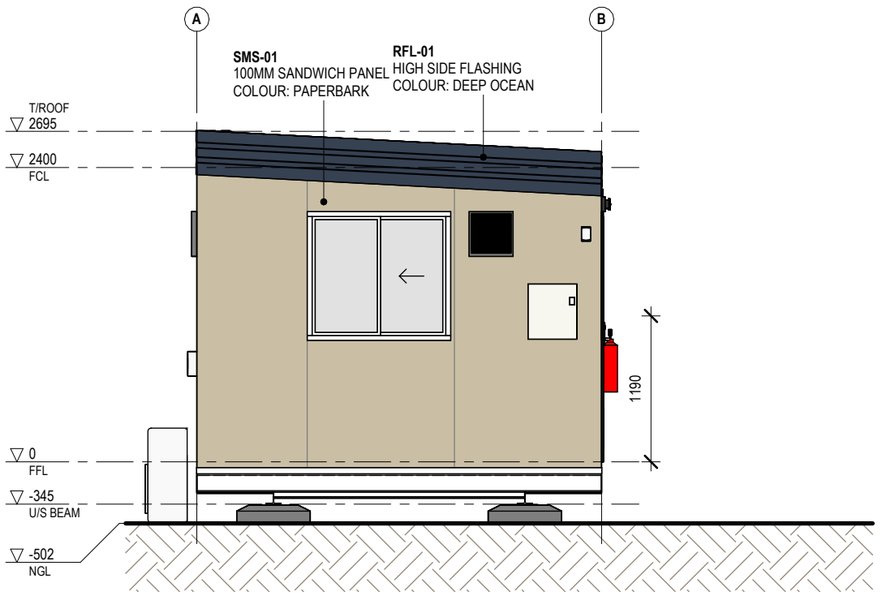
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PROJECT NO.: **J005076-B08**
PROJECT STATUS: **FOR SALES**
PROJECT CLIENT: **FLEETWOOD CAPEX**
PROJECT: **FIRST AID HUT**
PROJECT ADDRESS: **XX**

SHEET: **ELEVATIONS**
DRAWN: **SC** CHECKED: **KP** SCALE: **1 : 50** SIZE: **A3**
DRAWING NO.: **A03-EL02** REVISION: **A**
DC SIGN OFF:



1 / A02-FP01 FRONT ELEVATION
1 : 50



2 / A02-FP01 SIDE 1 ELEVATION
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	02/02/24	SC	KP

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PROJECT NO.: **J005076-B07**

PROJECT STATUS: **ISSUED FOR REVIEW**

PROJECT CLIENT: **FLEETWOOD CAPEX**

PROJECT: **LAUNDRY LINEN CLEANER**

PROJECT ADDRESS: **XX**

SHEET: **ELEVATIONS**

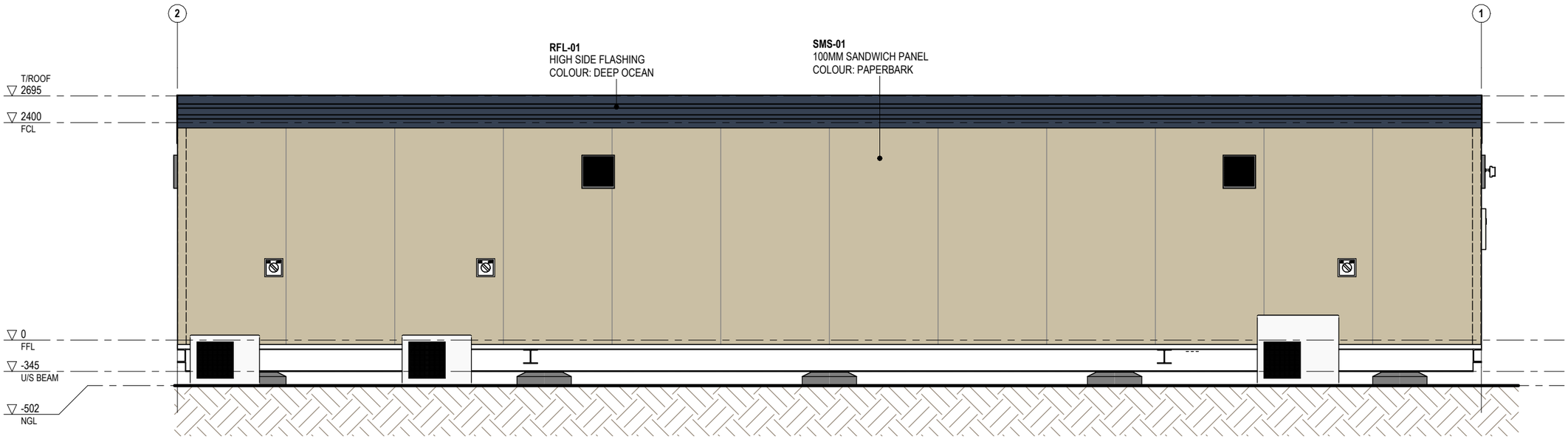
DRAWN	CHECKED	SCALE	SIZE
SC	KP	1 : 50	A3

DRAWING NO.: **A03-EL01**

REVISION: A

DC SIGN OFF:

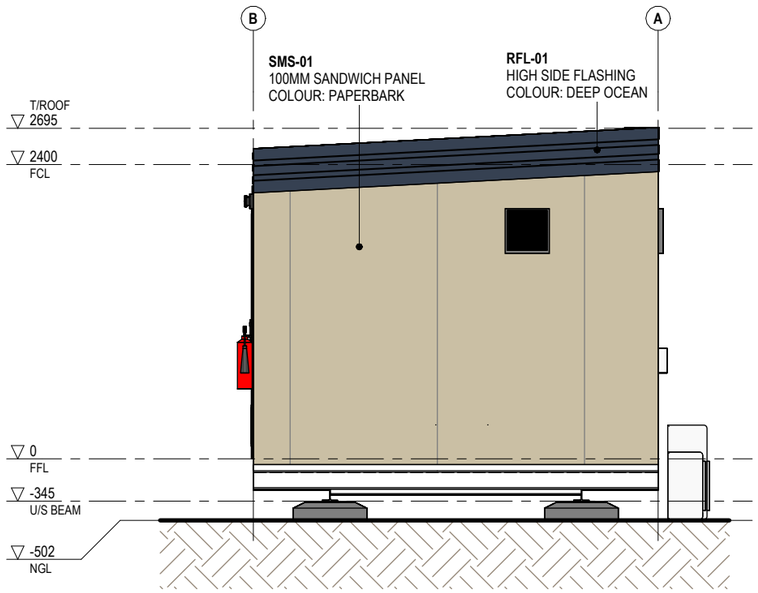
Autodesk Docs://J005076 - FWD CAPEX - 100P Camp Stock Build/J005076_B07_3.3x14 Laundry Linen Cleaner_R22.rvt



1 | A02-FP01

REAR ELEVATION

1 : 50



2 | A02-FP01

SIDE 2 ELEVATION

1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	02/02/24	SC	KP

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PROJECT NO.: **J005076-B07**

PROJECT STATUS: **ISSUED FOR REVIEW**

PROJECT CLIENT: **FLEETWOOD CAPEX**

PROJECT: **LAUNDRY LINEN CLEANER**

PROJECT ADDRESS: **XX**

SHEET: **ELEVATIONS**

DRAWN	CHECKED	SCALE	SIZE
SC	KP	1 : 50	A3

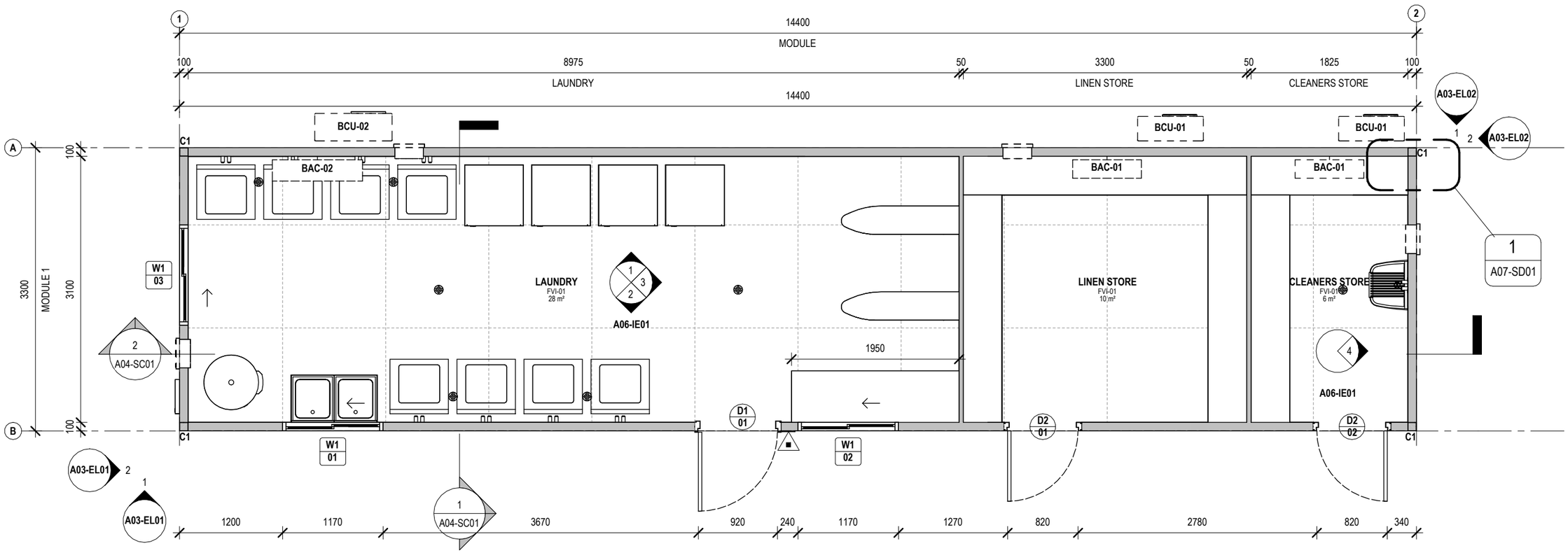
DRAWING NO.: **A03-EL02**

REVISION: A

DC SIGN OFF:

Autodesk Docs://J005076 - FWD CAPEX - 100P Camp Stock Build/J005076_B07_3.3x14 Laundry Linen Cleaner_R22.rvt

ROOM NAME	AREA
CLEANERS STORE	6 m²
LAUNDRY	28 m²
LINEN STORE	10 m²
TOTAL	44 m²



1 FLOOR PLAN
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	02/02/24	SC	KP

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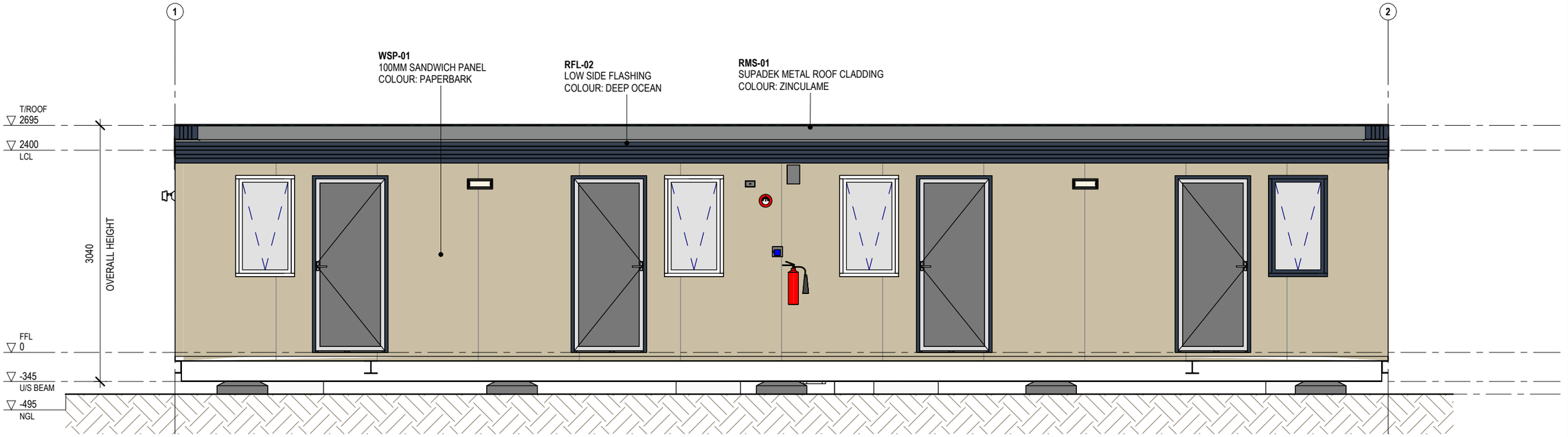
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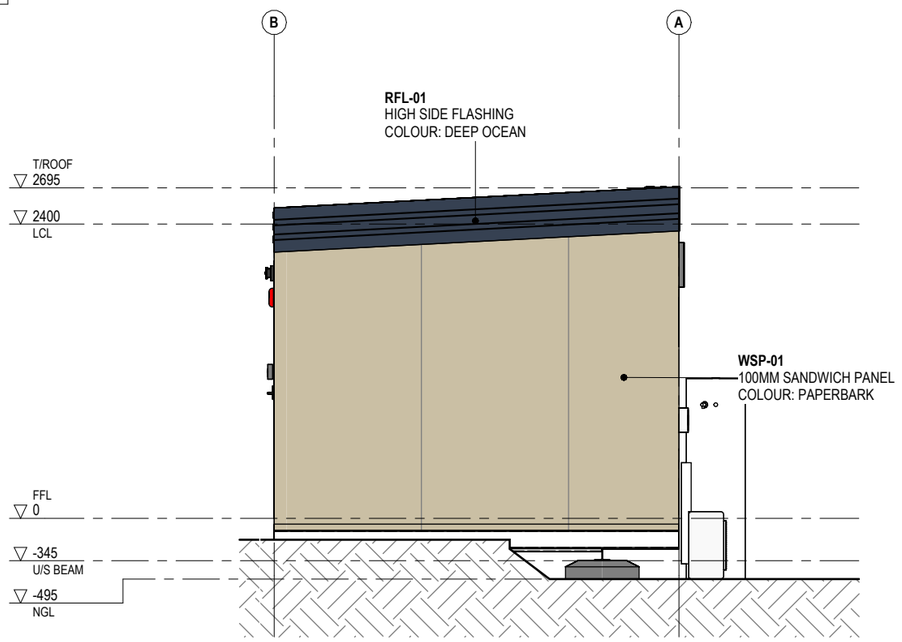
PROJECT NO.: J005076-B07
PROJECT STATUS: ISSUED FOR REVIEW
PROJECT CLIENT: FLEETWOOD CAPEX
PROJECT: LAUNDRY LINEN CLEANER
PROJECT ADDRESS: XX
NORTH

SHEET: FLOOR PLAN
DRAWN: SC | CHECKED: KP | SCALE: 1 : 50 | SIZE: A3
DRAWING NO.: A02-FP01 | REVISION: A
DC SIGN OFF:

Autodesk Docs://J005076 - FWD CAPEX - 100P Camp Stock Build/J005076_B07_3.3x14 Laundry Linen Cleaner_R22.rvt



1 | A02-FP01 — FRONT ELEVATION
1 : 50



2 | A02-FP01 — SIDE 1 ELEVATION
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	06.02.24	SC	KP

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PROJECT NO.: **J005076-B01**
PROJECT STATUS: **ISSUED FOR REVIEW**
PROJECT CLIENT: **FLEETWOOD CAPEX**

PROJECT: **4P SPQ**
PROJECT ADDRESS: **XX**

SHEET: **EXTERNAL ELEVATION**

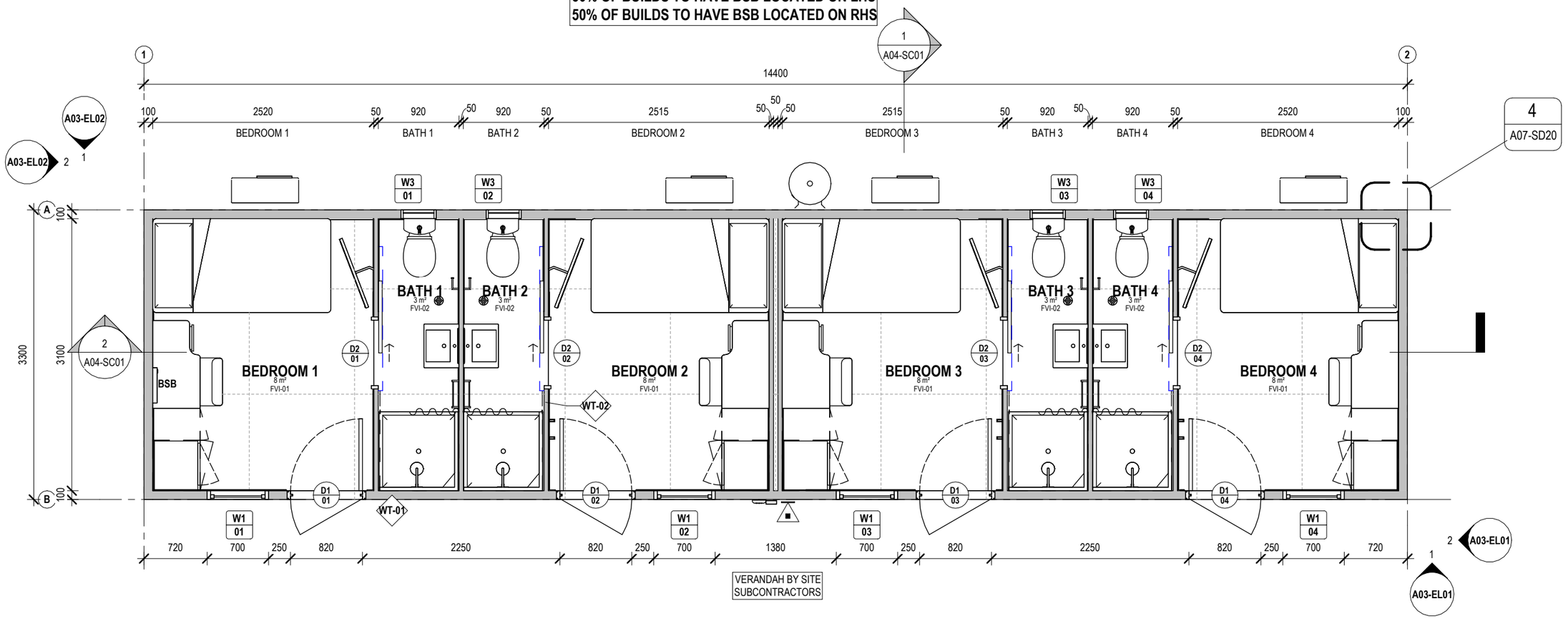
DRAWN: **SC** | CHECKED: **KP** | SCALE: **1 : 50** | SIZE: **A3**

DRAWING NO.: **A03-EL01** | REVISION: **A**

DC SIGN OFF:

ROOM NAME	AREA
BATH 1	3 m²
BEDROOM 1	8 m²
TOTAL	11 m²

50% OF BUILDS TO HAVE BSB LOCATED ON LHS
50% OF BUILDS TO HAVE BSB LOCATED ON RHS



1 FLOOR PLAN
1 : 50

WALL TYPES LEGEND

WT-01 **100MM WSP-01**
EXTERNAL WALL

WT-02 **50MM WSP-02**
INTERNAL WALL

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	06.02.24	SC	KP

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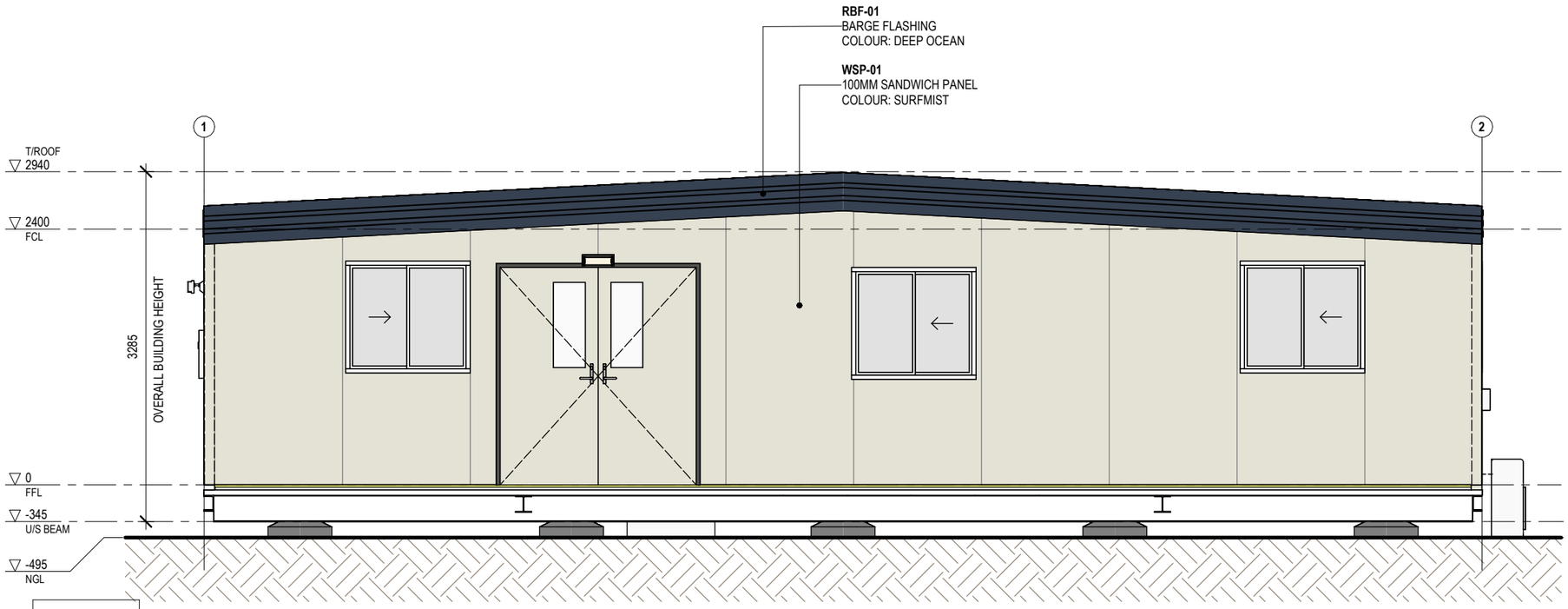
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PROJECT NO.: **J005076-B01**
PROJECT STATUS: **ISSUED FOR REVIEW**
PROJECT CLIENT: **FLEETWOOD CAPEX**

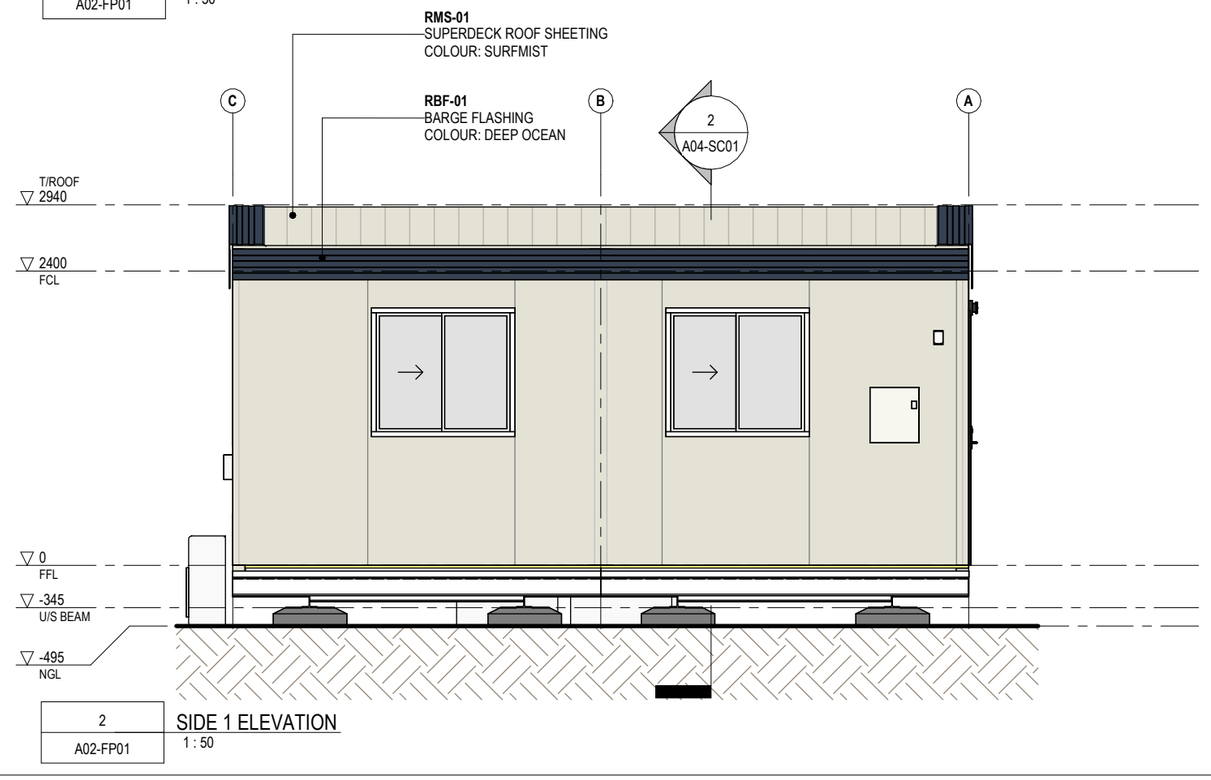
PROJECT: **4P SPQ**
PROJECT ADDRESS: **XX**

SHEET: **FLOOR PLAN**
DRAWN: **SC** CHECKED: **KP** SCALE: **As indicated** SIZE: **A3**
DRAWING NO.: **A02-FP01** REVISION: **A**
DC SIGN OFF:

Autodesk Docs://J005076 - FWD CAPEX - 100P Camp Stock Build/J005076-B01_4P SPQ_R22.rvt



1 / A02-FP01 FRONT ELEVATION
1 : 50



2 / A02-FP01 SIDE 1 ELEVATION
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	06/02/24	SC	KP

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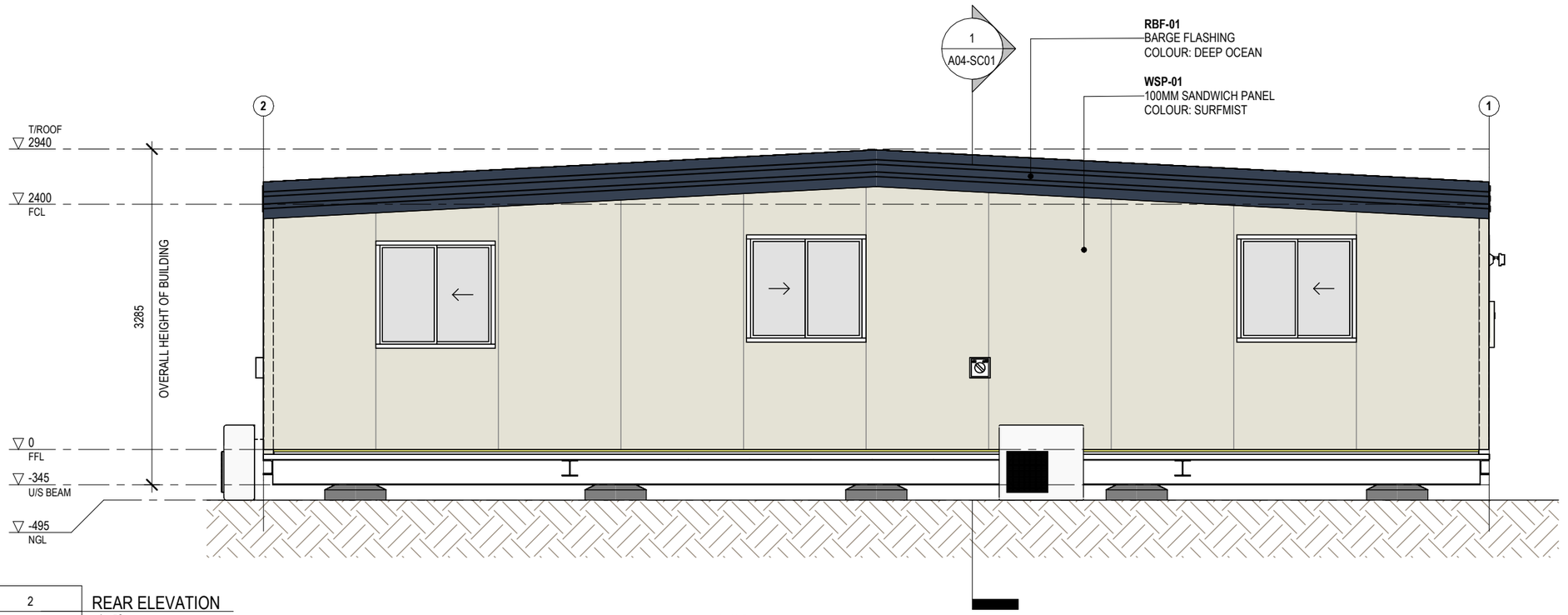
PROJECT NO.: **J005076-B05**
PROJECT STATUS: **ISSUED FOR REVIEW**
PROJECT CLIENT: **FLEETWOOD CAPEX**
PROJECT: **OFFICE**
PROJECT ADDRESS: **XX**

SHEET
ELEVATIONS

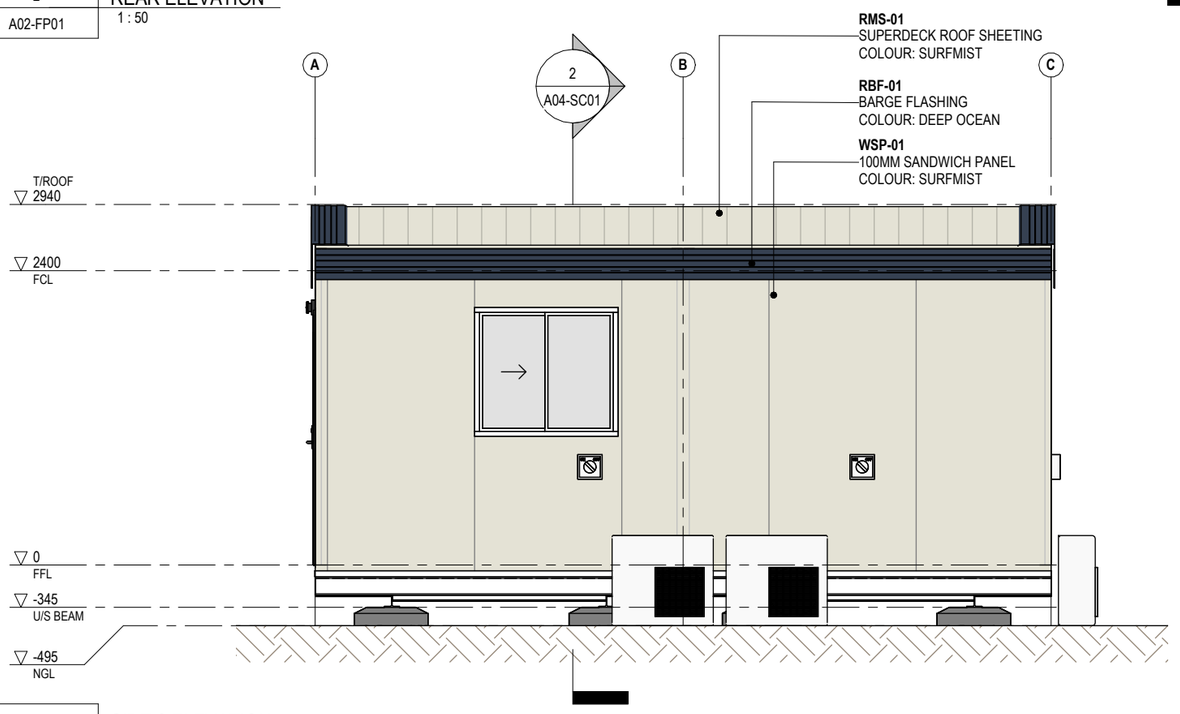
DRAWN **SC** CHECKED **KP** SCALE **1 : 50** SIZE **A3**

DRAWING NO. **A03-EL01** REVISION **A**

DC SIGN OFF:



2 REAR ELEVATION
A02-FP01 1 : 50



1 SIDE 2 ELEVATION
A02-FP01 1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	06/02/24	SC	KP

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PROJECT NO.: **J005076-B05**

PROJECT STATUS: **ISSUED FOR REVIEW**

PROJECT CLIENT: **FLEETWOOD CAPEX**

PROJECT: **OFFICE**

PROJECT ADDRESS: **XX**

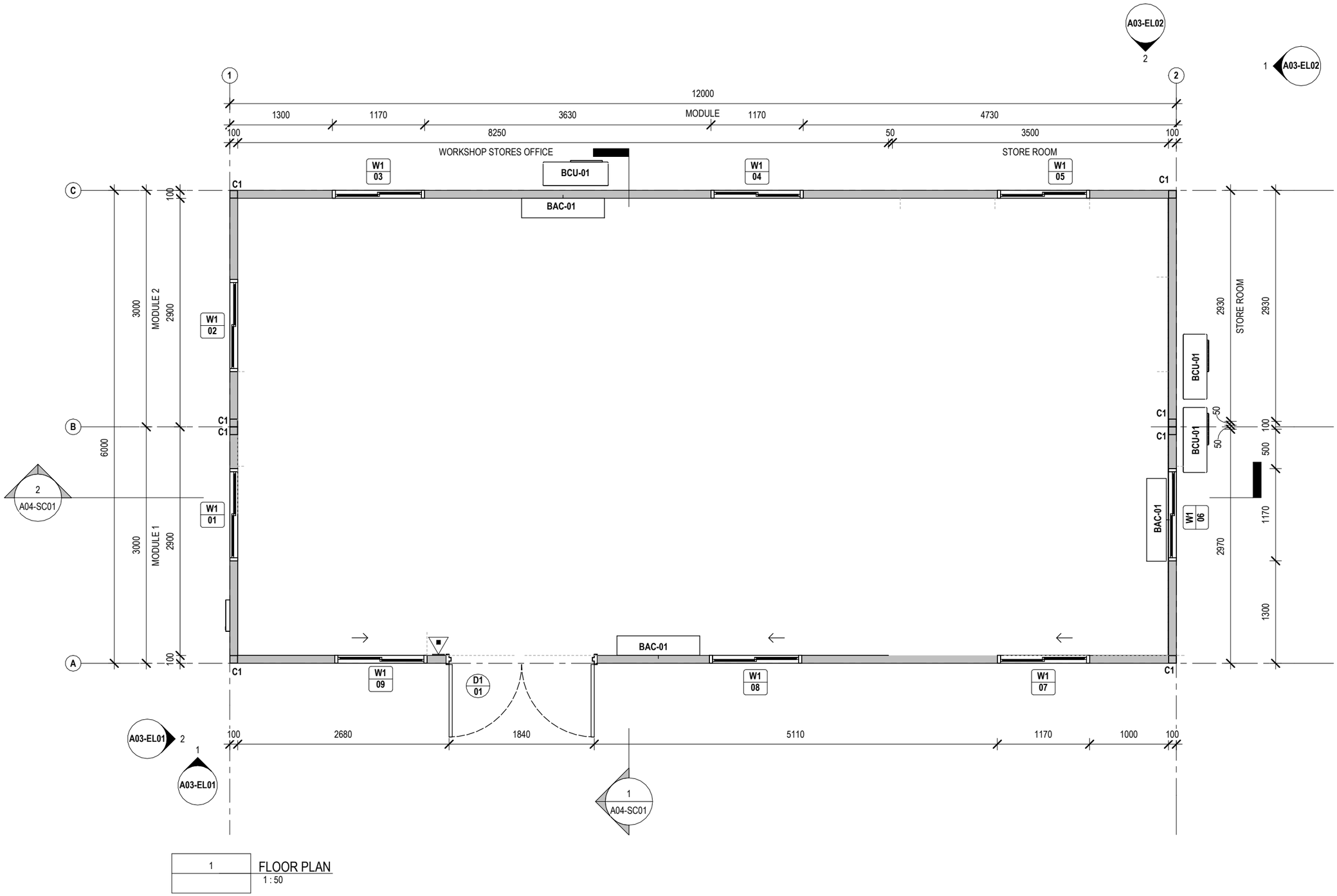
SHEET: **ELEVATIONS**

DRAWN	CHECKED	SCALE	SIZE
SC	KP	1 : 50	A3

DRAWING NO. **A03-EL02**

REVISION **A**

DC SIGN OFF:



1 FLOOR PLAN
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	06/02/24	SC	KP

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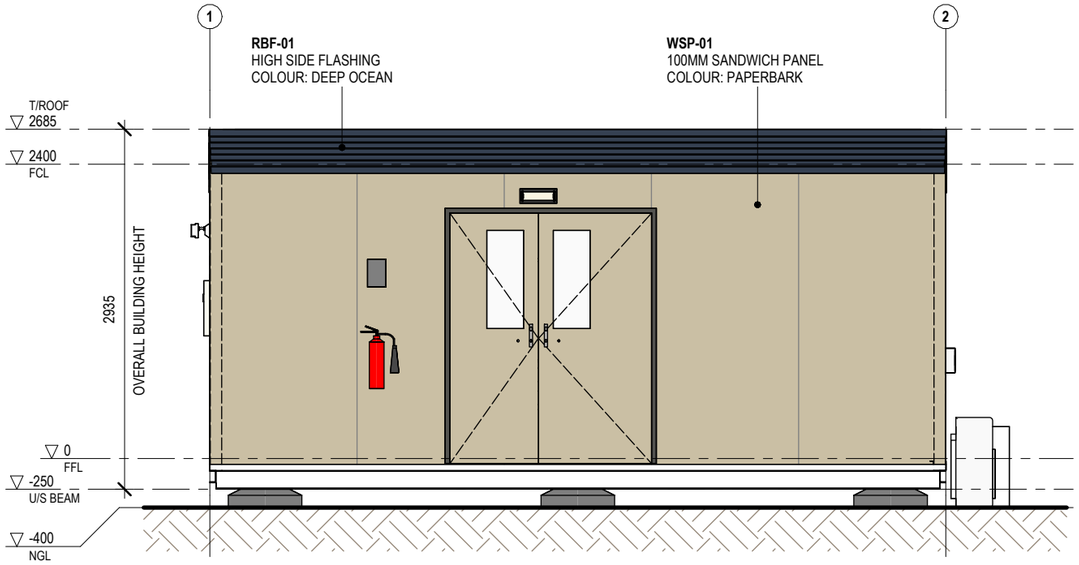
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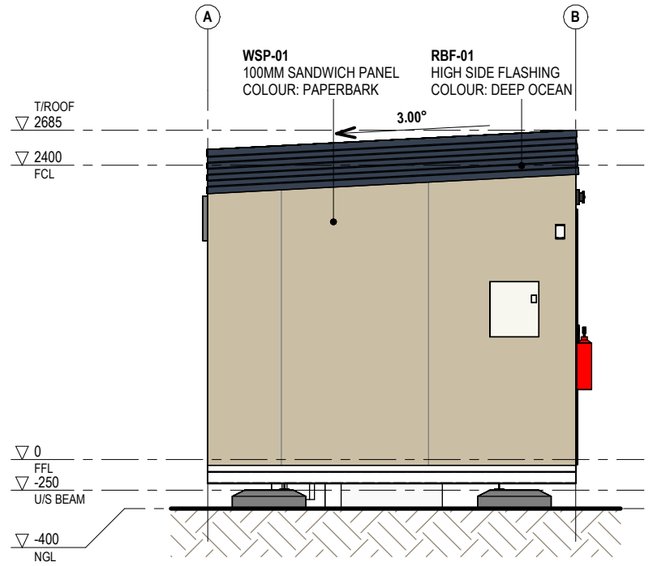
PROJECT NO.: J005076-B05
PROJECT STATUS: ISSUED FOR REVIEW
PROJECT CLIENT: FLEETWOOD CAPEX
PROJECT: LOCKER ROOM
PROJECT ADDRESS: XX
NORTH

SHEET: FLOOR PLAN
DRAWN: SC | CHECKED: KP | SCALE: 1 : 50 | SIZE: A3
DRAWING NO.: A02-FP01 | REVISION: A
DC SIGN OFF:

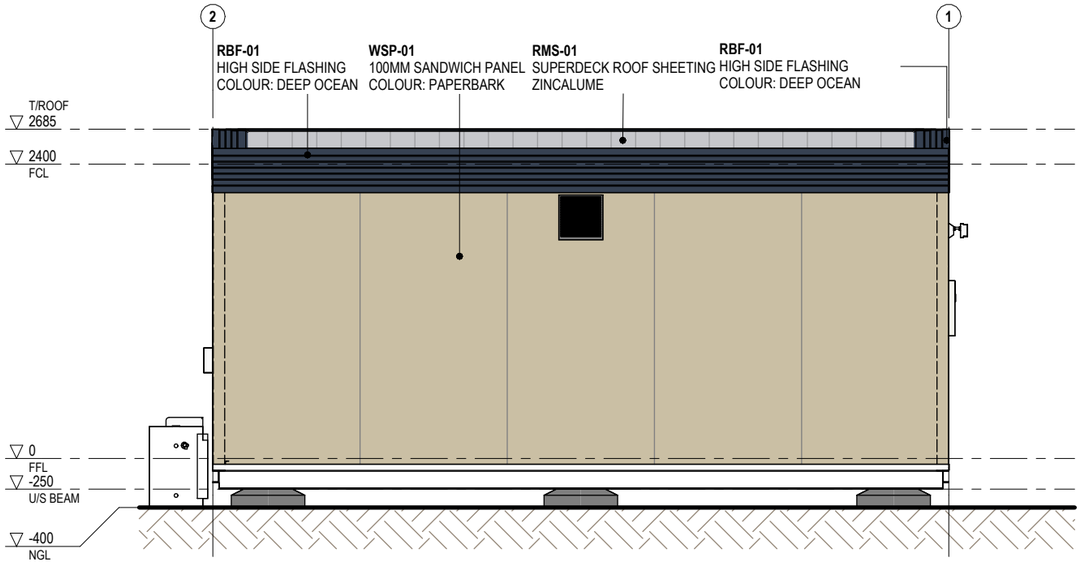
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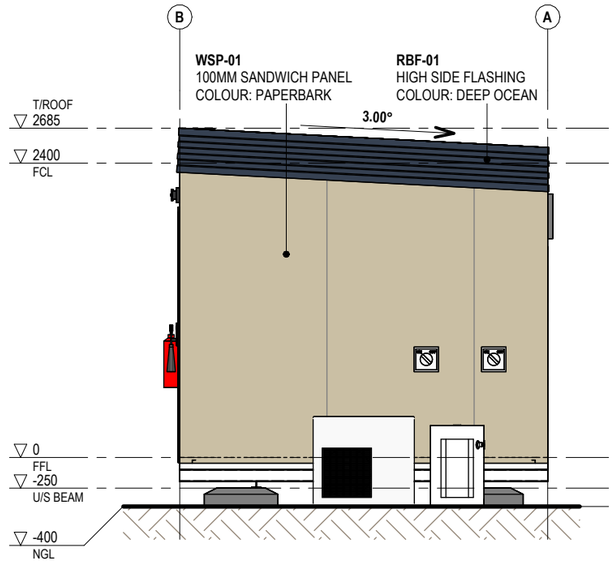
1 A02-FP01 FRONT ELEVATION
1 : 50



2 A02-FP01 SIDE 1 ELEVATION
1 : 50



3 A02-FP01 REAR ELEVATION
1 : 50



4 A02-FP01 SIDE 2 ELEVATION
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	30.01.24	SC	KP

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PROJECT NO.: **J005076-B04**

PROJECT STATUS: **ISSUED FOR REVIEW**

PROJECT CLIENT: **FLEETWOOD CAPEX**

PROJECT: **ICE ROOM**

PROJECT ADDRESS: **XX**

SHEET: **ELEVATIONS**

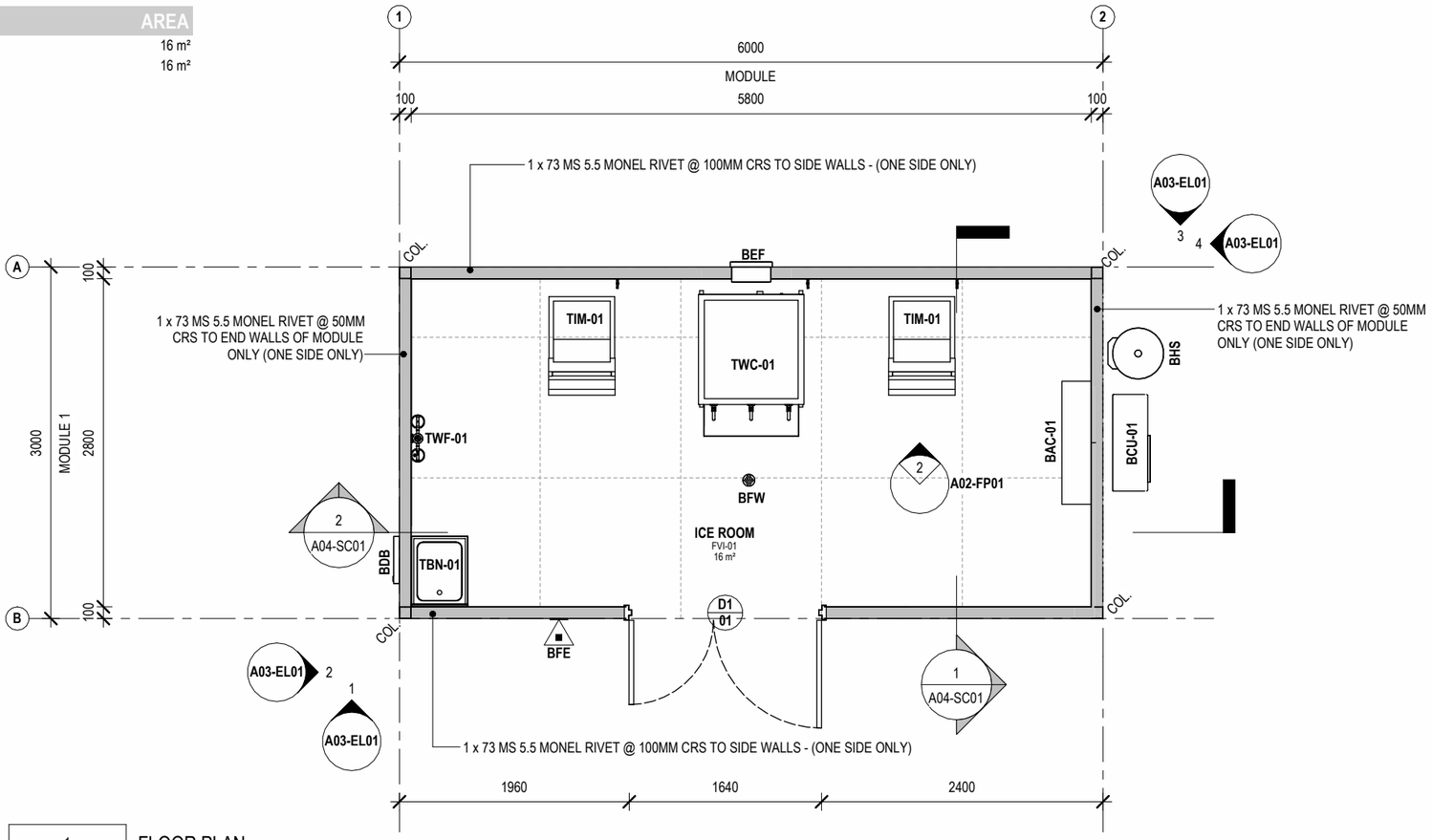
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DRAWING NO.: **A03-EL01** REVISION: **A**

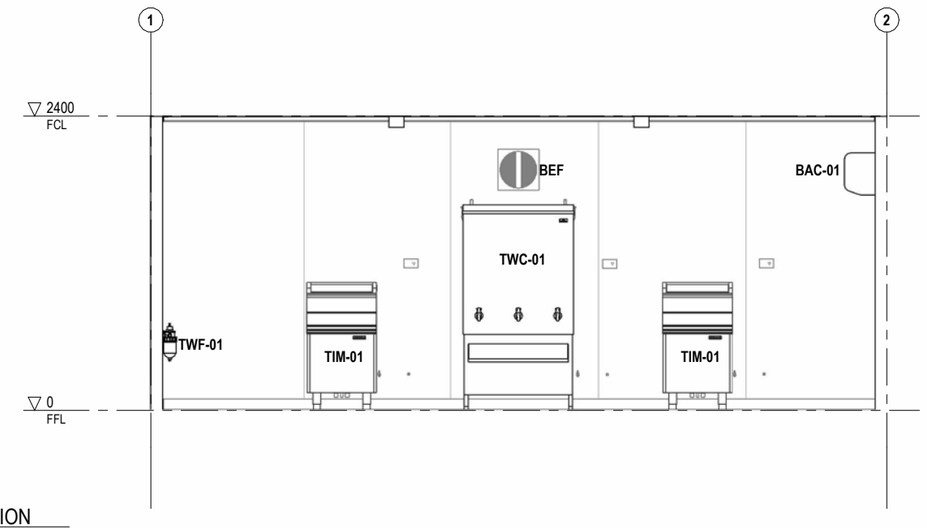
DC SIGN OFF:

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ROOM NAME	AREA
ICE ROOM	16 m²
TOTAL	16 m²



1 FLOOR PLAN
1 : 50



2 INTERNAL ELEVATION
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	30.01.24	SC	KP

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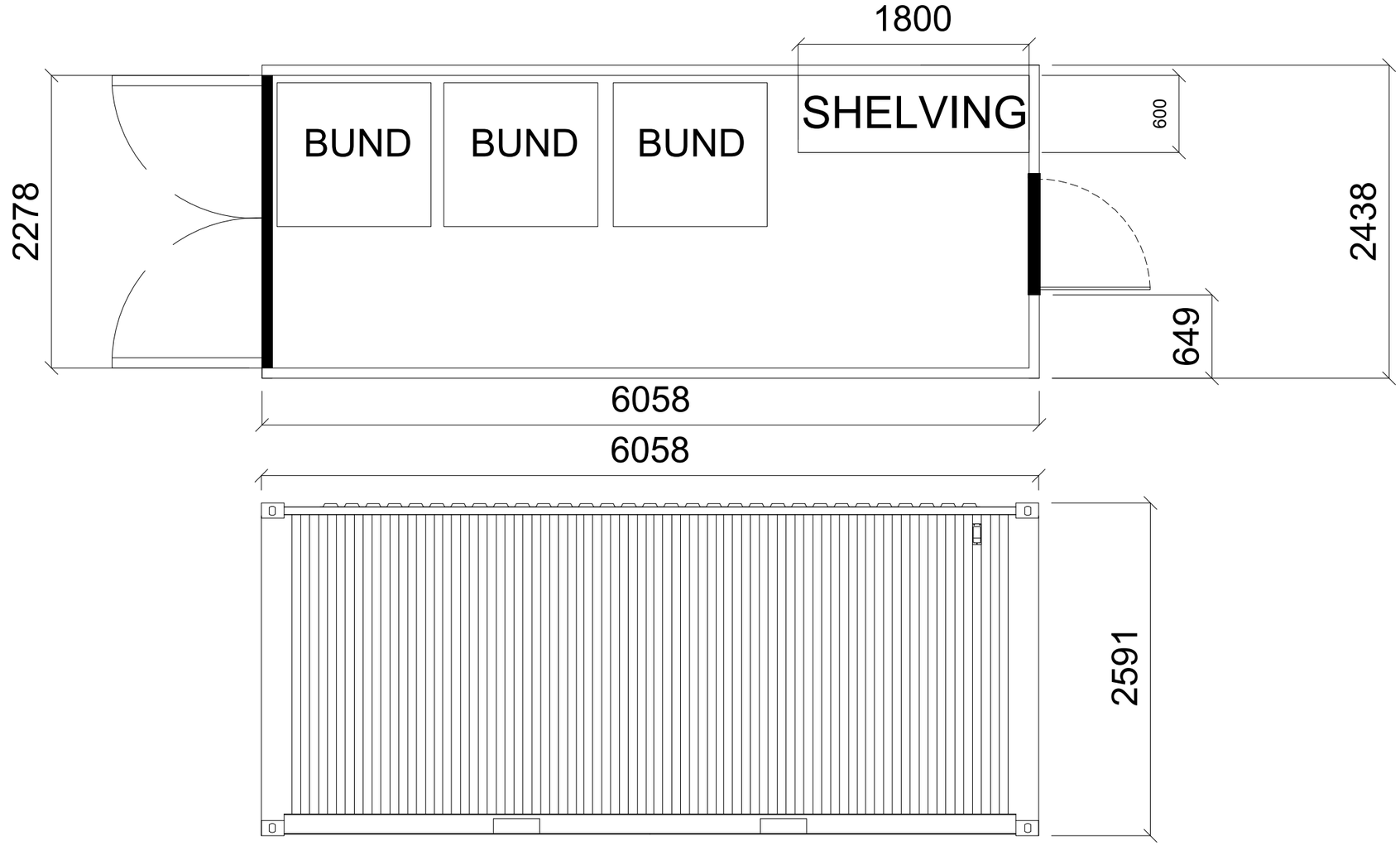
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PROJECT NO.: J005076-B04
PROJECT STATUS: ISSUED FOR REVIEW
PROJECT CLIENT: FLEETWOOD CAPEX
PROJECT: ICE ROOM
PROJECT ADDRESS: XX
NORTH

SHEET: FLOOR PLAN
DRAWN: SC | CHECKED: KP | SCALE: 1 : 50 | SIZE: A3
DRAWING NO.: A02-FP01 | REVISION: A
DC SIGN OFF:

Autodesk Docs://J005076 - FWD CAPEX - 100P Camp Stock Build/J005076_B04_Ice Room_R22.rvt

CHEM STORE



SIDE VIEW

REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	MRL
		0	06.12.23	ISSUED FOR CONSTRUCTION	BM						
		A	17.09.23	ISSUED FOR REVIEW	CM	RK	RK	OM	RK	RK	
		–	06.07.23	COMMENCED	OM						

Rapid Exploration Pty Ltd Trading as Rapid Camps

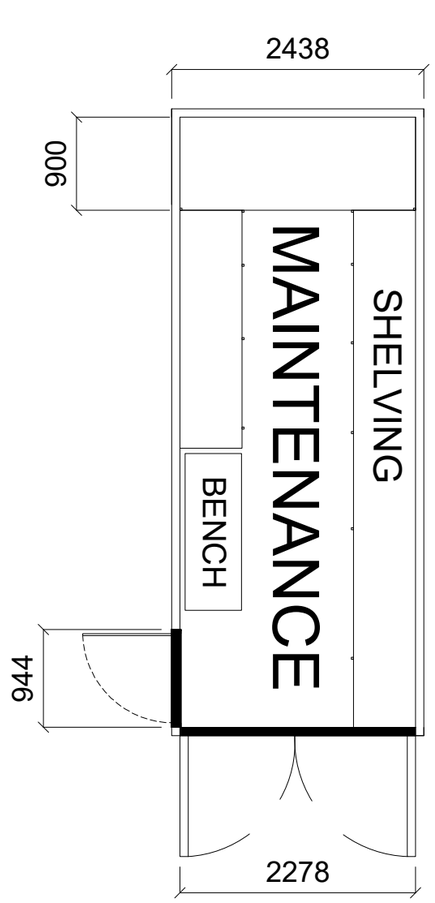
NORTH

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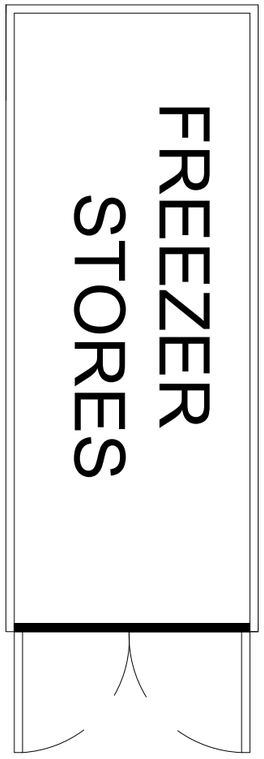
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REV:	0
PROJECT NUMBER	XXXX
	Mineral Recources Ltd
	CARDO EXPLORATION 60 PERSON CAMP
	CHEMICAL STORAGE
SCALE	A3 NTS
DRG No:	XXXX
REV:	0

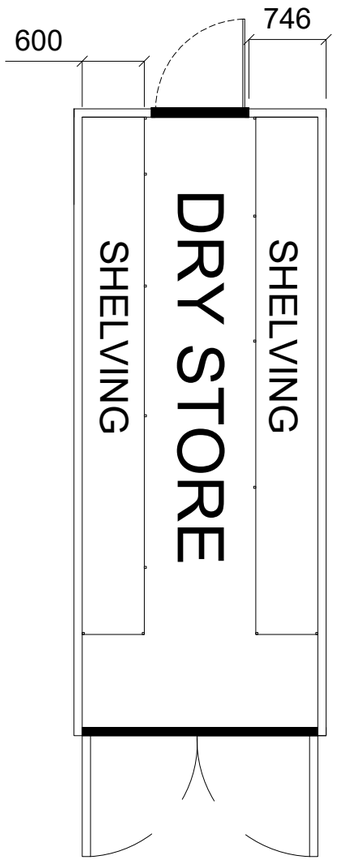
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STANDARD 20ft CONTAINERS

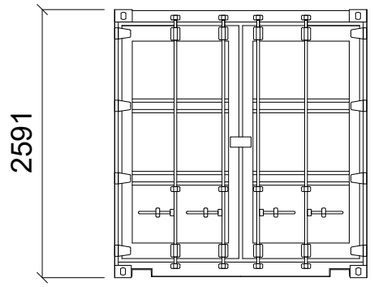




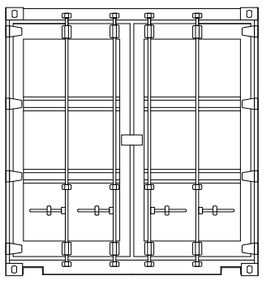




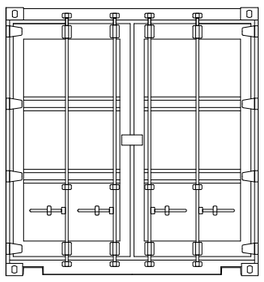
SIDE VIEW



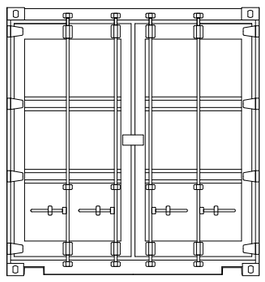
SIDE VIEW



SIDE VIEW



SIDE VIEW



SIDE VIEW

$FILE$
$TIME$
$DATE$

REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	MRL
		0	12.12.23	ISSUED FOR CONSTRUCTION	BM						
		A	25.08.23	ISSUED FOR REVIEW	CM	RK	RK	OM	RK	RK	
		–	06.07.23	COMMENCED	OM						

Rapid Exploration Pty Ltd Trading as Rapid Camps

Rapid Camps

NORTH

PROJECT NUMBER: XXXX

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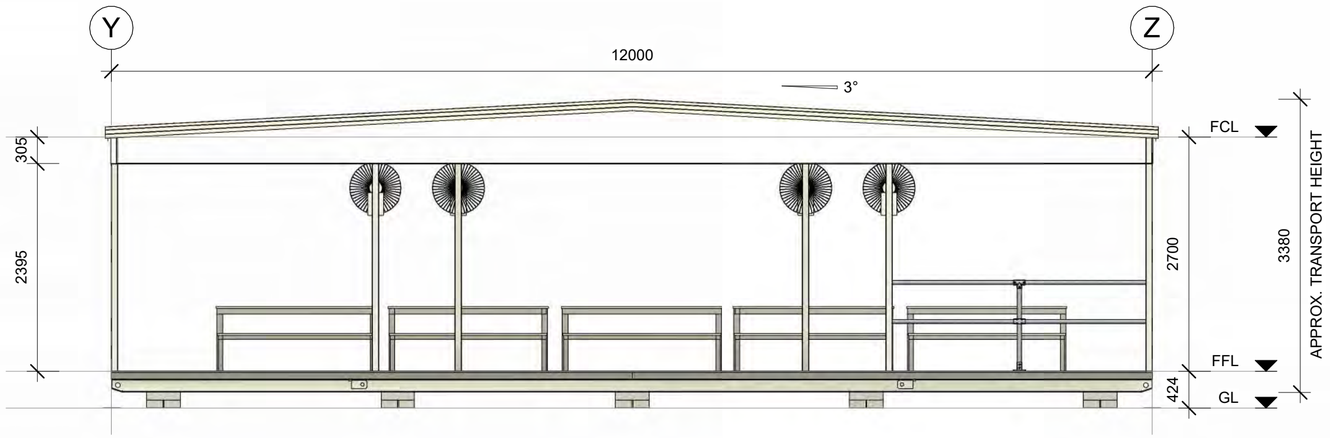
VENDOR/DESIGNER DRG No.: RC–MRL–C–DWG–AR–004 | REV: A

Mineral Recources Ltd

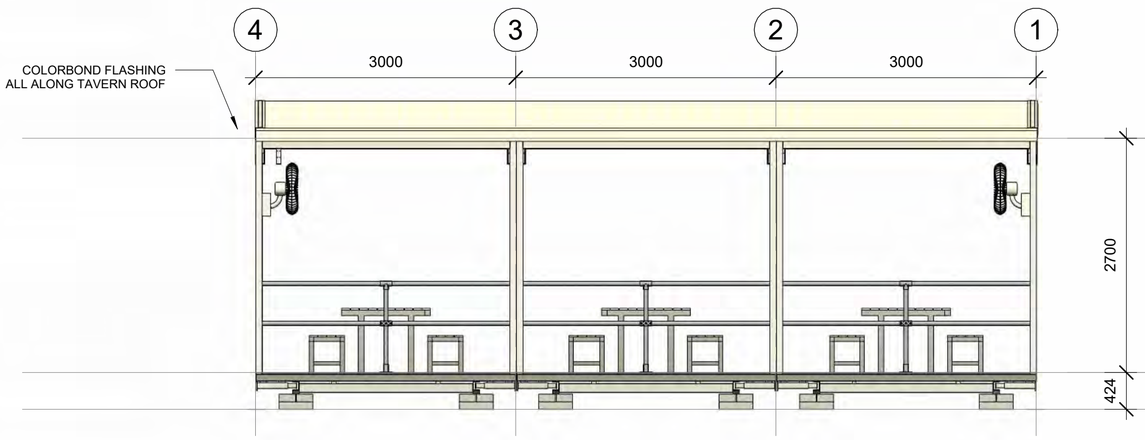
CARDO EXPLORATION
60 PERSON CAMP

DRY, COLD FREEZER STORES AND MAINTENANCE GA

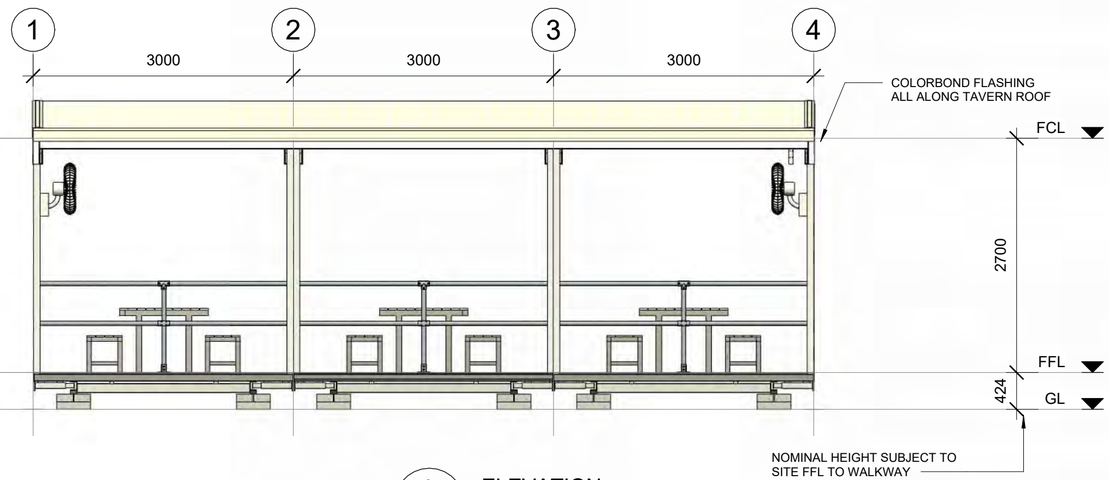
A3 | SCALE: NTS | DRG No: XXXX | REV: A



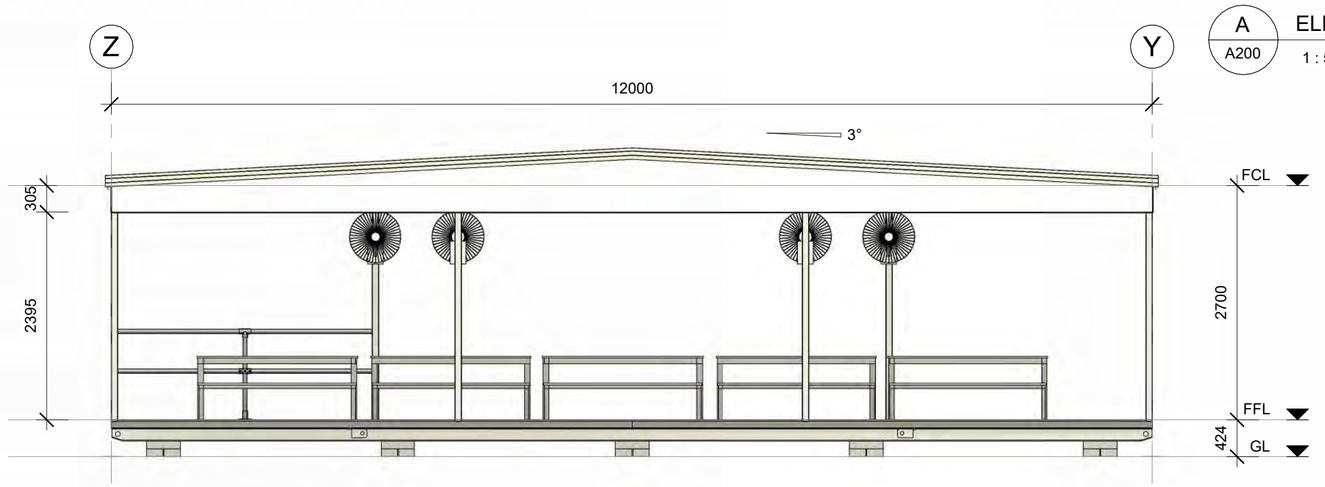
B / A200 ELEVATION
1 : 50



C / A200 ELEVATION
1 : 50



A / A200 ELEVATION
1 : 50



D / A200 ELEVATION
1 : 50

CONFIRM DETAILS OF SET OUTS, LEVELS AND CRITICAL DIMENSIONS ON SITE PRIOR TO SHOP DRAWINGS AND FABRICATION

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REV	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR APPROVAL	20.09.23	JO	IK

ATCO STRUCTURES & LOGISTICS PTY. LTD.
28 ARMSTRONG ROAD,
HOPE VALLEY, WA 6165
PO BOX 40, WATTLEUP, WA 6166
PHONE: (08) 9236 1500
ABN: 71 083 902 309
EMAIL: ASLAu.Sales@atco.com

DESCRIPTION
12.0 x 9.0m BEER GARDEN

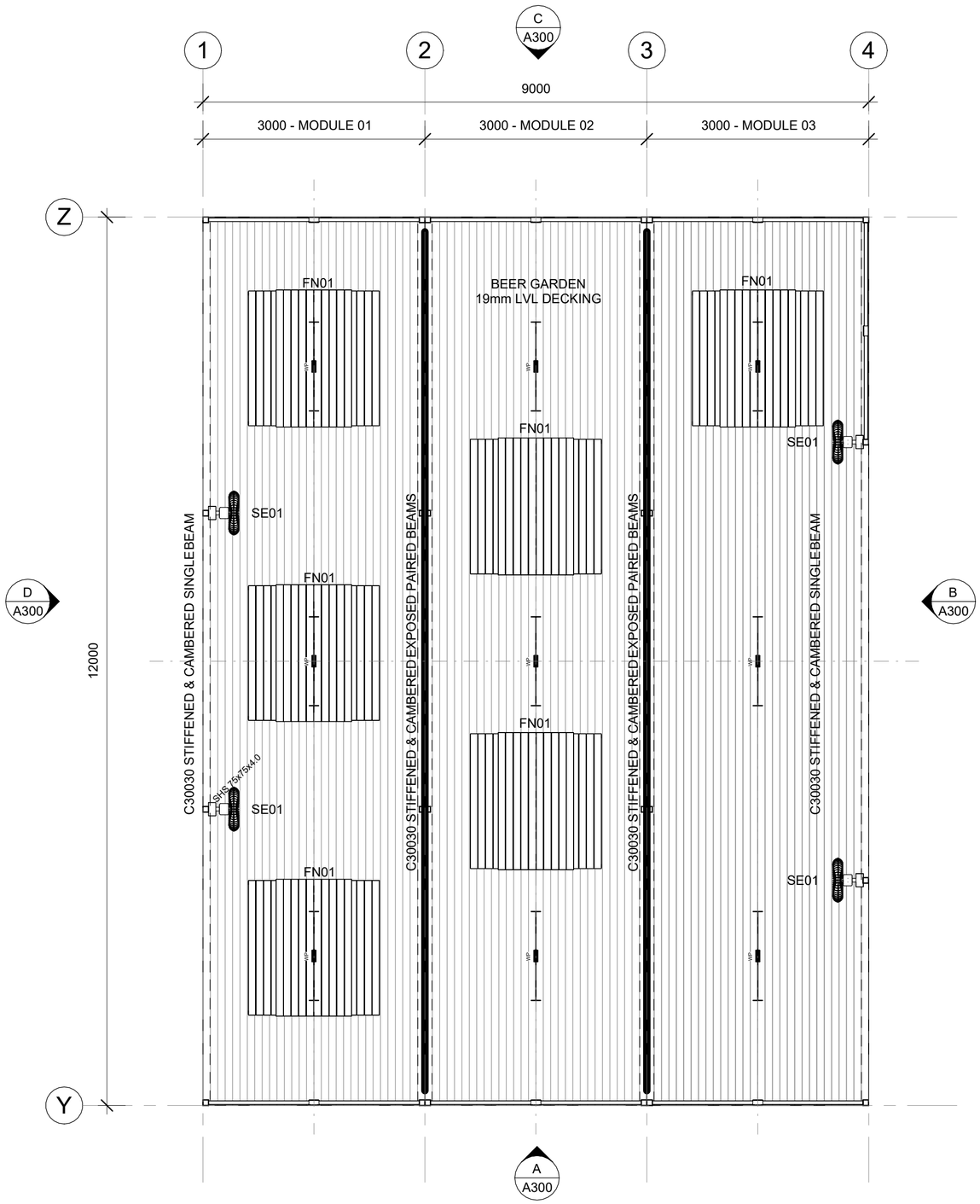
TITLE
ELEVATIONS

PROJECT No.

SCALE AT A2
1 : 50

DRAWING NUMBER
230925B -A300

REVISION
A



1 PLAN

1 : 50

SYMBOL LEGEND

LIGHT - 1200mm LED BATTEN & DIFFUSER

WIND REGION:		D
TERRAIN CATEGORY:		2
IMPORTANCE LEVEL:		2
SHIELDING FACTOR:		NS
BUILDING CLASS:		10a
FLOOR LOADS	DISTRIBUTED (kPa):	3.0
	CONCENTRATED (kN):	2.7
CLIMATE ZONE:		3

NORTH

FLOOR LOADS CALCULATED FROM AS1170.1 - 2002. WIND SPEED CALCULATED FROM AS1170.2 - 2011. BUILDING CLASS, IMPORTANCE LEVEL, PROBABILITY OF EXCEEDANCE, WIND REGION, TERRAIN CATEGORY, TOPOGRAPHIC CLASIFICATION, SHIELDING FACTOR, CLIMATE ZONE & NORTH POINT ARE ASSUMED UNLESS OTHERWISE ADVISED BY CLIENT.

FINISHES SCHEDULE	
CLADDING - EXTERNAL	COLORBOND MAXIRIB - HORIZONTAL
CEILING LINING	6mm FIBRE CEMENT, PAINTED
ROOF SHEETING	0.48mm BMT SUPERDEK ROOFING

ITEM LIST		
ITEM	QTY	DESCRIPTION
Furniture		
FN01	6	PICNIC TABLE, ALUMINUM - 1800L x 1770W
Specialty Equipment		
SE01	4	FAN, WALL MOUNTED

CONFIRM DETAILS OF SET OUTS, LEVELS AND CRITICAL DIMENSIONS ON SITE PRIOR TO SHOP DRAWINGS AND FABRICATION

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A	ISSUED FOR APPROVAL	20.09.23	JO	IK

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PHONE: (08) 9236 1500
ABN: 71 083 902 309
EMAIL: ASLAu.Sales@atco.com

DESCRIPTION: 12.0 x 9.0m BEER GARDEN

TITLE: PLAN

PROJECT No.

SCALE AT A2: 1 : 50

DRAWING NUMBER: 230925B -A200

REVISION: A



230925B

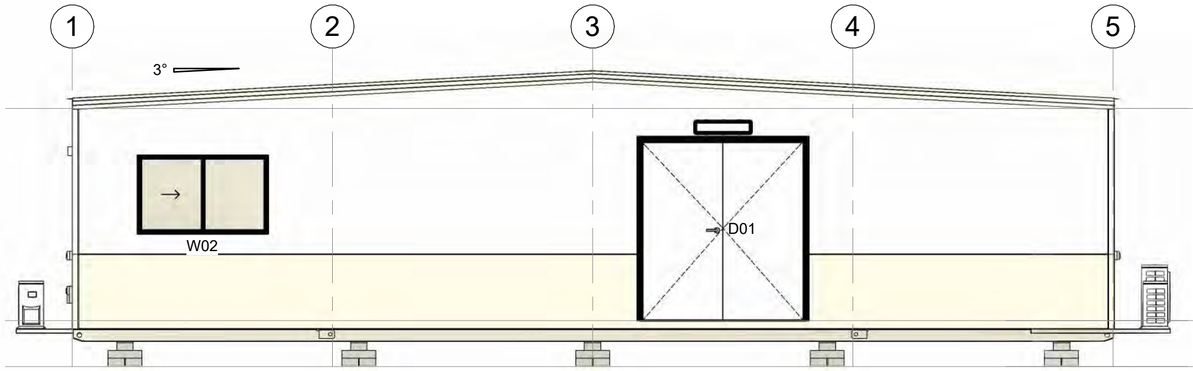
View indicative only

DRAWING LIST		
SHEET NUMBER	SHEET NAME	CURRENT REVISION
A000	TITLE PAGE	A
A200	PLAN	A
A300	ELEVATIONS	A
A500	SALES SCHEDULES	A

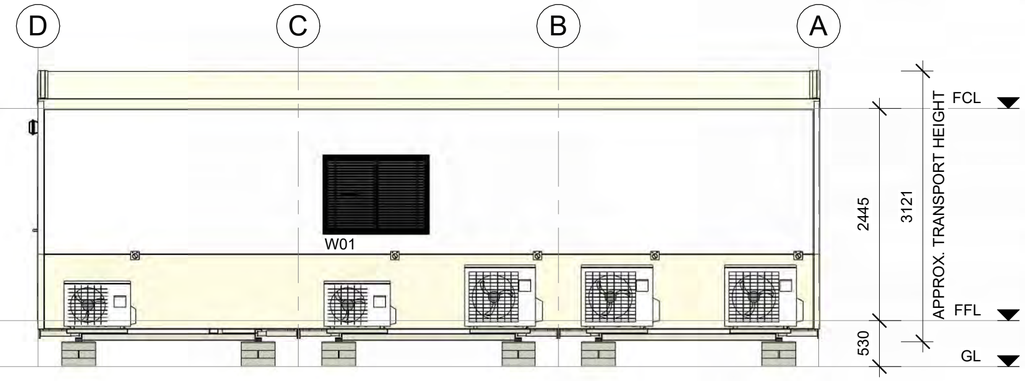
12.0 x 9.0m BEER GARDEN

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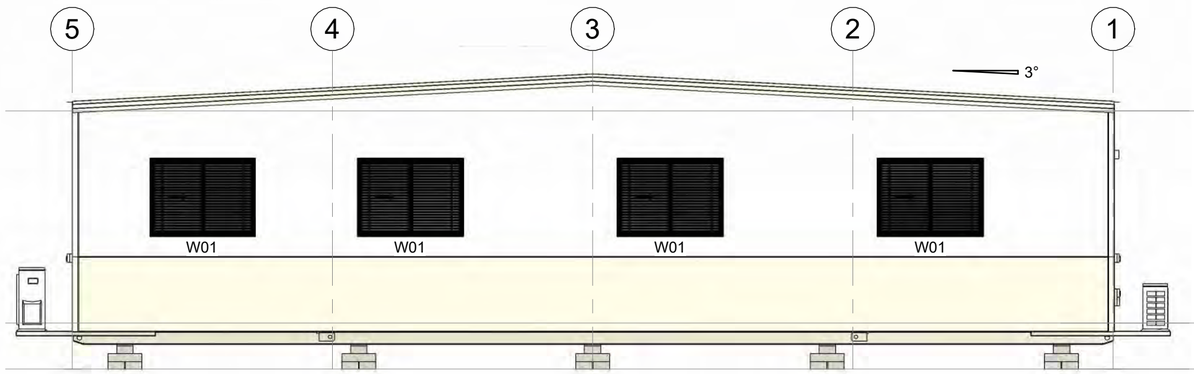
ISSUED FOR CERTIFICATION



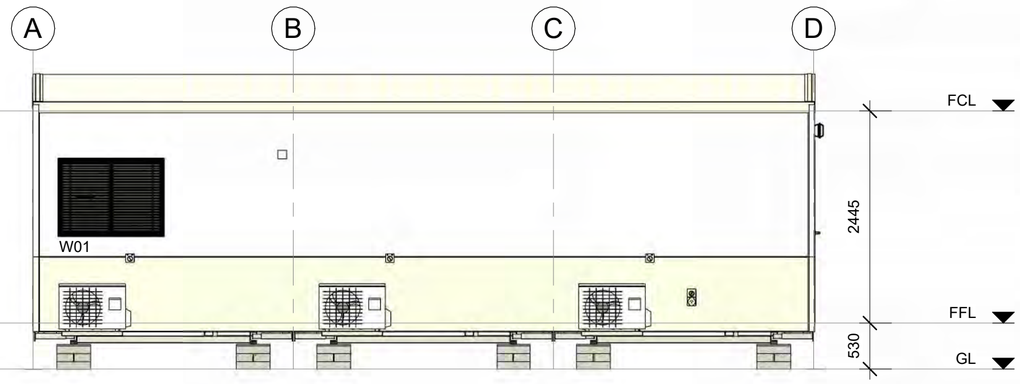
A A200 ELEVATION
1 : 50



B A200 ELEVATION
1 : 50



C A200 ELEVATION
1 : 50



D A200 ELEVATION
1 : 50

CONFIRM DETAILS OF SET OUTS, LEVELS AND CRITICAL DIMENSIONS ON SITE PRIOR TO SHOP DRAWINGS AND FABRICATION

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A	ISSUED FOR APPROVAL	06.10.23	JO	IK
B	ISSUED FOR CERTIFICATION	26.10.23	JO	NG

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PHONE: (08) 9236 1500
ABN: 71 083 902 309
EMAIL: ASLAu.Sales@atco.com

DESCRIPTION
12.0 x 9.0m CAMP OFFICE / SHOP OFFICE

TITLE
ELEVATIONS

SCALE AT A2
1 : 50

DRAWING NUMBER
230925E -A300

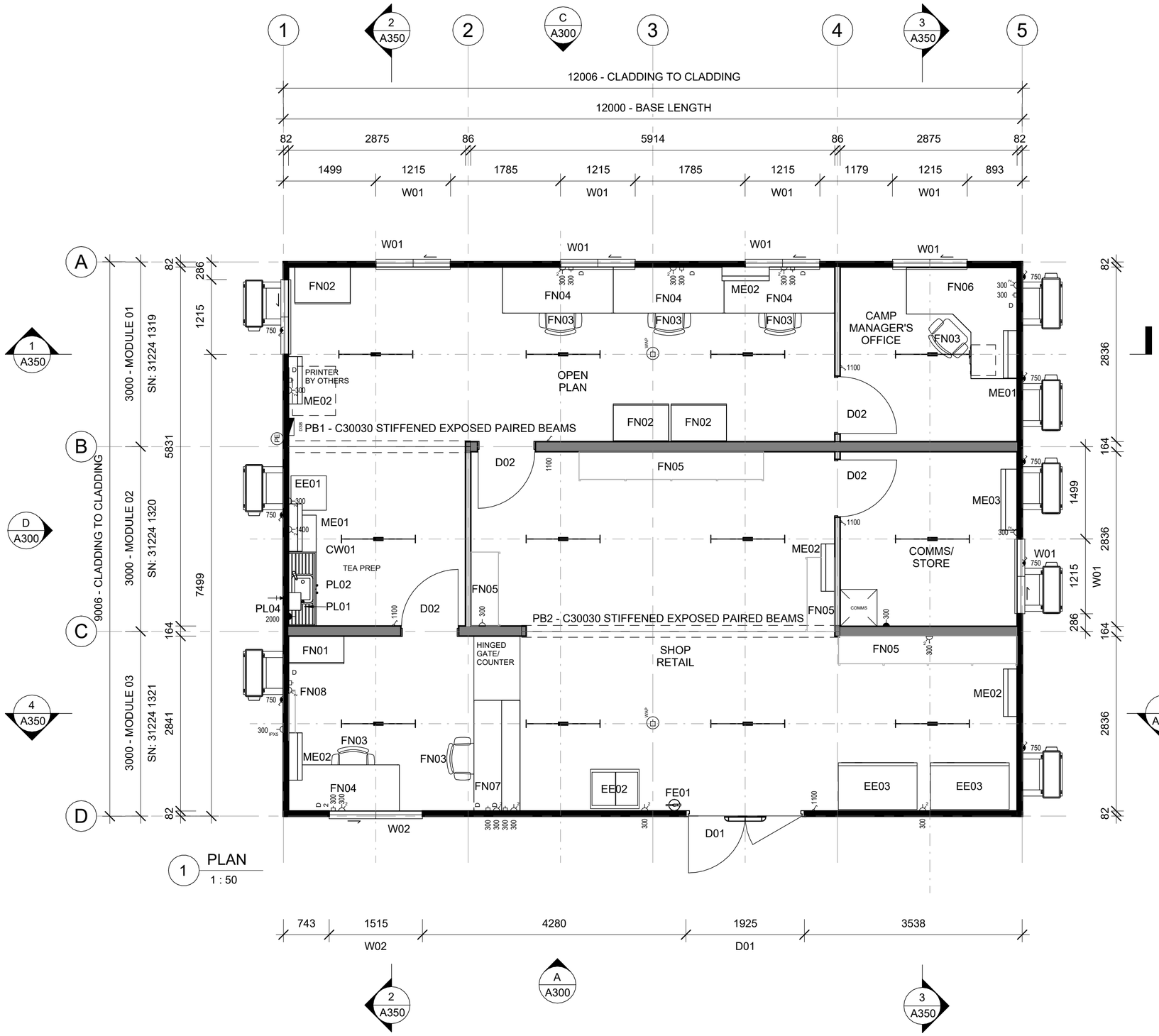
REVISION
B

ISSUED FOR CERTIFICATION

WIND REGION:		D
TERRAIN CATEGORY:		2
IMPORTANCE LEVEL:		2
SHIELDING FACTOR:		NS
BUILDING CLASS:		5
FLOOR LOADS	DISTRIBUTED (kPa):	3.0
	CONCENTRATED (kN):	2.7
CLIMATE ZONE:		3

NORTH

FLOOR LOADS CALCULATED FROM AS1170.1 - 2002. WIND SPEED CALCULATED FROM AS1170.2 - 2011. BUILDING CLASS, IMPORTANCE LEVEL, PROBABILITY OF EXCEEDANCE, WIND REGION, TERRAIN CATEGORY, TOPOGRAPHIC CLASIFICATION, SHIELDING FACTOR, CLIMATE ZONE & NORTH POINT ARE ASSUMED UNLESS OTHERWISE ADVISED BY CLIENT.



1 PLAN
1 : 50

FINISHES SCHEDULE	
FLOOR COVERING	2mm VINYL
CLADDING - EXTERNAL	COLORBOND MAXIRIB - HORIZONTAL
CLADDING - EXTERNAL	COLORBOND MAXIRIB - HORIZONTAL
WALL LINING - INTERNAL	3.6mm POLYESTER COATED PLYWOOD
CEILING LINING	3.6mm COATED PLYWOOD
ROOF SHEETING	0.48mm BMT SUPERDEK ROOFING

ITEM LIST		
ITEM	QTY	DESCRIPTION
Casework		
CW01	1	CUPBOARD, MELAMINE w/ EXTENDED TOP - 1200mm SINK
Electrical Equipment		
EE01	1	BAR REFRIGERATOR - 130Ltr
EE02	1	ICE CREAM FREEZER - ICS 150 Litre
EE03	2	SKOPE GLASS DOUBLE DOOR BME1200-A
Fire Alarm Devices		
FE01	1	FIRE EXTINGUISHER - 9.0Kg ABE c/w SIGNAGE
Furniture		
FN01	1	CABINET, STORAGE - 900 x 450 x 1800H
FN02	3	CABINET, STORAGE - 1200 x 580 x 2100H
FN03	6	CHAIR, CLERICAL w/ ARMS
FN04	4	DESK - 1800 x 750 x 727H
FN05	4	DISPLAY SHELVING (BY OTHERS)
FN06	1	WORKSTATION - 1800 x 1800 x 750
FN07	1	DESK, RECEPTION - 1800 x 750 x 727H
FN08	1	KEY STORAGE BOARD (BY OTHERS)
Plumbing Fixtures		
PL01	1	AUTOBOILER - 5.0Ltr w/ IN-BUILT TIMER
PL02	1	SINK, STAINLESS STEEL - 1200x450 (COLD ONLY)
PL04	1	WATER INLET c/w LINE STRAINER

SYMBOL LEGEND

- ELECTRICAL SWITCHBOARD
- ELECTRICAL POINT OF ENTRY
- LIGHT SWITCH, SINGLE
- ISOLATION SWITCH
- GPO, SINGLE POLE - 1x10A
- GPO, SINGLE POLE - 2x10A
- GPO, SINGLE POLE - 1x15A
- DATA - SINGLE w/ RJ45 FACEPLATE - CAT 6 OUTLET
- LIGHT - 1200mm LED BATTEN & DIFFUSER
- LIGHT, WEATHERPROOF - 600mm
- PHOTO ELECTRIC CELL
- PLUMBING WATER INLET POINT
- PLUMBING WASTE MANIFOLD OUTLET POINT

CONFIRM DETAILS OF SET OUTS, LEVELS AND CRITICAL DIMENSIONS ON SITE PRIOR TO SHOP DRAWINGS AND FABRICATION

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REV	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR APPROVAL	06.10.23	JO	IK
B	ISSUED FOR CERTIFICATION	26.10.23	JO	NG

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EMAIL: ASLAu.Sales@atco.com

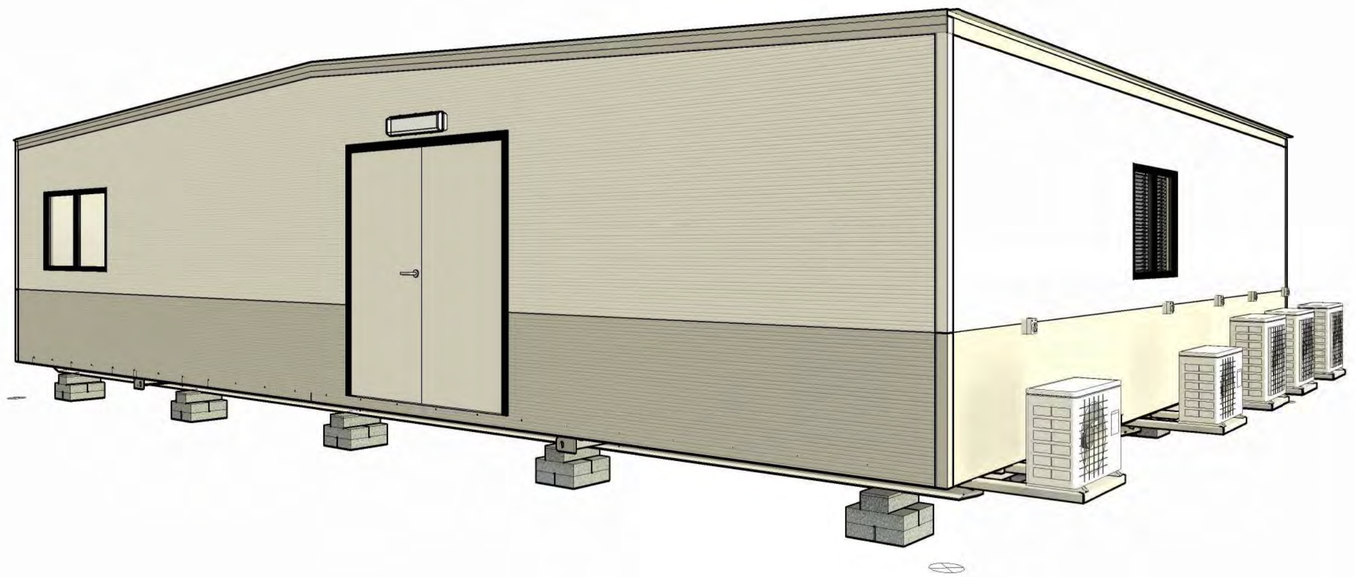
DESCRIPTION
12.0 x 9.0m CAMP OFFICE / SHOP OFFICE

TITLE
PLAN

SCALE AT A2
1 : 50

DRAWING NUMBER
230925E -A200

REVISION
B



View indicative only

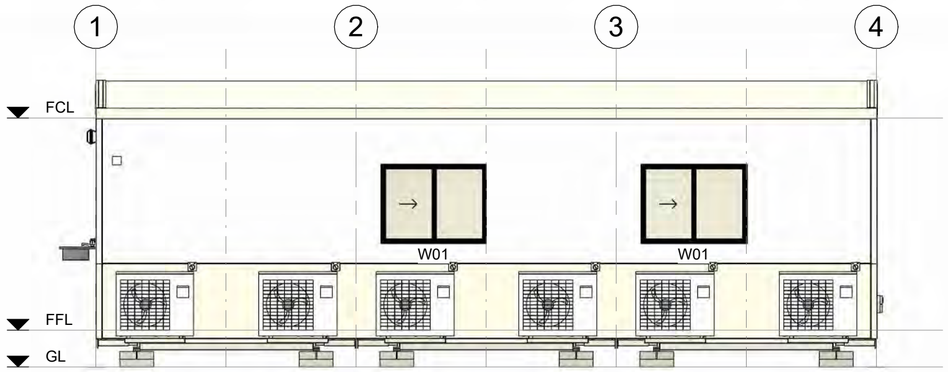
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SHEET NUMBER	SHEET NAME	CURRENT REVISION
A000	TITLE PAGE	B
A200	PLAN	B
A300	ELEVATIONS	B
A350	SECTIONS	A
A351	CONNECTION DETAILS	A
A400	FOUNDATION PLAN	A
A550	MANUFACTURING SCHEDULES	A
A555	PACKING LIST	A
S200	SHOP DRAWINGS - BASEFRAME GUIDE	A
S201	SHOP DRAWINGS - BASE 01	A

230925E

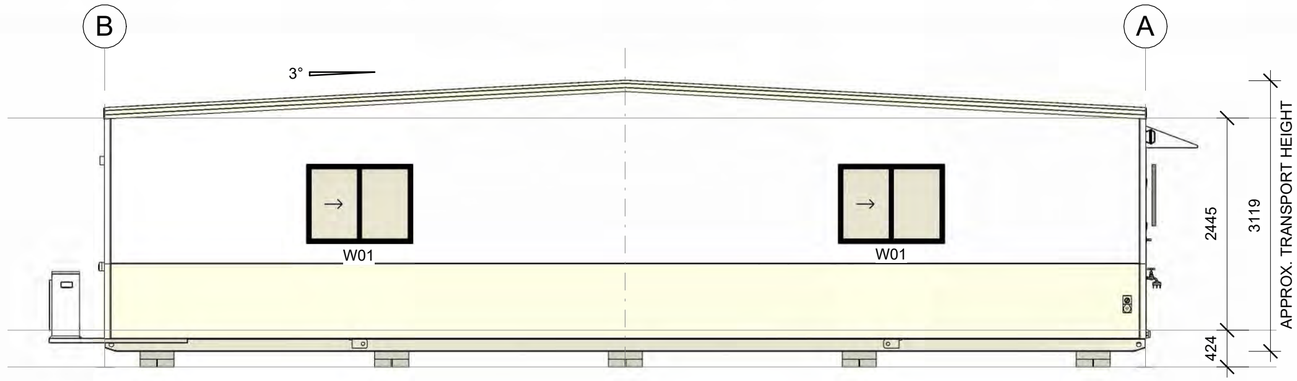
12.0 x 9.0m CAMP OFFICE / SHOP OFFICE

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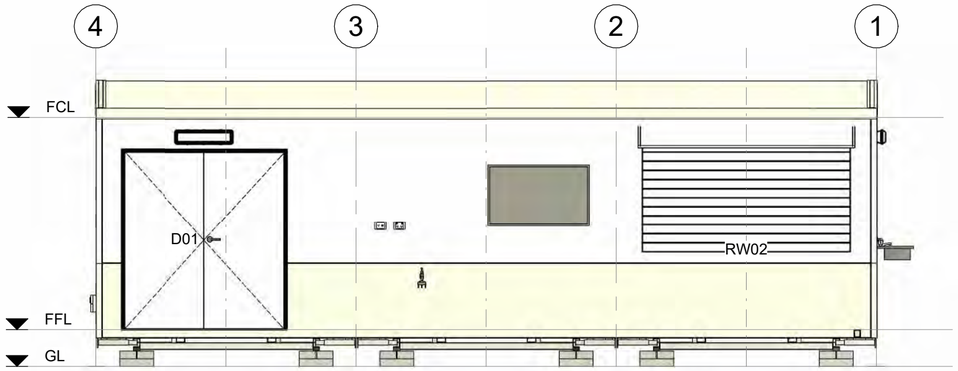
ISSUED FOR CERTIFICATION



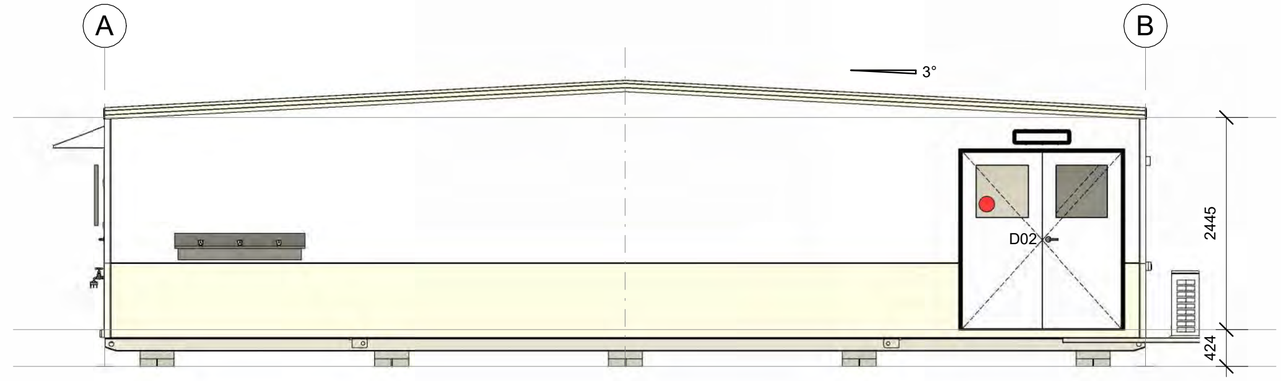
A A200 ELEVATION
1 : 50



B A200 ELEVATION
1 : 50



C A200 ELEVATION
1 : 50



D A200 ELEVATION
1 : 50

CONFIRM DETAILS OF SET OUTS, LEVELS AND CRITICAL DIMENSIONS ON SITE PRIOR TO SHOP DRAWINGS AND FABRICATION

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A	ISSUED FOR APPROVAL	20.09.23	JO	IK
B	ISSUED FOR CERTIFICATION	26.10.23	JO	NG
C	COORDINATES ADDED	02.11.23	JO	

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28 ARMSTRONG ROAD.
HOPE VALLEY, WA 6165
PO BOX 40, WATTLEUP, WA 6166
PHONE: (08) 9236 1500
ABN: 71 083 902 309
EMAIL: ASLAu.Sales@atco.com

DESCRIPTION
12.0 x 9.0m WETMESS

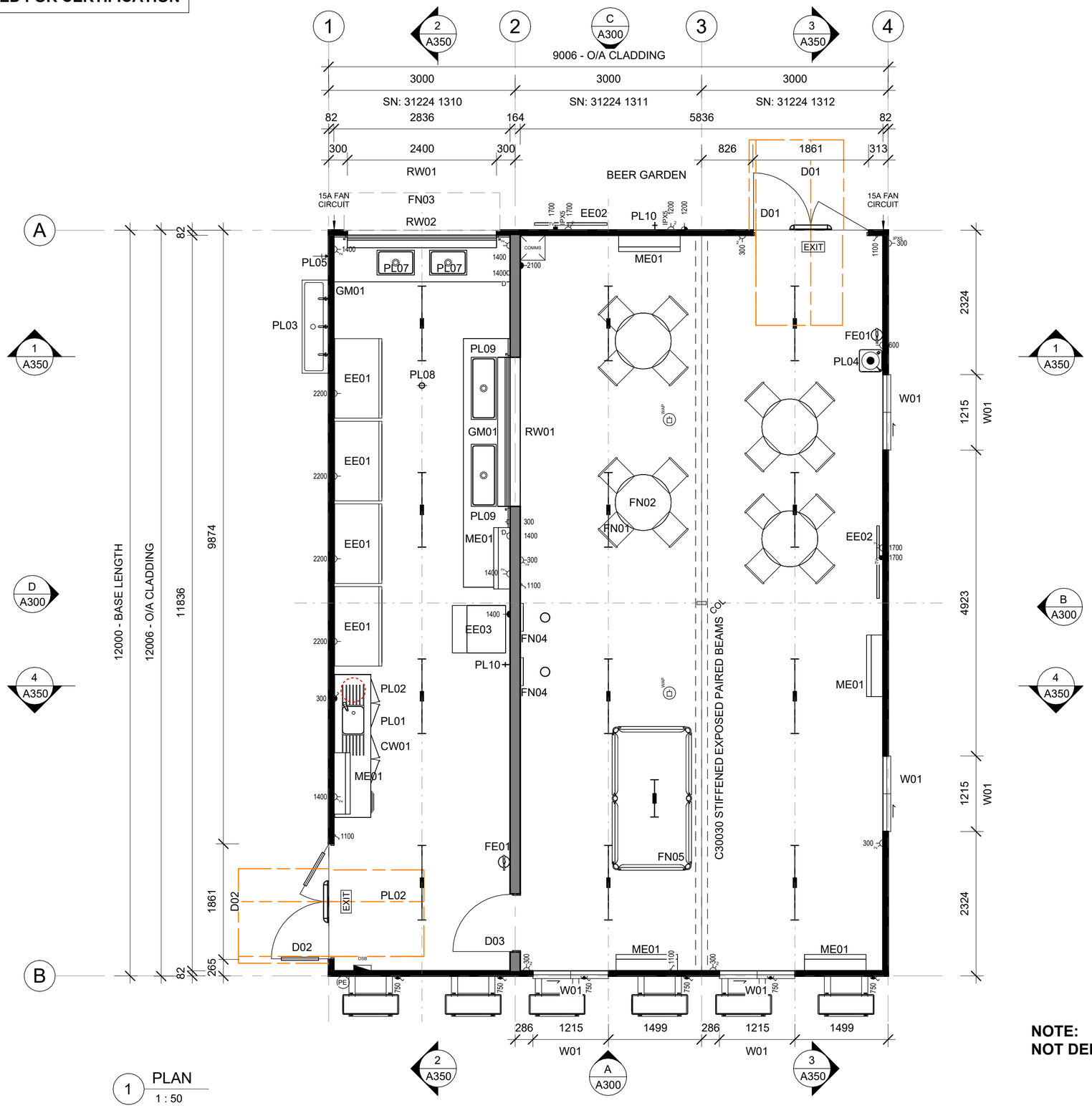
TITLE
ELEVATIONS

SCALE AT A2
1 : 50

DRAWING NUMBER
230925A -A300

REVISION
C

ISSUED FOR CERTIFICATION



1 PLAN
1 : 50

WIND REGION:	D
TERRAIN CATEGORY:	2
IMPORTANCE LEVEL:	2
SHIELDING FACTOR:	NS
BUILDING CLASS:	6
FLOOR LOADS – DISTRIBUTED (kPa):	3.0
FLOOR LOADS – CONCENTRATED (kN):	2.7
CLIMATE ZONE:	3

NORTH

FLOOR LOADS CALCULATED FROM AS1170.1 - 2002. WIND SPEED CALCULATED FROM AS1170.2 - 2011. BUILDING CLASS, IMPORTANCE LEVEL, PROBABILITY OF EXCEEDANCE, WIND REGION, TERRAIN CATEGORY, TOPOGRAPHIC CLASIFICATION, SHIELDING FACTOR, CLIMATE ZONE & NORTH POINT ARE ASSUMED UNLESS OTHERWISE ADVISED BY CLIENT.

FINISHES SCHEDULE	
FLOOR COVERING	2mm VINYL - SLIP RESISTANT- 150mm HIGH COVING
CLADDING - EXTERNAL	COLORBOND MAXIRIB - HORIZONTAL
CLADDING - EXTERNAL	COLORBOND MAXIRIB - HORIZONTAL
WALL LINING - INTERNAL	3.6mm POLYESTER COATED PLYWOOD
CEILING LINING	3.6mm COATED PLYWOOD
ROOF SHEETING	0.48mm BMT SUPERDEK ROOFING

ITEM LIST		
ITEM	QTY	DESCRIPTION
Casework		
CW01	1	BENCHTOP (32mm) c/w SPLASHBACK (150H), LAMINATED / CARCASS (16mm) END PANELS, CUPBOARDS & DRAWS UNDER, MELAMINE - 600D - 2300L - 900H
Electrical Equipment		
EE01	4	SKOPE GLASS DOUBLE DOOR BME1200-A
EE02	2	TELEVISION - FLAT SCREEN - 50" (127cm)
EE03	1	ICE MAKER w/BIN UNDER
Fire Alarm Devices		
FE01	2	FIRE EXTINGUISHER - 9.0Kg ABE c/w SIGNAGE
Furniture		
FN01	16	STACK CHAIR - BISTRO
FN02	4	ROUND TABLE - 5 STAR BASE 900mm DIAMETER
FN03	1	SERVERY HOOD - 2500 x 600
FN04	2	DART BOARD w/ DARTS (MAL ATWELL)
FN05	1	POOL TABLE - 7' x 3'6" (MAL ATWELL)
Generic Models		
GM01	1	BENCH, STAINLESS STEEL, w/ MID SHELF - 4000 LONG & PASS THROUGH
GM02	1	BENCH, STAINLESS STEEL, w/ MID SHELF - 2836 LONG & PASS THROUGH
Plumbing Fixtures		
PL01	1	SINK, STAINLESS STEEL - 1200x450 (HOT & COLD FLICKMIXER)
PL02	1	HOT WATER SYSTEM, MOUNTED INTERNALLY ON SAFE TRAY - 50Ltr, 1x3.6kW
PL03	1	WASH TROUGH, 3 TAP STAINLESS STEEL (PUSH BUTTON) - 1500mm LONG (SITE INSTALLED)
PL04	1	CHILLED FILTERED DRINKING FOUNTAIN
PL05	1	WATER INLET c/w LINE STRAINER
PL07	2	600L - INSULATED ICE WELL
PL08	1	FLOOR WASTE
PL09	2	1000L - INSULATED ICE WELL
PL10	2	HOSE COCK w/ SHROUD

SYMBOL LEGEND

- DSB — ELECTRICAL SWITCHBOARD
- ELECTRICAL POINT OF ENTRY
- LIGHT SWITCH, SINGLE
- ISOLATION SWITCH
- GPO, SINGLE POLE - 1x10A
- GPO, SINGLE POLE - 2x10A
- GPO, SINGLE POLE - 1x15A
- D — DATA - SINGLE w/ RJ45 FACEPLATE - CAT 6 OUTLET
- TV — TV ANTENNA SOCKET
- LIGHT - 1200mm LED BATTEN & DIFFUSER
- EXIT — LIGHT, EXIT. C0 = E2.0, C90 = E2.0, 24m VIEW DISTANCE
- LIGHT, LED SPOTLIGHT
- LIGHT, WEATHERPROOF - 600mm
- LIGHT, POOL TABLE
- PE — PHOTO ELECTRIC CELL
- PLUMBING WATER INLET POINT
- PLUMBING WASTE MANIFOLD OUTLET POINT

NOTE:
NOT DEEMED PART OF FOOD SERVICE OPERATION, DOES NOT COMPLY WITH AS4674

CONFIRM DETAILS OF SET OUTS, LEVELS AND CRITICAL DIMENSIONS ON SITE PRIOR TO SHOP DRAWINGS AND FABRICATION

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REV	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR APPROVAL	20.09.23	JO	IK
B	ISSUED FOR CERTIFICATION	26.10.23	JO	NG
C	COORDINATES ADDED	02.11.23	JO	

ATCO STRUCTURES & LOGISTICS PTY. LTD.
28 ARMSTRONG ROAD,
HOPE VALLEY, WA 6165
PO BOX 40, WATTLEUP, WA 6166
PHONE: (08) 9236 1500
ABN: 71 083 902 309
EMAIL: ASLAu.Sales@atco.com

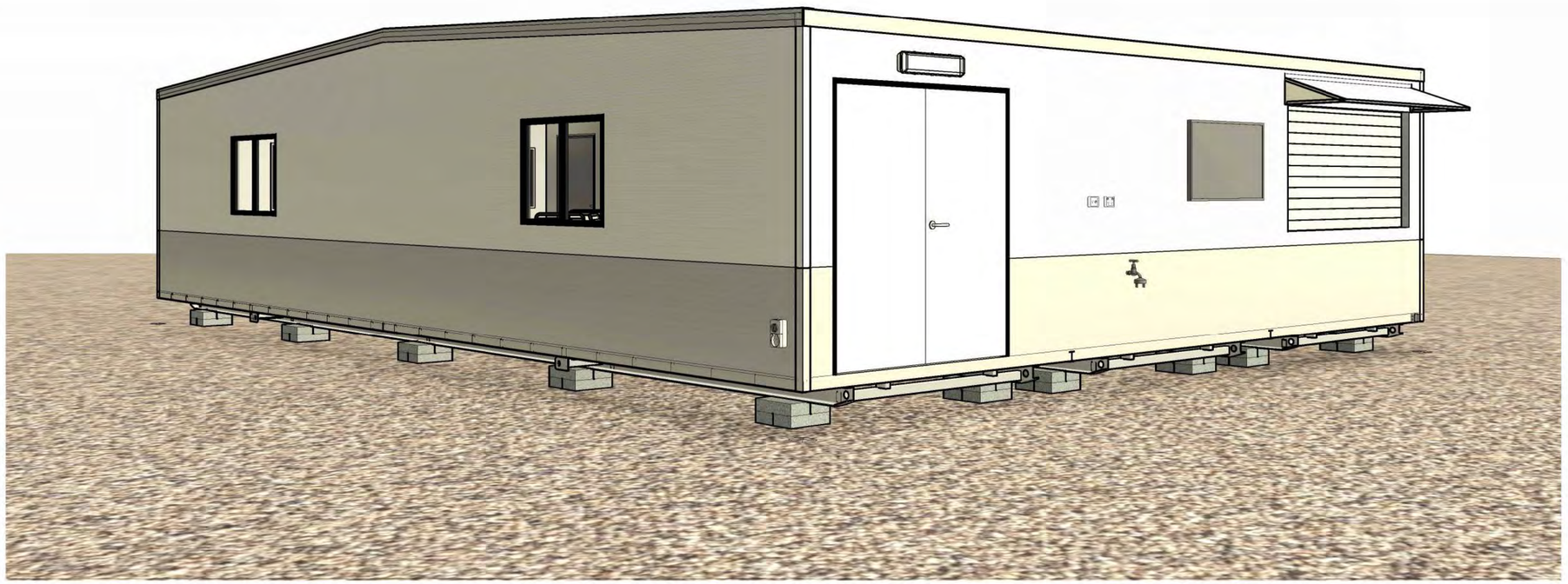
DESCRIPTION: 12.0 x 9.0m WETMESS

TITLE: PLAN

SCALE AT A2: 1 : 50

DRAWING NUMBER: 230925A -A200

REVISION: C



230925A

View indicative only

DRAWING LIST		
SHEET NUMBER	SHEET NAME	CURRENT REVISION
A000	TITLE PAGE	C
A200	PLAN	C
A300	ELEVATIONS	C
A350	SECTIONS	B
A351	CONNECTION DETAILS	B
A400	FOUNDATION PLAN	B
A550	MANUFACTURING SCHEDULES	B
A555	PACKING LIST	B
S201	SHOP DRAWINGS - BASE 01	B

12.0 x 9.0m WETMESS

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REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	CLIENT
.	.	B	06.12.24	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		A	26.11.24	ISSUED FOR REVIEW	OM	OM	AC	OM	RK	OM	
		–	26.11.24	COMMENCED	BM	CM	AC	OM	RK	OM	

Rapid Exploration Pty Ltd Trading as Rapid Camps

Rapid Camps

Yindjibarndi Energy

NORTH

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VENDOR/DESIGNER DRG No.: 029-DWG-AR-004 | REV: B

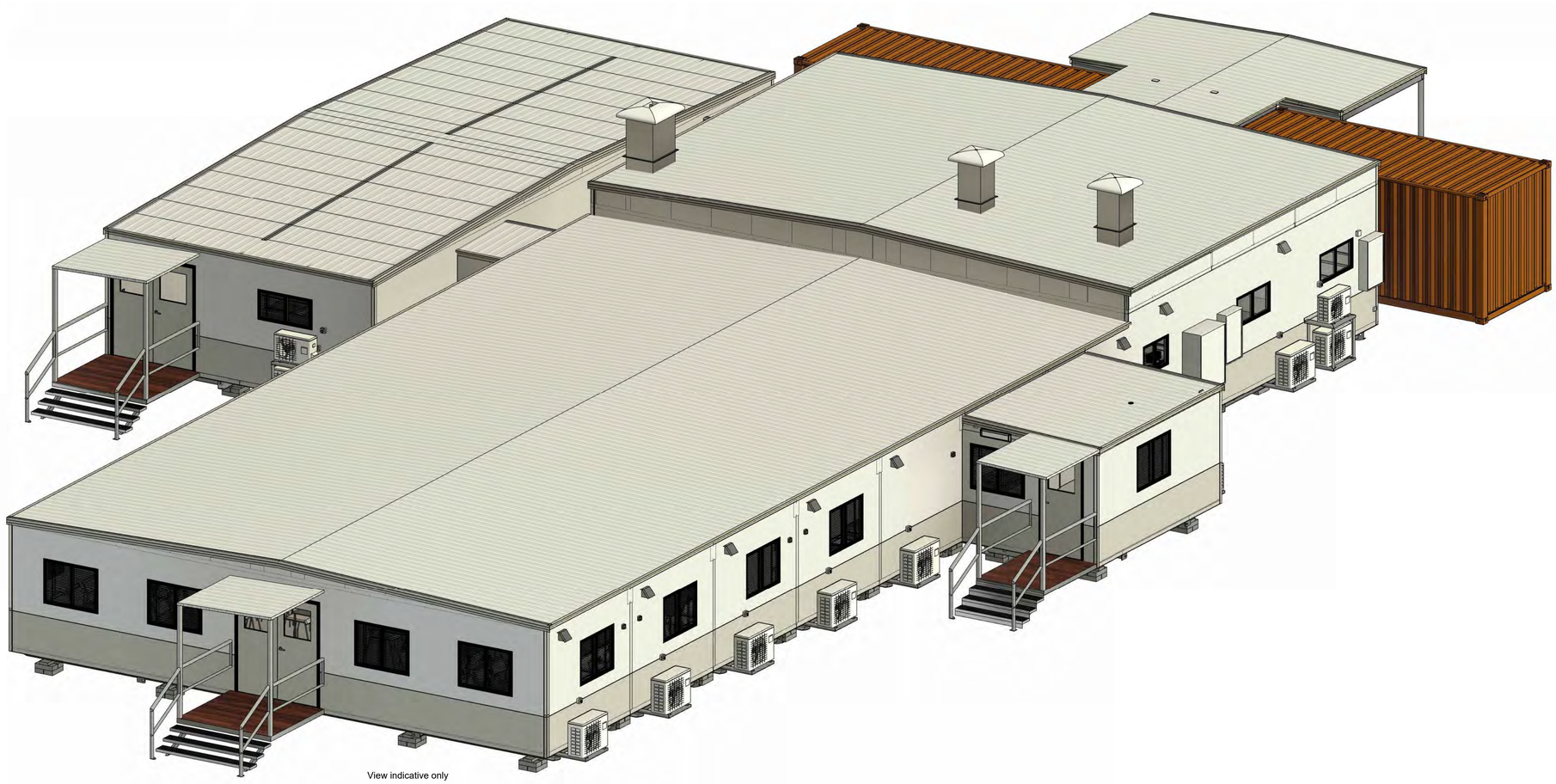
PROJECT NUMBER: XXXX

Yindjibarndi Energy

JINBI-WORKER CAMP 172 PERSON CAMP
(EXPANSION SHOWN UP TO 228 PERSON CAMP)
RAPID CAMPS
KITCHEN LAYOUT

A1 | SCALE: NTS | DRG No: 029-DWG-AR-004 | REV: B

$FILE$ $TIME$ $DATE$



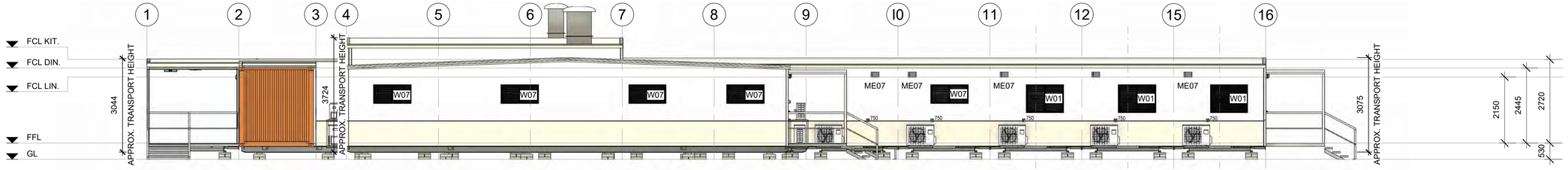
View indicative only

230624A

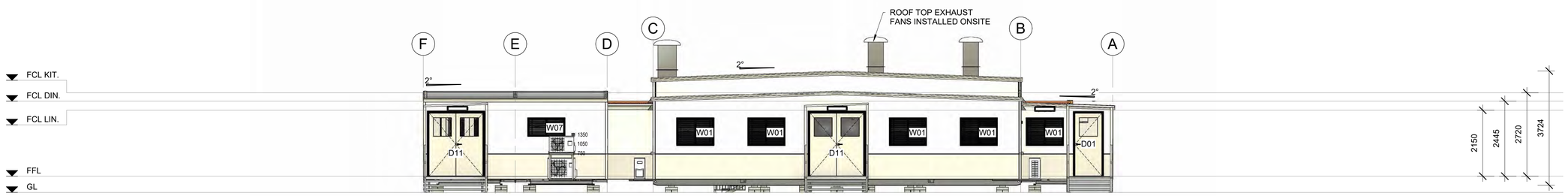
36.5 x 22.5m KITCHEN DINER & CRIB - 300P

ATCO STRUCTURES & LOGISTICS PTY. LTD.
55 TOMKA STREET,
LUSCOMBE, QLD 4207
P.O. BOX 393, BEENLEIGH, QLD 4207
PHONE: (07) 3412 8600
ABN: 71 083 902 309
EMAIL: ASLAu.Sales@atco.com

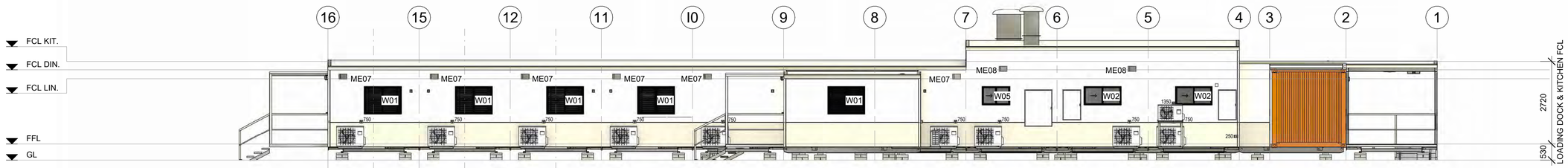
APPROVED FOR CONSTRUCTION



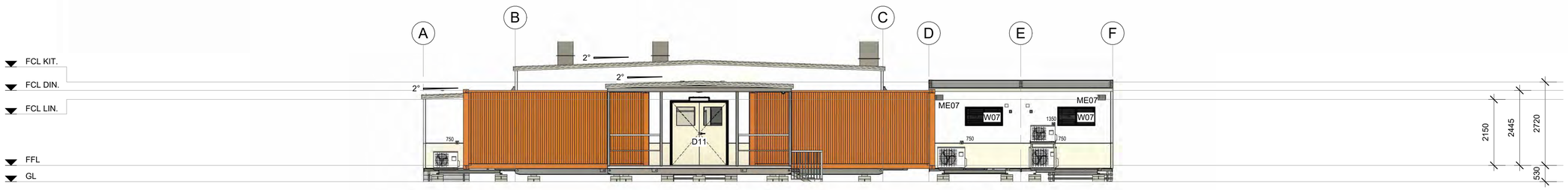
A200 A — ELEVATION
1 : 75



A200 B — ELEVATION
1 : 75



A200 C — ELEVATION
1 : 75



A200 D — ELEVATION
1 : 75

CONFIRM DETAILS OF SET OUTS, LEVELS AND CRITICAL DIMENSIONS ON SITE PRIOR TO SHOP DRAWINGS AND FABRICATION

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REV	DESCRIPTION	DATE	BY	CHK'D
0	APPROVED FOR CONSTRUCTION	30.08.23	DR	SL

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HOPE VALLEY, WA 6165
PO BOX 40, WATTLEUP, WA 6166
PHONE: (08) 9236 1500
ABN: 71 083 902 309
EMAIL: ASLAu.Sales@atco.com

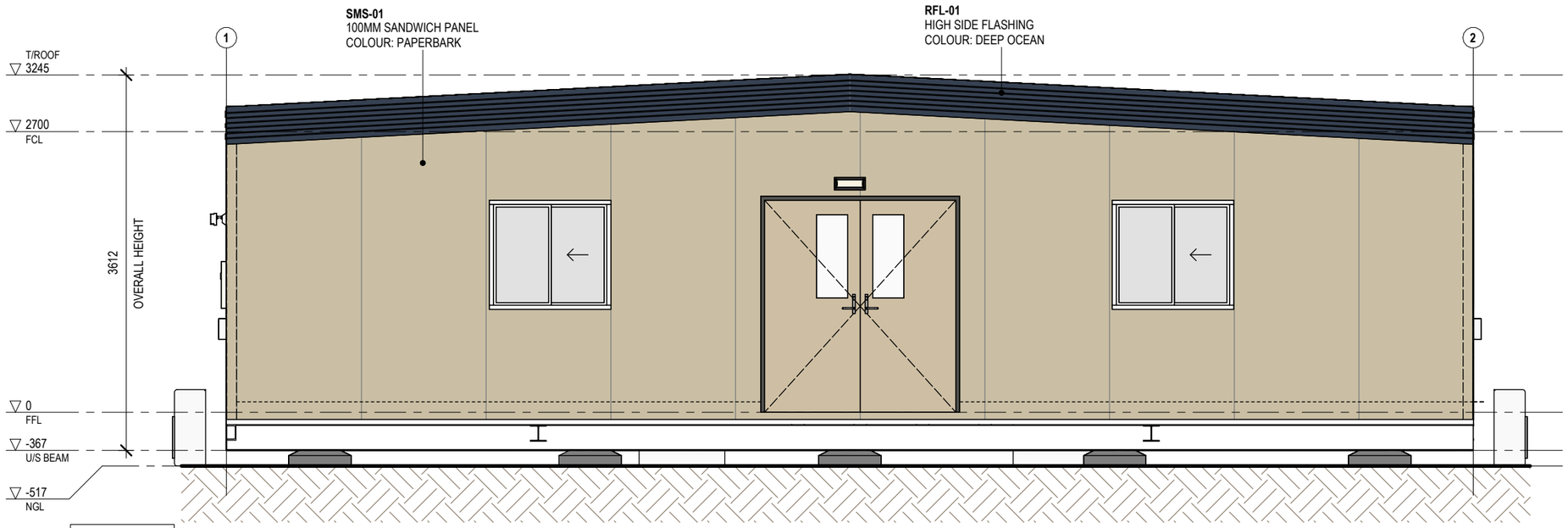
DESCRIPTION
36.5 x 22.5m KITCHEN DINER & CRIB - 300P

TITLE
ELEVATIONS

SCALE AT A1
1 : 75

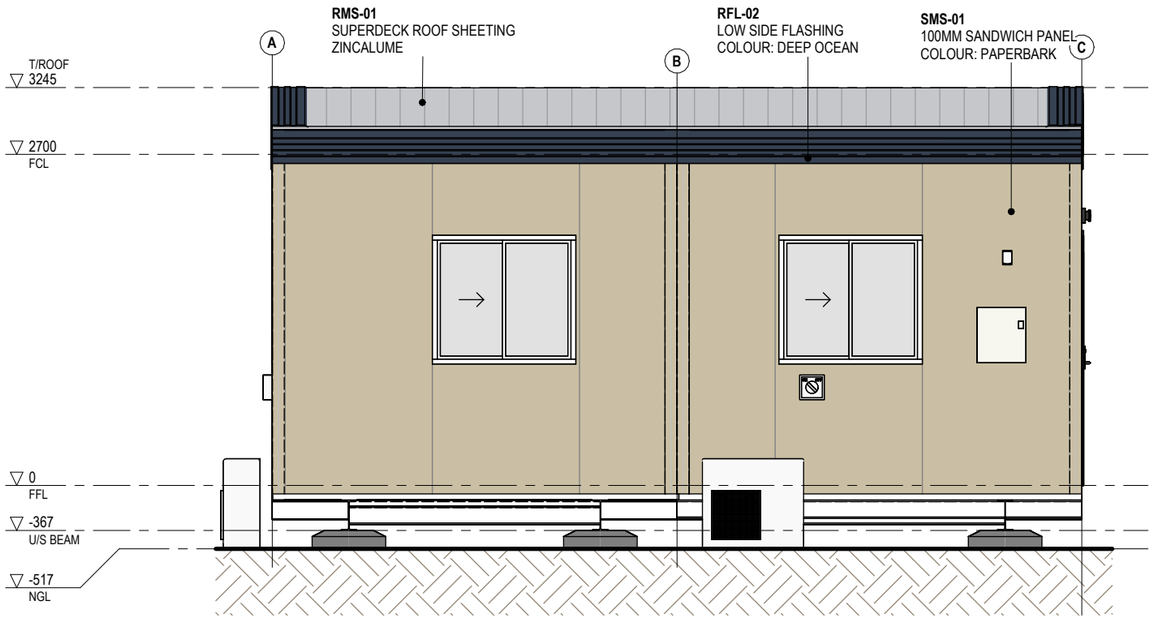
DRAWING NUMBER
230624A -A300

REVISION
0



1
A02-FP01

FRONT ELEVATION
1 : 50



2
A02-FP01

SIDE 1 ELEVATION
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	02.02.24	SC	KP

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PROJECT NO.: **J005076-B03**

PROJECT STATUS: **ISSUED FOR REVIEW**

PROJECT CLIENT: **FLEETWOOD CAPEX**

PROJECT: **GYM**

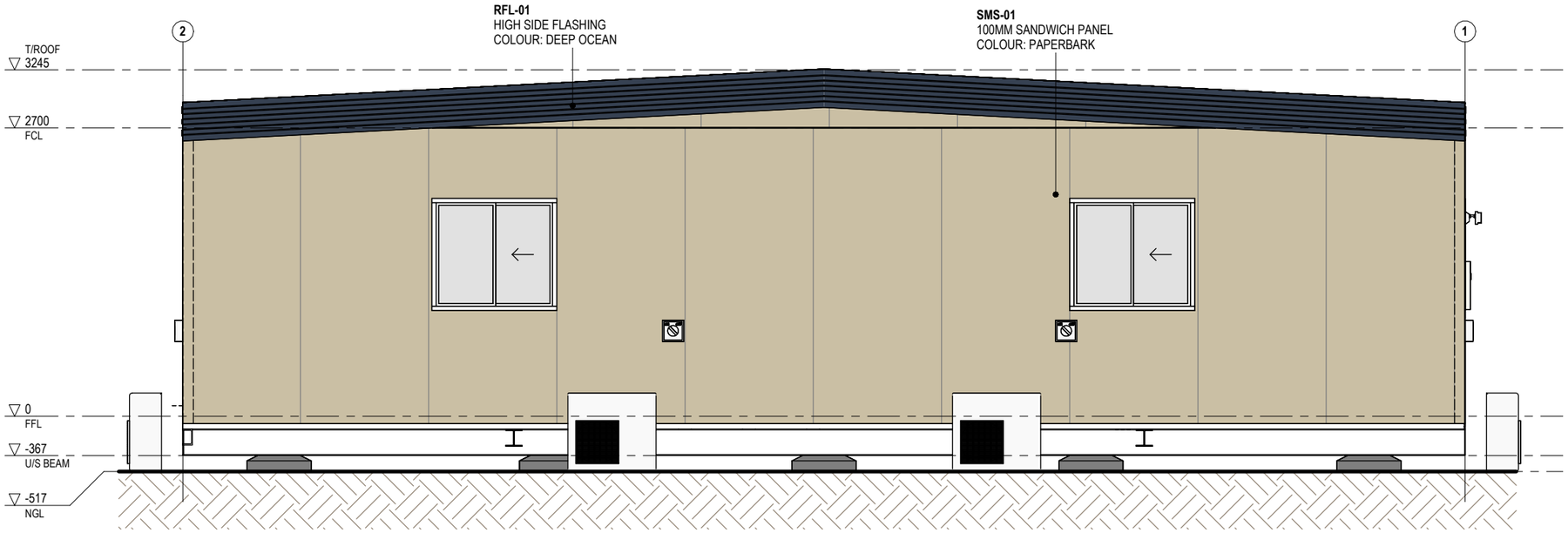
PROJECT ADDRESS: **XX**

SHEET: **ELEVATIONS**

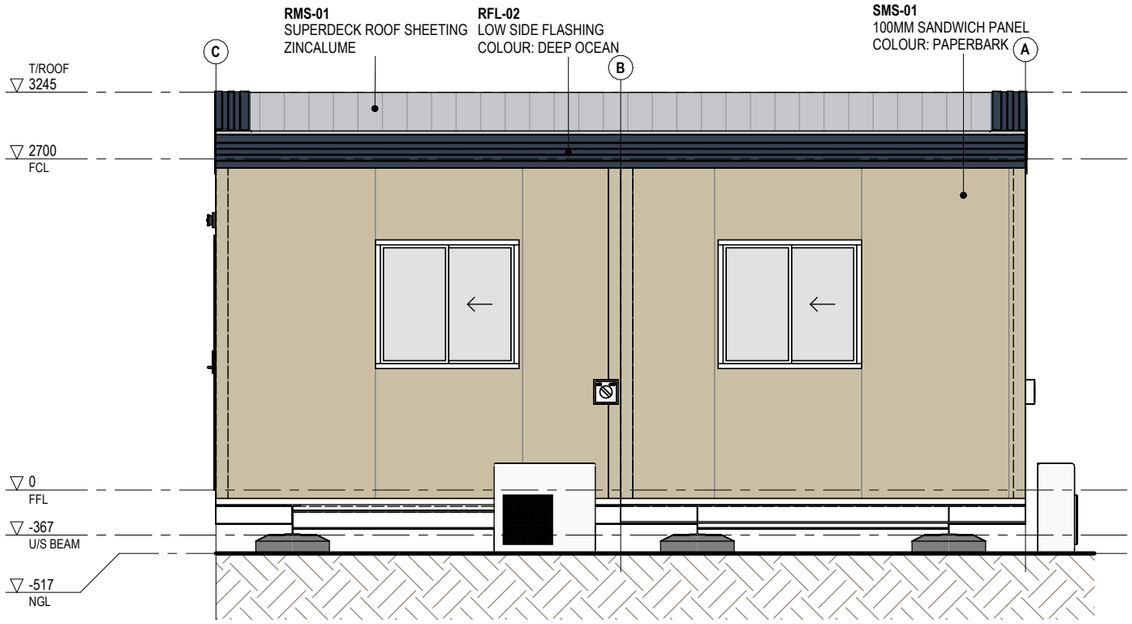
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DRAWING NO.: **A03-EL01** REVISION: **A**

DC SIGN OFF:



1 REAR ELEVATION
A02-FP01
1 : 50



2 SIDE 2 ELEVATION
A02-FP01
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	02.02.24	SC	KP

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PROJECT NO.: **J005076-B03**

PROJECT STATUS: **ISSUED FOR REVIEW**

PROJECT CLIENT: **FLEETWOOD CAPEX**

PROJECT: **GYM**

PROJECT ADDRESS: **XX**

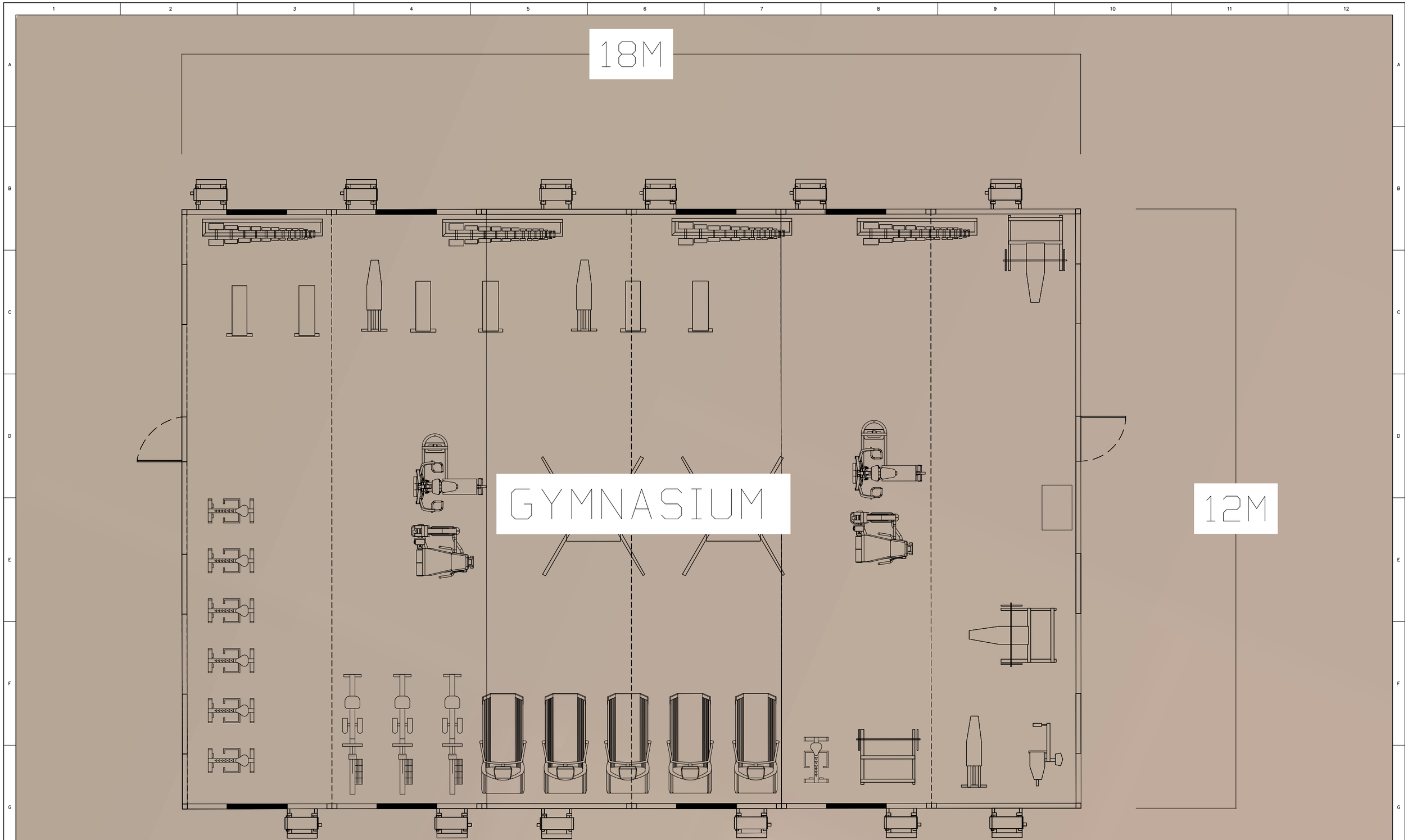
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DRAWN: **SC** CHECKED: **KP** SCALE: **1 : 50** SIZE: **A3**

DRAWING NO.: **A03-EL02** REVISION: **A**

DC SIGN OFF:

Autodesk Docs://J005076 - FWD CAPEX - 100P Camp Stock Build/J005076_B03_Gym_R22.rvt



REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	CLIENT
.	.	A	26.02.25	ISSUED FOR REVIEW	OM	OM	AC	OM	RK	OM	
.	.	–	26.11.24	COMMENCED	BM	CM	AC	OM	RK	OM	

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Rapid Camps

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VENDOR/DESIGNER DRG No.: 029–DWG–AR–005 | REV: A

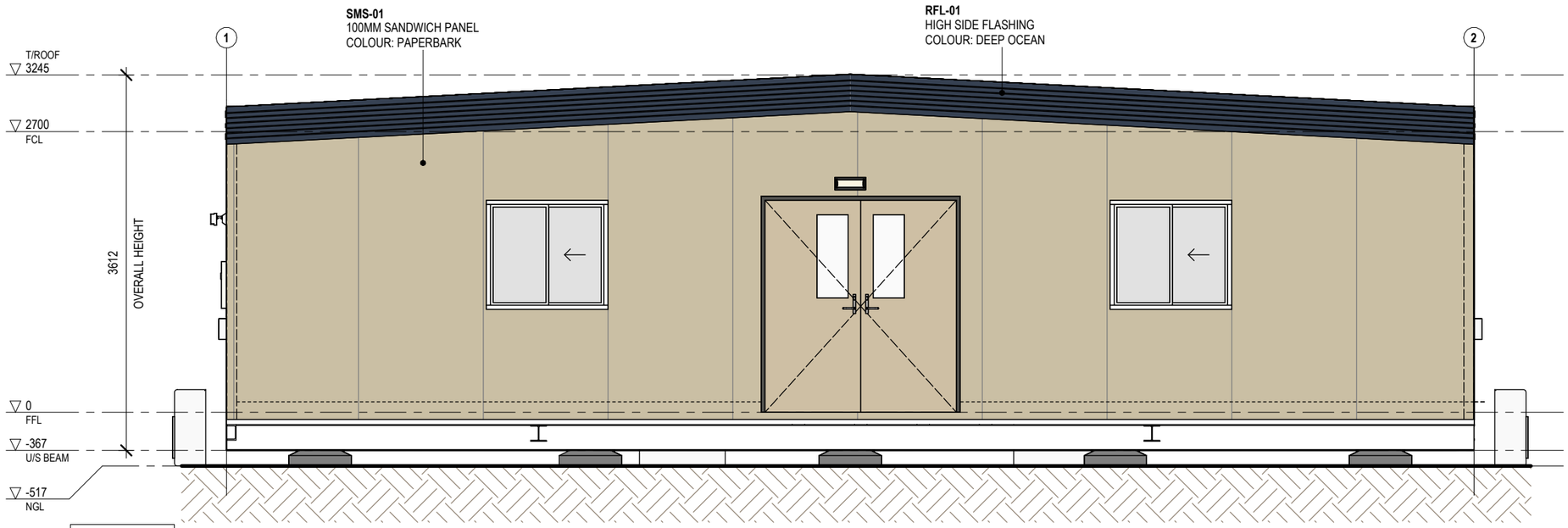
PROJECT NUMBER: XXXX

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JINBI–WORKER CAMP 172 PERSON CAMP
(EXPANSION SHOWN UP TO 228 PERSON CAMP)
RAPID CAMPS
GYM LAYOUT

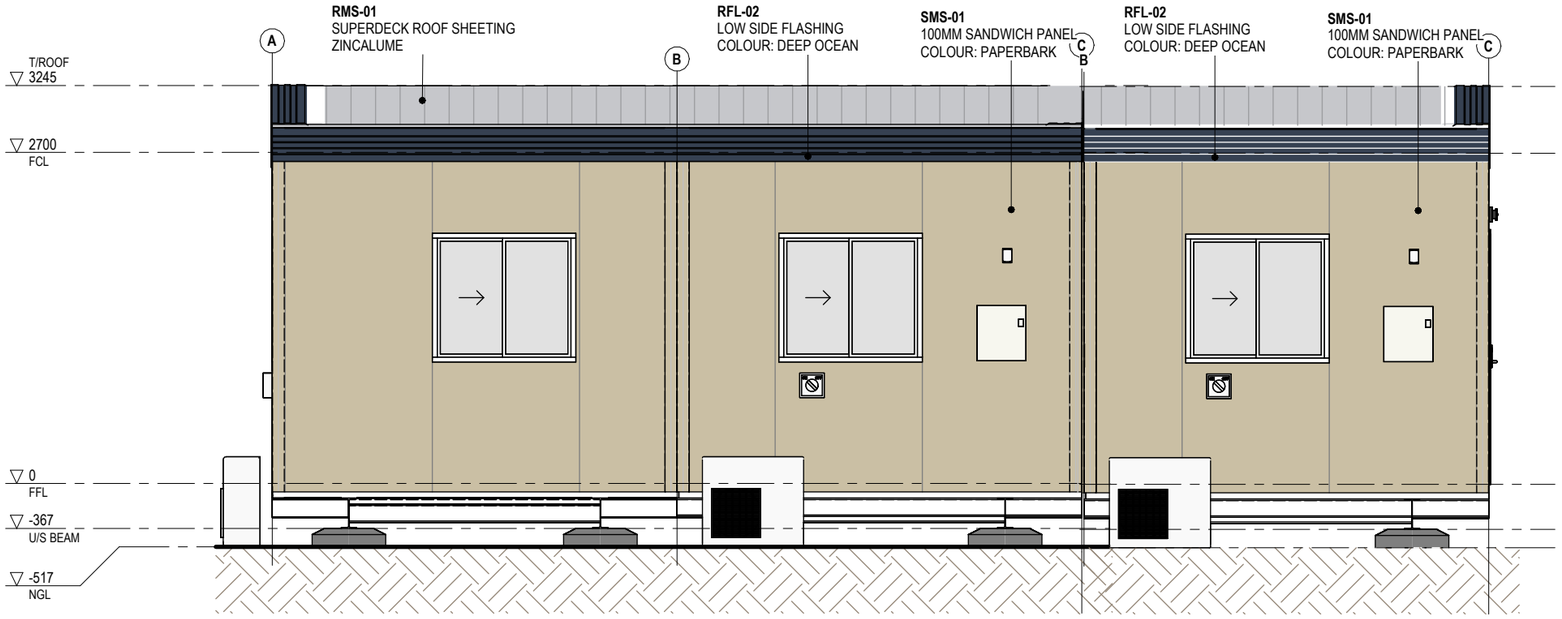
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$FILE$ $TIME$ $DATE$



1
A02-FP01

FRONT ELEVATION
1 : 50



2
A02-FP01

SIDE 1 ELEVATION
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	02.02.24	SC	KP

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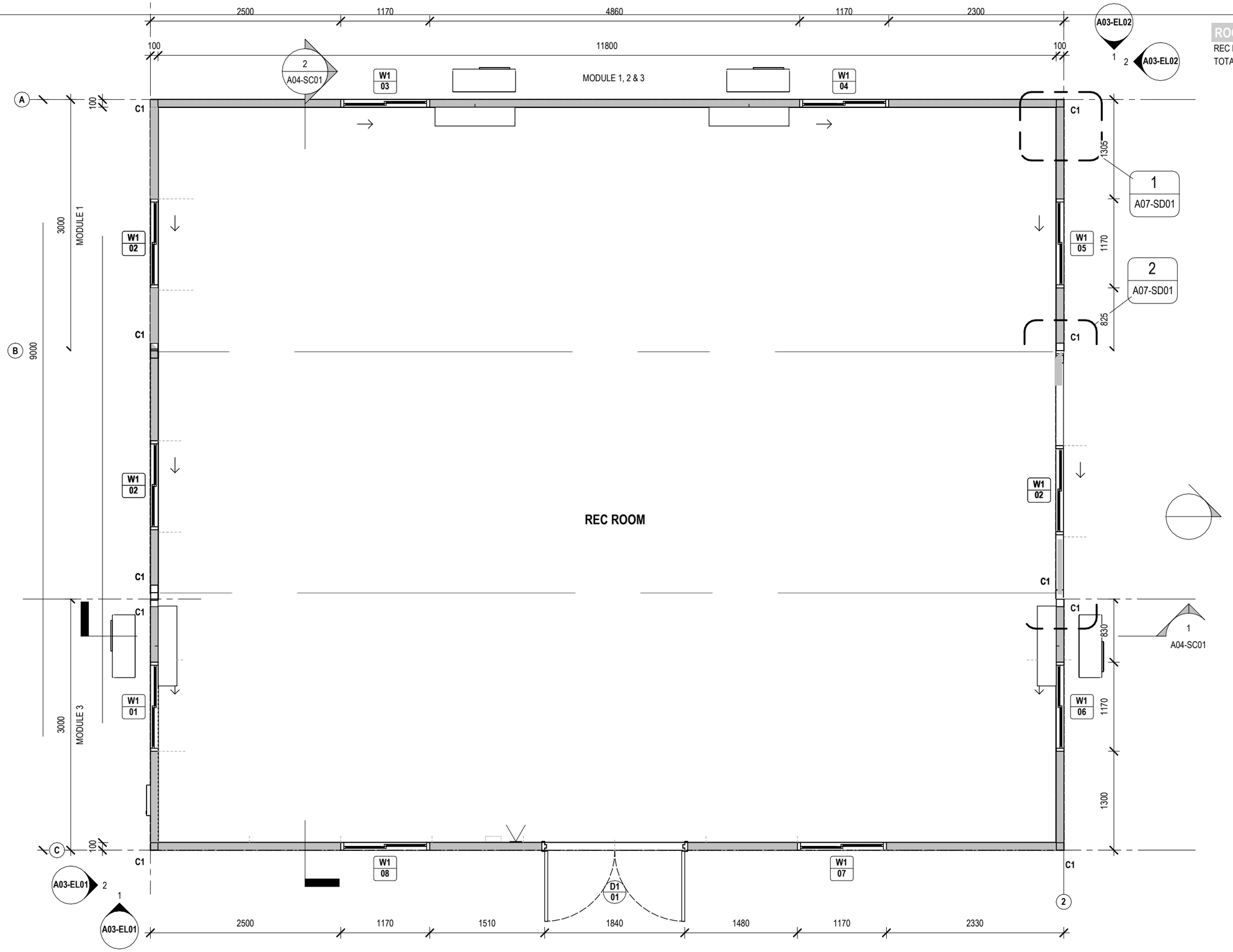
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PROJECT NO.: **J005076-B09**
PROJECT STATUS: **ISSUED FOR REVIEW**
PROJECT CLIENT: **FLEETWOOD CAPEX**
PROJECT: **REC ROOM**
PROJECT ADDRESS: **XX**

SHEET: **ELEVATIONS**
DRAWN: **SC** CHECKED: **KP** SCALE: **1 : 50** SIZE: **A3**
DRAWING NO.: **A03-EL01** REVISION: **A**
DC SIGN OFF:

ROOM NAME	AREA
REC ROOM	76 m²
TOTAL	76 m²



1 FLOOR PLAN
1 : 50

NO.	DESCRIPTION	DATE	BY	CHK'D
A	ISSUED FOR REVIEW	02.02.24	SC	KP

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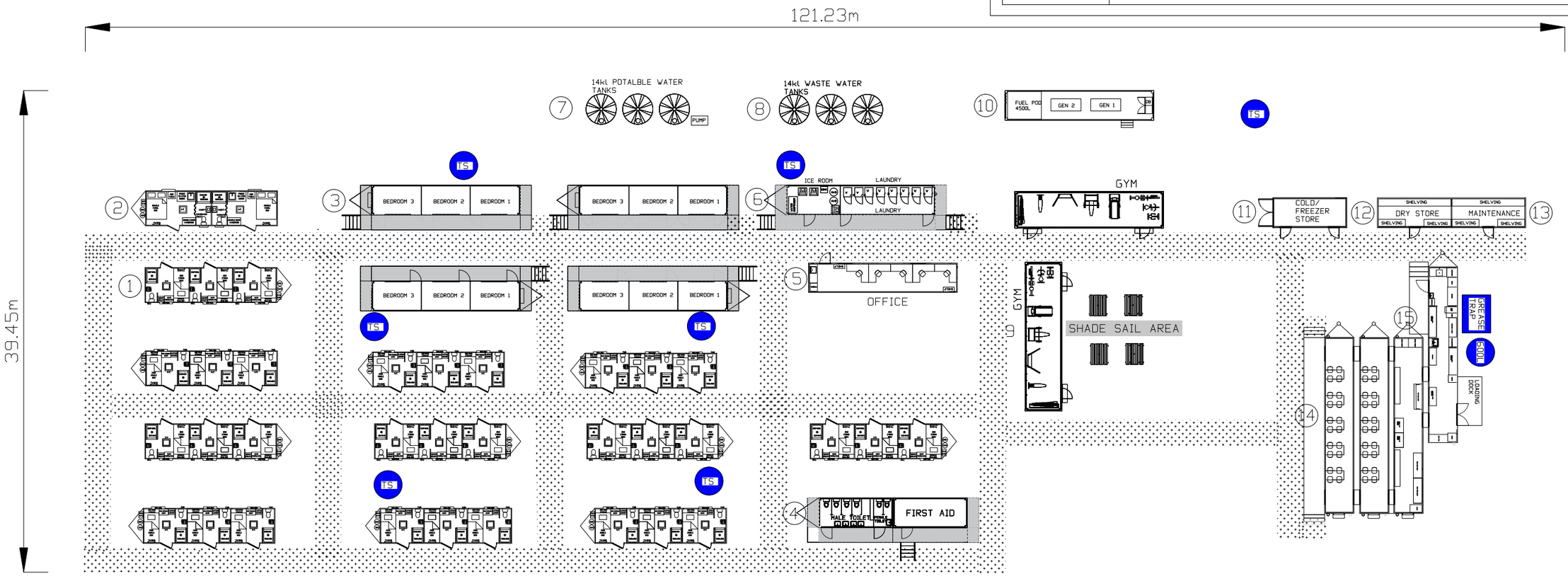
GENERAL NOTES
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PROJECT NO.: J005076-B09
PROJECT STATUS: ISSUED FOR REVIEW
PROJECT CLIENT: FLEETWOOD CAPEX
PROJECT: REC ROOM
PROJECT ADDRESS: XX
NORTH

SHEET: FLOOR PLAN
DRAWN: SC | CHECKED: KP | SCALE: 1 : 50 | SIZE: A3
DRAWING NO.: A02-FP01 | REVISION: A
DC SIGN OFF:

Autodesk Docs://J005076 - FWD CAPEX - 100P Camp Stock Build/J005076_B09_Rec Room_R22.rvt

Building Legend		
Building No.	Description	Quantity
1	3 PERSON STAFF QUARTER 10x2.9m	11
2	2 PERSON STAFF QUARTER 10x2.9m	1
3	3 PERSON TRAILER MOUNTED SPQ 12.2x2.4m	4
4	FIRST AID TRAILER 12.2x2.4m	1
5	CONTAINER OFFICE 12.2x3m	1
6	TRAILER MOUNTED LAUNDRY/ICE ROOM 12.2x2.4m	1
7	14KL POTABLE WATER TANK	3
8	14KL WASTE WATER TANK	3
9	CONTAINER GYMNASIUM 12.2x3m	2
10	GENERATOR SKID 12.2x2.4m	1
11	COLD/FREEZER ROOM 6x2.4m	1
12	DRY STORE 6x2.4m	1
13	MAINTENANCE STORE 6x2.4m	1
14	TRAILER MOUNTED DINER 14.4x2.4m	2
15	TRAILER MOUNTED KITCHEN 14.4x2.4m	2



REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	CLIENT
		E	01.05.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		D	25.02.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		C	20.02.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		B	06.12.24	RE-ISSUED FOR REVIEW	BM	OM	AC	OM	RK	OM	
		A	26.11.24	ISSUED FOR REVIEW	OM	OM	AC	OM	RK	OM	
.	.	–	26.11.24	COMMENCED	BM	CM	AC	OM	RK	OM	

$FILE$ $TIME$ $DATE$

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Rapid Camps

Yindjibarndi Energy

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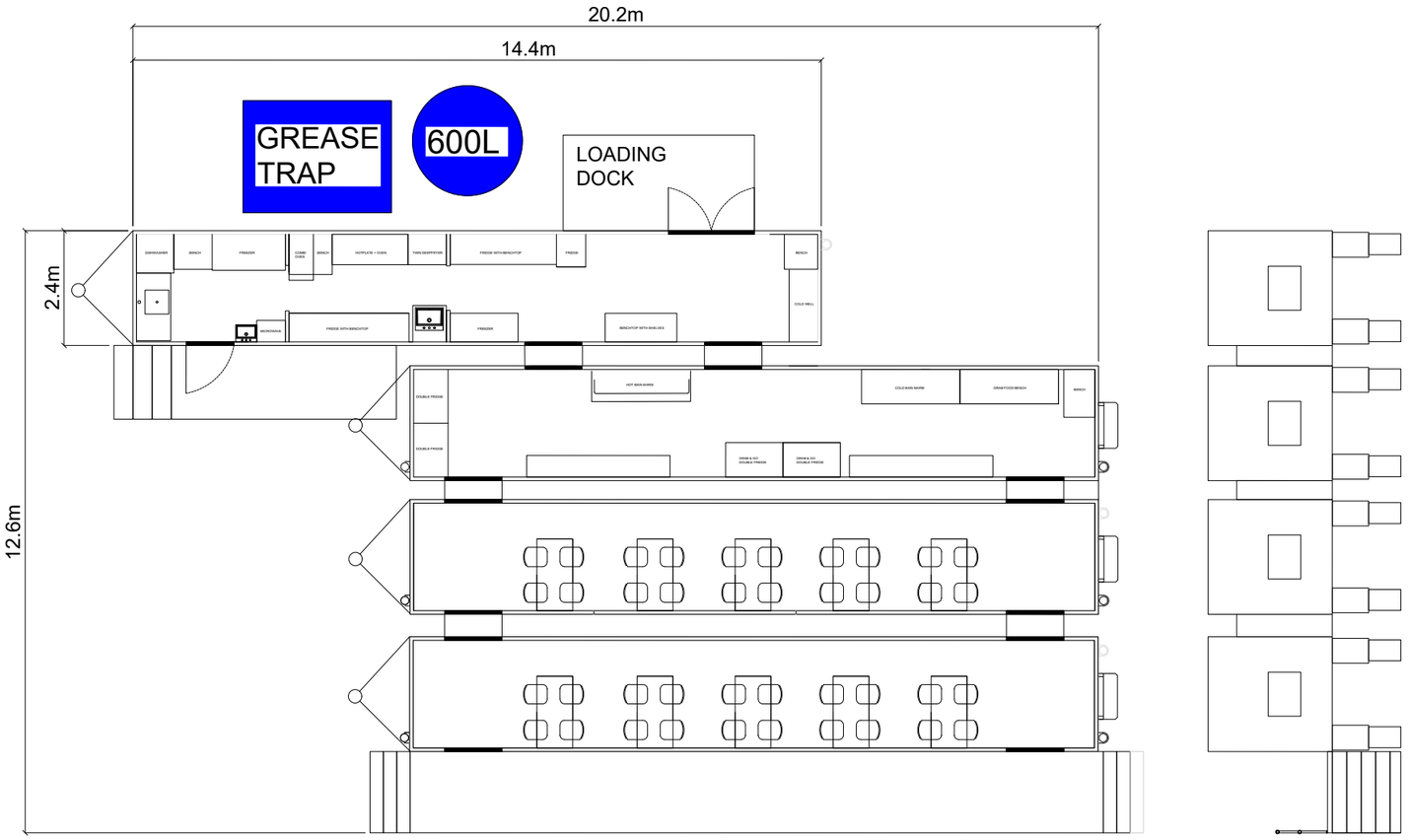
VENDOR/DESIGNER DRG No.: XXXX — REV: E

PROJECT NUMBER: XXXX

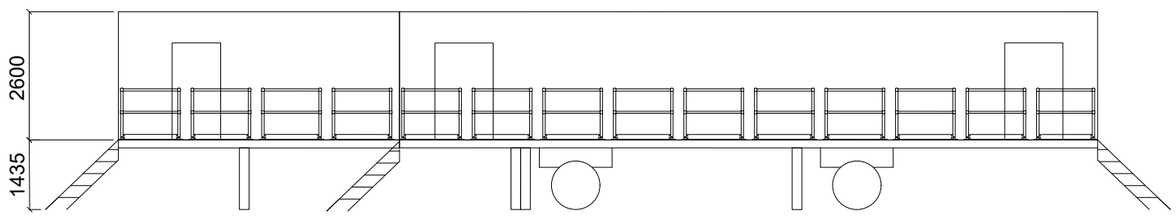
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JINBI CONSTRUCTION ACCOMODATION
47 PERSON FLY CAMP
RAPID CAMPS
FLY CAMP GENERAL LAYOUT

A1 | SCALE: NTS | DRG No.: XXXX | REV: E



SIDE VIEW



SIDE VIEW

REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	CLIENT
		C	01.05.25	RE-ISSUED FOR REVIEW	EOC	OM	AC	OM	RK	OM	
		B	06.12.24	RE-ISSUED FOR REVIEW	BM	OM	AC	OM	RK	OM	
		A	26.11.24	ISSUED FOR REVIEW	OM	OM	AC	OM	RK	OM	
.	.	–	26.11.24	COMMENCED	BM	CM	AC	OM	RK	OM	

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Rapid Camps

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VENDOR/DESIGNER DRG No. 029-DWG-AR-102 | REV: C

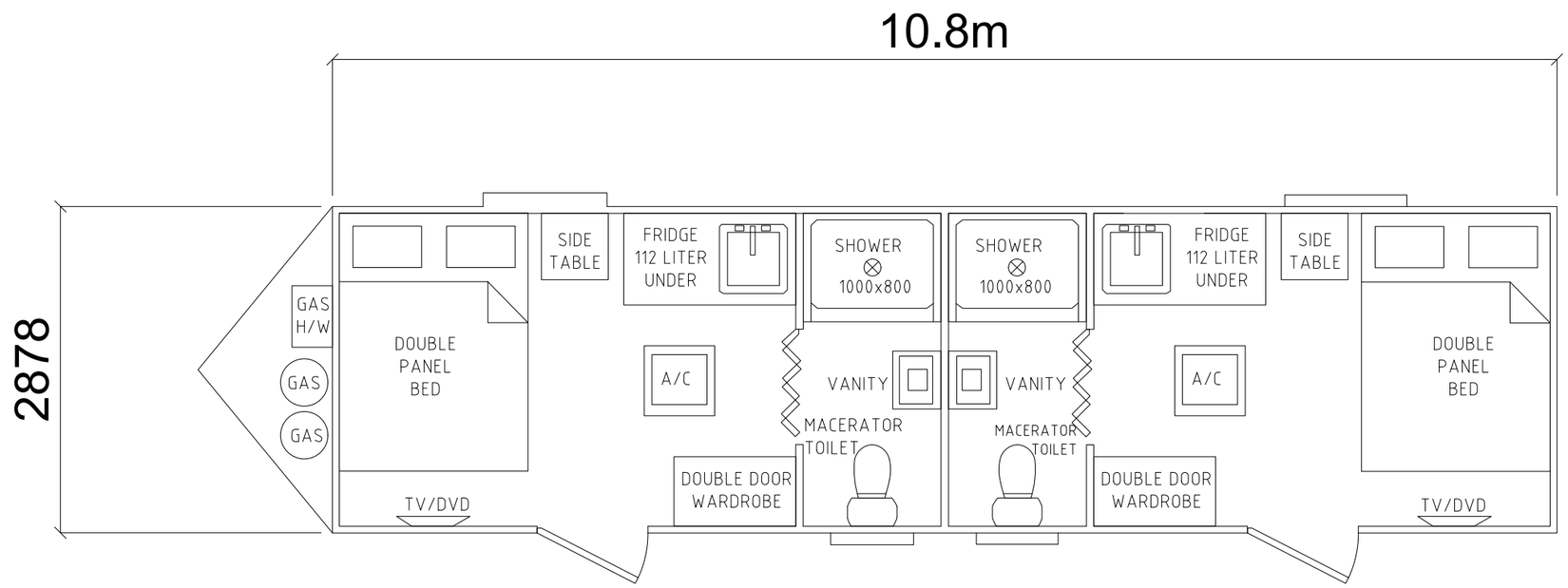
Yindjibarndi Energy

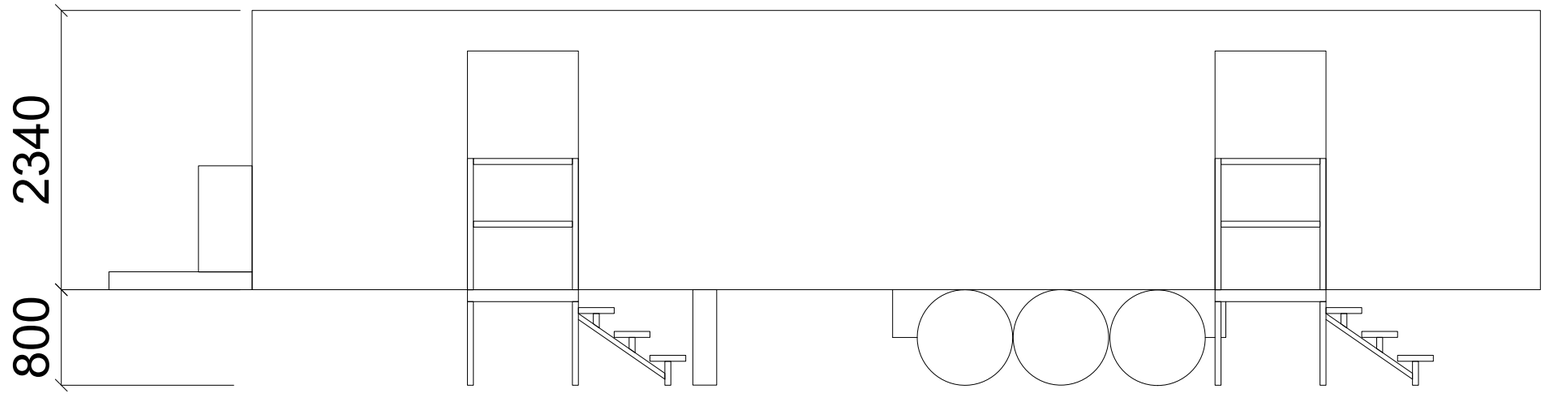
PROJECT NUMBER: 029

JINBI CONSTRUCTION ACCOMODATION
47 PERSON FLY CAMP
RAPID CAMPS
KITCHEN LAYOUT

A1 | SCALE: NTS | DRG No: 029-DWG-AR-102 | REV: C

$FILE$ $TIME$ $DATE$





REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	CLIENT
.	.	A	06.05.25	ISSUED FOR REVIEW	EOC	CM	AC	OM	RK	OM	
.	.	–	06.05.25	COMMENCED	EOC	CM	AC	OM	RK	OM	

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Rapid Camps

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PROJECT NUMBER: 029

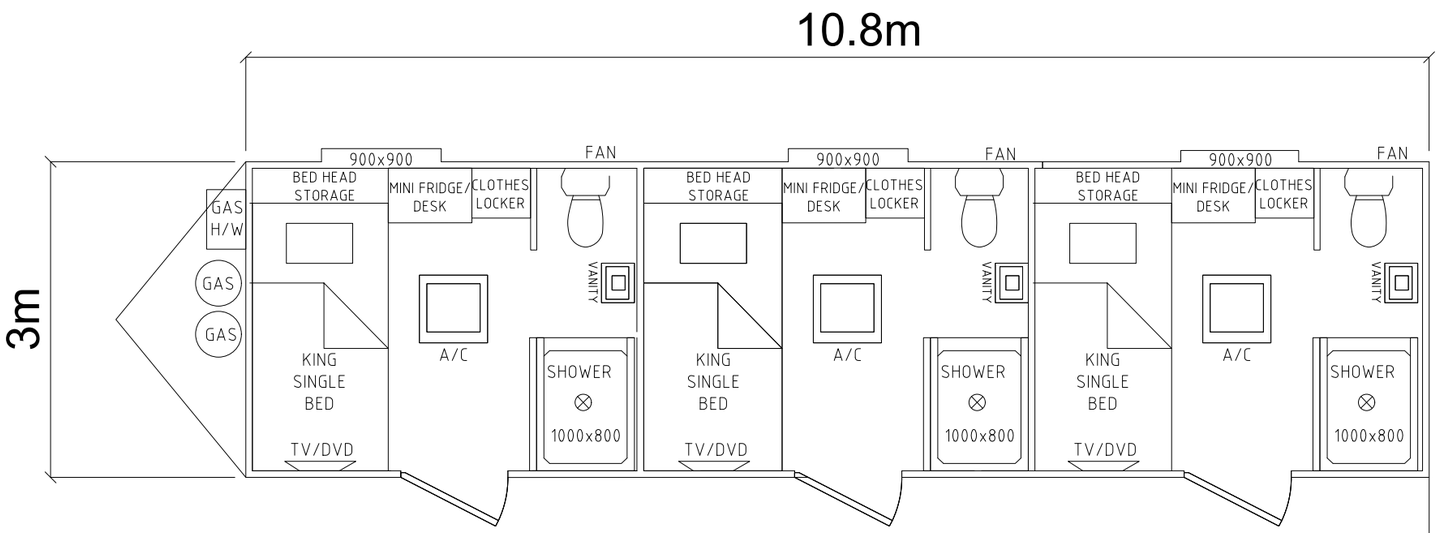
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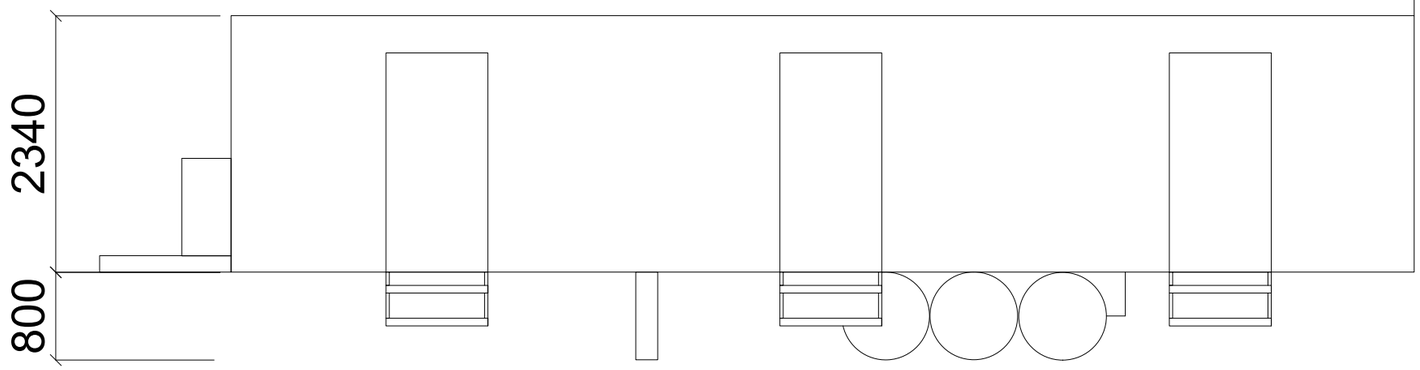
Yindjibarndi Energy

JINBI CONSTRUCTION ACCOMODATION
47 PERSON FLY CAMP
RAPID CAMPS
ACCOMMODATION TYPE 1 LAYOUT

A1 | SCALE: NTS | DRG No.: 029–DWG–AR–103 | REV: A

$FILE$ $TIME$ $DATE$





SIDE VIEW

REF DRG No.	TITLE	REV	DATE	DESCRIPTION	DRN	CHK	SUP	DES	DAP	PAP	CLIENT
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Rapid Camps

Yindjibarndi Energy

NORTH

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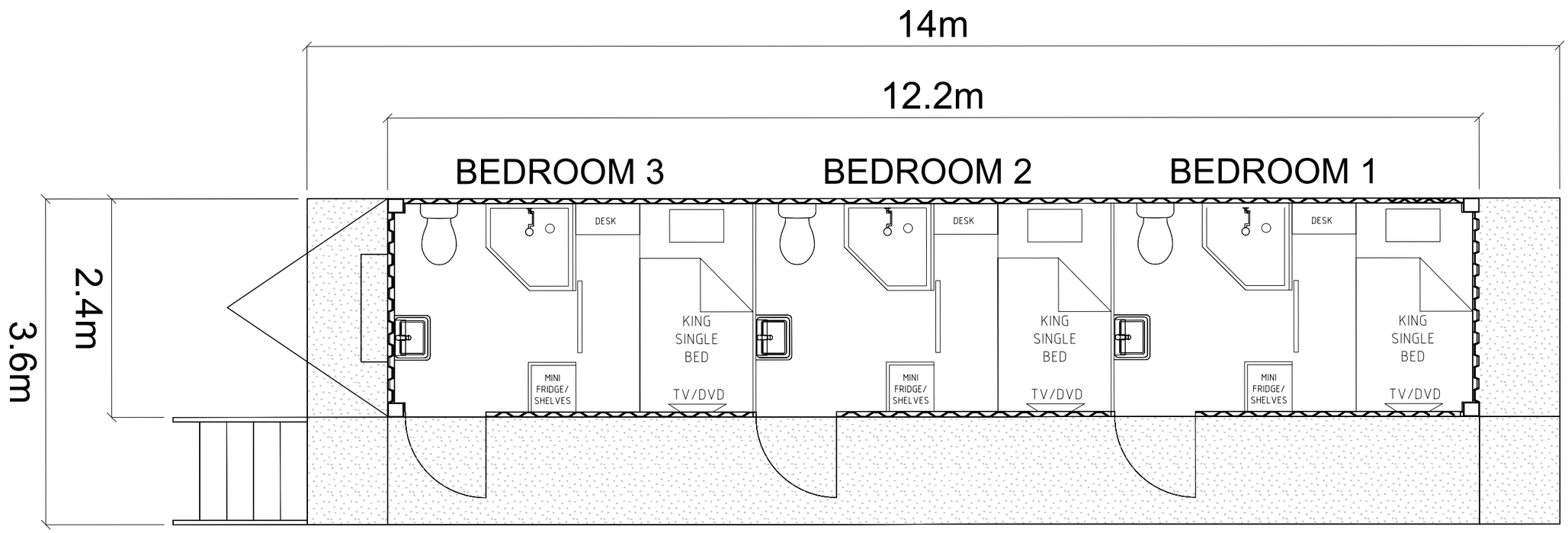
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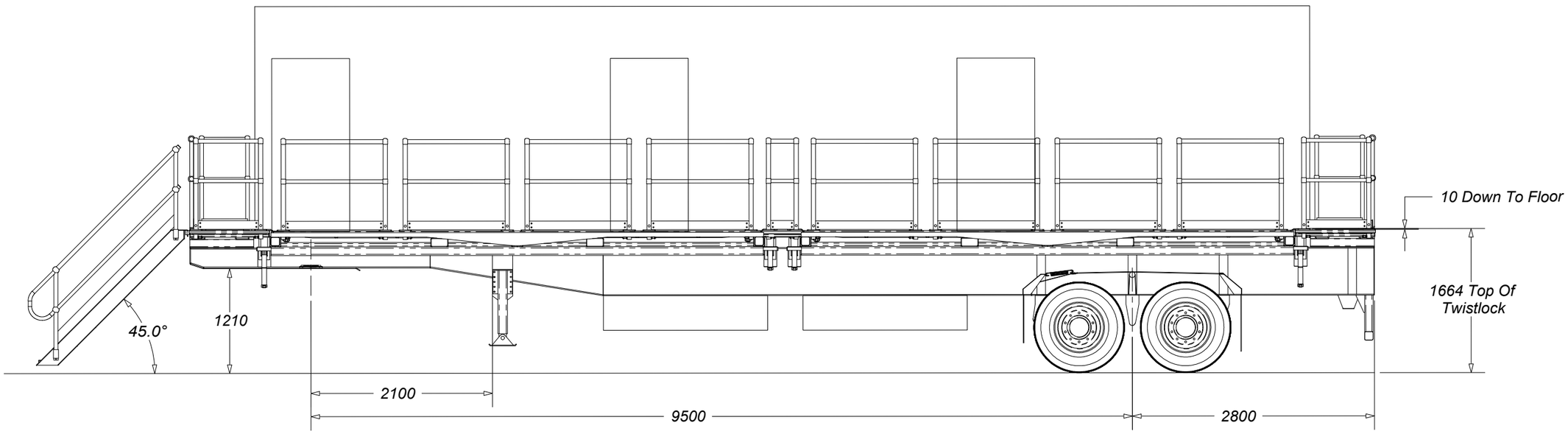
PROJECT NUMBER: 029

JINBI CONSTRUCTION ACCOMODATION
47 PERSON FLY CAMP
RAPID CAMPS
ACCOMODATION TYPE 2 LAYOUT

A1 | SCALE: NTS | DRG No: 029-DWG-AR-103 | REV: A

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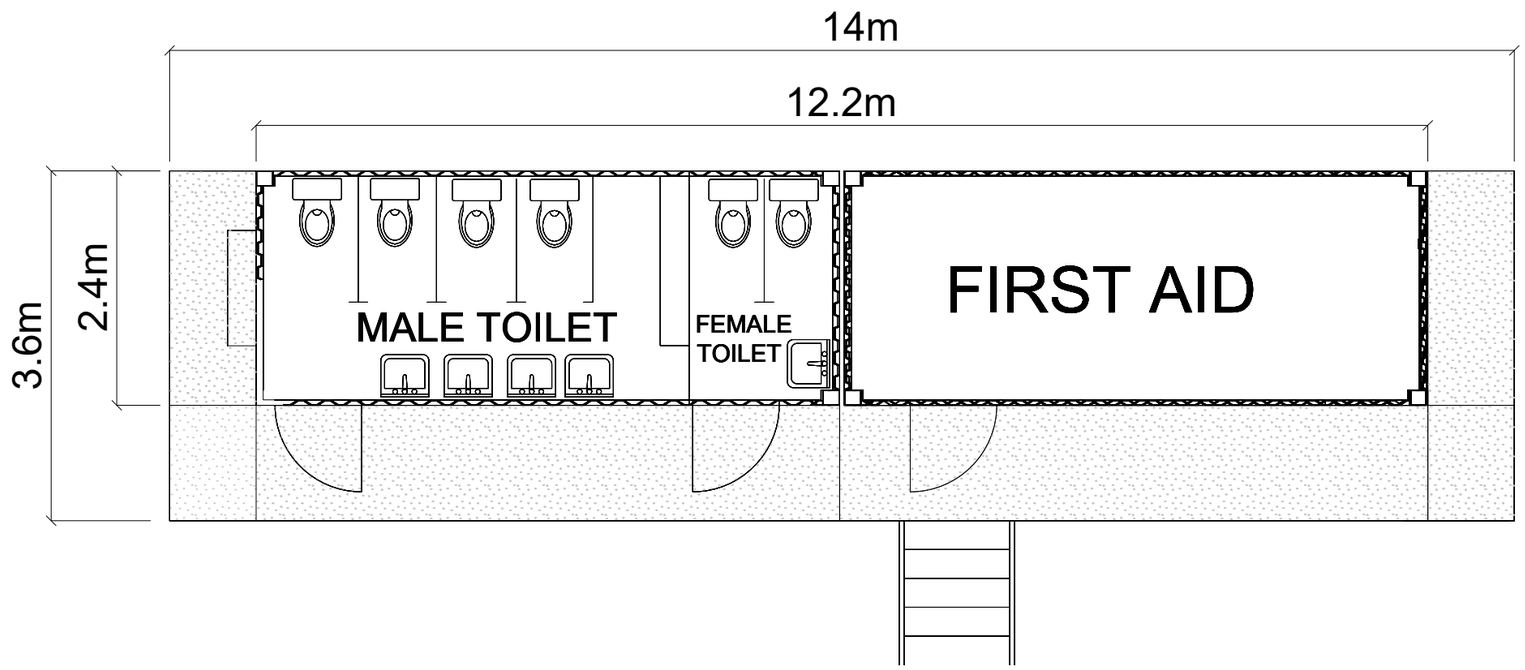
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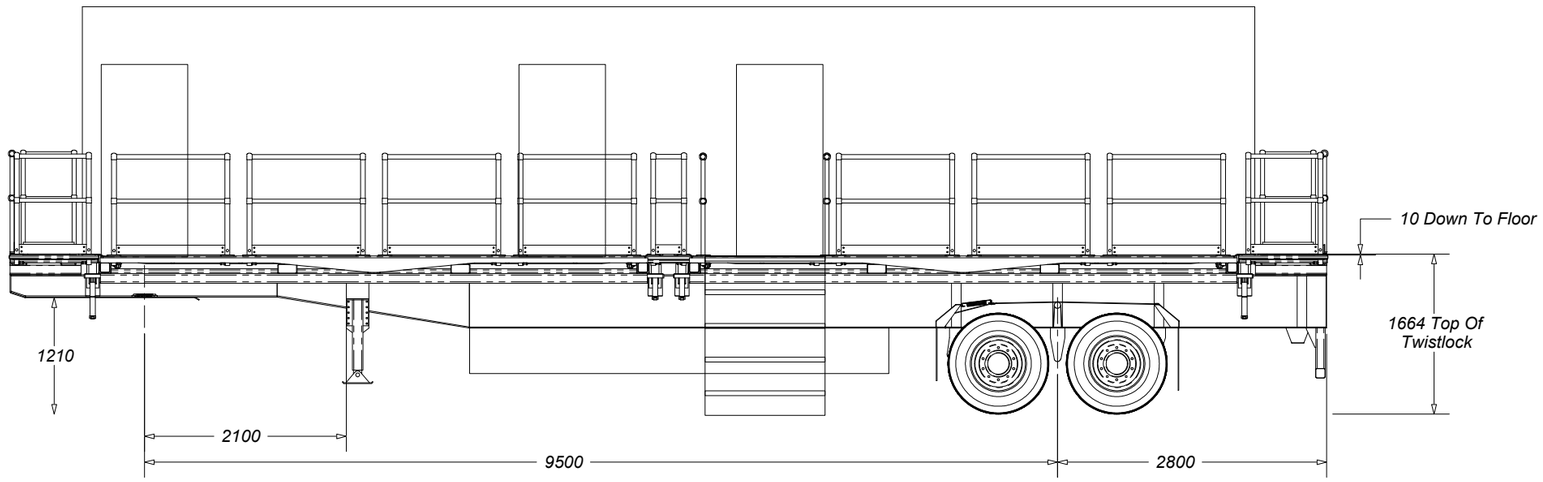
Yindjibarndi Energy

JINBI CONSTRUCTION ACCOMODATION
47 PERSON FLY CAMP
RAPID CAMPS
ACCOMMODATION TYPE 3 LAYOUT

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Rapid Camps

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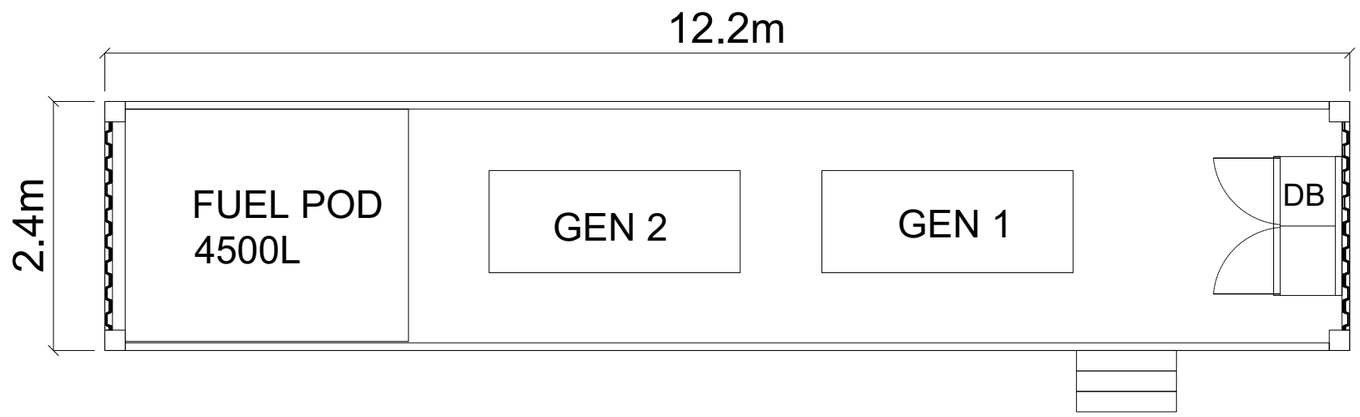
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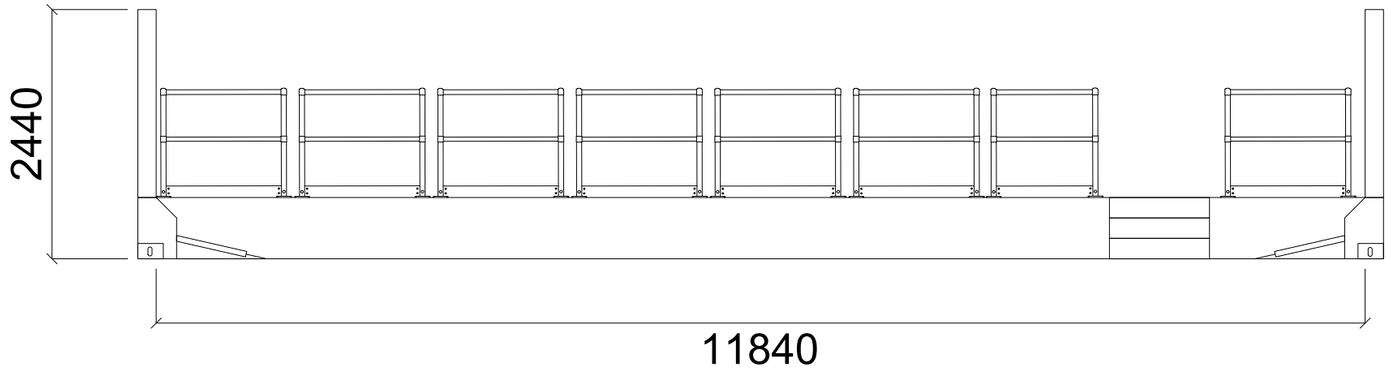
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JINBI CONSTRUCTION ACCOMODATION
47 PERSON FLY CAMP
RAPID CAMPS
FIRST AID LAYOUT

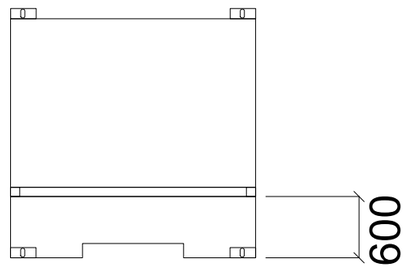
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SIDE VIEW



SIDE VIEW

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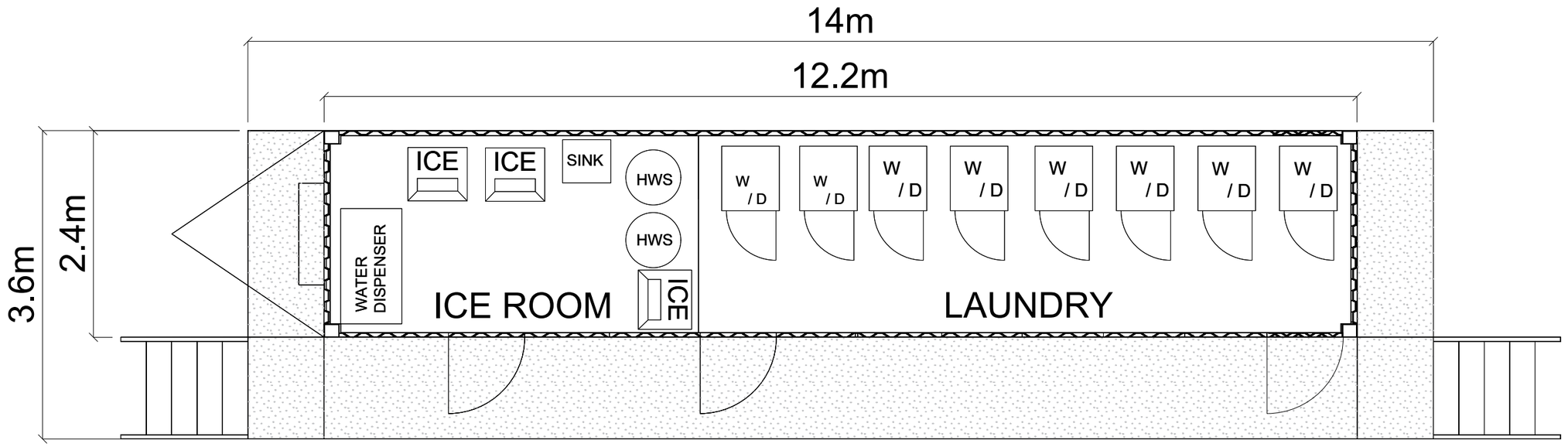
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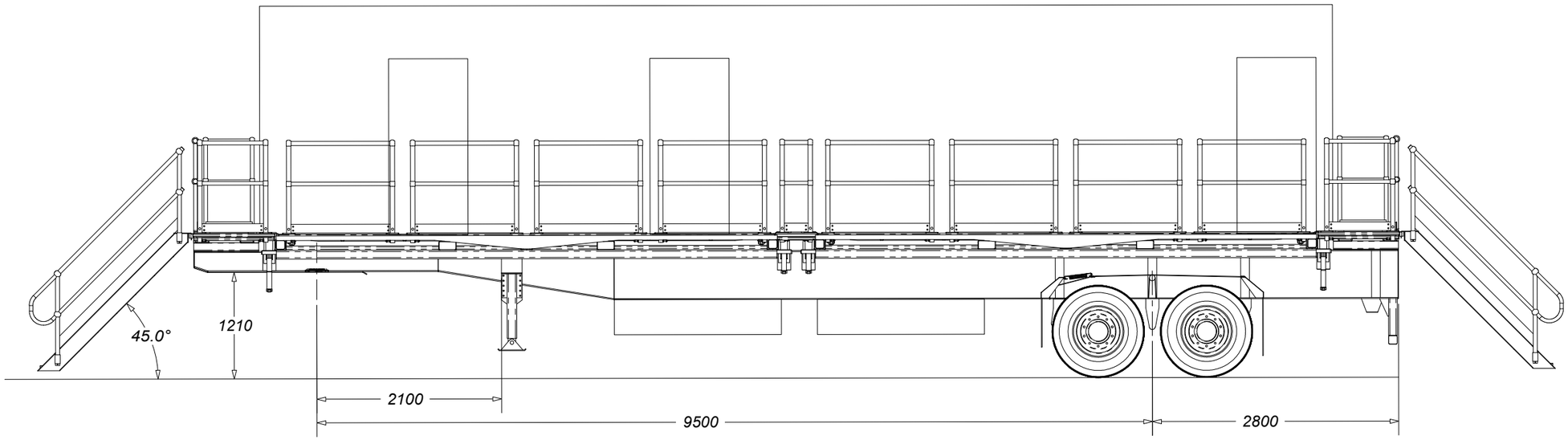
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JINBI CONSTRUCTION ACCOMODATION
47 PERSON FLY CAMP
RAPID CAMPS
OFFICE LAYOUT

A1 | SCALE NTS | DRG No: 029–DWG–AR–105 | REV: A

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SIDE VIEW

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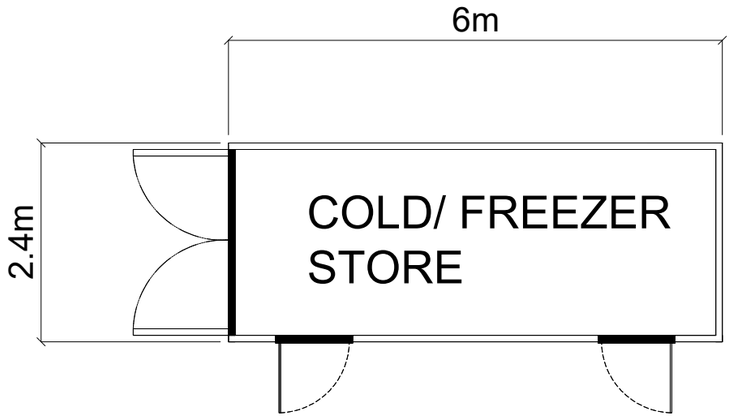
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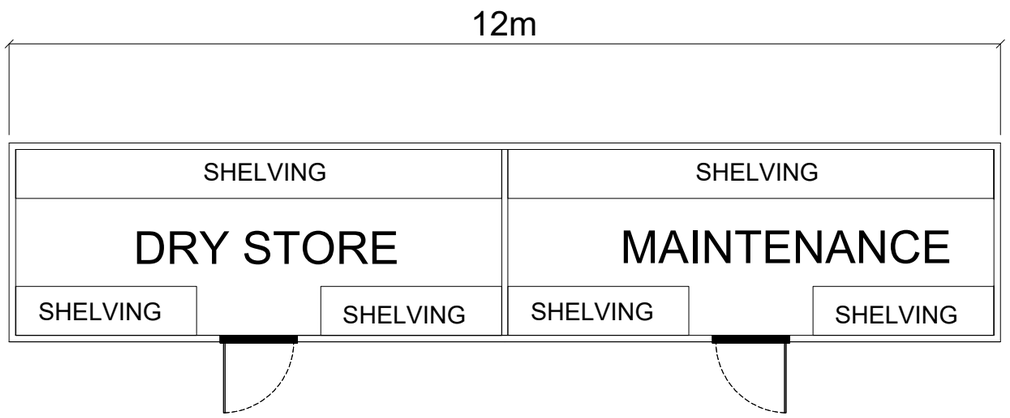
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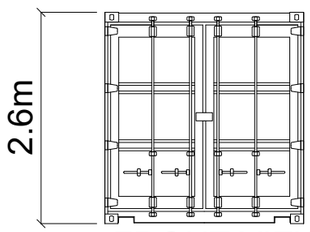
JINBI CONSTRUCTION ACCOMODATION
47 PERSON FLY CAMP
RAPID CAMPS
LAUNDRY/ICE ROOM LAYOUT

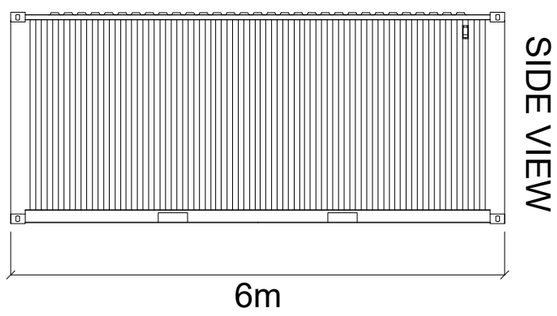
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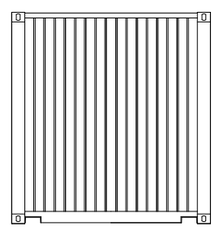
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Rapid Camps

Yindjibarndi Energy

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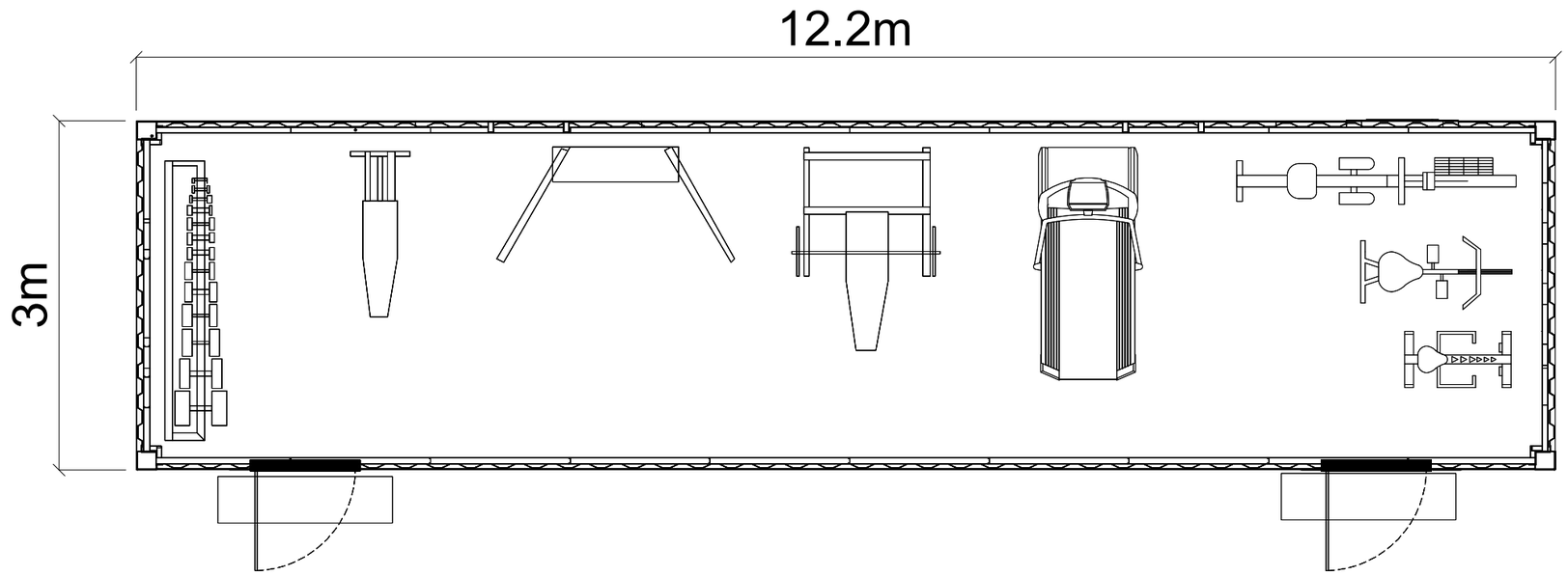
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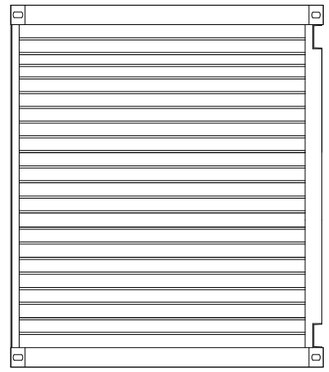
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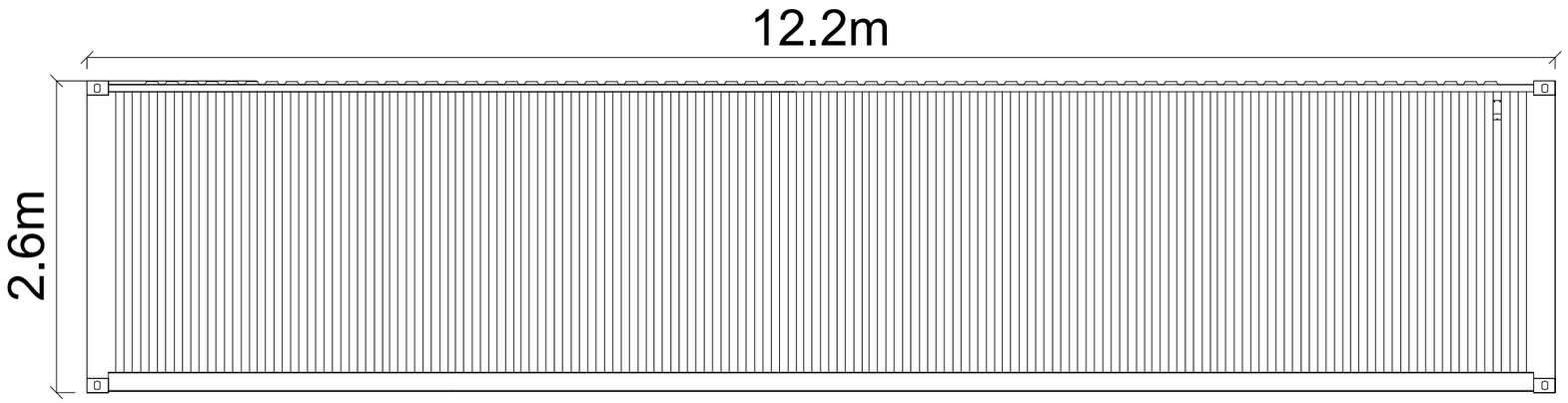
JINBI CONSTRUCTION ACCOMODATION
47 PERSON FLY CAMP
RAPID CAMPS
STORES + MAINTENANCE LAYOUT

A1 | SCALE: NTS | DRG No.: 029–DWG–AR–105 | REV: A





FRONT VIEW



SIDE VIEW

BACK VIEW

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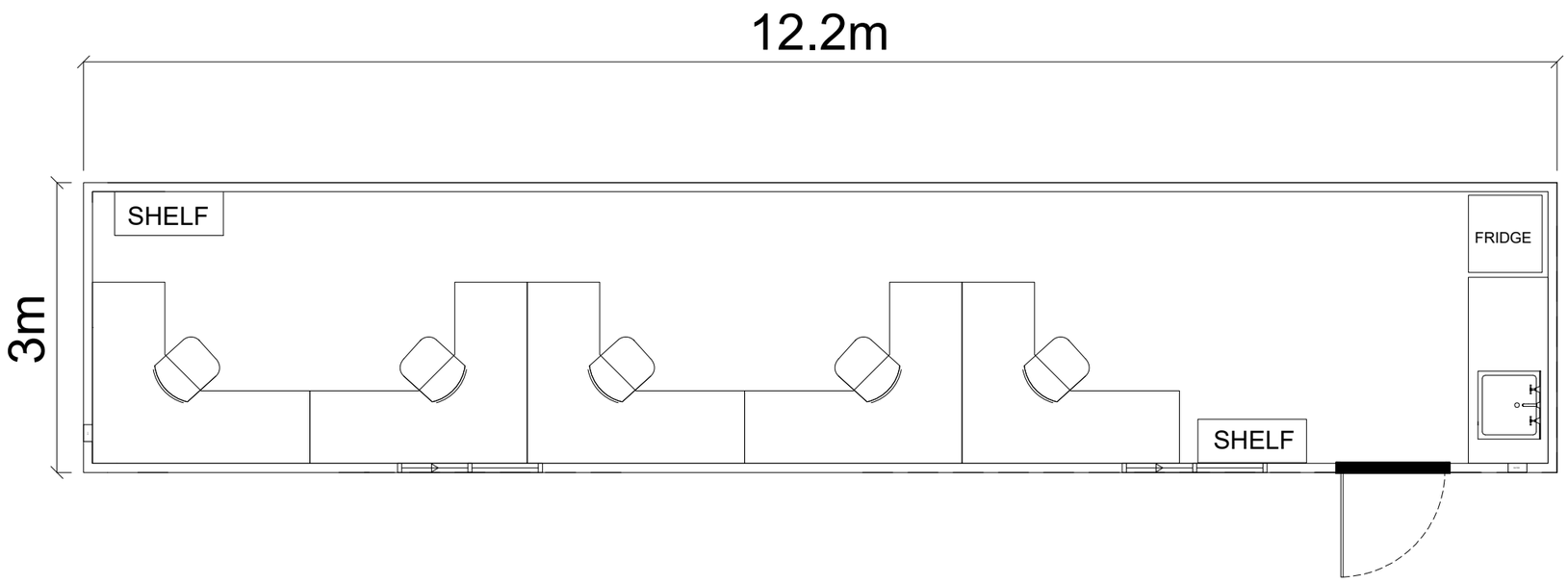
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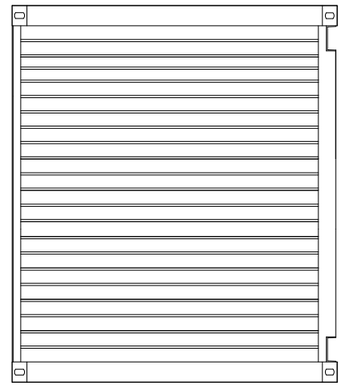
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JINBI CONSTRUCTION ACCOMODATION
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RAPID CAMPS
GYMNASIUM LAYOUT

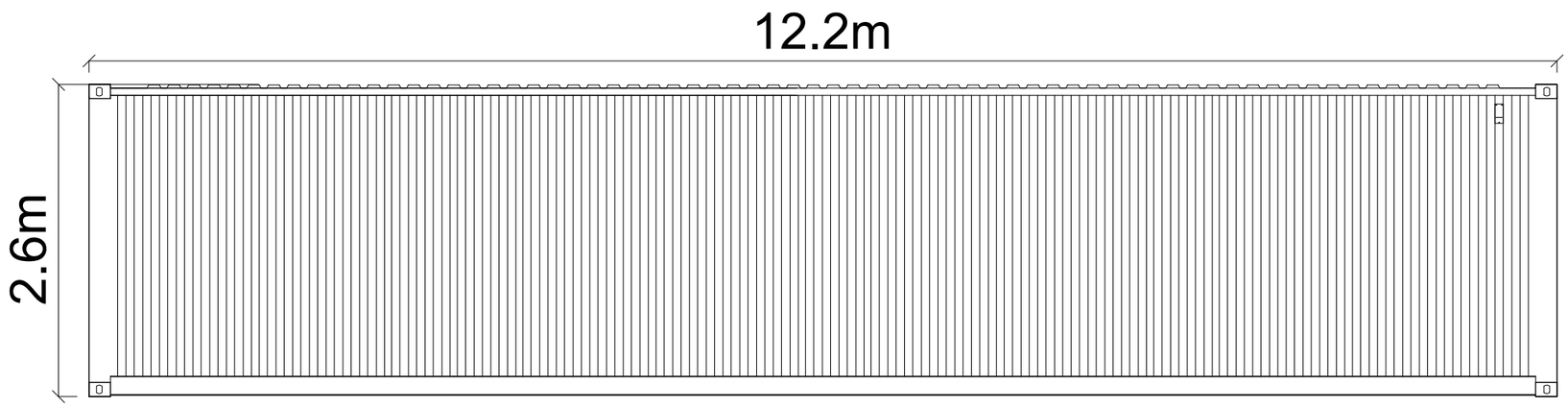
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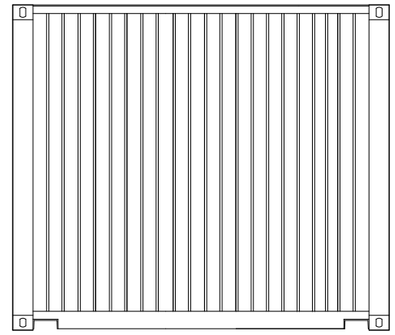




FRONT VIEW



SIDE VIEW



BACK VIEW

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PROJECT NUMBER: 029

JINBI CONSTRUCTION ACCOMODATION
47 PERSON FLY CAMP
RAPID CAMPS
OFFICE LAYOUT

A1 | SCALE: NTS | DRG No: 029–DWG–AR–105 | REV: A

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Yindjibarndi Energy
A partnership with ACEN

Project Jinbi Workers Camp
Social Impact Statement

August 2025



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1 INTRODUCTION

Yindjibarndi Energy Corporation (**YEC**) proposes to develop, own, and operate large scale renewable energy projects on Yindjibarndi Country in the Pilbara Region of Western Australia.

YEC currently has three green field site projects under development within the Local Government Area (**LGA**) of Shire of Ashburton:

- Project Jinbi: 75MWac solar array, with the ability to expand to 150MWac and an option to include Battery Energy Storage System (**BESS**)
- Project Baru: up to 450MW wind, plus solar and BESS; and
- Project Marnda: up to 600MW wind, plus solar and BESS.

This Social Impact Statement (**SIS**) has been prepared in accordance with the Shire of Ashburton's Local Planning Policy LPP20 Social Impact Assessment and is intended to support YEC's application to the Shire of Ashburton for development approval for the workforce accommodation required to support Project Jinbi.

1.1 Objectives and Scope

The solar component of Project Jinbi received development approval from the Department Planning Lands and Heritage (**DPLH**) through the City of Karratha's Joint Development Assessment Panel (**JDAP**) in December 2024.

The workforce accommodation required to support Project Jinbi was not included in the initial application for development approval and it was noted that separate development approval would be required for construction of temporary workforce accommodation on the Jinbi site.

Therefore, the specific objectives of this SIS are to:

1. Identify key stakeholders and communities that are likely to have an interest or be affected by the development of the Jinbi Workforce Accommodation Project (**the Project**) including any marginalised or more vulnerable community groups.
2. Provide a preliminary analysis of potential social impacts associated with the Project - both negative and positive.
3. Identify measures to reduce negative social impacts and enhance positive impacts where practically possible.
4. Inform further Social Impact Assessment (SIA) scopes of work to be undertaken as the Project progresses.

2 PROJECT OVERVIEW

2.1 Jinbi Workforce Accommodation Project

The Jinbi Workforce Accommodation Project consists of a purpose-built, temporary accommodation facility to house workers engaged in the construction of Project Jinbi and related infrastructure works, including the development of access roads.

Project Jinbi consists of a solar array and potential BESS on a greenfield site, with direct connection to existing transmission infrastructure. It is located within an area of Exclusive Native Title, being Unallocated Crown Land within Yindjibarndi Native Title Determination Areas. It is located approximately 56km south of Karratha and 180km north-west of Tom Price.

2.1.1 Project Jinbi Workforce Overview

Project Jinbi will require a construction workforce of approximately 100, followed by an ongoing operational workforce of 10 people. Construction of Project Jinbi is expected to take about two years, intended to commence in 2026. Operations and generation of clean, renewable electricity is expected from 2028.

2.1.2 WHS considerations

While it is expected that most of the construction workforce will be sourced locally from the Karratha area, the substantial distance from Karratha to the Project Jinbi site (approximately 1.5 hours) poses a significant risk of employee fatigue. The decision to establish an onsite workers camp was driven by several factors:

- Fatigue management: onsite accommodation eliminates long commutes, giving workers more time to rest.
- Enhanced safety: reducing fatigue lowers the risk of accidents and errors, contributing to a safer work environment.
- Increased productivity: well-rested workers are more alert and efficient, leading to higher productivity levels.
- Health and well-being: supports overall health by preventing chronic fatigue and related issues, promoting better mental and physical health.
- Extreme Heat Management: onsite accommodation helps manage extreme heat conditions by providing immediate access to cool, sheltered environments, reducing heat stress and related health risks. It also enables workers to take advantage of the cooler conditions in the early morning, further mitigating the impact of extreme temperatures.

2.1.3 Capacity

The camp has a maximum planned capacity of 272 people which includes construction workers to build the project, YEC staff and staff from the camp supplier to operate and maintain the facility.

2.1.4 Construction

The camp will be constructed in two stages:

Stage 1:

- Construction of a smaller “fly camp” with caravan-style accommodation to support an initial workforce of approximately 54 people. This camp will facilitate early civil works, such as roads and piling, and assist in the construction of the main workers’ camp.
- Construction will take 3 months, from February to April 2026.

Stage 2:

- Construction of the main workers’ camp. Once the main camp is complete, the initial “fly camp” will be removed.
- Construction will take 5 months, from April to August 2026.

2.1.5 Location

The camp will be located in the southern portion of the Jinbi lease – refer to Figure 1, Figure 2 and Figure 3. Locating the camp on the southern portion of the lease area represents the lowest risk from a timing point of view, being close to existing access roads and within an area that is not flagged for solar panel installation.

2.1.6 Operation

The camp is expected to be operational for 2 years.

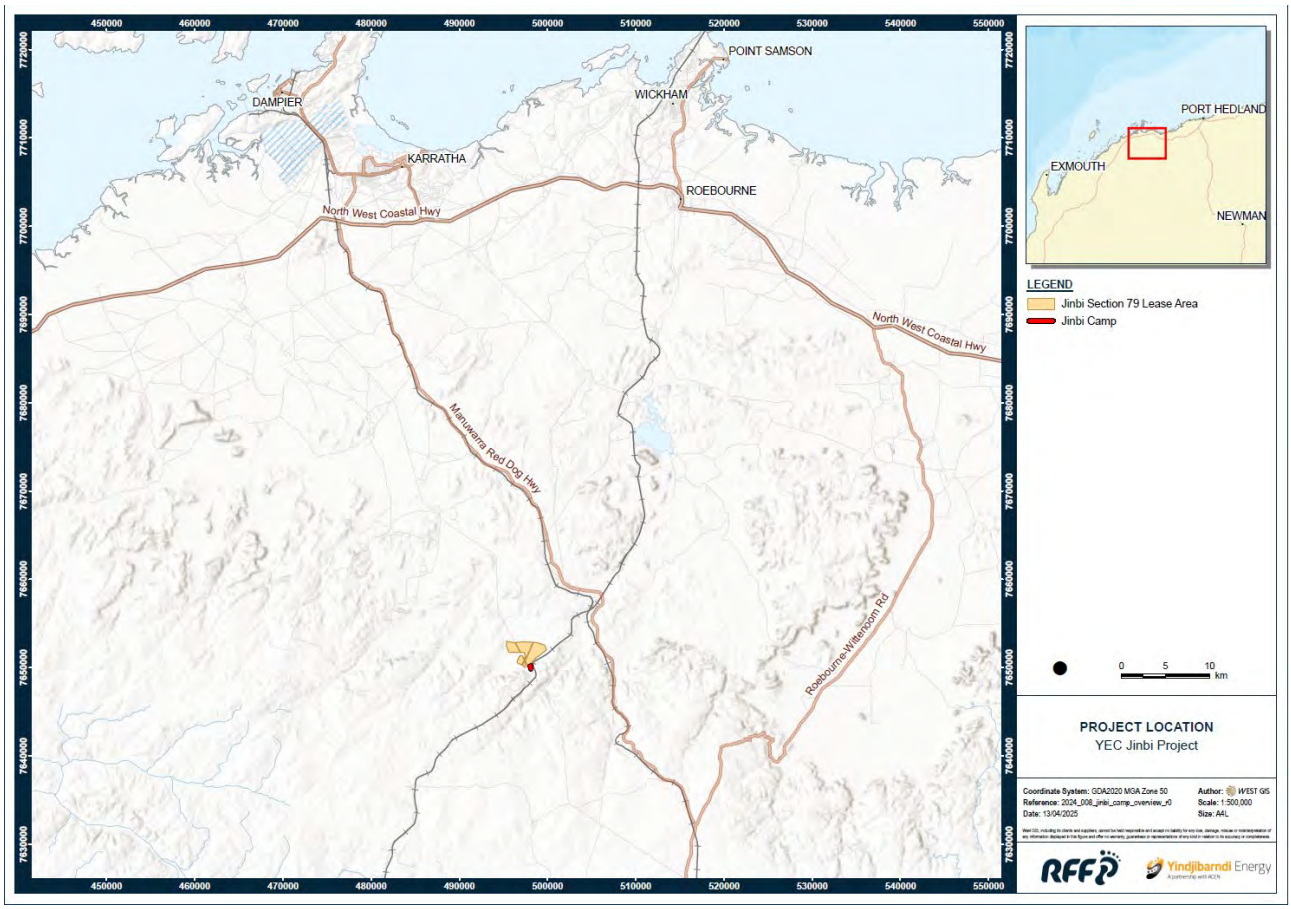


Figure 1 Workforce Accommodation Location

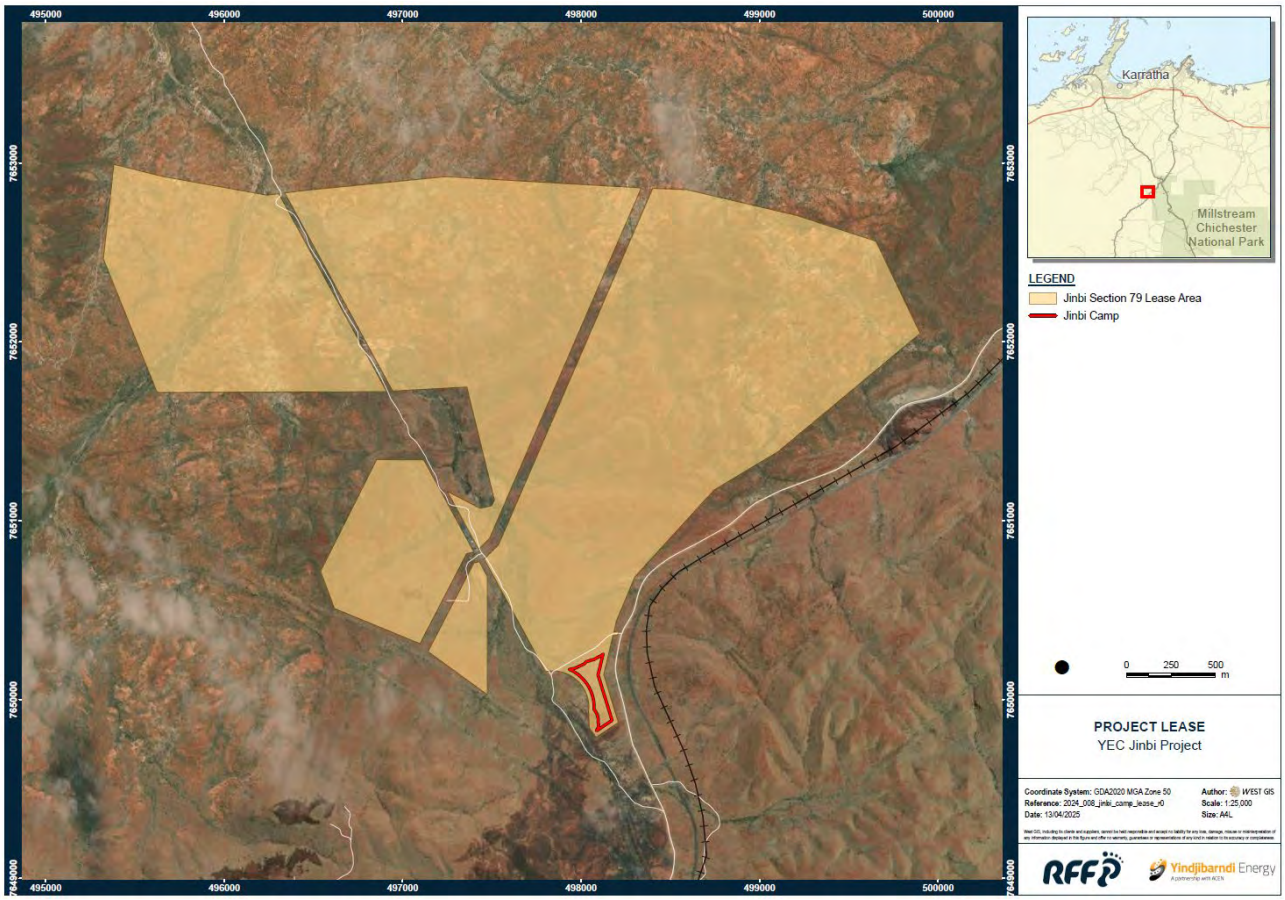


Figure 2 Location within Project Jinbi Lease Area

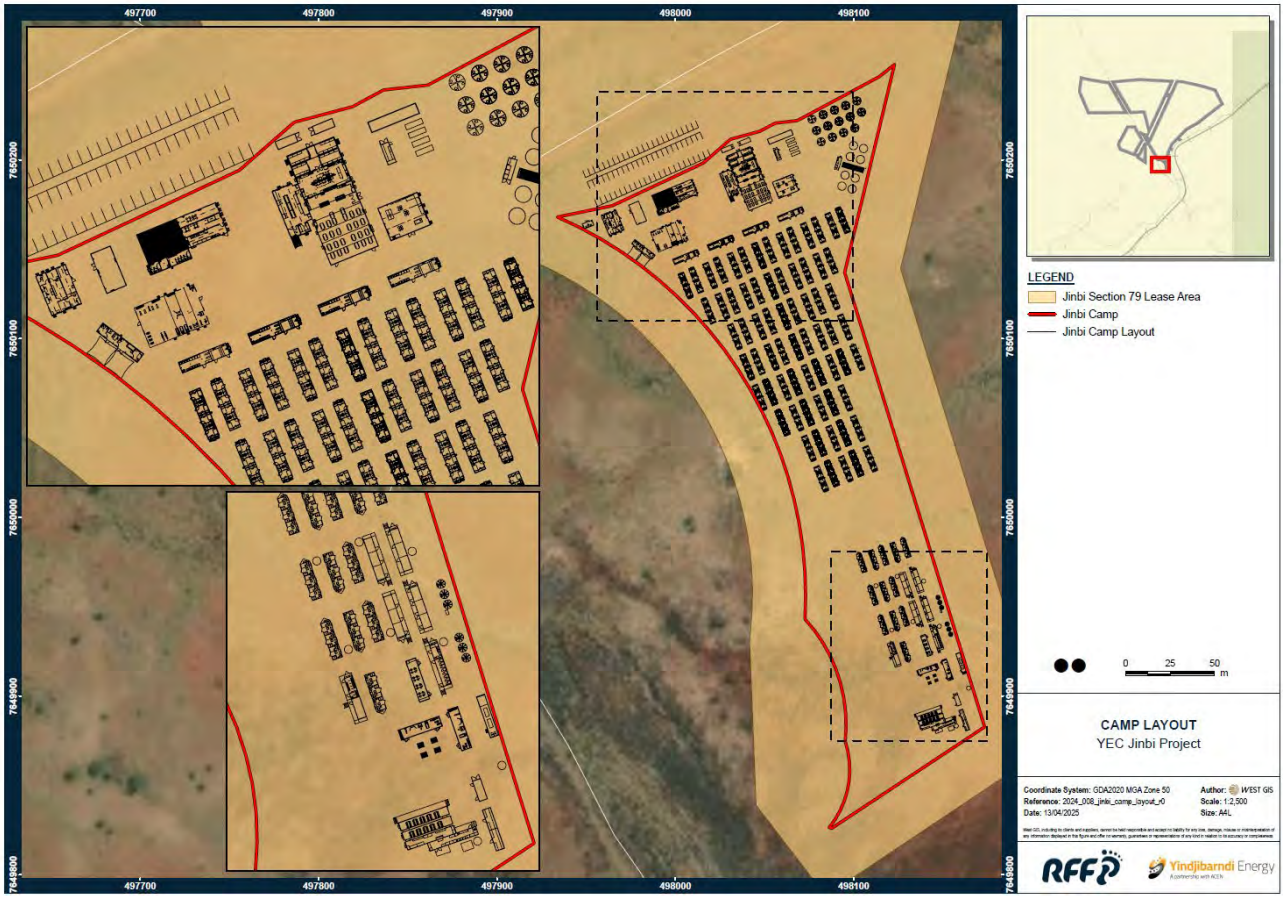


Figure 3 Proposed Camp Layout

3 AREA OF SOCIAL INFLUENCE

The Jinbi Workforce Accommodation Project is located within the Shire of Ashburton within an area of Exclusive Native Title, being Unallocated Crown Land within Yindjibarndi Native Title Determination Areas.

Areas of social influence	Features of the project's social context to be considered
• Ngurrawaana • Roebourne • Karratha	1. Proximity of communities to the project 2. The size of the project's construction and operations workforce 3. The movement of goods, materials and equipment 4. The movement and accommodation of workers 5. Access to local and Indigenous workforce and supply chain 6. Protection and enhancement of cultural heritage and values

4 CONSULTATION

YEC understands that community engagement is fundamental to SIA as it ensures that the voices and concerns of all stakeholders are heard and addressed, leading to more inclusive and sustainable project outcomes. By actively involving the community, projects can better understand and mitigate potential social impacts, fostering trust and collaboration.

YEC is guided by the following industry guidelines in relation to community engagement:

- Clean Energy Council - Community Engagement Guidelines for the Australian Wind Industry.
- First Nations Clean Energy - Aboriginal and Torres Strait Islander Best Practice Principles for Clean Energy Projects

Consistent with the above guidelines, community engagement undertaken by YEC as part of the proposed Project will be respectful, inclusive, and meaningful. Engagement is used to identify community values and aspirations in relation to the Project, and to identify key issues of concern for key stakeholders and local communities, including opportunities to further refine project design to address and/or enhance project impacts.

YEC is committed to developing and maintaining genuine partnerships to enable all stakeholders to provide feedback on the proposed Project and to raise any concerns that should be considered through the development process. YEC is committed to communicating openly, honestly and in a transparent manner with all stakeholders.

Stakeholder and community consultation will continue as the Jinbi Workforce Accommodation Project progresses and is a key component in understanding potential social impacts.

Consultation with the below groups has either already commenced or is planned to be undertaken:

- Yindjibarndi people and specifically the Ngurrawaana community
- Local government departments, agencies and elected representatives
- State government departments, agencies and elected representatives
- Commonwealth Government departments, agencies and elected representatives
- Potential suppliers
- Potential customers
- Ngarluma people
- Special interest groups

5 PRELIMINARY SOCIAL IMPACTS AND OPPORTUNITIES

- Minimise impact
- Maximise opportunity

THEME	POTENTIAL IMPACTS / OPPORTUNITIES	APPROACH	HOW IT MAY BE ADDRESSED
Economic	• Local jobs and income generation for Indigenous communities to improve individual and familial household income, strengthening economic independence and sustainable contribution to local economy • The construction and operation of the camp may create job opportunities for local residents		• Proportion of YEC profits filtered back to the community • Prioritise the engagement of Yindjibarndi businesses • Support for training programs to build pool of capable candidates
	Impact on Pilbara businesses via supply and procurement:		• Prioritise use of local businesses where practical • Establish online registration for local businesses to register interest • Host local supply forums
Social	• Local workforce likely to invest in community services and businesses contributing to local economy • Local businesses may experience increased demand for goods and services, boosting the local economy		• Use local and existing workforce where practical • Prioritise use of local businesses where practical
	Workforce accommodation will reduce strain on local housing demand and affordability		• Host workforce in proposed Jinbi workforce accommodation

THEME	POTENTIAL IMPACTS / OPPORTUNITIES	APPROACH	HOW IT MAY BE ADDRESSED
	Workforce puts strain on community and social services and facilities		• Use local and existing workforce where practical • Leverage existing established private industry services and facilities • The camp will have some facilities to reduce strain on local services and facilities
	Yindjibarndi community awareness and understanding of YEC aspirations, activities and benefits		• Culturally appropriate information materials • Long term Social Investment Program focussed on improving quality of life and benefits to local communities • YEC local presence
	Negative impact on community cohesiveness		• Ensure WHS planning includes guidance for workforce on acceptable behaviour in the local community • Provision of on-site recreational facilities • Distance to nearby communities renders negative impact on the nearby community unlikely due to time constraints (i.e. long shift work)
Transport	Increased traffic congestion with the transport of construction components		• Detailed transport and logistics route planning by suitably qualified specialists • Traffic will be reduced due to construction of workforce accommodation which is based on site.
	Public safety related to increased traffic on road networks		• Detailed transport and logistics route planning by suitably qualified specialists • Traffic will be reduced due to construction of workforce accommodation which is based on site. • Bus transport for workforce at start and end of shift.

THEME	POTENTIAL IMPACTS / OPPORTUNITIES	APPROACH	HOW IT MAY BE ADDRESSED
Ecological	Impact on environmentally significant species		• Detailed environmental assessments by suitably qualified specialists • Adherence to Clearing Permit conditions • Yindjibarndi participation in pre-clearing fauna and flora surveys
	Impact on waterways and hydrological features		• Detailed hydrological assessments by suitably qualified specialists • Design development with a focus to avoid existing hydrological pathways • Adherence to Clearing Permit conditions • Adherence to Beds and Banks Permit conditions • A Part V works approval will be obtained for site for the appropraitae management of waste water discharge
	Long term reduction in greenhouse gas emissions		• YEC energy is used to decarbonise existing Pilbara industries
Cultural	Workforce respect for Aboriginal cultural heritage and values		• Induction and cultural awareness training for workforce
	Impact on waterways and hydrological features		• Detailed hydrological assessments by suitably qualified specialists • Adherence to Heritage Protection Agreement • Adherence to Clearing Permit conditions
	Access to culturally significant sites		• Upgrade access tracks for Yindjibarndi community • Adherence to Heritage Protection Agreement • Culturally sensitive areas will be restricted and fenced off

THEME	POTENTIAL IMPACTS / OPPORTUNITIES	APPROACH	HOW IT MAY BE ADDRESSED
Other	Installation of infrastructure, telecommunications and services in remote areas		• Understand and where practical, align installation with Ngurrawaana Community Layout Plan
	Changed visual landscape following construction of the Jinbi Workforce Accommodation Project		• Yindjibarndi approval of site layout • Adherence to Heritage Protection Agreement • Use of visualisation tools to support engagement
	Remoteness of project location		• Suitable emergency management planning • Serviced construction compound with satellite communications • Detailed Construction and Environmental Management Plan • Optimise site amenity and safety provisions for workforce health and well-being

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Bushfire Management Plan

Development Application: Jinbi Solar Camp

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Bushfire Management Plan

Development Application: Jinbi Solar Camp

Report No:
A24.305-RPT-BMP_0_FINAL
Issue Date:
3-May-2025
Status
FINAL

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8-Apr-2025	**9-Apr-2025**	**7-May-2025**

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1. Introduction

1.1 Proposal Details

RFF, on behalf of Yindjibarndi Energy Corporation (YEC), is seeking to progress a development application (DA) for temporary workforce accommodation within a portion of Unallocated Crown Land (UCL; PIN 3115653), directly west of the Pannawonica (Robe River) Railway, and immediately east of Rio Tinto's Cape Lambert transmission line, which is contained within a general lease area (the subject site; Figure 1).

This Application seeks the approval of the Regional Development Assessment Panel ('DAP') to develop and operate a temporary Workforce Accommodation facility to accommodate 272 people, and comprising the following (Figure 2):

- Siting and use of 16 trailer-mounted accommodation facilities, each containing provision for accommodation of 47 people, providing a short-term accommodation solution.
- Development and use of a Workforce Accommodation Facility comprising:
    - 68 transportable buildings, providing accommodation for up to 272 people.
    - A kitchen and associated mess (dining) hall.
    - A wet mess (tavern) and associated beer garden.
    - Four laundry facilities.
    - A gym facility.
    - A recreation room.
    - Associated office, storage and ice rooms.

The proposal seeks approval for the proposed development to:

- Provide a short-term (approximately 4 months) accommodation solution for the workforce required to construct the longer-term facility (47 persons).
- Provide a longer-term, though still temporary, accommodation solution for the renewable energy (and related infrastructure) construction workforce (257 persons), and the associated facility operator (15 persons).

As aforementioned, the construction workforce facility is intended to accommodate the work force required to construct the approved Jinbi Solar Facility.

The subject site is within a designated bushfire prone area (Area 2) as per the *Western Australia State Map of Bush Fire Prone Areas* (DFES, 2024; Figure 3), which triggers bushfire planning requirements under *State Planning Policy 3.7 Bushfire* (SPP 3.7; WAPC, 2024a) and the associated *Planning for Bushfire Guidelines* (the Guidelines; WAPC, 2024b).

Western Environmental Approvals Pty Ltd (WEPL) was commissioned to prepare a Bushfire Management Plan (BMP) to support the DA. This BMP has been prepared by Senior Principal Bushfire Consultant Daniel Panickar (FPAA BPAD Level 3 Certified Practitioner No. BPAD37802) and Bushfire Consultant Bridie Farrar.

1.1.1 Site context

The subject site is located within a portion of UCL located within the north-west portion of the Yindjibarndi portion of the Yindjibarndi-Ngarluma Native Title Determination Area and is subject to exclusive native title rights. The subject site is also included within the boundaries of an existing license held by Yiyangu Pty Ltd, which has been granted pursuant to Section 91 of the *Land Administration Act 1997* (LAA).

Yiyangu (a shareholder of YEC) has also executed an Indigenous Land Use Agreement with Yindjibarndi Aboriginal Corporation and Yindjibarndi Ngurra Aboriginal Corporation, which grants the use of the land for renewable energy projects under the *Native Title Act 1993*.

A Lease over the Project Jinbi area has been granted under Section 79 of the LAA, which corresponds to approximately 720 hectares and includes the proposed camp development site.

The subject site is reserved for Other Purposes - Infrastructure under the provisions of the Shire of Ashburton Local Planning Scheme No. 7. Land surrounding the site to the north, south and west of the subject land is reserved for Public Purposes – Water and Drainage. The land lies within the infrastructure corridor that comprises the Rio Tinto Robe River railway and associated rail access roads. Land north of the subject site is zoned Rural under the provisions of the City of Karratha Local Planning Scheme No. 7, and the land east of the site, the Millstream Chichester National Park, is reserved for Conservation, Recreation and Natural Landscape.

1.2 Purpose and Application of the BMP

This BMP has been prepared in accordance with SPP 3.7 and the Guidelines to support the assessment of the DA submitted to the Shire of Ashburton.

In addition, this BMP provides strategies and guidance to reduce the level of bushfire risk exposure for the subject sites through implementation of a range of bushfire management measures in accordance with the Guidelines.

2. Environmental Considerations

SPP 3.7 policy objective 5.4 recognises the need to consider bushfire risk management measures alongside environmental, biodiversity and conservation values.

The subject site wholly lies within the approved Native Vegetation Clearing Permit (CPS 10494/1) area associated with the Jinbi Solar Farm Facility. The Permit, issued pursuant to Part V of the *Environmental Protection Act 1986*, was granted subject to conditions by the Department of Water and Environmental Regulation on 3 May 2024 over an area of 527.21 hectares over UCL (PINs 1017635 and 1017648), for the purpose of "constructing a solar facility and associated infrastructure".

No revegetation is proposed within the subject site and landscaping will be maintained in a low-threat state.

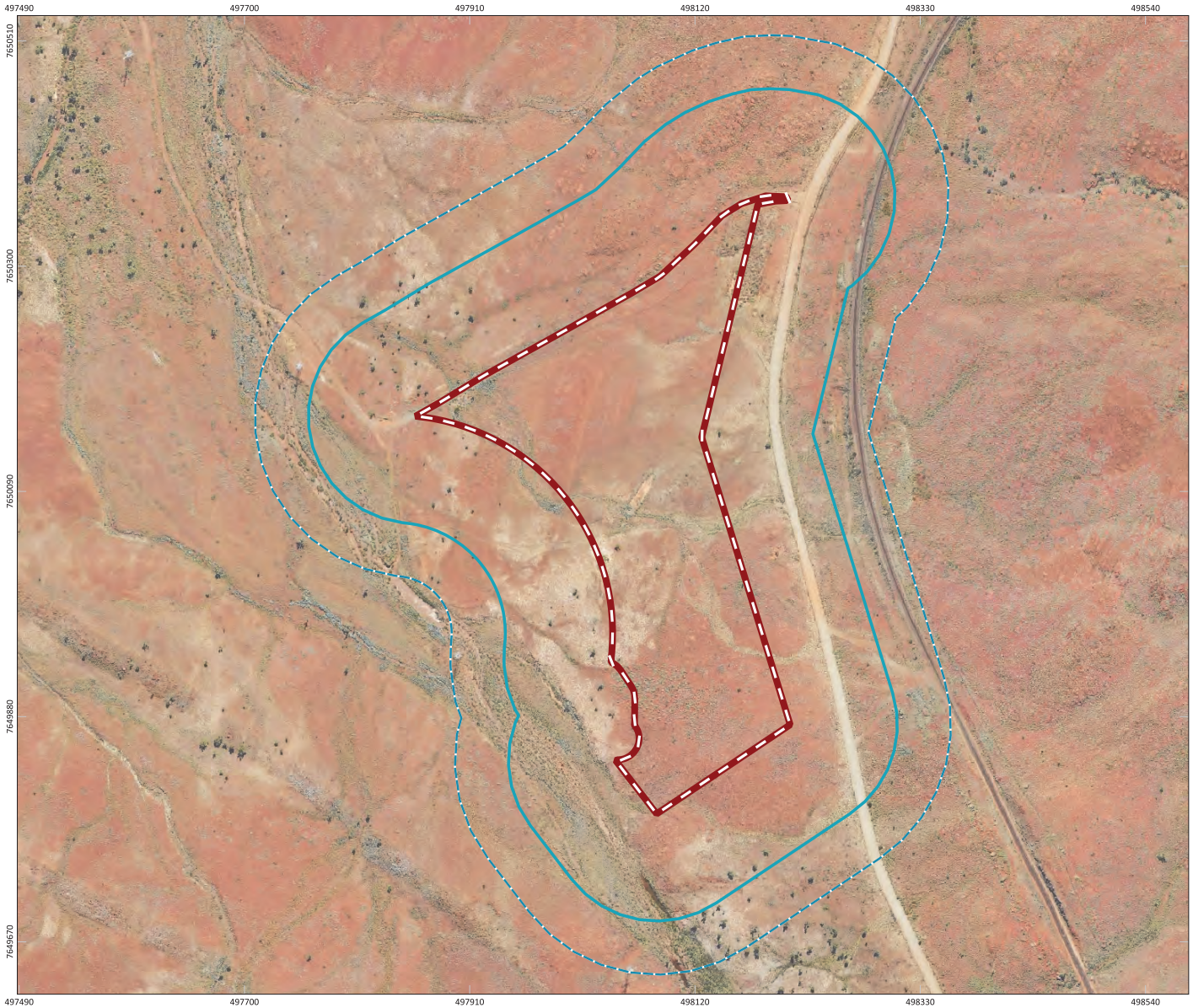






Figure 1: Site Overview

N	0 60 120 180 240 m
SCALE	1:4,200
SHEET SIZE	A3 COLOUR
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
DATA SOURCE	LANDGATE AERIAL IMAGERY
PROJECT/REPORT NAME	Bushfire Management Plan Yindjibarndi Energy Corporation Jinbi Solar Farm Workforce Accommodation
CLIENT	Yindjibarndi Energy Corporation
PROJECT NUMBER	A24.305
VERSION	0
DRAWN BY / REVIEWED BY	JP/DP
DATE	7/5/2025

Legend
- Subject Site
- Buffer 100m
- Buffer 150m

No	Description	Drawn	Approved	Date
A	Original issue	JP	DP	7/5/2025

NOTES:
Cadastral boundary (LGATE-002). Base map ESRI Topo. Townsites (LGATE-248).

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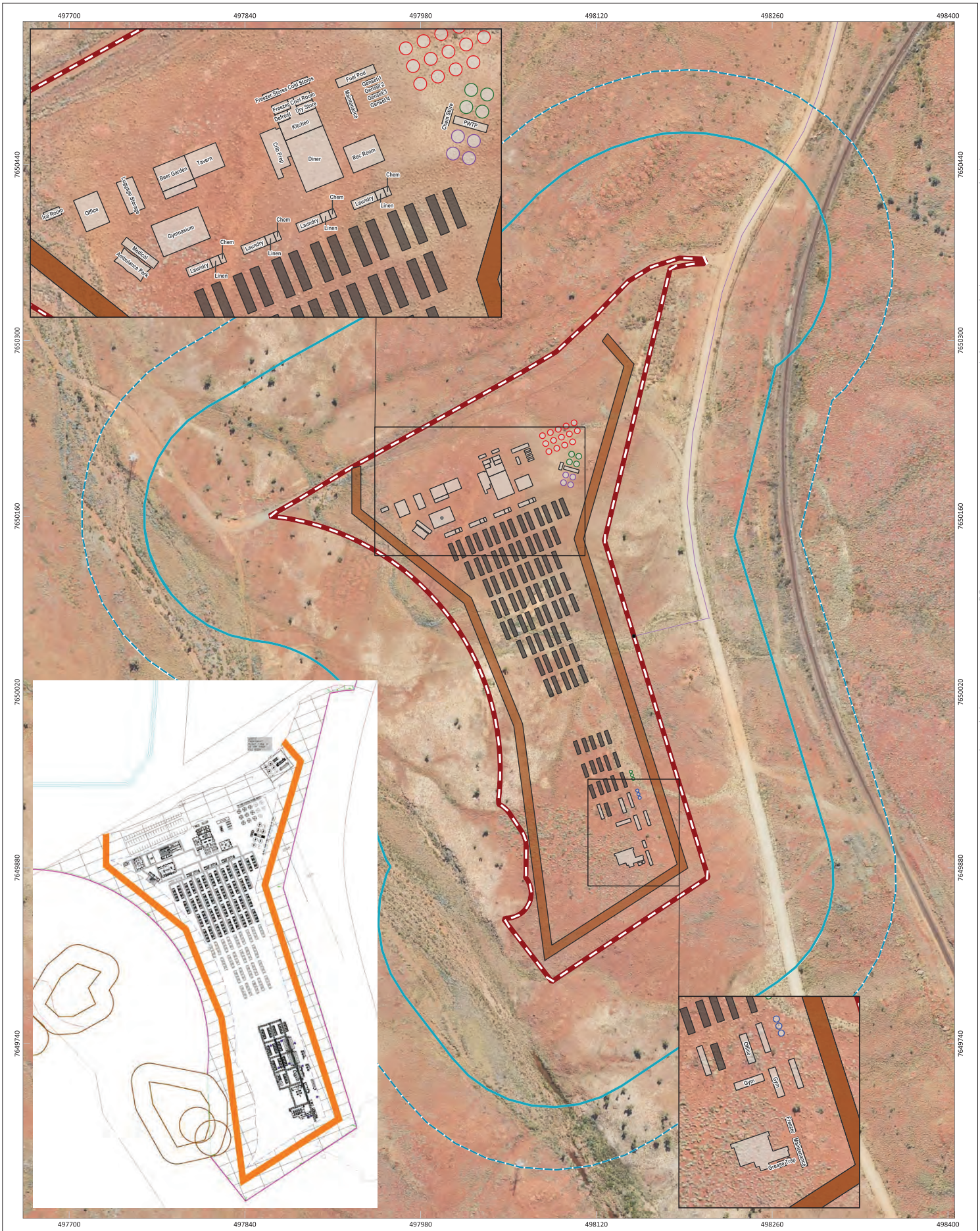


Figure 2: Site Plan

0 20 40 60 80 m

N

PROJECT/REPORT NAME	Bushfire Management Plan Yindjibarndi Energy Corporation Jinbi Solar Farm Workforce Accommodation
SCALE	1:2,800
SHEET SIZE	A3 COLOUR
CLIENT	Yindjibarndi Energy Corporation
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A24.305
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY
DRAWN BY / REVIEWED BY	JP/DP
DATE	7/5/2025

Legend

- Subject Site
- Buffer 100m
- Buffer 150m
- Accomodation building
- Non-accommodation building
- Ring road

Water tanks

- Raw
- Potable
- Waste water
- Fire fighting

No	Description	Drawn	Approved	Date
A	Original issue	JP	DP	7/5/2025

NOTES:

Cadastral boundary (LGATE-002). Label corresponds to the vegetation association number.

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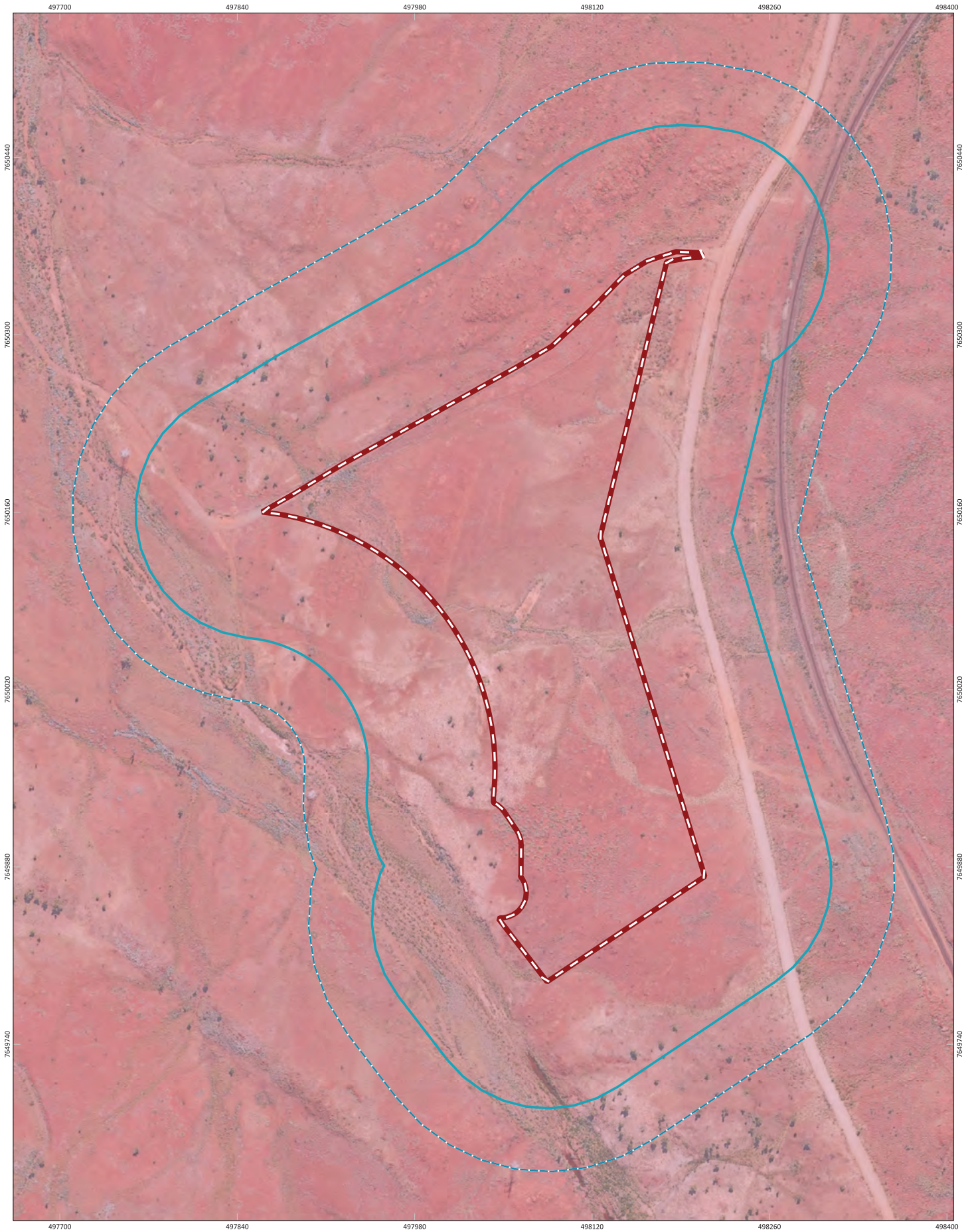


Figure 3: Bushfire Prone Areas

0 20 40 60 80 m

N

SCALE	1:2,800
SHEET SIZE	A3 COLOUR
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
DATA SOURCE	LANDGATE AERIAL IMAGERY

PROJECT/REPORT NAME	Bushfire Management Plan Yindjibarndi Energy Corporation Jinbi Solar Farm Workforce Accommodation
CLIENT	Yindjibarndi Energy Corporation
PROJECT NUMBER	A24.305
VERSION	0
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DATE	7/5/2025

Legend

- Subject Site
- Buffer 100m
- Buffer 150m

Bush Fire Prone Area Planning (OBRM-023)

- Bushfire Prone Area 2

No	Description	Drawn	Approved	Date
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3. Bushfire Assessment Results

3.1 Bushfire Assessment Inputs

A bushfire assessment has been undertaken for the DA in accordance with the Guidelines. Inputs to this assessment are detailed below.

3.1.1 Fire Danger Index

A blanket Fire Danger Index (FDI) 80 is adopted for Western Australia, as outlined in *Australian Standard AS 3959: 2018 Construction of Buildings in Bushfire Prone Areas* (AS 3959: 2018; SA, 2018).

3.1.2 Vegetation Classification and Slope under Vegetation

Vegetation and effective slope (i.e. slope under vegetation) within the subject site and surrounding 150 m (the assessment area) were assessed on 3/05/2024 in accordance with the Guidelines and AS 3959: 2018.

Identified vegetation plots and associated effective slope within the assessment areas are identified below in Table 1 and Figure 4.

Table 1: Classified Vegetation as per AS 3959: 2018

Plot	Vegetation classification	Effective slope
1	Class C Shrubland	All upslopes and flat land (0 degrees)
2	Excluded - clause 2.2.3.2 (e)	-

Photographs relating to each area and vegetation type are included in Appendix A.

3.1.3 Post Development Assumptions

The inset in Figure 5 illustrates the post-development vegetation plots following the subject site being cleared and landscaping being planted to a low threat state. The assessment outputs in this BMP have been based on the post development scenario.

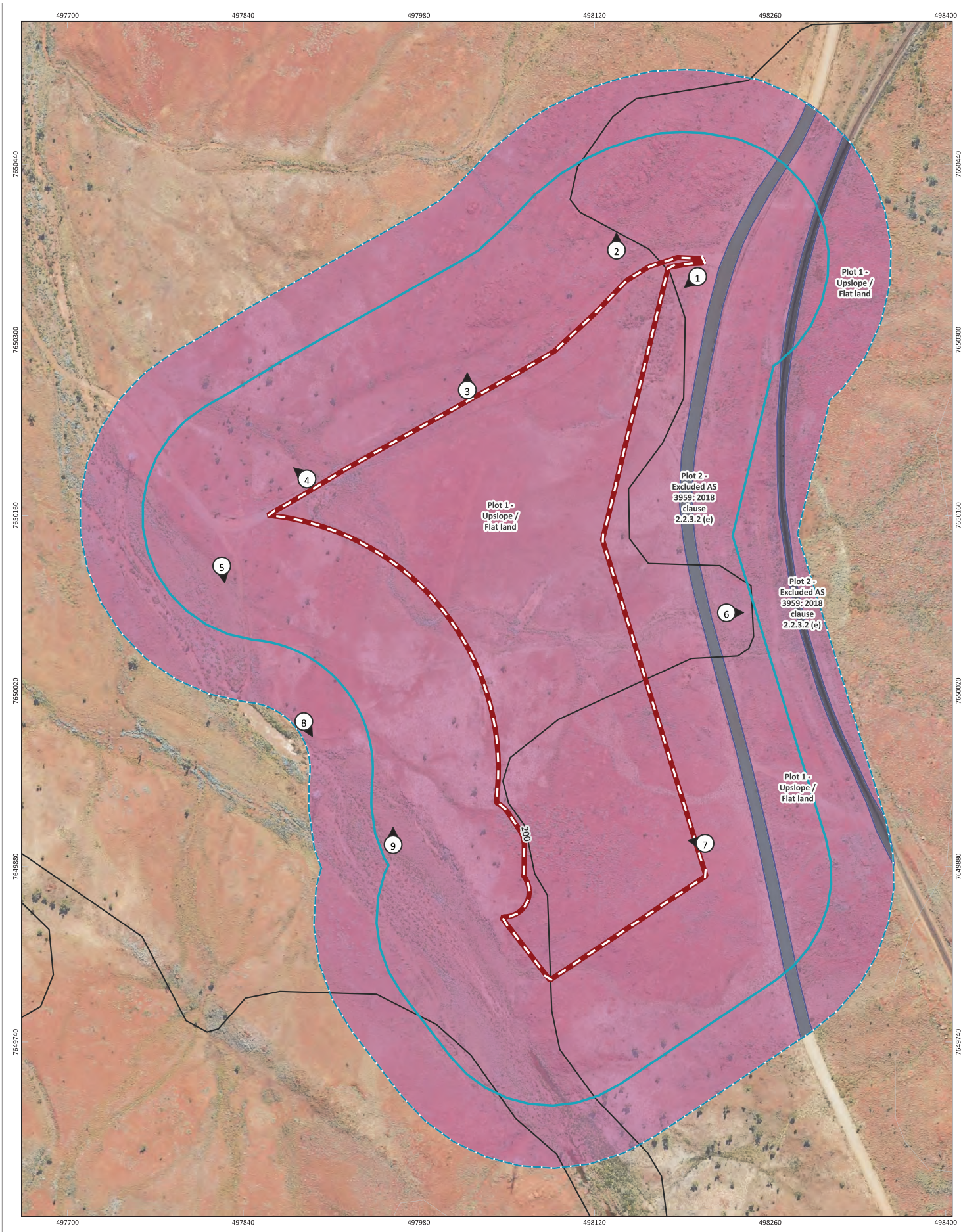


Figure 4: Vegetation Classification Pre-Development

N

0 20 40 60 80 m

SCALE	1:2,800
SHEET SIZE	A3 COLOUR
PROJECT/REPORT NAME	Bushfire Management Plan Yindjibarndi Energy Corporation Jinbi Solar Farm Workforce Accommodation
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PROJECT NUMBER	A24.305
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY
DRAWN BY / REVIEWED BY	JP/DP
DATE	7/5/2025

Legend

- Subject Site
- Buffer 100m
- Buffer 150m
- Contour Line (LGATE-015)
  - Each 50m
  - Each 10m
- Photos
- Vegetation Classification
  - Class C - Shrubland
  - Excluded AS 3959: 2018 2.2.3.2 (e)

No	Description	Drawn	Approved	Date
A	Original issue	JP	DP	7/5/2025

NOTES:

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3.2 Bushfire Assessment Outputs

A Bushfire Attack Level (BAL) assessment has been undertaken in accordance with SPP 3.7, the Guidelines, AS 3959: 2018 and the bushfire assessment inputs in Section 3.1.

3.2.1 BAL Assessment

All land located within 100 m of the classified vegetation depicted in Figure 4 is considered bushfire prone and is subject to a BAL assessment in accordance with AS 3959: 2018.

A Method 1 BAL assessment (as outlined in AS 3959: 2018) has been completed for the proposed subdivision and incorporates the following factors:

- Fire Danger Index (FDI) rating.
- Vegetation class.
- Slope under classified vegetation.
- Distance between proposed lots and the classified vegetation.

Based on the identified BAL, construction requirements for relevant buildings/structures can then be assigned. The BAL rating gives an indication of the expected level of bushfire attack (i.e. radiant heat flux, flame contact and ember penetration) that may be received by proposed buildings and subsequently informs the standard of construction required to increase building survivability.

3.2.2 Method 1 BAL Assessment

Table 2 and Figure 5 display the Method 1 BAL assessment (in the form of BAL contours) that has been completed for the proposed DA in accordance with AS 3959: 2018 methodology.

Table 2: Method 1 BAL Calculation (BAL Contours)

Plot	Vegetation classification	Effective slope	Separation distances required (m)				
			BAL-FZ	BAL-40	BAL-29	BAL-19	BAL-12.5
1	Class C Shrubland	All upslopes and flat land (0 degrees)	<7	7-<9	9-<13	13-<19	19-<100
2	Excluded - clause 2.2.3.2 (e)	-	No separation distances required - BAL-LOW				

Post-development, all proposed buildings within the subject site will be exposed to a radiant heat flux of 12.5 kW/m^2 (BAL-12.5) as depicted in Figure 5.

3.3 Identification of Issues Arising from the BAL Assessment

Post-development, all proposed buildings within the subject site will be exposed to a radiant heat flux not exceeding 12.5 kW/m^2 (BAL-12.5).

A reassessment of BAL ratings, through either a BMP addendum or revised BMP will be undertaken if changes to development design or classified vegetation within the assessment area which require a modified bushfire management response occur.

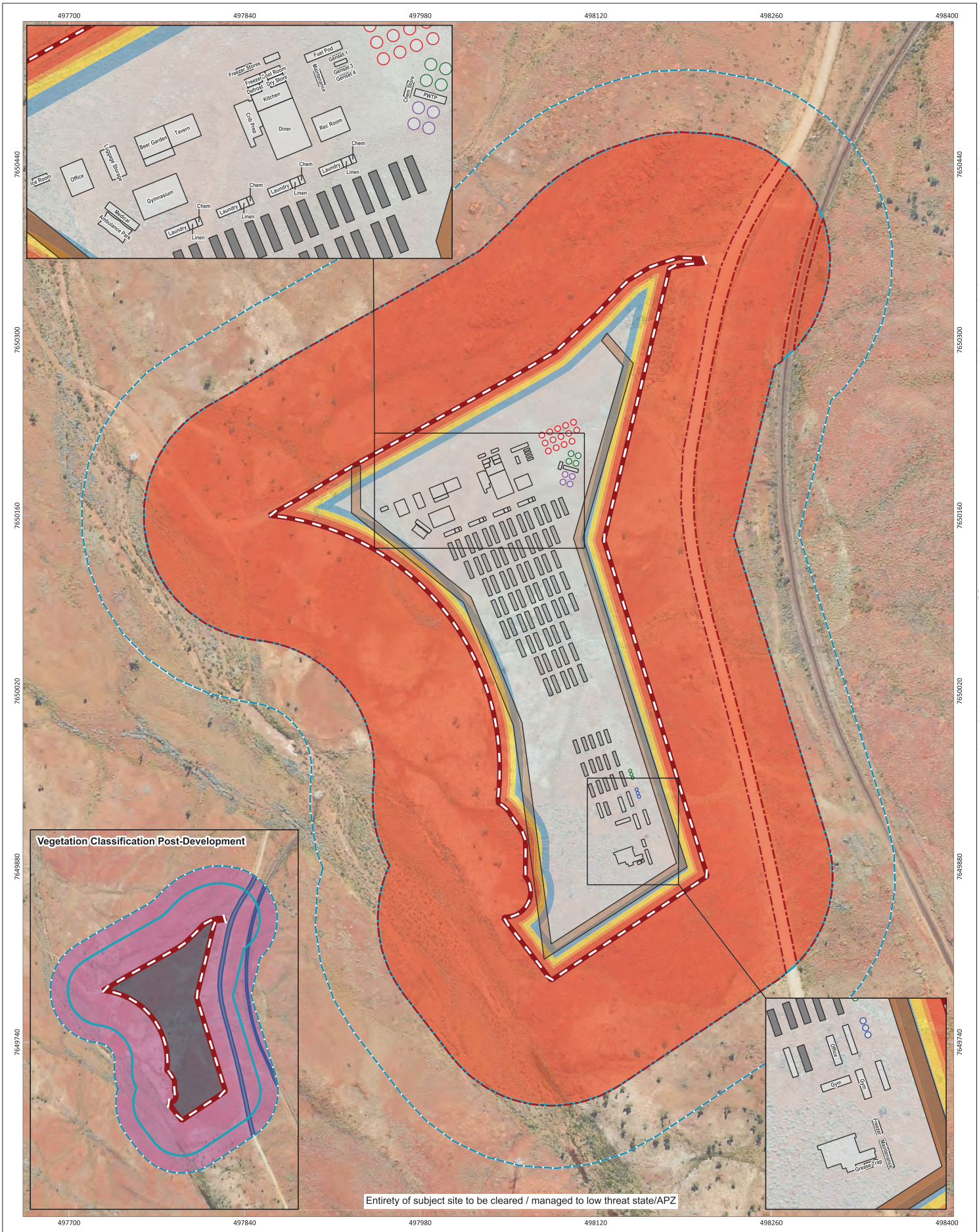


Figure 5: Bushfire Attack Level (BAL) Contours

0 20 40 60 80 m

N

SCALE	1:2,800
SHEET SIZE	A3 COLOUR
PROJECT/REPORT NAME	Bushfire Management Plan Yindjibarndi Energy Corporation Jinbi Solar Farm Workforce Accommodation
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PROJECT NUMBER	A24.305
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY
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DATE	7/5/2025

Legend

- Subject Site
- Buffer 100m
- Buffer 150m
- Bushfire hazard Interface
- Accomodation building
- Non-accommodation building
- Ring road

Water tanks

- Raw
- Potable
- Waste water
- Fire fighting

Bushfire Attack Level (BAL)

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

No	Description	Drawn	Approved	Date
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4. Assessment Against the Bushfire Protection Criteria

4.1 Compliance

The proposed DA is required to comply with Policy Measure 7.1 of SPP 3.7 and Bushfire Protection Criteria 6 of the Guidelines.

Table 3 outlines the Acceptable Solutions (AS) that are relevant to the proposed subdivision and summarises how the intent of each Bushfire Protection Criteria has been achieved through the application of bushfire risk management measures. No Outcomes-Based Approaches (OA) have been proposed for this subdivision. These management measures are depicted in Figure 6 where relevant.

Implementation of this BMP is expected to meet Policy Outcomes 6.1 to 6.4 of SPP 3.7.

Table 3: Assessment Against the Bushfire Protection Criteria

Bushfire Protection Criteria 5: Structure Plans and Subdivision Applications	AS	OA	N/A
Element 1: Location	☐	☐	✓
Not applicable - This Element does not apply to development applications.			
Element 2: Siting and design of development **A2.1 Siting and design**	✓	☐	☐
All proposed buildings will be subject to BAL-12.5, as depicted in Figure 5 and Figure 6. The development is considered to be compliant with A2.1.			
A2.2 Asset Protection Zone (APZ)	✓	☐	☐
The entirety of the subject site will be cleared for development. Post-development, there will be no classifiable vegetation on-site and all adjacent bushfire hazards will be separated from the proposed buildings such that the BAL ratings for the buildings will be BAL-12.5. Separation is in the form of roads, hardstand etc. which will be managed to APZ standards (Appendix B) (Figure 6). The development is considered to be compliant with A2.2.			
A2.3 Clearing of native vegetation	✓	☐	☐
Native vegetation will be cleared for development, which has been approved through a Native Vegetation Clearing Permit (CPS 10494/1). The development is considered to be compliant with A2.3.			
Element 3: Vehicular Access **A3.1 Private Driveways**	✓	☐	☐
Internal roads within the subject site will comply with private driveway requirements in the Guidelines, specifically: • All roads will be a minimum of 6 m wide; • All roads will comply with the technical specifications for private driveways in Appendix C; and • Turnaround areas will be provided as required. The proposed development is considered to be compliant with A3.1.			

Bushfire Protection Criteria 5: Structure Plans and Subdivision Applications	AS	OA	N/A
Element 4: Water Supply **A4.1 Water supply for residential habitable buildings**	✓	☐	☐
The subject site is not located within an area with reticulated water. Twelve, 50 kL interconnected firefighting water tanks (600 kL total capacity) are proposed within the subject site to provide water to protect assets within the site in the event of a bushfire. This water capacity has been calculated using a ratio of 10 kL per transportable 4 single person quarter building (SPQ). There are 43 SPQs proposed, requiring a minimum of 430 kL of water. The ultimate capacity will be 60 SPQs, requiring the 600 kL proposed. The water tanks will be installed when the site is developed and future assets are constructed, in accordance with the specifications in section 4.2 (Figure 6). Two additional 50 kL water tanks, supplying drinking water are also included on the plan. These are not connected to the firefighting water tanks. The proposed development is considered to be compliant with A4.1.			

Note: AS - Acceptable solution, OA - Outcomes-Based Approach, N/A - Not applicable.

4.2 Water Tank Requirements

Each tank and associated stand will be above-ground, constructed of non-combustible material and comply with *AS/NZS 3500.1:2018 Plumbing and drainage Water Services*.

All exposed water supply pipes and fittings will be metal. Fittings should be located away from the source of bushfire attack.

All nine tanks will be interconnected, and a 50 mm male camlock coupling with full flow valve will be fitted to one of the tanks to provide a dedicated point to draw water from.

As the tanks will be interconnected, only one active pump will be provided, with an additional pump available as a standby to provide redundancy. The camp is independent of the electricity grid and powered by generators with 100% redundancy. Therefore, both pumps will be electric with a minimum power of 3.7 kW each.

4.3 Additional Bushfire Management Strategies

Given the remoteness of the subject site, additional bushfire awareness and management measures have been recommended. These measures relate to monitoring and awareness of Fire Danger Ratings as well as subsequent actions.

In addition, Sections 4.3.1 and 4.3.2 identify potential evacuation and shelter-in-place locations, should such actions be required.

Table 4: Bushfire Awareness and Management Procedures

FIRE WEATHER FORECAST AREA: ASHBURTON INLAND		
Actions	**Frequency**	**Responsible Person**
Days forecast with No Rating		
No actions required		
Days forecast as Moderate FDR		
Monitor Emergency WA / or DFES website or ABC Radio for fire incidents	Once daily (1pm)	Camp Manager / Emergency Response Coordinator
Days forecast as High FDR		
Monitor Emergency WA / or DFES website or ABC Radio for fire incidents	Twice daily (1pm and 3pm)	Camp Manager / Emergency Response Coordinator
Complete building preparedness checks (refer to Appendix D)	Once daily (prior to 10am)	Camp Manager / Emergency Response Coordinator
Days forecast as Extreme FDR		
Monitor Emergency WA / or DFES website or ABC Radio for fire incidents	Four times daily (9am, 11am, 1pm and 3pm) or more frequently if fire event in locality	Camp Manager / Emergency Response Coordinator
Complete building preparedness checks (refer to Appendix D)	Once daily (prior to 8am)	Camp Manager / Emergency Response Coordinator
Ensure all vehicles are filled with fuel in case evacuation is advised by emergency services	Once daily (after completion of works each day)	Camp Manager / Emergency Response Coordinator
Days forecast as Catastrophic FDR		
Monitor Emergency WA / or DFES website or ABC Radio for fire incidents	Four times daily (9am, 11am, 1pm and 3pm) or more frequently if fire event in locality	Camp Manager / Emergency Response Coordinator
Complete building preparedness checks (refer to Appendix D)	Once daily (prior to 8am)	Camp Manager / Emergency Response Coordinator
Remove flammable items from around accommodation buildings and the gymnasium in the event that shelter in place is required. **Ensure adequate drinking water is available in the gymnasium.**	Once daily (prior to 8am)	Camp Manager / Emergency Response Coordinator
Visually inspect the area around the camp for signs of fire or smoke	Four times daily (9am, 11am, 1pm and 3pm) or more frequently if fire event in locality	Camp Manager / Emergency Response Coordinator
Ensure all vehicles are filled with fuel and at least 3L of potable water per person, in case evacuation is advised by emergency services	Once daily (after completion of works each day)	Camp Manager / Emergency Response Coordinator

FIRE WEATHER FORECAST AREA: ASHBURTON INLAND		
Additional Controls - Total Fire Ban in area where Camp is located		
Monitor Emergency WA / or DFES website or ABC Radio for fire incidents	Four times daily (9am, 11am, 1pm and 3pm) or more frequently if fire event in locality	Survey Camp Manager / Emergency Response Coordinator

In the event of a bushfire in the landscape, the Department of Fire and Emergency Services (DFES) may issue a Bushfire Warning that may require the Camp Manager to contemplate evacuation or shelter-in-place. Indicative evacuation and shelter-in-place locations have been identified below. Given the possibility for multiple bushfire scenarios to affect the proposed camp, the emergency management team should review these locations, refine if needed, and develop triggers for enacting each procedure.

4.3.1 Evacuation

OFF-SITE EVACUATION ROUTES and DESTINATIONS	
On-site assembly area (prior to off site evacuation)	
Name/Description	Inside the Gymnasium (Figure 6)
Off-site evacuation Destination	
Destination	Karratha Leisureplex Opposite Broadhurst Road, Dampier Hwy, Pegs Creek Nearest Intersection: Dampier Highway and Broadhurst Road
Evacuation route	Travel northeast along the Rio Tinto Rail Access Road toward Manuwarra Red Dog Highway for approximately 13 km, turn left onto Manuwarra Red Dog Highway, travel along Manuwarra Red Dog Highway for approximately 56 km, turn right onto North West Coastal Highway, and then left after 300 m onto Madigan Road, follow Madigan Road for 6 km, turn right onto Dampier Highway, travel along Dampier Highway for 4 km, turn right at the roundabout at Broadhurst Road and then turn left into the Karratha Leisureplex.
Vehicles	All personnel will use vehicles available on site.

4.3.2 Shelter-in-place

SHELTER-IN-PLACE DETAILS	
Building / Area	Location
Gymnasium (Figure 6)	Northwest of camp

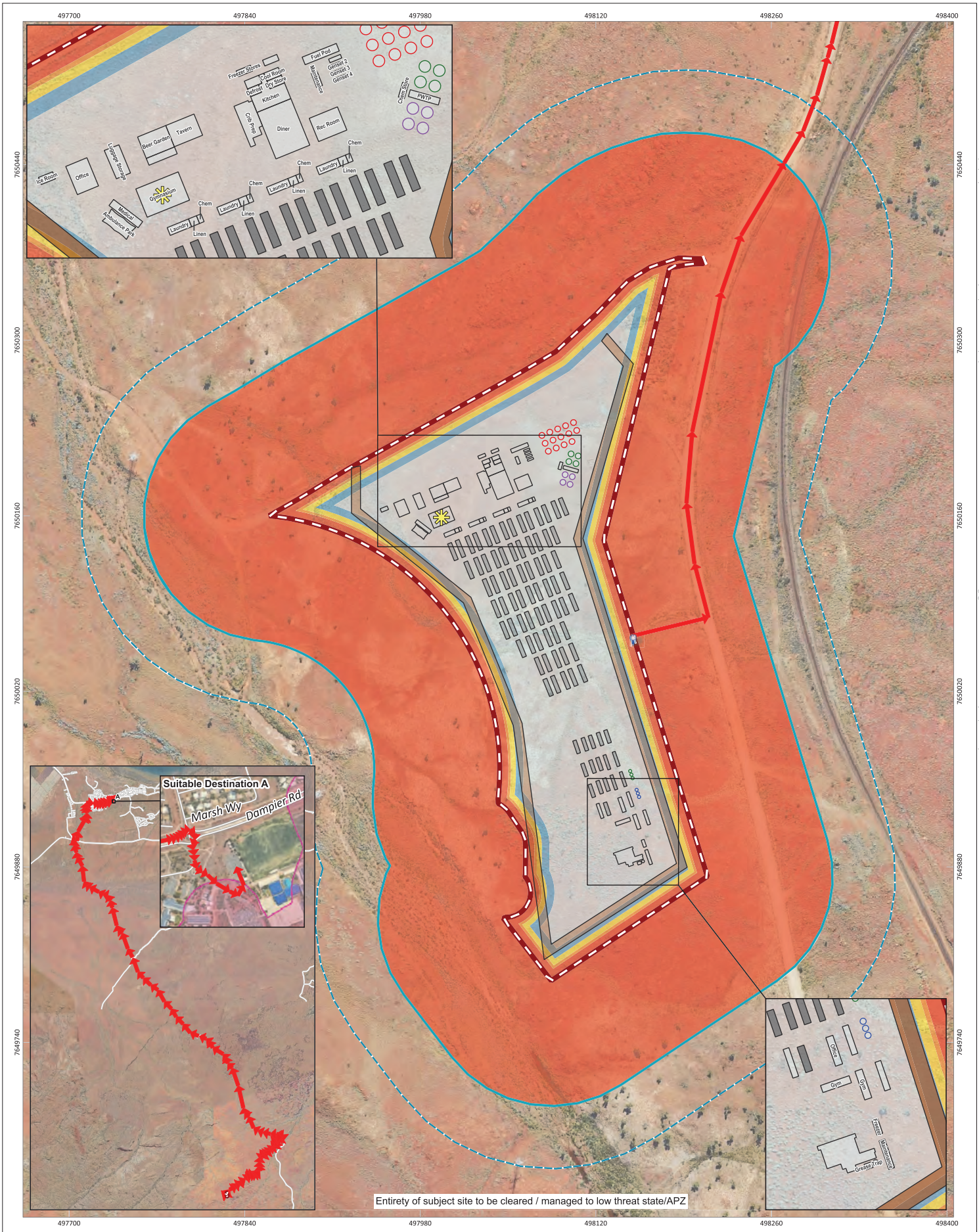


Figure 6: Spatial representation of the bushfire management strategies

0 20 40 60 80 m

N

PROJECT/REPORT NAME	Bushfire Management Plan Yindjibarndi Energy Corporation Jinbi Solar Farm Workforce Accommodation
SCALE	1:2,800
SHEET SIZE	A3 COLOUR
CLIENT	Yindjibarndi Energy Corporation
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A24.305
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY
DRAWN BY / REVIEWED BY	JP/DP
DATE	7/5/2025

Legend

- Subject Site
- Buffer 100m
- Buffer 150m
- Access point
- Shelter in place building
- Access / egress route
- Accomodation building
- Non-accommodation building
- Ring road

Water tanks

- Raw
- Potable
- Waste water
- Fire fighting

Bushfire Attack Level (BAL)

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

No	Description	Drawn	Approved	Date
A	Original issue	JP	DP	7/5/2025

NOTES:

Cadastral boundary (LGATE-002). Label corresponds to the vegetation association number.

WESTERN ENVIRONMENTAL

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5. Responsibilities for Implementation and Management of Bushfire Management Measures

Responsibility for implementation of the bushfire risk management measures outlined in Section 4 of this BMP applies to the developer, future owners/builders within the subject site and the local government. Table 5 provides a works program detailing these measures, timing of implementation and responsibility.

Table 5: Proposed Works Program

No.	Bushfire management measure
Developer responsibilities - Prior to occupancy	
1	Ensure the entirety of the subject site is either non-vegetated, or contains low-threat, maintained vegetation, managed to APZ standards.
2	Provide firefighting water tanks in accordance with Section 4.2 and Figure 6.
3	Construct proposed accommodation buildings to BAL-12.5 construction standards in AS 3959: 2018.
Camp operator responsibilities - Ongoing	
4	Maintain the entirety of the subject site as either non-vegetated areas, or low-threat, maintained vegetation, managed to APZ standards.
5	Review and update the Additional Bushfire Management Strategies in Section 4.3 on an annual basis, through consultation with the Camp Emergency Management Team.

6. Conclusion

In the professional opinion of the author, the proposed development satisfies the intent, aim and objectives of SPP 3.7 and the Guidelines and is recommended for approval.

7. References

Department of Fire and Emergency Services (DFES). (2024). *Map of Bush Fire Prone Areas*. Retrieved on 30/09/2024 from: http://www.dfes.wa.gov.au/regulationandcompliance/bushfireproneareas/Pages/default.aspx.

Standards Australia (SA). (2018). *Construction of buildings in bushfire-prone areas* (AS 3959: 2018).

Western Australian Planning Commission (WAPC). (2024a). *State Planning Policy 3.7 Bushfire*. Government of Western Australia.

Western Australian Planning Commission (WAPC). (2024b). *Planning for Bushfire Guidelines*. Government of Western Australia.

Appendix A:
Classified Vegetation Photos

Plot 1	Class C Shrubland
Photo 1 Vegetation comprises spinifex grassland with scattered shrubs. A Class G Grassland classification would be appropriate, however shrubs may regenerate following rains and/or fire so a conservative classification was adopted. The slope under this vegetation was assessed to be upslope/flat land.	
Plot 1	**Class C Shrubland**
Photo 2 Vegetation comprises spinifex grassland with scattered shrubs. A Class G Grassland classification would be appropriate, however shrubs may regenerate following rains and/or fire so a conservative classification was adopted. The slope under this vegetation was assessed to be upslope/flat land.	
Plot 1	**Class C Shrubland**
Photo 3 Vegetation comprises spinifex grassland with scattered shrubs. A Class G Grassland classification would be appropriate, however shrubs may regenerate following rains and/or fire so a conservative classification was adopted. The slope under this vegetation was assessed to be upslope/flat land.	

Plot 1	Class C Shrubland
Photo 4 Vegetation comprises spinifex grassland with scattered shrubs. A Class G Grassland classification would be appropriate, however shrubs may regenerate following rains and/or fire so a conservative classification was adopted. The slope under this vegetation was assessed to be upslope/flat land.	
Plot 1	**Excluded - clause 2.2.3.2 (e)**
Photo 5 Vegetation comprises spinifex grassland with scattered shrubs. A Class G Grassland classification would be appropriate, however shrubs may regenerate following rains and/or fire so a conservative classification was adopted. The slope under this vegetation was assessed to be upslope/flat land.	
Plot 1	**Excluded - clause 2.2.3.2 (f)**
Photo 6 Vegetation comprises spinifex grassland with scattered shrubs. A Class G Grassland classification would be appropriate, however shrubs may regenerate following rains and/or fire so a conservative classification was adopted. The slope under this vegetation was assessed to be upslope/flat land. Note: The Rio Tinto Iron Ore rail line is in the background.	

Plot 1	Class C Shrubland
Photo 7 Vegetation comprises spinifex grassland with scattered shrubs. A Class G Grassland classification would be appropriate, however shrubs may regenerate following rains and/or fire so a conservative classification was adopted. The slope under this vegetation was assessed to be upslope/flat land. Note: This is vegetation within the subject site which will be cleared for development.	
Plot 1	**Class C Shrubland**
Photo 8 Vegetation comprises spinifex grassland with scattered shrubs. A Class G Grassland classification would be appropriate, however shrubs may regenerate following rains and/or fire so a conservative classification was adopted. The slope under this vegetation was assessed to be upslope/flat land. Note: The open water has not been excluded, as it appears to be part of an ephemeral creekline that may not contain water during the fire season.	
Plot 1	**Class C Shrubland**
Photo 9 Vegetation comprises spinifex grassland with scattered shrubs. A Class G Grassland classification would be appropriate, however shrubs may regenerate following rains and/or fire so a conservative classification was adopted. The slope under this vegetation was assessed to be upslope/flat land.	

Appendix B:
Standards for Asset Protection Zones (WAPC, 2024b)

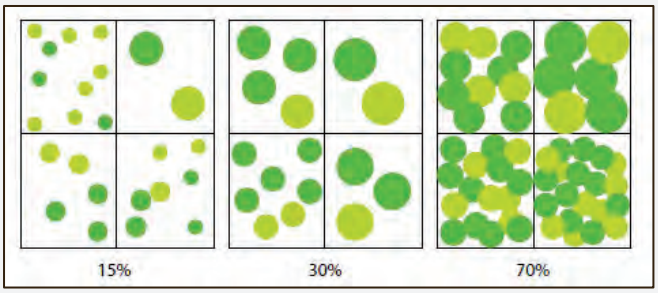
The following standards have been extracted from the Planning for Bushfire Guidelines (WAPC, 2024b).

Every habitable building is to be surrounded by, and every proposed lot can achieve, an APZ depicted on submitted plans, which meets the following requirements:

a. Width: the APZ is measured from the development site, and of sufficient size to ensure the radiant heat impact of a bushfire does not exceed 29kW/m² (BAL-29) in all circumstances.
b. Location: the APZ should be contained solely within the boundaries of the lot, except in instances where:
    - the vegetation on the adjoining lot(s) is, and will continue to be, low threat as per Clause 2.2.3.2 of AS 3959 or the APZ technical requirements, or an alternative standard on a local planning scheme, on an ongoing basis in perpetuity; or
    - the adjoining land is and will remain in perpetuity, non-vegetated.
c. Management: the APZ is managed in accordance with the APZ technical requirements (below), or an alternative standard in a gazetted local planning scheme.

APZ Technical Requirements

Object	Requirement
Fences within the APZ	Should be constructed from non-combustible materials (for example, iron, brick, limestone, metal post and wire, or bushfire-resisting timber referenced in Appendix F of AS 3959).
Fine fuel load (Combustible, dead vegetation matter less than 6 mm in thickness)	• Should be managed and removed on a regular basis to be maintained as a low threat vegetation. • Should be maintained at less than two tonnes per hectare (on average). • Mulches should be non-combustible such as stone, gravel, shells, rock or crushed mineral earth or wood mulch more than five millimetres in thickness.
Trees* **(more than 6 m in height)**	• Trunks at maturity should be a minimum distance of six metres from all elevations of the building. • Branches at maturity should not touch or overhang a building or powerline. • Lower branches and loose bark should be removed to a height of two metres above the ground and/or surface vegetation. • Canopy cover within the APZ should be less than 15 per cent of the total APZ area. • Tree canopies at maturity should be at least 5 m apart to avoid forming a continuous canopy. Stands of existing mature trees with interlocking canopies may be treated as an individual canopy provided the total canopy cover within the APZ does not exceed 15 per cent and is not connected to the tree canopy outside the APZ.

Object	Requirement
	 • Tree canopy cover – ranging from 15 to 70 per cent at maturity
Shrub* and scrub* (0.5 m to 6 m in height). Shrub and scrub more than 6 m in height are to be treated as trees.	• Should not be located under trees or within three metres of buildings. • Should not be planted in clumps more than five square metres in area. • Clumps should be separated from each other and any exposed window or door by at least 10 metres.
Ground cover*(less than 0.5 m in height. Ground cover more than 0.5 m in height is to be treated as shrub)	• Can be planted under trees but must be maintained to remove dead plant material, as prescribed in 'Fine fuel load' above • Can be located within two metres of a structure but three metres from windows or doors if more than 100 mm in height.
Grass	• Grass should be maintained at a height of 100 mm or less, at all times • Wherever possible, perennial grasses should be used and well-hydrated with regular application of wetting agents and efficient irrigation.
Defendable space	• Within three metres of each wall or supporting post of a habitable building; the area is kept free from vegetation but can include ground cover, grass and non- combustible mulches as prescribed above.
Liquid petroleum gas cylinders	• Should be located on the side of a building farthest from the likely direction of a bushfire or on the side of a building where surrounding classified vegetation is upslope, at least one metre from vulnerable parts of a building. • The pressure relief valve should point away from the house. • No flammable material within six metres from the front of the valve. • Must sit on a firm, level and non-combustible base and be secured to a solid structure.
• *** Plant flammability, landscaping design and maintenance should be considered - refer to explanatory notes in the Guidelines.**	

ADDITIONAL NOTES

An Asset Protection Zone (APZ) is a low fuel area, maintained around a building to increase the likelihood a building will survive a bushfire, by reducing the potential for direct flame contact, radiant heat exposure and ember attack. The APZ allows emergency services access and provides an area for firefighters and homeowners to defend their property.

An APZ should be contained within the boundaries of the lot on which the building is situated, except in instances where it is demonstrated the vegetation on the adjoining land is, and will continue to be, low threat as per cl. 2.2.3.2 of AS 3959, or the vegetation on the adjoining lot is, and will remain in perpetuity, non-vegetated. However, it should be noted there is no requirement for a neighbouring landowner or land

manager (public or private) to be party to a legal agreement to undertake ongoing management of vegetation as low threat, in perpetuity.

Appendix C:
Vehicular Access Technical Requirements (WAPC, 2024b)

Technical requirements	Perimeter Roads		Public Roads		Emergency Access Way3		Fire Service Access Route3		Battle-Axe and Private Driveways1	
Map of Bush Fire Prone Areas Designation	Area 2	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2	Area 1
Minimum horizontal clearance (m)	12	8	See note 5		10	6	10	6	6	
Minimum vertical clearance (m)	4.5									
Minimum weight capacity (t)	15									
Maximum grade unsealed road2	See note 5		See note 5		1:10 (10% or 6 degrees)					
Maximum grade sealed road2, 4					1:7 (14.3% or 8 degrees)					
Maximum average grade sealed road					1:10 (10% or 6 degrees)					
Minimum inner radius of road curves (m)					8.5					

NOTES

1. Driveways and battle-axe legs to comply with the Residential Design Codes and Development Control Policy 2.2 Residential Subdivision where not required to comply with the widths in this Appendix or the Guidelines.

2. Dips must have no more than a 1 in 8 (12.5% - 7.1 degrees) entry and exit angle.

3. To have crossfalls between 3 per cent and 6 per cent.

4. For sealed roads only the maximum grade of no more than 1 in 5 (20 per cent) (11.3 degrees) for no more than 50 metres is permissible, except for short constrictions to 3.5 metres for no more than 30 metres in length where an obstruction cannot be reasonably avoided or removed.

As outlined in the Institute of Public Works Engineering Australasia (IPWEA) subdivision guidelines, Liveable Neighbourhoods, Austroads Standards Main Roads standard, supplement, policy or guideline and/or any applicable or relevant local government standard or policy.

Appendix D:
Bushfire Preparedness

The following actions are to be undertaken by the Camp Operators at the specified times.

Ongoing Actions (Year-round)

Ensure the landscaped grounds are maintained to the requirements of Standards for Asset Protection Zones (WAPC, 2024) with the following items checked prior to 1 January each year:

- Objects: within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors.
- Fine Fuel load: combustible dead vegetation matter less than 6 millimetres (mm) in thickness reduced to and maintained at an average of two tonnes per hectare.
- Trees (> 5 metres in height): trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.
- Shrubs (0.5 metres to 5 metres in height): should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.
- Ground covers (<0.5 metres in height): can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.
- Grass: should be managed to maintain a height of 100 millimetres or less.

Detailed information and checklists are available on the DFES website including 'Preparing Your Property'[1] and the 'My Bushfire Plan Toolkit'[2] published by DFES.

[1] https://publications.dfes.wa.gov.au/publications/preparing-your-property

[2] https://mybushfireplan.wa.gov.au/

Actions Immediately Prior to the Bushfire Season

- Ensure the emergency management team is briefed on bushfire risk and the actions required in this BMP.
- Ensure contact phone numbers for the emergency management team are correct and up to date.
- Ensure adequate levels of drinking water are available in the facility in case of emergency.
- Ensure any firefighting equipment (hoses etc.) are serviceable and available.
- Ensure no hazards are present around buildings (for example, rubbish piles) that could contribute to increased fire intensity.
- Ensure property access is kept clear and easily trafficable.
- Ensure first aid kits, fire extinguishers, emergency lighting and other emergency resources are current, serviceable and accessible.
- Ensure roof and gutters are free from leaf litter and debris.
- Ensure an emergency evacuation kit has been prepared and is easily accessible by staff. Refer to https://www.dfes.wa.gov.au/hazard-information/emergency-kits for examples of potentially relevant items to include in the kit.
- Brief all staff on the bushfire evacuation procedures with updated advice provided when fire warnings are issued by Emergency Services (currently DFES) for the locality.

Ongoing Actions During the Bushfire Season

- Maintain the landscaped grounds and APZs in accordance with Standards for Asset Protection Zones.
- Maintain compliance with the local government's annual firebreak and fuel load notice issued under s33 of the *Bush Fires Act 1954*.
- Ensure defendable spaces around buildings and assembly points are maintained.
- Update contact details of the emergency management team and employees.
- Ensure that attendance and visitor registers are updated and accurate at least twice daily.

6 NEXT STEPS

Stakeholder and community consultation will continue as the Jinbi Workforce Accommodation Project progresses and is a key component in understanding social values, impacts and opportunities.

YEC has in place a number of project controls to manage feedback and social risks. The preliminary social impacts and opportunities listed in this SIS will be integrated into project design and reviewed regularly.

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Freight Train Noise Assessment

Jinbi Worker Camp – Yindjibarndi Energy

Reference: 250410151-01

Prepared for:
RFF Australia

Reference: 250410151-01

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Date	Rev	Description	Author	Verified
29-Apr-25	0	Issued to Client	Terry George	Matt Nolan

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Appendix A – Terminology 9

1. INTRODUCTION

It is proposed to subdivide land for Jinbi Worker Camp – Yindjibarndi Energy with the proposed locality shown in *Figure 1-1*. Some of the accommodation modules are within 200 metres of a freight railway, such that a noise assessment is required in accordance with *State Planning Policy No. 5.4 Road and Rail Noise*, being the subject of this report.



Figure 1-1: Subdivision Location (Source: DPLH PlanWA)

Appendix A contains a description of some of the terminology used throughout this report.

2. CRITERIA

The criteria relevant to this project is provided in *State Planning Policy No. 5.4 Road and Rail Noise* (hereafter referred to as SPP 5.4) produced by the Western Australian Planning Commission (WAPC). SPP 5.4 is supported by the *Road and Rail Noise Guidelines* (the Guidelines) and the Department of Planning, Lands and Heritage mapping. The objectives of SPP 5.4 are to:

- Protect the community from unreasonable levels of transport noise;
- Protect strategic and other significant freight transport corridors from incompatible urban encroachment;
- Ensure transport infrastructure and land-use can mutually exist within urban corridors;
- Ensure that noise impacts are addressed as early as possible in the planning process; and
- Encourage best practice noise mitigation design and construction standards.

Table 2-1 sets out noise targets that are to be achieved by proposals under which SPP 5.4 applies. Where the targets are exceeded, an assessment is required to determine the likely level of transport noise and management/mitigation required.

Table 2-1: Noise Targets for Noise Sensitive Land-Use

Scenario	Outdoor Noise Target		Indoor Noise Target	
Noise-sensitive land-use and/or development	55 dB $L_{Aeq(Day)}$	50 dB $L_{Aeq(Night)}$	40 dB $L_{Aeq(Day)}$ (Living and Work Areas)	35 dB $L_{Aeq(Night)}$ (Bedrooms)

Notes:

- Day period is from 6am to 10pm and night period from 10pm to 6am.
- The outdoor noise target is to be measured at 1-metre from the most exposed, habitable[1] facade of a noise sensitive building.
- For all noise-sensitive land-use and/or development, indoor noise targets for other room usages may be reasonably drawn from Table 1 of Australian Standard/New Zealand Standard AS/NZS 2107:2016 *Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors* (as amended) for each relevant time period.
- Outdoor targets are to be met at all outdoor areas as far as is reasonable and practicable to do so using the various noise mitigation measures outlined in the Guidelines.

The application of SPP 5.4 is to consider anticipated traffic volumes for the next 20 years from when the noise assessment has been undertaken.

[1] *A habitable room is defined in State Planning Policy 3.1 as a room used for normal domestic activities that includes a bedroom, living room, lounge room, music room, sitting room, television room, kitchen, dining room, sewing room, study, playroom, sunroom, gymnasium, fully enclosed swimming pool or patio.*

3. METHODOLOGY

Noise modelling have been undertaken in accordance with the requirements of SPP 5.4 and associated Guidelines, as described in *Section 3.1* and *Section 3.2*.

3.1. Noise Level Data

Given the remoteness of the site, rather than undertake noise measurements, a desktop study has been undertaken by using the noise data presented in the SPP 5.4 Guidelines as shown in *Figure 3-1*.

Railway Transport Corridor Classification		Forecast period average noise level and exposure category based on distance from nearest rail centreline (m)																
		adjacent	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	175	200
Passenger railways	Fremantle, Midland and Thornlie main lines only	68	64	62	60	59	58	56	56	55	54	53	52	52	51	51	49	48	
	All other metro passenger rail lines, and where multiple metro rail services share the same transport corridor	70	66	64	62	61	60	58	57	56	56	55	54	54	53	52	51	50	
Freight railways, up to 1 movement per hour		72	68	65	63*	62*	60*	59*	58*	57*	57*	56	55	55	54	53	52	51	

Figure 3-1: Noise Level Data from SPP 5.4 Guidelines

The above noise levels form the basis of the assessment, whereby the model is calibrated for these values. The model is then modified to include the proposed buildings so that the attenuation provided by buildings can be taken into account.

The basis of the noise model was:

- Train Speed – 80 km/hr
- Train Length – 2000 metres
- Locomotive Source Height – 4.0 metres above rail;
- Wagon Source Height – 0.8 metres above rail;
- Number of Trains – 1 per hour. This aligns with the minimum required to be assumed in SPP 5.4.

3.2. Noise Modelling

The computer program *SoundPLAN 9.1* was utilised incorporating the Nordic Rail Prediction Method (Kilde Rep. 130) algorithms, calibrated against the *Figure 3-1* sound levels.

Predictions are made at heights of 1.4 metres above ground floor level. The noise is predicted at 1-metre from a building façade, resulting in a + 2.5 dB correction due to reflected noise.

Various input data are included in the modelling and these are discussed in *Section 3.2.1* to *Section 3.2.2*.

3.2.1. Ground Topography

Topographical data was imported from *Google* as spot heights and assumed to be unchanged in the future.

The plan of the development was provided and incorporated into the noise model with buildings assumed to be 3.0 metres above ground. These buildings can provide barrier attenuation when located between a source and a receiver, in much the same way as a hill or wall.

3.2.2. Ground Absorption

The ground absorption has been assumed to be 0.6 (60%) across the study area, noting that 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

4. RESULTS

A noise model was initially set-up for flat open ground, to enable calibration against the SPP 5.4 Guidelines. Once the input data was determined to generally match the Guidelines, these same inputs were used for the existing railway. The results are presented as a noise contour plot in *Figure 4-1*.

Note that as it is assumed the number of train movements are even throughout the day, the $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ will be the same and as such, the $L_{Aeq(Night)}$ will be the critical parameter.

Figure 4-1



Noise levels
$L_{Aeq(Night)}$ dB

=	51	Exposure A
=	52	
=	53	
=	54	
=	55	
=	56	
=	57	Exposure A+
=	58	
=	59	Exposure B+
=	60	
=	61	Exposure C+
=	62	
=	63	

SPP 5.4 (Sep 2019)

Signs and symbols
- General Building
- Noise Sensitive Building
- Freight Railway

N

Length Scale 1:4000

0 20 40 80 120 160 m

Freight Train Noise Assessment
Jinbi Worker Camp - Yindjibarni Energy

$L_{Aeq(Night)}$ Noise Level Contours Based on SPP 5.4 Screening Tables
Ground Floor Level

SoundPLAN v9.1
Kilde Algorithms
Job No. 250410151

27 April 2025

Lloyd George Acoustics
PO Box 717
HILLARYS WA 6923
(08) 9401 7770

5. ASSESSMENT

The objectives of SPP 5.4 are to achieve:

- Indoor noise levels specified in *Table 2-1* in noise-sensitive areas (e.g. bedrooms and living rooms of houses); and
- A reasonable degree of acoustic amenity for outdoor living areas.

Where the outdoor noise targets of *Table 2-1* are achieved, no further noise controls are necessary. With reference to *Section 4*, it is evident the outdoor noise target will be exceeded at some of the eastern most accommodation modules. As such, *Table 5-1* provides the minimum required construction with *Figure 5-1* and *Figure 5-2* providing the module numbering with rooms within each module labelled A to D, irrespective of which way it is facing.

Table 5-1: Minimum Construction Requirements

Element	Module-Room	Minimum Construction
External Glazing	1A, 1B, 1C, 1D, 3D, 4A, 4B, 4C, 4D, 9D, 15D	Window approximately 27% of floor area and assessed as side on to corridor, thereby requiring $R_w + C_{tr} \geq 26$, likely achievable using 6mm thick glass in fixed/awning style frame with acoustic seals.
	All Other Habitable Rooms	Note - As good practice for close proximity living, it is recommended all glazing be minimum $R_w + C_{tr} \geq 26$, likely achievable using 6mm thick glass in fixed/awning style frame with acoustic seals.
External Doors	1A, 1B, 1C, 1D, 3D, 4A, 4B, 4C, 4D, 9D, 15D	Door to be minimum 35mm thick solid, timber core door with full perimeter acoustic seals. Any small glass inserts to be minimum 5mm thick. Alternative door to be $R_w + C_{tr} \geq 25$.
	All Other Entry Doors	Note - As good practice for close proximity living, it is recommended all entry doors be as specified above.
External Walls	1D, 4D, 8D	Install 2x 13mm thick sound-rated plasterboard direct to inside of south and east 100mm thick sandwich panels.
	1A, 1B, 1C, 2D, 3D, 4A, 4B, 4C, 5D, 6A, 6B, 6C, 6D, 7A, 7B, 7C, 7D, 8A, 8B, 8C, 9D, 10D, 11A, 11B, 11C, 11D, 12A, 12B, 12C, 12D, 13A, 13B, 13C, 13D, 15D, 16A, 16B, 16C	Install 1x 13mm thick sound-rated plasterboard direct to inside of north, south and east (where applicable) external 100mm thick sandwich panels.
Roof / Ceiling	1A, 1B, 1C, 1D, 2D, 3D, 4A, 4B, 4C, 4D, 5D, 6A, 6B, 6C, 6D, 7A, 7B, 7C, 7D, 8A, 8B, 8C, 8D, 9D, 10D, 11A, 11B, 11C, 11D, 12A, 12B, 12C, 12D, 13A, 13B, 13C, 13D, 15D, 16A, 16B, 16C	Metal roof with minimum 90mm thick, 11 kg/m^3 R2 fibrous insulation and ceiling to be 13mm thick sound-rated plasterboard.

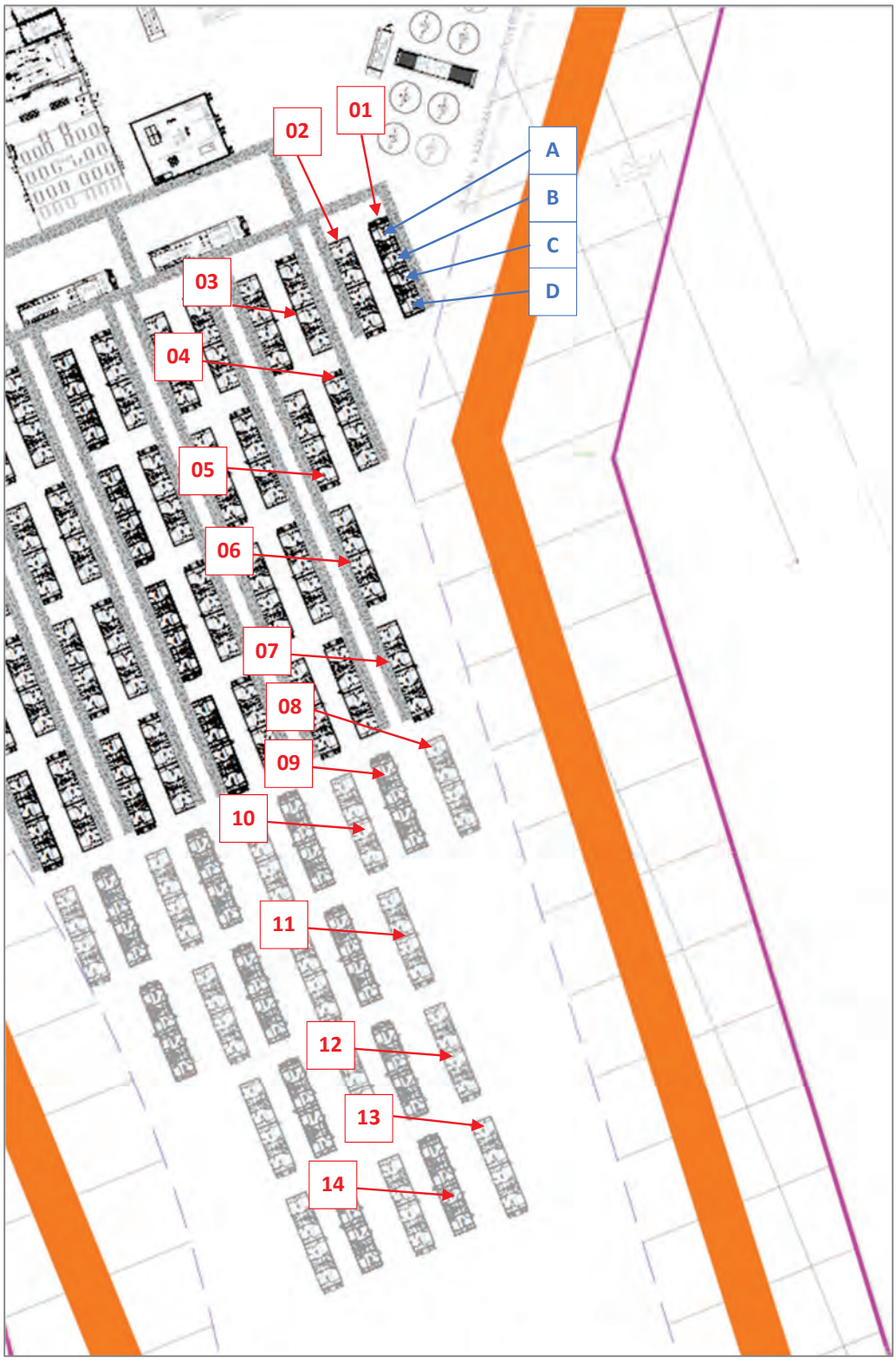


Figure 5-1: Module Numbering North



Figure 5-2: Module Numbering South

Appendix A – Terminology

The following is an explanation of the terminology used throughout this report:

- **Decibel (dB)**

The decibel is the unit that describes the sound pressure levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

- **A-Weighting**

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A, dB.

- **L_{eq}**

The L_{eq} level represents the average noise energy during a measurement period.

- **$L_{Aeq(Day)}$**

The $L_{Aeq(Day)}$ level is the logarithmic average of the L_{Aeq} levels from 6.00am to 10.00pm.

- **$L_{Aeq(Night)}$**

The $L_{Aeq(Night)}$ level is the logarithmic average of the L_{Aeq} levels from 10.00pm to 6.00am.

- **Noise-sensitive land use and/or development**

Land-uses or development occupied or designed for occupation or use for residential purposes (including dwellings, residential buildings or short-stay accommodation), caravan park, camping ground, educational establishment, child care premises, hospital, nursing home, corrective institution or place of worship.

- **R_w**

This is the weighted sound reduction index. It is a single number rating determined by moving a grading curve in integral steps against the laboratory measured transmission loss until the sum of the deficiencies at each one-third-octave band, between 100 Hz and 3.15 kHz, does not exceed 32 dB. The higher the R_w value, the better the acoustic performance.

- **C_{tr}**

This is a spectrum adaptation term for airborne noise and provides a correction to the R_w value to suit source sounds with significant low frequency content such as road traffic or home theatre systems. A wall that provides a relatively high level of low frequency attenuation (i.e. masonry) may have a value in the order of – 4 dB, whilst a wall with relatively poor attenuation at low frequencies (i.e. stud wall) may have a value in the order of -12 dB.

- **About the Term 'Reasonable'**

An assessment of reasonableness should demonstrate that efforts have been made to resolve conflicts without comprising on the need to protect noise-sensitive land-use activities. For example, have reasonable efforts been made to design, relocate or vegetate a proposed noise barrier to address community concerns about the noise barrier height? Whether a noise mitigation measure is reasonable might include consideration of:

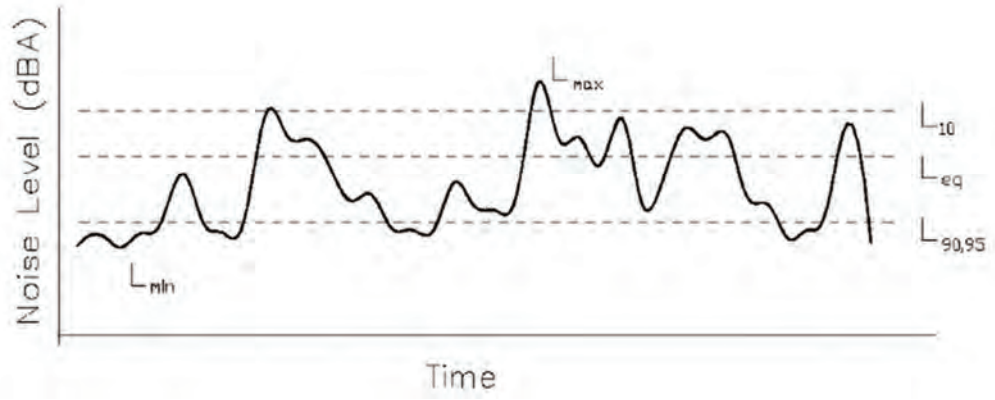
- The noise reduction benefit provided;
- The number of people protected;
- The relative cost vs benefit of mitigation;
- Road conditions (speed and road surface) significantly differ from noise forecast table assumptions;
- Existing and future noise levels, including changes in noise levels;
- Aesthetic amenity and visual impacts;
- Compatibility with other planning policies;
- Differences between metropolitan and regional situations and whether noise modelling requirements reflect the true nature of transport movements;
- Ability and cost for mobilisation and retrieval of noise monitoring equipment in regional areas;
- Differences between Greenfield and infill development;
- Differences between freight routes and public transport routes and urban corridors;
- The impact on the operational capacity of freight routes;
- The benefits arising from the proposed development;
- Existing or planned strategies to mitigate the noise at source.

- **About the Term 'Practicable'**

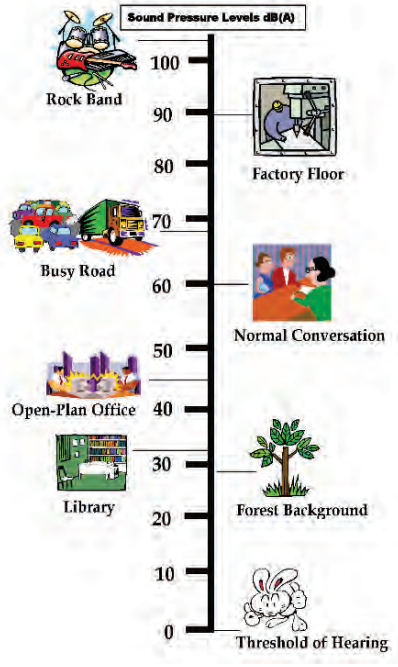
'Practicable' considerations for the purposes of the policy normally relate to the engineering aspects of the noise mitigation measures under evaluation. It is defined as "reasonably practicable having regard to, among other things, local conditions and circumstances (including costs) and to the current state of technical knowledge" (*Environmental Protection Act 1986*). These may include:

- Limitations of the different mitigation measures to reduce transport noise;
- Competing planning policies and strategies;
- Safety issues (such as impact on crash zones or restrictions on road vision);
- Topography and site constraints (such as space limitations);
- Engineering and drainage requirements;
- Access requirements (for driveways, pedestrian access and the like);
- Maintenance requirements;
- Bushfire resistance or BAL ratings;
- Suitability of the building for acoustic treatments.

- **Chart of Noise Level Descriptors**



- **Typical Noise Levels**



PART C – SHIRE OF NARROGIN

1. Declarations of Due Consideration

2. Disclosure of Interests

3. Form 1 DAP Applications

Nil

4. Form 2 DAP Applications

Nil

5. Section 31 SAT Reconsiderations

5.1 Lots 21, 22, 7067, 1189 Contine and Parks Road, Lots 3014, 3015, 3017, 2922, 2921, 1976 Great Southern Highway And Lots 1195, 29, 27, 7207, 6349 Wanerie Road, Narrogin – Proposed Solar and Battery Hybrid – DAP/25/02861

State Administrative Tribunal Reconsideration: Responsible Authority Report

(Regulation 12)

Part C - Item 5.1 - Lots 21, 22, 7067, 1189 Contine and Parks Road, Lots 3014, 3015, 3017, 2922, 2921, 1976 Great Southern Highway And Lots 1195, 29, 27, 7207, 6349 Wanerie Road, Narrogin – Proposed Solar and Battery Hybrid

State Administrative Tribunal Reconsideration – Responsible Authority Report

(Regulation 12)

DAP Name:	Regional
Local Government Area:	Shire of Narrogin
Summary of Modifications:	Additional information only so as to consider modification(s) to condition(s)
Applicant:	Rebekah Hampson, Land Insights
Owner:	Graeme David Steele, Travis John Waller, Vernon Barry Gibson
Value of Development:	$400 million
Responsible Authority:	Shire of Narrogin
Authorising Officer:	Chief Executive Officer
LG Reference:	DA9-24/25
DAP File No:	DAP/25/02861
SAT File No (DR reference):	DR97/2025
Date of Decision under Review:	12 June 2025
Application for Review Lodgement Date:	9 July 2025
Attachment(s):	1. Development Application Report 2. Schedule of Submissions 3. DAP Determination 12 June 2025 4. Additional Information – Staging – Construction Access Plan

Responsible Authority Recommendation

That the Regional Development Assessment Panel, pursuant to section 31 of the *State Administrative Tribunal Act 2004* in respect of SAT application DR 97 of 2025, resolves to:

Reconsider its decision dated 12 June 2025 and **VARY its** decision for DAP Application reference DAP/25/02861 and accompanying plans in accordance with Clause 68 of Schedule 2 (Deemed Provisions) of the *Planning and Development (Local Planning Schemes) Regulations 2015* and the provisions of the Shire of Narrogin Local Planning Scheme No. 3, by deleting Condition 4(e), amending Condition 13, and inserting new Advice Note 18 so that it now reads as follows:

Amended Condition:

13. Prior to the commencement of construction works, the applicant shall undertake road upgrade works to the satisfaction of the Shire of Narrogin, as follows:

    - The section of Contine Road extending from the intersection with Great Southern Highway shall be upgraded and sealed for a minimum length of 550 metres, including the vehicle crossover forming part of the designated site access point.
    - The section of Parks Road where construction traffic will cross between Lot 21 and Lot 7067 shall be upgraded and sealed, including all relevant vehicle crossover(s)

    The scope, standard, and specification of the upgrade works shall be to the satisfaction of the Shire of Narrogin and must be suitable for accommodating construction traffic associated with the approved development.

New Advice Note:

18. With respect to Condition 4, the applicant is advised that if the required landscape screening cannot be fully accommodated within the boundaries of the development site, the Shire of Narrogin may consider the establishment of new plantings within the Great Southern Highway road reserve, subject to the prior authorisation of Main Roads Western Australia (MRWA). The applicant is encouraged to liaise with both the Shire and MRWA early in the process to explore this option and ensure compliance with relevant approvals and standards.

All other conditions, advice notes and requirements detailed in the approval dated 12 June 2025 shall remain unaltered.

Details: outline of development application

Region Scheme	N/A
Region Scheme Zone/Reserve	N/A
Local Planning Scheme	Shire of Narrogin Local Planning Scheme No. 3
Local Planning Scheme Zone/Reserve	Rural
Structure Plan/Precinct Plan	N/A
Structure Plan/Precinct Plan Land Use Designation	N/A
Use Class (proposed) and permissibility:	Renewable Energy Facility – “A” use
Lot Size:	962.4ha
Net Lettable Area (NLA):	N/A
Number of Dwellings:	N/A
Existing Land Use:	Rural
State Heritage Register	No
Local Heritage	☒ N/A

	☐ Heritage List ☐ Heritage Area
Design Review	☒ N/A ☐ Local Design Review Panel ☐ State Design Review Panel ☐ Other
Bushfire Prone Area	Yes Bushfire management plan provided as supporting document
Swan River Trust Area	No

Proposal:

The application proposes a Solar Energy Generation and Battery Energy Storage System (BESS) in Narrogin. The proposal is to be located on multiple lots comprising of three (3) property owners along Great Southern Highway, Contine Road, Parks Road and Wanerie Road in Narrogin. The proposed development will comprise:

- A 200MW solar facility consisting of approximately 400,000 solar panels each of approximately 600W and mounted on a single axis tracking system along with approximately 48 solar inverters on 48 skids. The mounting of the solar panel will be at a height of 1.8m and the maximum height of the solar panels will be at a height of 2.5m.
- A 200MW 4-hour BESS (800MWh) and associated infrastructure including approximately 48 inverters located to the northeast of the subject site, including approximately 144 BESS containers which are generally 20 foot in length.
- 1 Project substation including 2 high voltage transformers located to the south of the BESS facility.
- A grid connection route that connects the site to the existing Western Power Narrogin South substation. Cabling from the substation and BESS facility to the Western Power substation is expected to be underground, crossing Great Southern Highway and the rail line via Booth Street. The proponent has consulted relevant agencies and is finalising landholder permissions, which will be secured prior to project commencement.
- Construction phase - laydown areas, storage areas, crib rooms, meeting rooms and water tanks to support the construction workforce.
- Operational workforce will be accommodated within the town of Narrogin and its surround.

Proposed Land Use	Renewable Energy Facility
Proposed Net Lettable Area	N/A
Proposed No. Storeys	N/A
Proposed No. Dwellings	N/A

Background:

The subject site is located west of the Great Southern Highway and south of Wanerie Road. It comprises several landholdings with a total combined area of approximately 962.4 hectares.

Land use in the surrounding area is predominantly extensive cropping and limited grazing on unimproved pastures, which benefit from surface water drainage and seasonal inundation. The site lies within a shallow valley, with topography ranging from approximately 300m AHD on the south-eastern side to 336m AHD on the western side. The land is typical of the locality, largely cleared for agriculture with small remnants of wetland vegetation scattered across the site

The broader landscape is mostly cleared and used for grazing and cropping. While there are a few farmhouses in the vicinity, there are also various small buildings associated with farming operations. A large hay processing facility is located less than 1 kilometre to the south of the site.

Some tree replanting has occurred along road reserves and existing creek lines, although these are still in early stages of establishment. As such, the landscape remains characteristic of open farmland.

Due to the project's lead time and staged delivery, the applicant requested an extended substantial commencement period of four (4) years, rather than the standard two (2) year timeframe.

History of Application

The scope of the proposed development has remained unchanged since its original lodgement date with the Shire.

The application was first listed and considered by the Regional Development Assessment Panel (DAP) on 15 May 2025. During the course of this meeting, it was noted that there was some contention surrounding the proposed conditions of approval and as such, a motion was moved to defer consideration of the application to allow the applicant and Shire time to discuss the proposed conditions and for the DAP members to review the same.

Following from the above, the application was then listed for consideration by the DAP on 12 June 2025 whereby the DAP approved the application subject to conditions (Attachment 3).

Application to the State Administrative Tribunal

An application for review was lodged with SAT on 9 July 2025 with the applicant seeking the removal of both Conditions 4(e) and 13.

A mediation session was held on 15 August 2025 where the applicants views were considered and discussed. The result of the SAT process had led to the applicant providing additional information with respect to site access clarification and staging of construction. The additional information is provided as Attachment 4

The State Administrative Tribunal (SAT) has made orders inviting the decision-maker, under Section 31 of the *State Administrative Tribunal Act 2004* (SAT Act) to reconsider its decision. The decision-maker may:

- affirm the previous decision,
- vary the decision, or
- set aside the decision and substitute a new decision.

Legislation and Policy:

Legislation

- *Planning and Development Act 2005*
- *Planning and Development (Local Planning Schemes) Regulations 2015*
- *Planning and Development (Development Assessment Panels) Regulations 2011*
- Shire of Narrogin Local Planning Scheme No. 3

State Government Policies

- State Planning Strategy 2050
- WAPC Position Statement: Renewable Energy Facilities (2020)
- State Planning Policy 2.0 – Environment and Natural Resources (SPP2.0)
- State Planning Policy 2.5 – Rural Planning (SPP2.5)
- State Planning Policy 3.7 – Planning in Bushfire Prone Areas (SPP3.7)

Structure Plans/Activity Centre Plans

Not applicable.

Local Policies

- Draft Local Planning Policy (Advertised 17 May 2025) – Temporary/Transient Workforce Accommodation
- Community Enhancements Fund Policy
- Public Art Contribution Policy (11.4)

Consultation:

Public Consultation

The application was advertised for public comment through:

- Public Notice in the Shire's website, Face book and the Local Paper (Narrogin Observer) commencing on 15 January 2025 and closing on 28 February 2025;
- Hard copies made available at the Shire's Administration office and library;
- Letters to nearby and surrounding landowners; and
- Letters to relevant stakeholders.

At the conclusion of the advertising period, a total of 13 submissions were received. A detailed report of the submissions was/is included in the Schedule of Submission in Attachment 2.

The applicant distributed letters to surrounding landowners to introduce the project and invite questions or discussions.

Shire elected members and staff were also briefed on 25 September 2024, providing an overview of the current design, potential impacts, and anticipated benefits of the proposal.

To further engage the community, the applicant hosted two Community Information Sessions on 29 and 30 October 2024 at the John Higgins Community Centre in Narrogin.

Approximately 31 people attended, including local residents, Shire representatives, and elected officials. The sessions featured displays of project plans, maps, and visualisations, and offered attendees the opportunity to ask questions and provide feedback.

A summary of key themes noted through the public consultation process is as follows:

Issues Raised	**Officer comments**
Concerns over increased traffic on internal roads and the impact on road safety.	A Traffic Impact Assessment has been prepared by Shawmac. According to the report the WAPC TIA guidelines, an increase of between 10 to 100 peak hour vehicles is considered to have a low to moderate impact and is generally deemed acceptable without requiring detailed capacity analysis. The estimated 14 vehicles per hour during construction and 18 vehicles once operational is at the lower end of this range and so the development traffic is considered to have a low impact and can be accommodated within the existing capacity of the road network.
Potential impacts on Aboriginal heritage values; request for detailed Aboriginal Heritage Due Diligence Assessment.	As part of the Development process, the applicant will undertake the required Heritage Assessment and to regularly check the ACHIS register should any new Aboriginal Heritage site be reported within the subject area.
Subject land is within a designated bushfire-prone area.	The applicant has provided a Bushfire Management Plan prepared by Bushfire Prone Planning. A detail of the submission and comments provided are included in the attached Schedule of Submissions.
The need to confirm availability and capacity of water, wastewater, and power infrastructure to service future development.	Requirements for water, wastewater, and power infrastructure will be addressed at the building approval stage for any future habitable buildings

<u>Referrals/consultation with Government/Service Agencies</u>

The Shire of Narrogin sent written referrals to the following agencies:

- Department of Jobs, Tourism, Science and Innovation
- Department of Local Government, Sport and Cultural Industries

- Main Roads WA
- Public Transport Authority
- Water Corporation
- Wheatbelt Development Commission
- Development WA
- Department of Primary Industries and Regional Development (DPIRD)
- Department of Planning, Lands and Heritage (DPLH) - Aboriginal Cultural Heritage Services
- Environmental Protection Authority (EPA)
- Department of Biodiversity, Conservation and Attractions (DBCA)
- Department of Fire and Emergency Services (DFES)
- Department of Water and Environmental Regulation (DWER)
- South West Catchments Council
- Wheatbelt Natural Resource Management
- Western Power

During the public advertising period, the following agencies provided their comments. A detail of their response is included in the Schedule of Submissions.

- Water Corporation;
- Public Transport Authority;
- Aboriginal Heritage (DPLH);
- Main Roads WA;
- DFES;
- DWER; and
- Department of Jobs, Tourism, Science and Innovation

Design Review Panel Advice

Not applicable

Swan Valley Planning

Not applicable.

Planning Assessment:

Through the SAT process, the applicant has requested to remove both Condition(s) 4(e) and 13.

Condition 4(e) currently reads as follows:

Prior to the completion of construction, the applicant shall submit to, and have approved by, the Shire of Narrogin a Landscape Screening Plan that demonstrated how visual screening will be achieved through a combination of retained vegetation and new planting along visually sensitive boundaries of the site, particularly where the development is visible from public roads or sensitive receptors. The plan shall:

(e) Including the potential for additional planting to be implemented along Great Southern Highway subject to approval of the Shire of Narrogin in consultation with MRWA.

Throughout the course of the SAT process, the applicant identified that there is every intention to provide the visual screening by way of vegetation and that the screening can be contained wholly within the site boundaries.

While the applicants' intentions are noted, until such time that a final plan is submitted and approved, there is no definitive way of knowing that the screening can be achieved wholly within the site. Additionally, Condition 4(e) was provided to allow the applicant an avenue to negotiate screening, if required, within the MRWA road reserve.

For the benefit of the applicant, it is suggested that the Condition be reallocated as an "Advice Note" to further imply that the Shire is open to the applicant having discussions with MRWA as an alternative solution.

Condition 13 of the DAP approval currently reads as follows:

Prior to the commencement of construction, applicant shall upgrade and seal the following road sections to a standard suitable for accommodating construction traffic, or alternate measures to ensure dust suppression on the roads, to the satisfaction of the Shire of Narrogin:

- *Contine Road from Great Southern Highway intersection to Parks Road.*
- *Parks Road, from its intersection with Contine Road to southern boundary of Lot 6499.*

The scope, standard, and specification of the upgrade works shall be determined in consultation with the Shire of Narrogin and may be implemented in stages or secured through a bond or other form of financial guarantee, as agreed in writing by the Shire.

The original RAR established that the Traffic Impact Assessment (TIA) submitted in support of the application, referred to vehicular access on both Contine Road and Parks Road.

Through the SAT mediation process, the applicant has offered clarification that, through the form of a works staging plan (Attachment 3) vehicular movements associated with construction, can be achieved primarily within the confines of the site boundaries, albeit with the addition of accessing the southern sites by using up to 550m of Contine Road and crossing from Lots 21 and 7067 over Parks Road.

Given that this clarification does not remove the need from using the Shire's local road network, it is not possible to delete the condition, rather, it should be reworded in line with the construction staging plan.

Conclusion:

The Shire's original RAR provided a full assessment of the proposal based on the information provided in the applicant's submission.

Through the SAT process, the applicant has provided additional information with respect to the intended staging of the construction of the facility. Through this additional information, it is noted that the proposal does not intend to use the local road network other than those sections referred to previously.

The remainder of the approval remains unchanged and there is sufficient comfort from a Shire perspective that all other conditions provide suitable recourse where non-compliance may be observed during the construction phase.

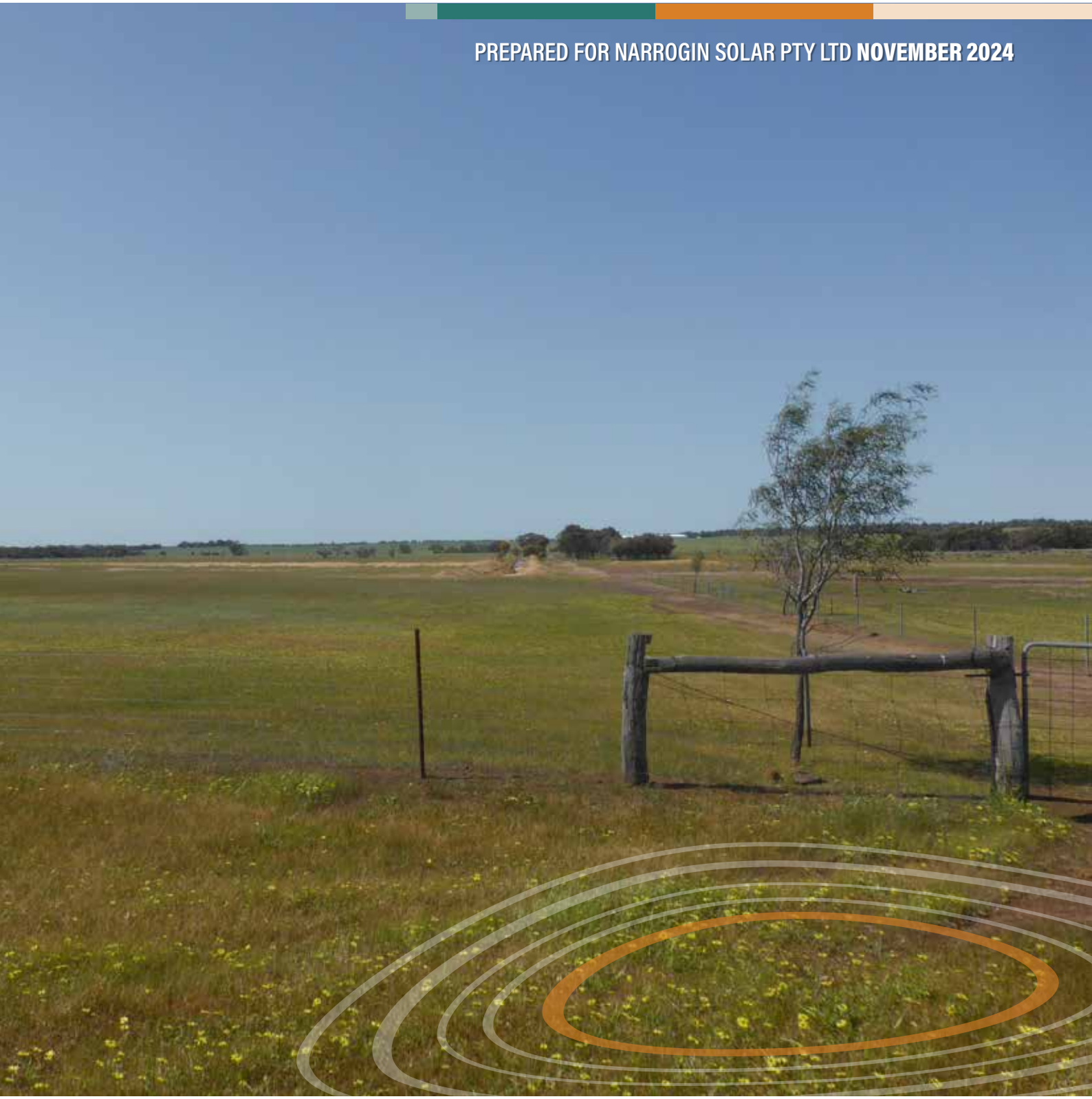
It is therefore recommended the proposed development be reconsidered for approval subject to (amended) conditions.

Alternatives

Nil

NARROGIN SOLAR
AND BATTERY HYBRID PROJECT

PREPARED FOR NARROGIN SOLAR PTY LTD **NOVEMBER 2024**



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Document History:

DATE	DOCUMENT REVISION	DOCUMENT MANAGER	SUMMARY OF DOCUMENT REVISION	CLIENT DELIVERED
Sep-23	0	RH	Initial Incomplete Draft at client request	Dec-23
Nov – 24	1	RH	Pre-Lodgement Draft at client request	Nov -24
Nov – 24	1a	RH	Document for Lodgement	

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glossary

BESS – Battery Energy Storage System
DWER – Department Of Water And Environmental Regulation
DPLH – Department Of Planning Lands And Heritage
RDAP – Regional Development Assessment Panel
SWIS – Southwest Interconnected System
TIA – Traffic Impact Assessment





executive summary

Land Insights acts for Narrogin Solar Pty Ltd, (the proponents of this project) and lodges this application on their behalf. The project comprises a Solar and Battery Hybrid facility (herein 'the project') and substation along with a connection cable linking the project with an existing Western Power substation to the north.

The application proposes the establishment of a 200MW AC solar farm and a 200MW AC 4-hour (800MWh) battery storage energy facility. It seeks approval from the Regional Development Assessment Panel (RDAP) for a 4-year period to allow for design and implementation refinement of the project taking account of the production timelines for equipment to be installed on site.

The project is significant as it will supply energy generated from solar irradiation into the broader Southwest Interconnected System (SWIS), to support the renewable energy targets set out by the Western Australian government. The inclusion of a battery in the proposal will allow for flexible operation of the site and deliver many network benefits. It is consistent with both the State and Local planning frameworks.

The proponents worked closely with all co-consultants and stakeholders to ensure that the project avoids or minimises impacts to the site and the adjacent area. It is noted that remnant vegetation is to be retained and managed to provide a benefit to the environment. The layout has been refined over a 12-month period in conjunction with relevant landowners to ensure that there were minimal impacts on the continued use of relevant properties for farming purposes. As such, once operational the site will still be suitable for continued sheep grazing, thus retaining an agricultural use within the Shire.

This Development Application is supported by a Bushfire Management Plan for the whole of the site and High-Risk Land Use Management Plan in regard to the BESS facility, Traffic Impact Assessment, Visual Assessment, Flora and Fauna Survey's, a Glint and Glare Assessment and an Acoustic Assessment. These background studies demonstrate the proposed development application and report has taken a proper account of local matters as part of its design development process. It therefore warrants consideration for approval with conditions as requested.

1. Introduction

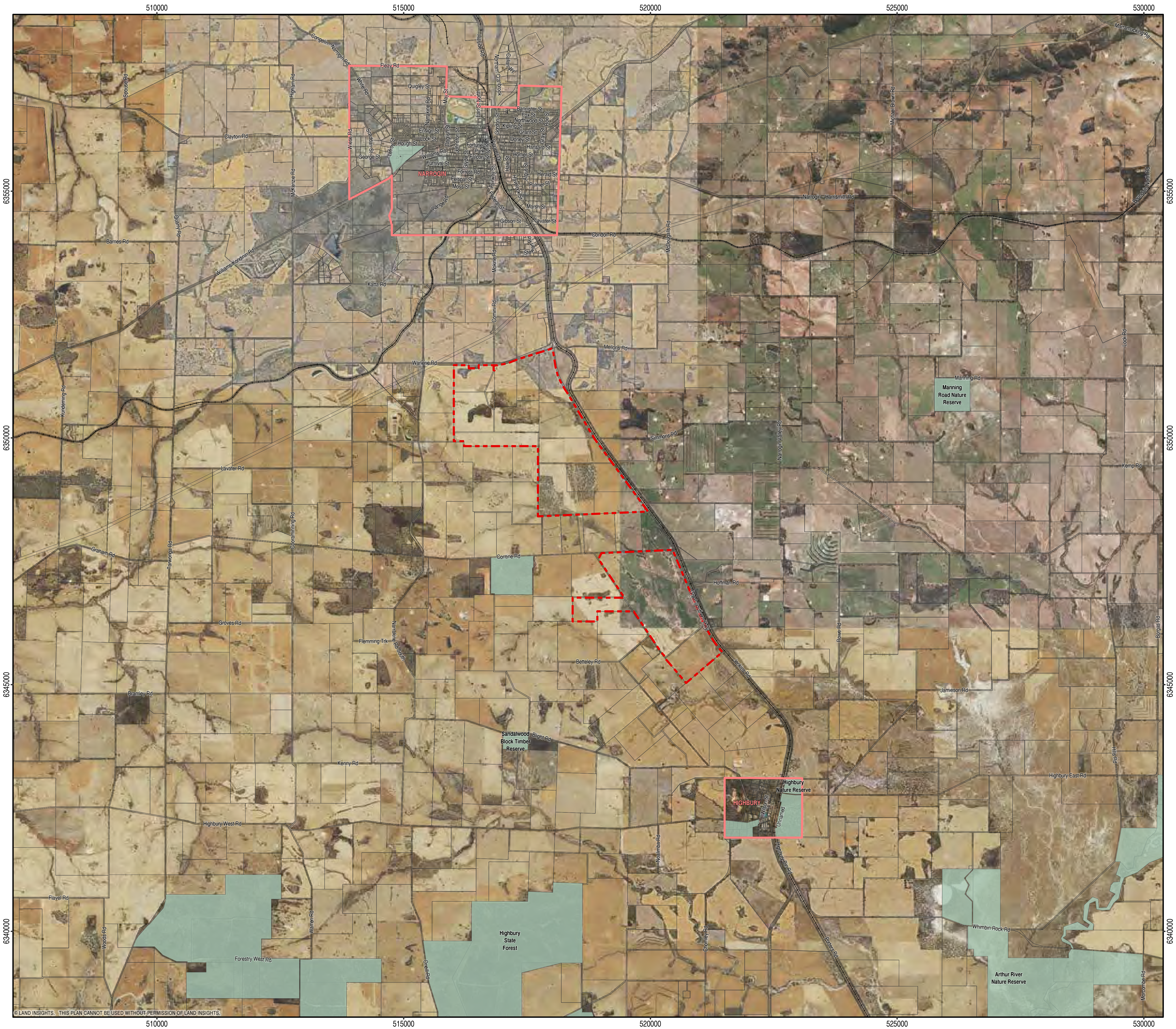
1.1 Background

Land Insights act on behalf of Narrogin Solar Pty Ltd (the proponents), to seek approval to develop a solar energy generation and Battery Energy Storage System (BESS) on rural land approximately 5km south of Narrogin.

The project site covers a land area of approximately 962.4ha, noting some additional land will be used for the connecting transmission line to link the project to an existing Western Power substation located approximately 2km to the north of the site. The actual land area covered by the solar array and BESS facility is less than the entire 962.4ha areas, because areas of remnant native vegetation and some parts of the proposed site deemed unsuitable for the installation of solar panels will be excluded. These may continue to be used for agricultural purposes by the current farm landowners.

A Context and Extent Plan are provided at Figures 1.1 and identify the extent and location of the proposal. Further details within this report relate to site suitability and site selection demonstrating that this site, its location and context are suitable for the proposed development.





Project Boundary

Cadastre

Townsites (LGATE-248)

DBCA - Legislated Lands and Waters (DBCA-011)

N
W E
S

0 1 2 3 4

Kilometres

1:75,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 7/11/2024 3:37 PM
Layout Name: ARP 1121-009-01-01 Site Context

landinsights PLANNING DESIGN ENVIRONMENT
PO Box 289 Mt Lawley WA 6929
Ph: 9271 8506
admin@landinsights.com.au
landinsights.com.au

Site Context

Narrogin Solar and Battery Hybrid Project

NARROGIN

Narrogin Solar Pty Ltd



ACE Power, the owners of Narrogin Solar Pty Ltd are experienced developers of renewable energy projects which use solar power generation and battery energy storage to meet national and state renewable energy adoption targets.

The proposed development will comprise:

- A 200MW solar facility consisting of approximately 400,000 solar panels each of approximately 600W and mounted on a single axis tracking system along with approximately 48 solar inverters on 48 skids. The panels will be installed on piles fixed into the ground with engineered footings to suit soil conditions.
- A 200MW 4 hour BESS (800MWh) and associated infrastructure including approximately 48 inverters located to the northeast of the subject site. Advanced final design and layout of this area will provide a more detailed and specified design suited to the site and could include approximately 144 BESS containers which are generally 20 foot in length.
- 1 Project substation including 2 high voltage transformers located to the south of the BESS facility.
- A grid connection route that connects the site to the existing Western Power Narrogin South substation.

The operational workforce will be accommodated both within the town of Narrogin and its surrounds.

For the construction phase of the project the site requires laydown areas, storage areas, crib rooms, meeting rooms and water tanks to support the construction workforce.

The completed facility will be securely fenced. Internal fencing and gates throughout the site provide for access during both the construction and operation phases, continued grazing of the site and maintenance of solar farm equipment.

The BESS facility and associated substation requires a higher level of security for safety reasons. Chain link fencing with secure locked gates to gain entry will be installed. CCTV will provide an added layer of security and safety. Buildings constructed on site serve the long-term operation of the facility. These include the switchrooms within the high voltage substation set back from Great Southern Highway and Wanerie Road.

A new transmission line will connect the Project to the existing Western Power Narrogin South substation. The new connection will cross under Great Southern Highway from the Project substation connecting to the north within the eastern portion of the Great Southern Highway reserve, then into the Local Government reserve along Booth Street. Preliminary discussions with key stakeholders regarding the grid connection route have occurred prior to lodging this Development Application. Once Development Approval has been obtained, subsequent construction permits for works will be required from applicable agencies.

The site is historically used for farming and therefore substantially cleared of vegetation for that purpose. This development will therefore require limited further clearing and may result in focussed screen replanting to mitigate potential visual impact on neighbouring properties and along Great Southern Highway. The Shire's LPS No.3 requires all proposed development to be set back 50m from Great Southern Highway. The setback will allow for access to the proposed development for maintenance and also help with bushfire management. An additional setback for structures (20m) is required from other lot boundaries. This assists with bushfire management access across the site.

The development is thereby designed to address the recently endorsed Shire of Narrogin Local Planning Scheme No.3 (LPS3) in terms of the design and layout to meet development requirements.

Development Application Forms as provided at Appendix A, and a full suite of drawings and specifications is provided at Appendix B.

1.2 About Narrogin Solar Pty Ltd

Narrogin Solar Pty Ltd is owned by ACE Power who are an Australian Company with extensive experience in developing renewable energy projects across Australia.

ACE Power's portfolio is delivering quality renewable energy products throughout Australia with a pipeline of over 10 gigawatt (GW) power of wind, solar and battery projects. ACE Power has been involved in the development of several wind, solar and battery storage projects across Australia and overseas, with greater than 1.6 GW currently operational in Australia.

1.3 Land Description

The subject site is to the west of Great Southern Highway and south of Wanerie Road. The site consists of several landholdings covering the combined area of approximately 962.4ha

Table 1.1 below outlines the Certificate of Title ownership details of involved lots of this application, a copy of the Certificate of Titles for each property is **at Appendix C – Certificate of Titles.**

Table 1.1 – Certificate of Title Details

There are several unconstructed road reserves throughout the site.



Existing Use

Properties in the locality are generally used for extensive cropping and limited grazing on unimproved pastures which benefit from surface drainage and seasonal inundation.

The site is within a shallow valley and the topography ranges from RL300m Australian Height Datum (AHD) on the south-eastern side of the site to 336m AHD on the western side. The site is typical of this locality, being cleared for farmland with small pockets of remnant wetland and related vegetation within the site.

A Flora and Fauna Survey and the Basic Fauna and Black Cockatoo Assessment found at **Appendix E** of this report identifies any areas with conservation and habitat value, and reports that the site is substantially cleared, and the footprint of the solar farm and BESS facility are not likely to affect vegetated and habitat values.

The properties are fenced into large paddocks, with features including internal tracks, some small light structures and some dams and several houses. The farmhouses and associated farm outbuildings are located outside the area of the proposed development and therefore not impacted. They will continue to be used by landowners in support of ongoing farming practices.

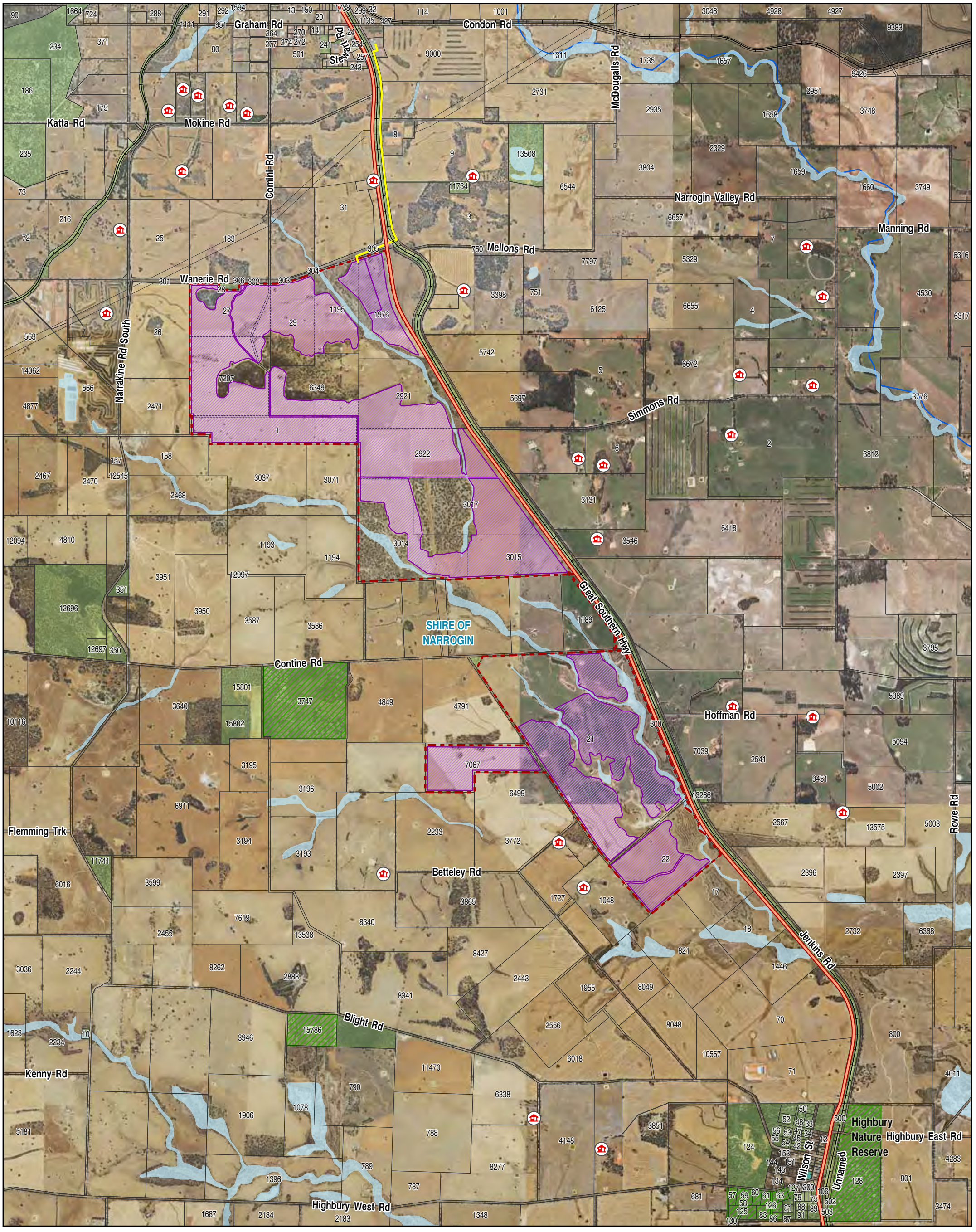
Figure 3.1 below shows locations for several houses on land and surrounding the proposed site (refer to Figure 1.3 – Location of Houses on Surrounding Land below).

Watercourses cross the site, and small existing dams intercept any surface flows into these creeks to be used for farming supply purposes. Wetland vegetation fringes creek lines. The proposed development does not affect the existing watercourses. Some dams may also be retained on site. Sheep grazing may be undertaken beneath and between the solar panels and so these dams support this continued use. Dams provide an additional water source for possible firefighting purposes.

Surrounding land

The surrounding land use is predominantly cleared land, used for grazing and cropping purposes. Whilst there are few farmhouses (refer to Figure 1.3) there are various small buildings located in the area that are ancillary to farming purposes. Less than 1 km to the south of the site there is a very large hay processing plant building. Tree replanting has been undertaken close to or within road reserves and along existing creek lines, however these are establishing and therefore the landscape is best described as open farmland.

The small hamlet of Highbury is located approximately 4 km to the southern extent of the subject site. This is a very small collection of houses and farm buildings. Refer to Figure 1.1 and 1.2 above showing the sites location/ context.



Houses
Extent
Cadastre
State road
Polyline to Power Station
Major river
Wheatbelt wetlands
Panel Area
DBCA - Legislated Lands and Waters (DBCA-011)
Reserves

Base data provided by SLIP.

N

0 500 1000 1500 2000 m

Scale: 1:35,000 @ A3

Surrounding Houses
Narrogin Solar and Battery Hybrid Project
NARROGIN
Narrogin Solar Pty Ltd

2. The Proposal

2.1 Overview

The proposed Project comprises both a solar farm and a BESS facility and will have a generation capacity of approximately 200MW AC. The proposal includes but is not limited to:

- Photovoltaic Modules
- Piles and trackers
- Solar Inverters (and associated housings)
- High voltage Transformers (and associated housings)
- Substation (including circuit breakers, control/switching room and metering)
- Underground cabling
- Overhead cabling
- Perimeter fence
- CCTV (at entrance and adjacent to substations)
- Battery storage containers
- Battery inverters
- Spares storage building
- Maintenance compound
- Some onsite accommodation for workers during the construction phase including ablutions, crib rooms, water tanks, onsite wastewater treatment (this will be removed post the construction phase)
- Transmission line from the project site to the Narrogin South substation (likely to be underground).
- All ancillary infrastructure required to construct a project of this nature

An indicative layout is shown on the plan at **Appendix B – Proposal Plans and Specifications** of this application.

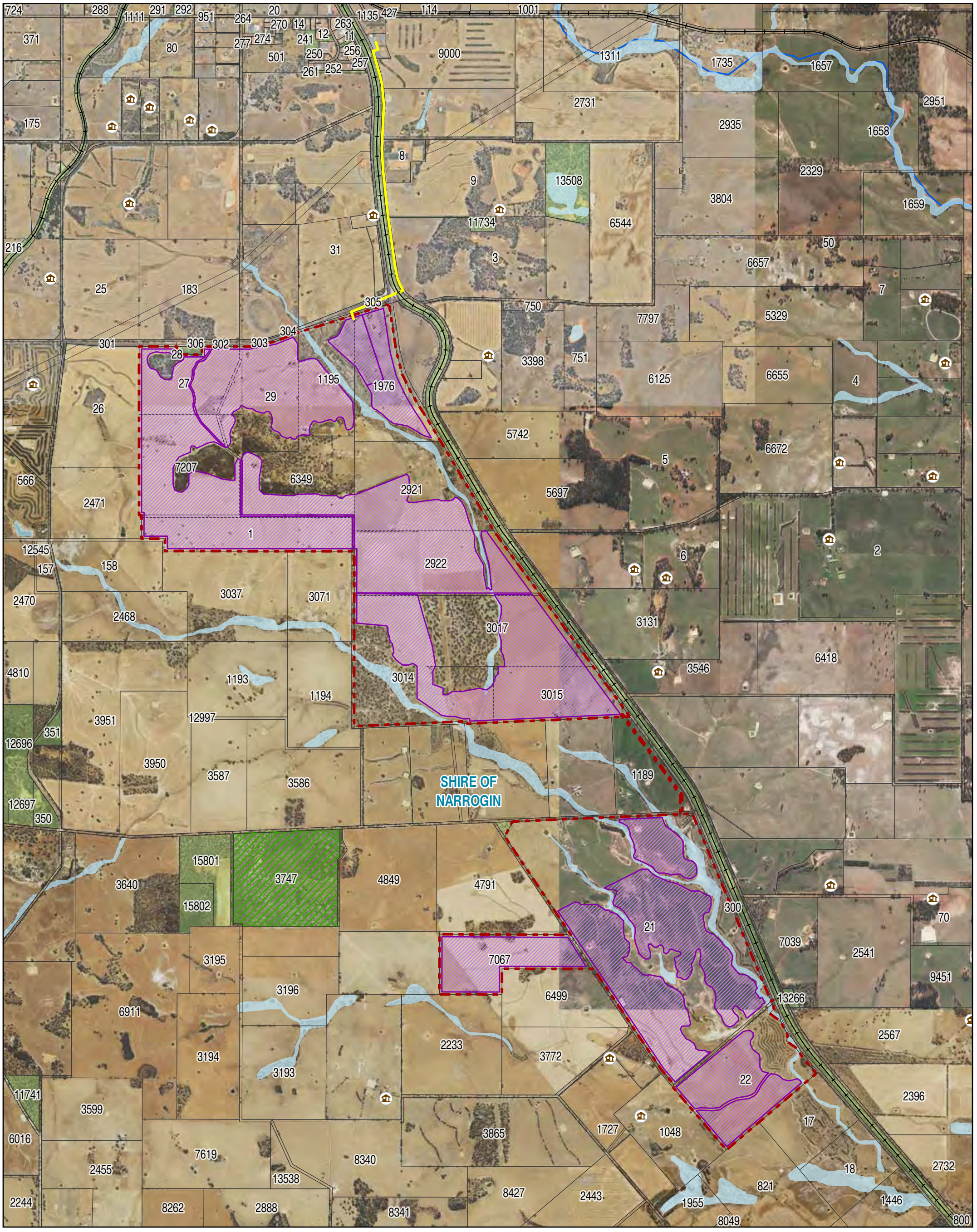
This development application seeks approval for the proposed solar energy and BESS generation facility in-toto, including the connection route to the Narrogin substation.

Construction period of the entire facility will take approximately 12 to 18 months, in a staged manner based on design and the availability of the components for the project. The staging may mean that either the BESS is constructed first in isolation, the solar is constructed first in isolation or both the solar and BESS are constructed concurrently.

The continued use of the site for sheep grazing will not only assist in maintaining the ongoing agricultural use of the site but will also manage weed and pasture vegetation to achieve bushfire management objectives.

The layout of the proposed development has been refined several times and has been carefully designed to avoid any areas of significant remnant vegetation over the site. The remnant vegetation will also screen views of the proposed solar panels and associated infrastructure from the public road areas and to maintain ecological functions. This approach also reduces the concern about requirements for extensive vegetation clearing permits for the site.

The final design refinement of the solar farm and BESS will occur following approval being granted. Materials and component design will be confirmed during detailed design to improve the efficiency and benefits, as well as potentially reduce impacts. The grid connection application process with Western Power is in the early stages and will take 18-24 months to complete. The applicant will also need to work through the appointment of construction contractors and arrangement of project financing and commencement of construction will be after all of these activities have been completed. Therefore, this application seeks a 4-year substantial-commencement timeframe from the Regional Development Assessment Panel (RDAP) to accommodate this process. Construction facilitation and site preparation works will signify the substantial commencement of the project whereby staged construction may be required to progressively install the solar panels and the BESS.



Houses
Extent
State road
Rail Line
Polyline to Power Station
Major river
Wheatbelt wetlands
Panel Area
Cadastre
DBCA - Legislated Lands and Waters (DBCA-011)
Reserves

Base data provided by SLIP.

landinsights

N

0 500 1000 1500 2000 m

Scale: 1:27,500 @ A3

Solar Farm and Power Station
Narrogin Solar and Battery Hybrid Project
NARROGIN
Narrogin Solar Pty Ltd

Path: C:\Users\ShirleyMcIntyre\OneDrive - Land Insights\Drafting Jobs\1121 ARP - Narrogin Solar Mapping\Map\1121 NarroginSolar.aprx

2.2 Pre-Lodgement Liaison/ Consultation

An initial meeting was held with the Shire of Narrogin to introduce the project, and to take notice of any local planning scheme matters which may affect the design and execution of the works plan, this occurred in early April of 2023. A further briefing was conducted following the advance of the proposed design and landowner consultation and prior to the lodgement of this application for development approval.

Shire technical officers advised the Shire was supportive of renewable energy projects and had adopted a new town planning scheme which recognises renewable energy development and provides for it in the Zoning Table.

Officers advised the application would be likely to receive officer support in principle, and the development application should provide planning context, technical explanation and supporting information confirming the site is suitable for the proposed project. The report needs to demonstrate the design and development approach would not adversely impact the surrounding land uses or farming productivity for the broader south Narrogin area.

In addition, the Shire of Narrogin advised that a detailed Bushfire Management Plan and a Risk Management Plan would need to be developed to address both the construction phase and the long-term operation and management of the facility. Such a plan is to assess not only the management of the site, but also comment about its potential to be affected in a bushfire situation or to affect a bushfire risk for the area.

Narrogin Solar Pty Ltd met with Main Roads WA, ARC Rail, Shire management and private landowners in relation to the options for the project connection route. This element will link the development across private lots, across Great Southern Highway and will rely upon existing railway infrastructure crossing and road reserve to contain works.

Consultation with Western Power will further refine the design of the development and this application concurrent with this assessment of the development application. This approach can best ensure an appropriate design outcome for the facility in this site location.

A letter has been sent to surrounding landowners to introduce them to the project and to receive any questions or to consult with Narrogin Solar Pty Ltd. Elected members and selected staff members were briefed on the 25th of September 2024 at the Shire's offices about the current design and to allow for questions in relation to the impacts and benefits of the project.

There were two community information sessions subsequently held on the 29th and the 30th of October 2024 at the John Higgins Community Centre in Narrogin. Approximately 31 members of the public, elected members and Shire staff attended. Attendees could view project information, ask questions about the project and to view large scale maps and visualisations of the project, showing the proposed layout of the panels and the BESS facility.

The project has received interest from several local businesses and service providers that are interested in future collaboration.

Session participants were also informed about stages of the planning application process and the formal advertisement and comment period where community will be able to review all applicable information and make submission on the application during this time.

2.3 Components

Appendix B – Technical Plans and Specifications contains the proposed specifications for all generation components shown over the site and will include the following.

Solar Layout

The solar layout consists of approximately 400,000 600Wp modules sited across the footprint. Solar modules will be mounted on a single axis tracking system to follow the movement of the sun throughout the day and will capture and convert the energy of the sun into direct current electricity. The mounting for the solar panel will be at approximately 1.8 meters in height. The trackers allow the solar panels to rotate to capture the sun light during the day at the optimum angle and the maximum height of the panels is approximately 2.5 metres at full pitch. A glint and glare assessment for the solar panels forms part of this report and concluded there will be no impact on aviation nor surrounding land users with suggested mitigation measure to add screening or limit the pitch of a small number of modules near Parks Road and Great Southern Highway to reduce glint and glare impacts on traffic.

Solar Inverters are distributed across the site. The solar inverters convert the DC electricity generated by the solar modules into grid quality AC electricity. The solar inverters have MV transformers to step up the voltage of the electricity to 33kV which then routes back to the project substation via underground cables buried in trenches.

Cabling – Connection Route

Most internal reticulation cables will be underground and contained within the site except for one to link the southern portion of the proposed facility with the northern portion of the proposed facility. This cable will run over Contine Road and then will be contained within private land over lot 1189 (52 Contine Rd, Dumberning) and this route is subject of a private agreement between the landowner and the proponent.

Cabling linking the substation and BESS facility to the Western Power substation will likely run underground to cross Great Southern Highway and the rail infrastructure and along Booth Street to the substation. The proponent has had discussions with the appropriate affected agencies. The proponent is finalising permissions with landholders and this will be completed prior to commencement.

Substation

Two high-voltage transformers will be contained within the substation located adjacent to the BESS facility to the northeastern edge of the site. Proposed specifications for these facilities are contained within **Appendix B – Technical Plans and Specifications** and will be updated as the project goes through design refinements to achieve the best available design outcomes for the facility.

Structures require a building approval prior to any development occurring over the site. Further and final design and planning approval will inform Building License application plans. Substation lightning-protection works are included to protect the substation from any damage that may occur through a potential lightning strike. The location of the project substation alongside the BESS units will be away from Great Southern Highway and behind a band of trees and landform screening units from viewing along Great Southern Highway and Wanerie Road. There will be limited visual impact from the proposal on passing traffic.

Battery Energy Storage System (BESS)

The BESS facility will be located in the Northeast corner of the proposed development along Wanerie Road and set back to meet the Shire LPS3 development requirements. Views will be screened by significant areas of remnant vegetation on the site and within the Wanerie Road reserve. The BESS facility will contain approximately 144 battery units along with approximately 48 BESS inverters on 48 skids.

The specifications and initial designs and dimensions for these facilities are contained within **Appendix B** of this report. The final design for the BESS facility site will require building license application subject to application for Shire to issue an approval and Building License prior to construction.

Fencing

Fencing for the facility is required for security and safety. This also recognises the Project co-exists with a working farm. Accordingly, two new forms of fencing will be provided on the site with existing farm fencing also retained where possible so that existing farming practices can be undertaken without risk. Some of the existing farm fences may therefore need to be removed to accommodate the solar panel array to extend over lot boundaries within the whole site.

The solar panels will be fenced by a 1.6 - 2-metre-high open-view fence with gates throughout to allow access for maintenance and the controlled movement of livestock. The BESS facility and project substation will be secured with a 2m chain-link fence for safety and security reasons and to protect the infrastructure. A gate will be located near the Wanerie road entrance to allow for workers to access this part of the site for ongoing maintenance and operational purposes.

Remote monitoring will be via CCTV cameras, located at the BESS facility and elsewhere throughout the site. These cameras will be aligned so that they are pointed inwards to the facility and will most likely be motion detection activated.

2.4 Construction

Narrogin Solar Pty Ltd seeks a 4 year approval sufficient to provide flexibility in the design construction schedule for the project. This provides this project with resilience to unexpected delays events in the supply chain beyond the control of the project. Once commenced the development will be constructed within a 12-to-18-months.

An approval is requested to construct a BESS facility, Solar PV array, project substation and a connection to the Narrogin South substation. The construction of these infrastructure assets may be required to take place separately or in parallel as previously noted in this report.

A pre-construction phase will prepare the site, footings and the delivery of the infrastructure. Local and specialist construction workers from outside the local area will travel to the site in light vehicles. Some workers will be driven to the site in small buses to reduce the demand for on-site parking and on the local traffic network The traffic impact study assesses this activity, efer to the Traffic Impact Assessment **Appendix H**. Additional reports of compliance with the applicable requirements are reported in **2.6 Access**.

Narrogin Solar Pty Ltd will appoint a contractor to construct and install the facility. The contractor will be responsible for all items relevant to construction and for adherence to all approvals and relevant standards.

Several construction laydown areas will be required throughout the site, to store materials and equipment and be used for worker and staff parking. Construction of a crossover and deceleration lane may be required for the trucks delivering to the site to access local and major roads.

The construction capacity of on-site workers during the peak construction period is estimated to be approximately 200 people, however this may be reduced through the staging of the construction occurring over the site.

A construction compound and two or three satellite offices of demountable buildings and site preparation will precede the facility construction phase of the project. This is designed to minimise visual impact and to provide site amenity for workers, the site will be rehabilitated post construction.

Narrogin Solar Pty Ltd will use renewable or low-carbon techniques during their construction phases and wherever practicable and feasible in support of their renewable energy ethos.

Indicative equipment within the main construction compound will include the following:

- Site reception office
- Toilet blocks
- Crib rooms
- First aid office
- Office kitchen
- Meeting rooms
- Water tanks
- Visitor car park
- Construction/worker car park
- Undercover rest area with tables
- Satellite site offices spread across the site which may include meeting room, lunchroom, toilets and ablution facilities.
- Shade trees and dust suppression treatments will deliver good amenity to users.

2.5 Operations

Narrogin Solar Pty Ltd will draw upon experience of operating energy facilities elsewhere within Australia to deliver an efficient and automated facility. On-site work includes maintenance (of both the solar and the BESS facility), repairs and security inspections with trips via car or van. Ongoing periodic maintenance includes, fire management, panel washing and grass cutting. Once installed the current landowners will likely manage the grazing over the site.

Electrical equipment will be serviced when required over their operational life.

Operations Management Plans will ensure responses are appropriate and timely to any issues that may arise on the site. The autonomous operational systems in place will alert relevant authorities in the event of a problem or incident, or when unscheduled maintenance is required to any of the components.

2.6 Access

Access to the project site is from public roads as shown as the green dots on the site map at **Appendix J** of this report.

- Wanerie Road services the northern section of the proposed development and
- Contine Road for the southern section with proposed laydown areas shown on the map at **Appendix J**.
- Some Great Southern Highway access points will also be used during the construction phase of the project to allow for components to be laid down in close proximity to where they are to be installed. These access points will also be used later to allow for operations and maintenance.

Note: These access points are used by the current landowners and have existing dedicated crossovers, no new crossovers are proposed to be constructed.

The layout provides for internal circulation and access points for large construction and delivery.

A construction laydown and parking area will be constructed adjacent to the proposed access crossovers to be used for construction personnel and trucks. The BESS facility will inherit one of these areas.

The required setbacks from Great Southern Highway and Wanerie and Contine Roads can be used for periodic internal circulation and access movements during operations.

A traffic impact study has been undertaken for the project. According to the Western Australian Planning Commission (WAPC) Traffic Impact Assessment (TIA) Guidelines this study found that:

> **'An increase of between 10 to 100 peak hour vehicles is considered to have a low to moderate impact and is generally deemed acceptable without requiring detailed capacity analysis. The report concluded that an estimated 14 vehicles per hour is at the lower end of this range and so the construction traffic is considered to have a low to moderate impact and can be accommodated within the existing capacity of the road network.'**

In regard to access to both the Southern and Northern sites during the construction phase of the project, traffic visibility models were run to ensure that Stopping Sight Distances (SSD) and Safe Intersection Sight Distance (SISD) were achievable at the proposed access points throughout the site in reference to Austroads Guide to Road Design Part 3 and Part 4a.

The report can be found at **Appendix H** of this report that supports the above information. The submitted design is deemed suitable and appropriate for the site.

2.7 Staffing

Staffing will peak during the construction stage and taper considerably for operations. Construction staffing will peak at 200 people per day for several weeks only with a graded ramp-up and down in site workforce numbers from these peak levels. This can be achieved by staging of the development across the two sites. Construction personnel will be sourced from the greater Narrogin locality. A mix of local day workers will be supplemented by specialist contractors from further afield.

The operational facility will employ a small number of locally based personnel. Some specialist contractors may be required where such services cannot be locally sourced. Main operational duties will be attending to maintenance of the infrastructure and ensuring fire management requirements are met.

2.8 Community and Economic Benefits

This large renewable energy project represents a major capital investment into the local and State economy and transformational investment in a lower carbon future for the region and Australia. There are benefits likely to flow to businesses in local and broader communities.

The estimated capital cost for developing the project is approximately $526,000,000.

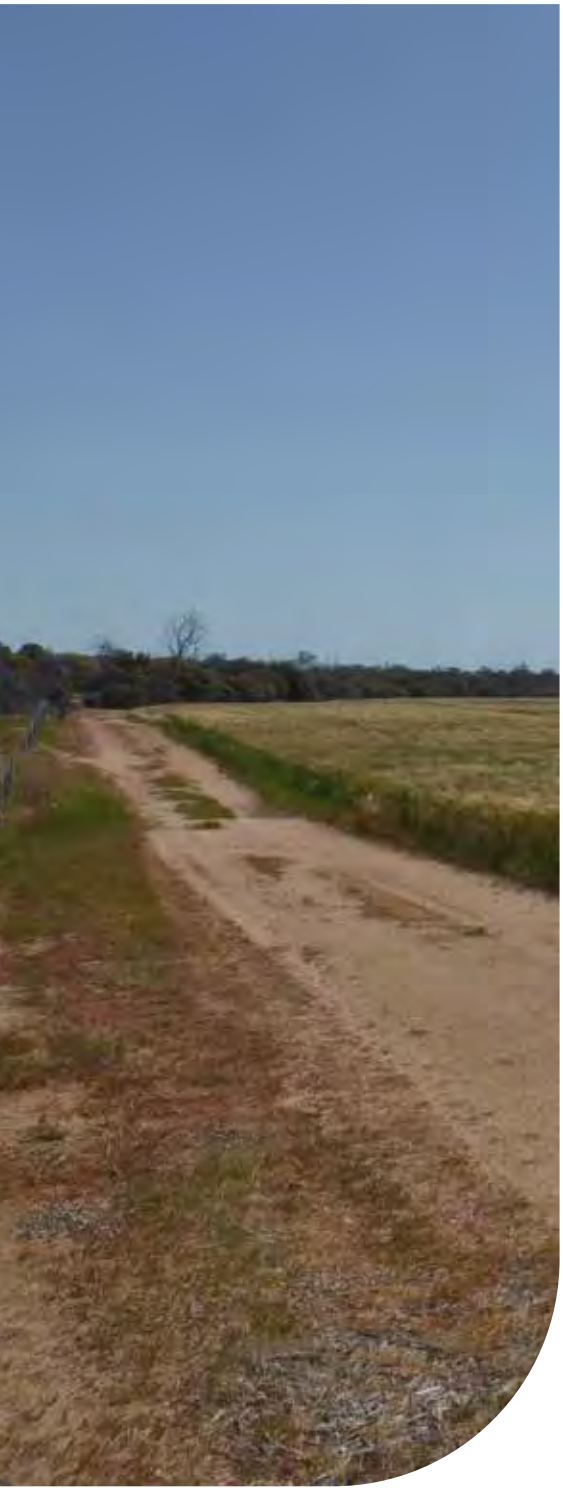
Narrogin Solar Pty Ltd is currently in discussions with the Shire of Narrogin Council to establish a Community Enhancement Fund (CEF). The purpose of the fund is to provide tangible benefits to the community and would be managed by the a dedicated committee to support a range of social initiatives, infrastructure development, and environmental conservation projects in the region.

Construction and operation of the Project will aim to source as much local, regional or Western Australian labour hire and materials as practicable. The peak construction estimate of approximately 200 jobs will generate spin-off investment within the local economy. There will be specific flow-on economic benefits and local employment for Narrogin, including the requirement for accommodation/housing during the construction period and a higher population in the area procuring goods and services during the construction period which will maximise benefits to the local community.

As a principle Narrogin Solar will buy locally where practicable.

Buy-local policy applies during the ramp up phase of the project, where local companies will be invited to apply for or tender for certain jobs such as electrical, security, groundwork, plumbing, and mechanical work giving local companies and their employees a chance to secure work over the construction phase. The Shire is assisting Narrogin Solar in its quest to maximise local employment and service procurement. Several local companies have already expressed an interest in supporting the project.





3. Strategic Considerations

3.1 State Planning Strategy 2050

The State Planning Strategy "highlights the principles, strategic goals and strategic directions that are important to the land-use planning and development of Western Australia".

The strategy further states under point **2.3 Energy** that:

- Effective and flexible planning, policy and regulatory frameworks provide an enabling environment for investment and the uptake of new technologies.
- Existing and emerging industries are encouraged to locate in appropriate regional areas to encourage economic diversification.
- With global and domestic pressures likely to cause further increases in the cost of fossil fuels, it is in Western Australia's long-term interest to develop a diverse energy supply mix, including the use of renewable fuel sources.
- Renewable energy initiatives help to mitigate the risks from climate change, lessen fossil fuel use and reduce greenhouse emissions.

The development of the proposed project facility meets the objectives of the State Planning Strategy 2050 in that the facility will provide a source of clean energy within the Shire and the broader SWIS.

3.2 Strategy Update: Western Australia's Future Battery and Critical Minerals Industries November 2020 – November 2022

This strategy was developed by the Department of Jobs, Tourism, Science and Innovation (JTSI) and states at **Priority 4** to support energy storage applications that consider or address:

- Increasing the uptake of battery energy storage will support new industry development opportunities.
- Large and small-scale batteries offer opportunities for low cost, low emissions energy, and will form a large part of Western Australia's energy transformation into the future.
- The increasing uptake of batteries in rural and remote communities, as well as emerging applications in mining, defence and other advanced manufacturing industries will help to create new jobs, skills and technological capabilities in the assembly, installation and management of energy storage in Western Australia

With the next steps to be to:

- Promote the uptake and integration of batteries across a range of settings and industries in Western Australia.
- Support enhanced workforce capability in the assembly, installation, and management of batteries.

The proposed development of this facility is within a rural area located close to an existing Western Power substation and is therefore meeting the priorities outlined within the strategy in relation to development of the proposed Project.



4. Planning Framework

4.1 Position Statement: Renewable Energy Facilities (2020)

The Western Australian Planning Commission (WAPC) developed a policy in anticipation of the emerging green or renewable energy generation and storage sector. The policy contemplates planning issues and identifies assessment measures to facilitate an appropriate development of renewable energy facilities and directs that proposed facilities to areas that can minimise any impact on the environment, natural landscape, and urban areas while maximising energy production and operational efficiency.

The objectives of the position statement are to:

- Outline key planning and environmental considerations for the location, siting, and design of renewable energy facilities.
- Promote the consistent consideration and assessment of renewable energy facilities
- Facilitate appropriate development of renewable energy facilities while minimising any potential impact upon the environment, natural landscape, and urban areas
- Encourage informed public engagement early in the renewable energy facility planning process.

Under Clause 6 of the position statement a definition of a Renewable Energy Facility is outlined as follows:

> **Renewable energy facility means premises used to generate energy from a renewable energy source and includes any building or other structure used in, or relating to, the generation of energy by a renewable resource. It does not include renewable energy electricity generation where the energy produced principally supplies a domestic and/or business premises and any on selling to the grid is secondary.**

Clause 5.3 of the position statement applies to renewable energy facility proposals and includes matters that should be considered when assessing proposals, these include:

- Community consultation
- Environmental Impact
- Visual and Landscape impact
- Noise Impact
- Public and aviation safety
- Heritage
- Construction impact

The clauses and matters that are applicable to this application are detailed in the **Table 4.1 – Renewable Energy Position Statement** below:

Table 4.1 – Renewable Energy Position Statement

CLAUSE	RESPONSE
5.3.1 Community consultation Early consultation with the community and stakeholders by the proponents is encouraged to ensure that the proposal is compatible with existing land uses on and near the site. The local government should be consulted with respect to the community consultation program.	Pre-lodgement briefing has been conducted by both Land Insights and the proponents Narrogin Solar Pty Ltd. The Shire was briefed about the project and to gauge initial thoughts on support for the development application. A further briefing to elected members and selected staff members at the Shire offices on the 25th of September updated them about the project and to assist them to understand and provide answers to any community questions likely to be received. Detailed site visits were also undertaken on the 26th of September 2024 with the site landowners to identify any issues or constraints with the site and to inform further refined design of the facility. Discretionary pre-lodgement engagement occurred with identified adjoining landowners. Letters were sent to advise them of the project and invite them to meet the proponents and members of Land Insights to discuss the project. Narrogin Solar Pty Ltd received 2 responses, one expressing concern the proposal may impact their property and the other seeking expansion of the development to their property. Representatives from Narrogin Solar Pty Ltd and Land Insights met with the adjoining landowner to discuss the project and to provide answers to the questions that they had. Some mitigation measures, such as additional tree planting along a lot boundary to further screen the proposed development was agreed to be considered. On the 29th and 30th of October 2024 Community Consultation Sessions were held at the John Higgins Community Centre in the town of Narrogin. Several drop-in sessions allowed members of the broader community to view mapping and visualisations of the project and to ask questions about the proposal.
5.3.2 Environmental Impact An environmental survey of the site should be conducted prior to the commencement of the renewable energy facility design. The type, location and significance of flora and fauna, particularly rare and endangered or threatened communities that may be impacted, should be described, and mapped so that remnant vegetation and sensitive areas can be avoided.	Several environmental surveys have been undertaken over the subject site including: – Flora and Fauna Survey (northern portion of the site) – Basic Fauna and Targeted Black Cockatoo Assessment (southern portion of the site) – Glint and Glare Assessment – Visual Impact Assessment – Visual Simulation showing how the development site may appear from certain vantages. – An acoustic assessment The design of the solar farm has been specifically oriented to protect all areas of significant remnant vegetation and small creeks within the site. The design and siting of the panels and associated infrastructure was to retain vegetation and avoid need for clearing permits prior to the construction of the solar farm. The size of the subject site and the overall 200MW AC capacity of the solar farm proposed to can be accommodated on cleared areas of the site. The solar panels and the BESS facility and associated infrastructure such as the substations and inverters can be constructed with sufficient remaining area for grazing and vegetation retention.
Facilities should be located near the grid to minimise clearing of vegetation for grid connection power lines. Solar arrays over a large area may have significant effect on the clearing of native vegetation. Already cleared farming land may offer a practical solution to minimise any environmental impact.	Project site selection is made on the basis that large portions of this site do not contain native vegetation and are used for cropping purposes. As stated in the clause this land has already been cleared for farming and therefore may meet the intent of the WAPC's position statement. Facilities are to be located near the Narrogin substation with a cable connecting the site and the substation over approximately 1.5km. This is subject to further detailed design and discussion and will be negotiated between the proponent, the Shire and Western Power and any other entity such as Main Roads who manage these identified infrastructure corridors. Further discussions will seek to gain the most suitable outcome.

CLAUSE	RESPONSE
5.3.3 Visual and Landscape impact The location and siting of a renewable energy facility may require a visual and landscape impact assessment that addresses:	Landscape impact can be either used to describe the impact of a design, or it can shape and improve a design to reduce any future impact on amenity and resource values. The site is undulating and contains significant areas of mature and replanted vegetation. Large amounts of remnant vegetation across the site complement vegetation within the road reserve of Great Southern Highway and Wanerie Road to screen the visibility of the solar panels from passing traffic along these roads. The most imposing elements of the proposed development are the BESS facility and several substations plus lightning mitigation equipment. These have been sited set well back from Great Southern Highway behind an existing mound and an area of remnant vegetation within the site. This diminishes the visibility from along the Wanerie Road road reserve. The undulating landform on the site further lends itself to reducing the visual impact of the BESS facility and substation in that in front of these the land is at a high point and gradually recedes which is where these facilities are to be located. Some grading of this land will be required so that the BESS and substation can be sited on level concrete footings and then fenced.
landscape significance and sensitivity to change, site earthworks, topography, extent of cut and fill, the extent and type of vegetation, clearing and rehabilitation areas, land use patterns, built form character, public amenity and community values.	The design for the project has sought to minimise cut and fill, earthwork, clearing of vegetation and disruption to land use patterns. As stated above specialist studies (a flora and fauna study, glint and glare assessment, noise assessment and Visual Impact Landscape Assessment and Landscape renders) were undertaken for the development on the site. These assessments guided the design and siting of the solar farm to avoid areas of high conservation value vegetation. A Visual Impact Landscape Assessment found the facility to be visible however unlikely to introduce an adverse limited visual impact taking account of the glare assessment and presence of screening elements such as tree belts and undulating landforms. Much of the subject site is already cleared farmland covered by cropping and grazing uses which resulted in the clearance of large portions of the subject site or all endemic flora. Given the location of the subject site outside of the Narrogin townsite and surrounded by largely cleared areas containing agricultural land uses it is unlikely that the proposed development will have any impact on the built form character, public amenity or community values. The proposed development will comply with the development requirements outlined in Table 5 of the Shire's LPS3 for rural zoned land meaning that the solar panels and proposed BESS development will be setback 50m from Great Southern Highway and 20m from other roads and lot boundaries. These setbacks will reduce the visual influence of views into and around the site. As mentioned above the topography of the site lends itself to reducing the visual impact of the BESS and Substation facility with only minimal amounts of cut required to ensure that these facilities can be installed on flat/level concrete pads.

CLAUSE	RESPONSE
likely impact on views including the visibility of the facility using view shed analysis and simulations of views from significant viewing locations including residential areas, major scenic drives and lookouts	A glint and glare study has been undertaken at **Appendix F** and a Visual Impact Assessment has also been undertaken and forms part of this report showing that the proposed development is suitable on the subject site and that the solar panels, associated infrastructure along with the battery facility will not have a detrimental effect on the surrounding agricultural land nor the views through the agricultural land. The study has also shown that the proposed development will not have a detrimental effect on drivers, driving along Great Southern Highway, Wanerie Road and Continue Road. Further, the topography of the site being rather flat in nature and the large scale cropping use in the surrounding area it will not have a visual impact on the surrounding area. Visual Impact The Visual Impact Landscape Assessment found the project would replace one landscape aesthetic with another, namely an array of solar panels located at grade with the landform, rather than cleared and sparsely vegetated fields and swampy lowlands. This is a change rather than an impact because the receptor landscape is one of altered nature. There are no likely adverse visual impacts which might not be capable of mitigation by management measures such as replanting tree screens, and siting obtrusive elements behind trees or obscured from public view by landscaped bunds. There are pockets of significant vegetation throughout the site which hold the potential to reduce the visual impact, and the solar panels and ongoing investment may fund landscape repair in significant view corridors adjacent to major roads and scenes which might otherwise be dominated by the view of solar panels. The assessment used 11 Viewing Points to gauge the extent of visibility and thereby the likely impact. It found the facility would change the visual character however from most of the Viewing Points this change would be not observed, or if seen would be of no or negligible adverse impact; it would replace one view with another similar view. It also found the development to be most highly visible from one point on Wanerie Road and a couple of points on the Great Southern Highway. At these places, the report suggested it would be possible to undertake margin tree planting to create a screen which may deflect and diffuse direct view of the panels and make for a more rural or natural appearance from those most exposed viewing points. The battery location in the northeast corner of the site will be a prominent and bulky structure visible from the intersection of Great Southern highway and Wanerie Road unless it can be screened or obscured. Some of this impact can be mitigated with lowering of the battery and/or bunding and planting to screen direct views from the roads. This recommendation can be considered in refinement of the design and layout. Whilst the Narrogin township is located several kilometres to the north and on higher ground, it is unlikely the solar farm would be visually dominant from the town and may not even be seen at all. The State Policy identifies conflict with urban areas as a prime consideration, and so given the background of farming and non-residential character of this location, the solar farm might be considered compatible with State Policy for such facilities.
layout of the facility including the number, height, scale, spacing, colour, surface reflectivity and design of components, including any ancillary buildings, signage, access roads, and incidental facilities	The layout of the facility of this report and shown in **Appendix B – Layout Plan and Specifications** Which includes the detailed plans of the proposal. Ancillary buildings and associated infrastructure will be located away from the main roads so as to not have any visual impact on the surrounds. Further, given the size of the site it is easy to locate the ancillary buildings and infrastructure out of site from the main roads. Proposed signage is expected to be minimal and associated way finding signage.

CLAUSE	RESPONSE
measures proposed to minimise unwanted, unacceptable or adverse visual impacts. Visual Landscape Planning in WA: a manual for evaluation, assessment, siting and design, (November 2007) and the Australian Wind Energy Association and the Australian Council of National Trusts Publication Wind Farms and Landscape Values (2005) provide detailed guidance on visual landscape impact assessments.	As detailed previously in this report the proposed development has been sensitively designed to ensure that: Significant remnant vegetation is retained over the subject site The existing remnant vegetation within the subject site and also along the roads will help break up sightlines to the solar panels and in some instances obscure them from sight entirely. A glint and glare study has been undertaken to show that the proposed development will not have any adverse impact on the drivers or surrounding land uses. Given the enormity of the site the panels and all ancillary buildings and infrastructure have been located on the subject site so as to not have an adverse impact on it's surrounds.
Some locations may hold Aboriginal heritage, natural or historic heritage significance which may impact site suitability. An assessment should address: local archaeological and ethnographical records any impact upon the natural environment that have aesthetic, historical, scientific or social significance or other special value for the present and future community any impact upon the historic heritage characteristics of adjoining/nearby places with an impact assessment of the proposal undertaken where relevant. Consultation with the Department of Planning, Lands and Heritage may be required if heritage issues are identified. Appropriate consultation should be undertaken with respect to Aboriginal heritage matters.	A search of the Department for Planning Lands and Heritages database did not reveal any areas of Aboriginal Heritage significance on any of the lots that form the subject site. Further, an Aboriginal Cultural Heritage Study has been undertaken over the site and can be found at **Appendix I** of this report. The study noted that the site has historically been used for agricultural and farming purposes and as a result the site has been highly modified. A search of the ACHIS was undertaken and found that there were no recorded Aboriginal sites. The assessment concludes that the areas of land that Narrogin Solar Pty Ltd intend to develop for the solar farm and BESS facility are extremely unlikely to contain any heritage sites that are important in Aboriginal tradition. In line with best practices when developing the site a number of recommendations were made which included: – Noting the contents of the report – Noting that it is a criminal offence to 'damage, destroy, alter or conceal an Aboriginal site' – Note that there is limited to no potential for unrecorded Aboriginal sites to be present in the areas of land proposed for the development of the project – Note that there is potential for unrecorded Aboriginal cultural values to be present in the undisturbed areas of the land and in the wetlands
5.3.7 Construction impact It is important to accommodate the full scope of works to occur on the site in the development of a renewable energy facility. Consideration needs be given to resolving effective staging and may also include one type of renewable energy being subsequently complemented by a second type of renewable energy to supplement continuity of feed into the grid, for example, wind turbines supplemented by solar arrays on the same site. Delivery of a hybrid facility is more complex. Key matters that should be addressed during the construction phase are:	The full scope of works and development that are to be carried out on the subject site will form part of the further detailed design and the construction management plan.
a site construction management plan that identifies standards and procedures for the construction of the development including the management of environmental emissions such as dust and noise	A Construction Management Plan (CMP) can be implemented as a Condition of Approval by the Shire. The CMP will be in line with the Shire's requirements and will include the standards and procedures for the construction of the proposed development including the environmental emissions such as dust and noise. An acoustic report demonstrating that the proposed development complies with applicable legislation forms part of this application.

CLAUSE	RESPONSE
site disturbance should be minimised during construction through careful siting and measures to address erosion, drainage run-off, flooding, water quality, retention of remnant vegetation, stabilisation of topsoil, and weed and disease hygiene	The proposed development has been designed to sensitively respond to the site and site disturbance will be minimised during the construction phase. The design reflects the best possible use of the site considering all the various matters outlined under this point.
vehicle and machinery access and movement. A decommissioning program should be separately developed in relation to removal of the facility and any rehabilitation requirements.	A Transport Impact Statement (TIS) accompanies this application at **Appendix H** This shows that the proposed vehicle and machinery access is suitable for the site during both the construction phase and the operational phase.



4.2 State Planning Policy 2.0 – Environment and Natural Resources (SPP2.0)

The policy states that:

Western Australia is one of the most biologically diverse regions in the world, home to a broad range of ecological communities and species, and natural landscapes. The States vast areas encompass rich and extensive agricultural, pastoral, marine and mineral resources. The protection and wise management of the environment and natural resources of the State are of paramount importance if we are to maintain our lifestyle now and into the future.

SPP 2.0 further states that:

Careful assessment will be required to resolve conflicts between land use and protection of natural resources, giving consideration to the potential impacts on the environment, community lifestyle preferences, and economic values. This requires an understanding of the competing pressures of development and environmental protection, together with the economics of sustainable land use and management practices, advances in technology, and the priorities of the community.

The site is largely cleared and currently used for cropping and grazing purposes and careful consideration during the design phase to ensure that areas of remnant vegetation over the subject site have been carefully considered and avoided. Further the land capability mapping contained in this report clearly shows that the subject site does not contain areas of high agricultural value and is therefore a suitable economic opportunity within the Shire for development.

Table 4.2 - Clause 5.6 of SPP 2.0 below relates to Agricultural Land and Rangelands and states that:

Planning strategies, schemes and decision making should refer:

Table 4.2 – Clause 5.6 of SPP2.0

	RESPONSE
Protect and enhance areas of agricultural significance, having regard to State, regional and local issues and characteristics, and to the requirements of Statement of Planning Policy No.11: Agricultural and Rural Land Use Planning	The site as shown in the associated mapping in this report in relation to Agricultural Capability shows the site has no exceptional or significant agricultural qualities which would warrant application of SPP 2.0. The proposed use would not displace nor remove significant agricultural land, and it is proposed to continue the farming of land to co-exist with renewable energy generation. Post the development of the site the gazing of sheep will be able to continue underneath the panels, this ensures that the land is still used for agricultural purposes and is also a means of bushfire mitigation over the site. Within this report an assessment of agriculturally capable land within the area was undertaken and found that of all the capable land that the proposed solar farm only forms 0.3% of the agriculturally capable land. Further the solar panel array and proposed BESS facility do not cover the entire site with large areas left clear for agricultural practices to still be undertaken over the site.
Consider the natural resource capability of rangelands and agricultural lands	As outlined above the Agricultural capability mapping shows that the site does not contain areas of high agricultural capability and is therefore suitable for the proposed use.
Diversify compatible land use activities in agricultural areas and rangelands based on principles of sustainability and recognizing the capability and capacity of the land to support those uses.	The proposed development offers an opportunity to decarbonise and offset farming greenhouse gas by developing a renewable energy facility. This would not only diversify the production of the Rural zoned area of the Shire of Narrogin but would be able to co-exist with continued farming of the land and adjoining lands.

Table 4.3 below responds to Clause 5.10 of SPP 2.0 relates to **Greenhouse Gas Emission and Energy Efficiency which states:**

> **There is a widespread awareness of the need to increase the efficiency with which energy is used in Western Australia, including the need to reduce our reliance on energy produced from non-renewable resources such as fossil fuels. The primary objective is to reduce greenhouse gas emission by means (but not limited to) increasing energy efficiency, decreasing reliance on non-renewable fuels, and increasing usage of renewable energy sources.**
>
> **Planning strategies, schemes and decision making should:**

Table 4.3 – Clause 5.10 of SPP2.0

	RESPONSE
Promote energy efficient development and urban design incorporating such issues as energy efficient building design, walkable neighbourhoods, higher densities in areas accessible to high quality public transport, local access to employment, retail and community facilities, and orientation of building lots for solar efficiency.	Not applicable to this development.
Support the retention of existing vegetation and revegetation in subdivision and development proposals.	It is proposed that all remnant vegetation within the site be retained with the proposed layout designed to avoid these areas. Some areas of revegetation will take place over the site to break up sight lines and to provide buffers to surrounding land uses.
Support the use of alternative energy generation, including renewable energy, where appropriate.	The proposed renewable energy facility is in an appropriate location and its co-location near the existing Western Power substation allows it to transmit renewable energy back into the SWIS grid.
Support the adoption of adaption measures that may be required to respond to climate change.	The proposed facility will provide renewable energy to the local network with low environmental impacts thereby increasing climate resilience of the Narrogin area. Storage of energy within the BESS facility provides options to prevent outages due to network outages and provides energy to the grid at peak times. This alternative for energy generation responds to both the State and Federal Governments initiatives to become net zero in response to climate change.

Clause 6 of SPP2.0 relates to the **Implementation** of the policy and states that:

> **Implementation will also occur through the day-to-day process of decision-making on subdivision and development applications, and the actions of other State agencies in carrying out their responsibilities. Local Governments and State agencies will need to take account of these policy measures to ensure integrated decision-making and in the planning and management of the environment and natural resources.**

As outlined throughout this report, the proposed development has considered the current environment and development possibilities on the subject site and has through refinement through the design process protected those areas that are significant environmentally such as remnant vegetation and existing watercourses from development.

4.3 State Planning Policy 2.5 – Rural Planning (SPP2.5)

The purpose of this policy is to protect and preserve Western Australia's rural land assets due to the importance of their economic, natural resource, food production, environmental and landscape values. In terms of the proposed project development compliance with SPP2.5 and compatibility with surrounding rural land uses.

The objectives of SPP2.5 are outlined and addressed in Table 4.4 – below:

Table 4.4 – Objectives of SPP2.5

OBJECTIVE	RESPONSE
Support existing, expanded and future primary production through the protection of rural land, particularly priority agricultural land and land required for animal premises and/or the production of food;	The site is not identified as priority agricultural land in the Local Planning Strategy or other documents nor applicable mapping. Once the solar farm is operational, the site can still be used for sheep grazing, this will not only keep the grasses and weeds down over the site but continue rural practices and production in this location.
Provide investment security for existing, expanded and future primary production and promote economic growth and regional development on rural land for rural land uses;	The proposed project will promote economic growth and regional development through the development of a new land use and the protection of energy for the region. The proposed Project will in the short term increase the workforce during the construction phase, this will occur in terms of accommodation options but also the workers spending money within the Shire.
Outside the Perth and Peel planning regions, secure significant basic raw material resources and provide for their extraction	NA - Extraction of basic raw materials is not proposed.
Provide a planning framework that comprehensively considers rural land and land uses, and facilities consistent and timely decision-making	The local planning framework is addressed under Section 3.2 of this report.
Avoid and minimise land use conflicts	Surrounding land uses are typically broad acre farming and it is considered that the proposed Project is compatible and therefore will not result in significant land use conflicts within the broader rural area. Once the facility is constructed and operating there will be little to no conflict with the surrounding land uses.
Promote sustainable settlement in, and adjacent to, existing urban areas; and	NA - The subject site is not proposing urban development.
Protect and sustainably manage environmental, landscape and water resource assets.	Environmental, landscape and water resources are discussed in both the technical reports held within the appendices of this report and throughout various sections of this report. It is considered and has been demonstrated that the proposed Project will not result in significant environmental impacts, and in fact delivers a global environmental benefit. Given the carefully designed development the proposal can be approved to protect significant areas of remnant vegetation throughout the subject site.

Section 5.5 of SPP2.5 relates to Regional variation, economic opportunities and regional development it states that:

> **Western Australia is a large and diverse State with regional variations of climate, economic activity, cultural values, demographic characteristics and environmental conditions. The WAPC's decisions will be guided by the need to provide economic opportunities for rural communities and to protect the States primary production and natural resource assets. WAPC policy is to:**
>
> **(a) continue to promote rural zones in schemes as flexible zones that cater for a wide range of land uses that may support primary production, regional facilities, environmental protections and cultural pursuits**

The proposed Project meets the above Section 5.5 of the policy in that:

- The proposal is providing economic opportunities for the Shire, can transform and reduce the carbon footprint of local farms and businesses and will not have a detrimental effect on the State's primary production and natural resource assets.
- The proposal represents a regional facility and therefore flexibility within the Rural Zone considered by both the Shire and the WAPC can be supportive of this land use.

Section 5.12 relates to preventing and managing impacts in land use planning and states that:

> **Planning decision makers need to consider the broad suitability of land uses and the ability to manage offsite impacts prior to determining whether the use of a buffer is necessary.**

Section 5.12.1 relates to Avoiding Land Use conflict and outlines the matters that planning decision makers shall take to avoid lad use conflict which are outlined in the Table 4.5 below:



Table 4.5 – Objectives of Section 5.12.1 of SPP2.5

OBJECTIVE	RESPONSE
a) Where an existing land use that may generate impacts is broadly compatible with surrounding zones and land uses, a separation distance should be indicated in a local planning strategy so there is broad awareness of the land use	The site is not identified as priority agricultural land in the Local Planning Strategy nor any other associated documents. The proposed solar power generation facility and BESS generates little impacts on surrounding land. The Development Requirements of Table 5 of the Local Planning scheme requires separation distances from boundaries to other rural lots surrounding the subject site. The approved development will address and meet these.
b) Where a development is proposed for a land use that may generate offsite impacts, there should be application of the separation distances used in environmental policy and health guidance, prescribed standards, accepted industry standards and/or Codes of Practice, followed by considering I. Whether the site is capable of accommodating the land use and/or II. Whether surrounding rural land is suitable, and can be used to meet the separation distances between the nearest sensitive land use and/or zone, and would not limit future rural land uses; and III. Whether if clauses (i) and/or (ii) are met, a statutory buffer is not required	The subject site can accommodate the proposed land use with sufficient separation distances within the zone outlined for the Rural zone under the Shire's local planning Scheme. Applicable separation distances will also be provided for through the development of a Bushfire Management Plan (BMP) which will provide suitable distances over the site for all of the infrastructure that will be developed over the site. The proposed development meets both clauses (i) and (ii) and therefore a statutory buffer is not required.
c) where a development is proposed for a land use that may generate off-site impacts and does not meet the standard outlined in clause 5.12.1 (b) then more detailed consideration of off-site impacts will be required, in accordance with clause 5.12.3 of this policy; and	It is unlikely that the Project will generate off site impacts, therefore further detailed consideration is not required. The only potential offsite impact in relation to the facility will be noise. Narrogin Solar Pty Ltd have worked closely with Lloyd George Acoustics to ensure that the Project is compliant with applicable noise regulations.
d) where a development is proposed that could be contemplated in the zone, and has been assessed under clause 5.12.3 as having unacceptable off-site impacts that cannot be further mitigated or managed, the proposal should be refused	Not applicable to this proposal as it will not have unacceptable off-site impacts as demonstrated throughout this report.

4.4 State Planning Policy 3.7 – Planning in Bushfire Prone Areas (SPP3.7)

The subject site is covered by bushfire prone areas as shown in **Figure 4.1 – Bushfire Prone Areas** below and demonstrates that the subject site is affected by identified bushfire prone areas.

The intent of the policy is to:

Implement effective, risk-based land use planning and development to preserve life and reduce impact of bushfire on property and infrastructure.

Policy measure 5 of SPP 3.7 relates to the policy objectives and are as follows:

5.1 Avoid any increase in the threat of bushfire to people, property and infrastructure. The preservation of life and the management of bushfire impact are paramount.

5.2 Reduce vulnerability to bushfire through the identification and consideration of bushfire risks in decision making at all stages of the planning and development process.

5.3 Ensure that higher order strategic planning documents, strategic planning proposals, subdivision and development application take into account bushfire protection requirements and include specified bushfire protection measures.

5.4 Achieve an appropriate balance between bushfire risk management measures and, biodiversity conservation values, environmental protection and biodiversity management and landscape amenity, with consideration of the potential impacts of climate change.

The proposed development meets the objectives of the policy in that it will:

- Not increase the threat of bushfire to people, property, and infrastructure and as part of the application the preservation of life and the management of the possible bushfire impact are paramount. A risk assessment of the BESS facility forms part of this application with mitigation measures forming part of the recommendation with a large water tank being located near the BESS facility and then throughout the solar panel array.
- It will reduce the vulnerability of bushfire over the subject site through the identification and consideration of bushfire risks through all stages of the planning and development process.
- The proposed development application will consider bushfire protection requirements and it will include specified bushfire protection measures within the applicable Bushfire Management Plan and the Bushfire Risk Management assessment.
- The proposed development is aiming to achieve through careful design, a balance between bushfire risk management measures, biodiversity and conservation values, environmental protection and biodiversity management and landscape amenity.

Policy measure 6.2 of SPP3.7 relates to development applications and states that:

a) Strategic planning proposals, subdivision and development applications within designated bushfire prone areas relating to land that has or will have a Bushfire Hazard Level (BHL) above low and/or where a Bushfire Attack Level (BAL) rating above BAL-LOW apply, are to comply with these policy measures.

b) Any strategic planning proposal, subdivision or development application in an area to which policy measure 6.2 a) applies, that has or will, on completion, have a moderate BHL and/or where BAL-12.5 to BAL-29 applies, may be considered for approval where it can be undertaken in accordance with policy measures 6.3, 6.4 or 6.5.

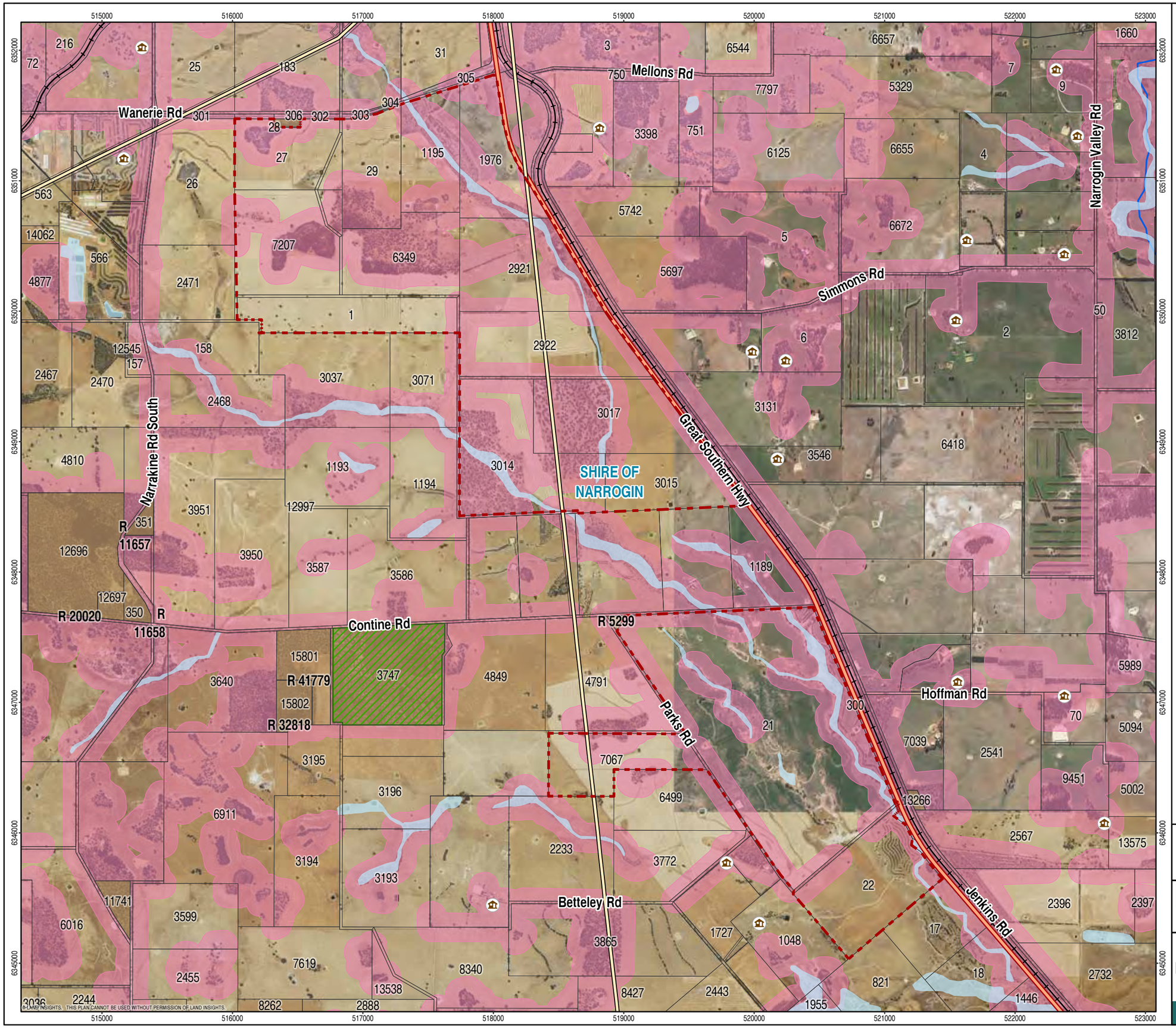
c) This policy also applies where an area is not yet designated as a bushfire prone area but is proposed to be developed in a way that introduces a bushfire hazard, as outlined in the Guidelines.

The proposed development complies with the policy measure so that a bushfire management plan has been prepared for the development and can be found at **Appendix D** and shows that the proposed development complies with the requirements of SPP3.7.

Policy measure 6.5 relates to information that is required to accompany a development application and states that:

Any development application to which policy measure 6.2 applies is to be accompanied by the following information in accordance with the Guidelines:

a) (i) a BAL assessment. BAL assessments should be prepared by an accredited Level 1 BAL Assessor or a Bushfire Planning Practitioner unless otherwise exempted in the Guidelines; or



© LAND INSIGHTS. THIS PLAN CANNOT BE USED WITHOUT PERMISSION OF LAND INSIGHTS.

- Houses
- Extent
- Transmission Overhead Powerlines
- State road
- Major river
- Wheatbelt wetlands
- Bush fire prone areas
- DBCA - Legislated Lands and Waters (DBCA-011)
- Reserves
- Cadastre

0 250 500 750 1,000

Metres

1:28,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 7/11/2024 3:20 PM
Layout Name: ARP 1121-001-02-02 Narrogin Bushfire Areas

PO Box 289 Mt Lawley WA 6929
Ph: 9271 8506
admin@landinsights.com.au
landinsights.com.au

Bush Fire Prone Areas

Narrogin Solar and Battery Hybrid Project

NARROGIN

Narrogin Solar Pty Ltd

Path: C:\Users\ShirleyMcIntyre\OneDrive - Land Insights\Drafting Jobs\1121 ARP - Narrogin Solar Mapping\Map\1121 NarroginSolar.aprx

(ii) a BAL Contour Map that has been prepared for an approved subdivision clearly showing the indicative acceptable BAL rating across the subject site, in accordance with the Guidelines. BAL Contour Maps should be prepared by an accredited Bushfire Planning Practitioner

b) the identification of any bushfire hazard issues arising from the BAL Contour Map or the BAL assessment; and c) an assessment against the bushfire protection criteria requirements contained within the Guidelines demonstrating compliance within the boundary of the development site

This information can be provided in the form of a Bushfire Management Plan or an amended Bushfire Management Plan where one has been previously endorsed

A Bushfire Management Plan (BMP) and a Risk Assessment of the BESS facility and solar array has been undertaken for the proposed development over the site. These studies have adequately addressed all matters in relation to bushfire over the site and will inform the final refined design of the project to adequate risk mitigation measures across the subject site and prescribe measures such as the size and location of firefighting equipment such as water tanks and other associated infrastructure to comply with relevant applicable standards to ensure this is properly executed.

The BMP found that the proposed development was suitable over the site and made several recommendations in relation to the project to comply with current bushfire requirements and SPP3.7. This includes both operator and local government responsibilities and ongoing management actions that are essentially standard for these types of facilities.

The main finding of the BMP is in relation to firefighting requirements and states that:

The Solar Farm development will require 4 tanks installed throughout the site, each with a minimum capacity of 50,000L. The specific location of water tanks will be determined once the internal access network is known at the detailed design phase. The following requirements will apply to the 4 tanks:

- **Tanks must be installed adjacent to access points into solar farm areas, either from public road reserves or from other parts of the development area.**
- **Tanks may be installed within public road reserves in consultation with the Shire of Narrogin.**
- **All areas of the solar farm footprint must be within 5km travel of a water tank.**

The BESS development static firefighting water supply must be calculated per AS2419. Based on the approximately 12,800m2 footprint, the required supply will be 432,000L.

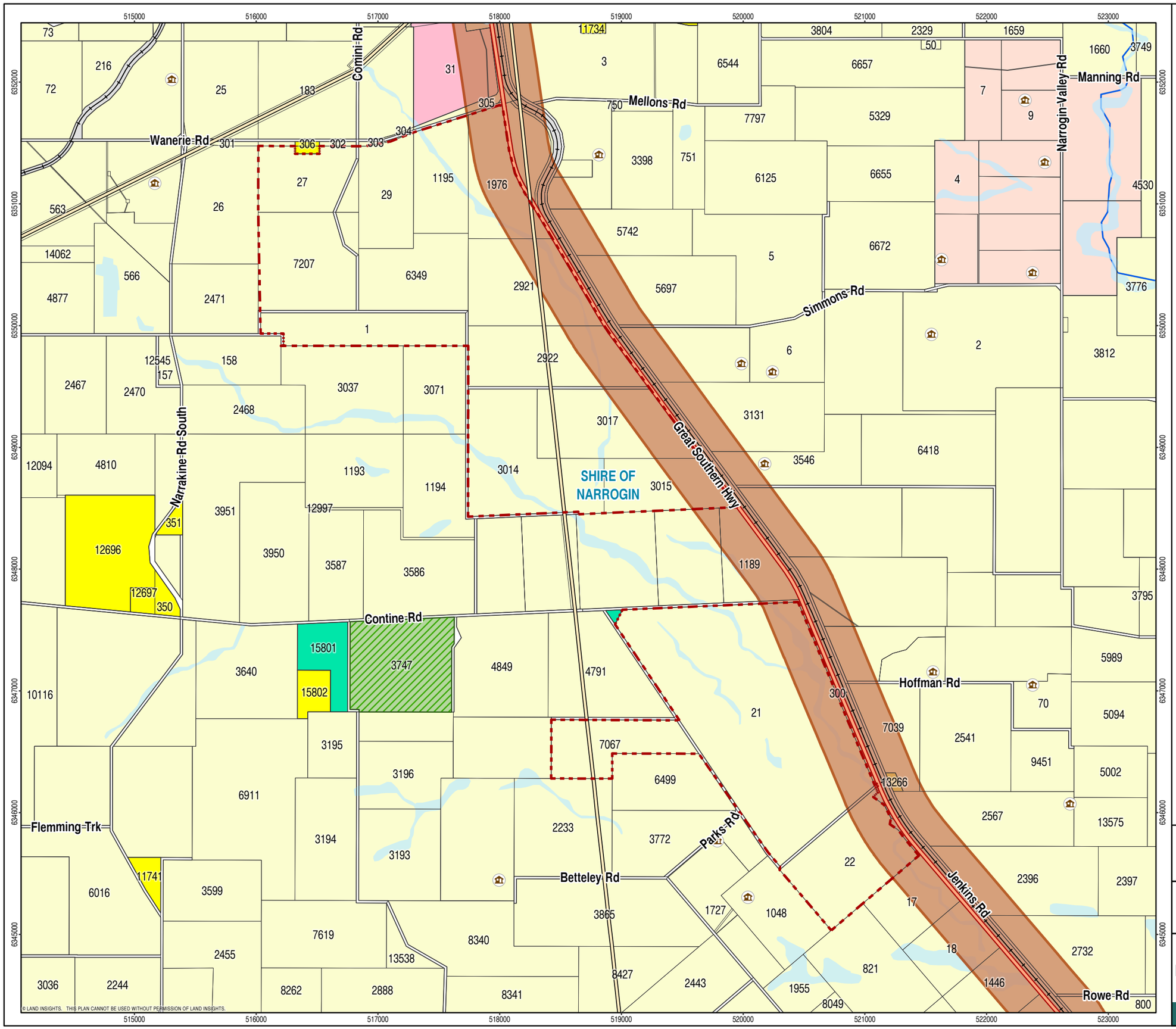
Water tanks will be installed within the development in accordance with the requirements established in the Bushfire Risk Report. These requirements have been outlined in Section 5.7 of this BMP.

The proponent will comply with all requirements outlined in both the BMP and the Risk assessment that form part of this report.

4.5 State Planning Policy 5.4 – Road and Rail Noise (SPP5.4)

The purpose of SPP5.4 is to minimise the adverse impact of road and rail noise on noise-sensitive land-use and/or development within the specified trigger distance. The subject site is adjacent to Great Southern Highway and as shown in Figure 4.2 below the subject site is affected by the buffer.

Given that the proposed development is that of a solar energy and battery facility it is not considered that the development is a sensitive land use. The buffer will have no impact on the proposed development as the solar panels are not sensitive to the noise produced by road and/or rail uses.



- Houses
- Extent
- Transmission Overhead Powerlines
- Rail
- State road
- Major river
- Wheatbelt wetlands
- DBCA - Legislated Lands and Waters (DBCA-011)
- Strategic freight and/or major traffic route
- Cadastre

Local Planning Scheme - Zones and Reserves (Narrogin)

- Conservation reserve
- Public open space
- Public purposes
- Railways
- Rural
- Rural residential
- Special use

0 250 500 750 1,000
Metres
1:30,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 7/11/2024 4:11 PM
Layout Name: ARP 1121-003-01-01 Narrogin Buffer Area

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Road and Rail Noise Buffer
Narrogin Solar and Battery Hybrid Project
NARROGIN
Narrogin Solar Pty Ltd

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4.6 Other Matters to be Considered

Clause 67(2) of the Deemed Provisions of the Planning and Development (Local Planning Schemes) Regulations 2015 (Regulations) sets out the other matters for which due regard is to be given when considering a development application. Refer to Table 4.6 – Clause 67(2) – Other Matters to be Considered below for an assessment against the matters to be considered.

TABLE 4.6 – CLAUSE 67(2) – OTHER MATTERS TO BE CONSIDERED MATTERS TO BE CONSIDERED	RESPONSE
a) the aims of the provisions of this Scheme and any other local planning scheme operating within the Scheme area;	The aims and provisions of the Shire's recently endorsed LPS3 can be delivered by the approval of the proposal at this site. This section outlines in detail how the proposed development meets the aims and provisions of the applicable Scheme.
b) the requirements of orderly and proper planning including any proposed local planning scheme or amendment to this Scheme that has been advertised under the Planning and Development (Local Planning Scheme) Regulations 2015 or any other proposed planning instrument that the local government is seriously considering adopting or approving;	The proposed development meets the requirements of orderly and proper planning in that it meets the aims and objectives of the current local planning scheme. The Shire does not currently have any local planning policies applicable to the current development. The proposed development also meets the aims and objectives of both Federal and Commonwealth objectives for Australia and Western Australia to become net zero.
c) any approved State Planning Policy	As outlined in Section 4 of this report the proposed development meets the requirements of the State's planning policies applicable to this development.
d) any environmental protection policy approved under the Environmental Protection Act 1986 section 31(d)	The proposed development has met the requirements under the EPA Act in relation to the proposed development including the acoustic assessment being compliant and no clearing of vegetation over the site is required.
e) any policy of the Commission	All applicable policies and position statements of the Commission have been addressed under Section 4 of this report.
f) any policy of the State	All applicable planning policies of the State have been addressed under Section 4 of this report. Further the proposed development meets the requirements of the State Governments aim to be net zero by 2030.
g) any local planning policy for the Scheme area	All applicable local planning policies have been addressed under Section 3.2 of this report.
h) any structure plan, activity centre plan or local development plan that relates to the development	There are no applicable structure plans, activity centre plans or local development plans that relate to the proposed development.
i) any report or review of the local planning scheme that has been published under the Planning and Development (Local Planning Schemes) Regulations 2015	The Shire's new Local Planning Scheme No.3 was endorsed by the Minister in May 2023 and this report addresses the applicable planning requirements outlined within the scheme.
j) in the case of land reserved under this Scheme, the objectives for the reserve and the additional and permitted uses identified in this Scheme for the reserve	Not applicable
k) the built heritage conservation of any place that is of cultural significance	There are no areas of built heritage conservation. A Cultural Assessment of the site has been undertaken and forms part of this report and shows that the initial desktop assessment has not identified any areas of cultural significance.

TABLE 4.6 – CLAUSE 67(2) – OTHER MATTERS TO BE CONSIDERED MATTERS TO BE CONSIDERED	RESPONSE
l) the effect of the proposal on the cultural heritage significance of the area in which the development is located	The proposed development will have no detrimental effect on the cultural heritage significance of the area given that the majority of the site is cleared disturbed farmland.
m) the compatibility of the development with its setting including the relationship of the development on adjoining land or on other land in the locality including, but not limited to, the effect of height, bulk, scale, orientation, and appearance of the development	The proposed renewable energy project is a series of solar panels located along the landform in an array – not a lot different from an array or trees as an orchard, or a line of grapevines as in a vineyard. The visual geometry is therefore compatible. In terms of impacts there may be glare or reflection from the panels and this will need to be managed with screening plant belts and earth bunding at critical impact points. Generally, however reflection from sheds, and metal structures in the rural landscape is an accepted off-site result in a rural zone, development is compatible with its setting. The intent of the design of this development is to visually screen and therefore mediate from impact its surrounds. Retention of remnant vegetation over the entirety of the subject site is an aid to this design objective. The large scale of the development over the subject site means that the placement outside of built-up areas is possible.
n) The amenity of the locality including the following – I. Environmental impacts of the development II. The character of the locality III. Social impacts of the development	i. The proposed development will have a beneficial environmental impact in the locality. Climate change is second to clearing as the big threat to native and endangered vegetation in the southwest of WA. The positive action to replace energy from non-renewables with green energy is a proven and appropriate method of redressing this environmental threat. Areas of remnant vegetation will be retained over the subject site with little to no clearing of vegetation proposed. The proposed development has been carefully designed for the solar panels to be located over the already cleared cropping land and therefore will retain the current environmental impacts over the subject site. ii. The proposed development will not have an impact on the character of the locality. The broadacre farming that surrounds the subject site will not be affected by the development and the character of the rural area will not be affected. iii. There will be no social impacts of the proposed development. In the long term only a small number of workers will be required to maintain the development which will provide employment opportunities for residents of the Shire.
o) The likely effect of the development on the natural environment or water resources and any means that are proposed to protect or to mitigate impacts on the natural environment or the water resource	As stated previously the proposed development has been carefully designed so that the solar panels will be placed over the already cleared cropping land. Further, the retention of the remnant vegetation over the entirety of the subject site and no clearing being proposed will protect the current natural environment.
p) Whether adequate provision has been made for the landscaping of the land to which the application relates and whether any trees or other vegetation on the land should be preserved	Remnant vegetation will be retained over the site with no further clearing proposed. Some further landscaping is proposed to introduce screening at critical view corridors to relieve the overall significance of the solar PV array on the landscape views.

TABLE 4.6 – CLAUSE 67(2) – OTHER MATTERS TO BE CONSIDERED MATTERS TO BE CONSIDERED	RESPONSE
q) The suitability of the land for the development taking into account the possible risk of flooding, tidal inundation, subsidence, landslip, bushfire, soil erosion, land degradation or any other risk	The land has been selected by the proponent due to the suitability of the site for the proposed development and its location near the Narrogin South substation. Other factors that have an effect on the proposed development such as bushfire and traffic will be addressed by way of the co-consultant reporting providing technical advice in relation to the proposed development.
r) The suitability of the land for the development considering the possible risk to human health or safety	There is no risk to human health or safety from the proposed development
s) The adequacy of - I. The proposed means of access and egress from the site; and II. Arrangements for the loading, unloading, manoeuvring, and parking of vehicles	A TIS can be found at **Appendix H** and outlines the adequate access and egress arrangements from the site. All access and egress points to the site are existing and currently used for farming the site. The construction of new access points over the site is not proposed. The TIS also outlines the adequacy of the arrangements over the site for the unloading, manoeuvring, and parking of vehicles. Within the site there is ample areas of land to provide for workers parking, manoeuvring of trucks and for the provision of laydown areas for the components required to construct the Project.
t) The amount of traffic likely to be generated by the development, particularly in relation to the capacity of the road system in the locality and the probable effect on traffic flow and safety	During the construction phase of the development, it is expected that there will be significant car and truck movements to and from the subject site during the peak periods. However, it is proposed that the construction phase requires flexibility due to lead times for equipment and components reducing the impacts of traffic on the sites surrounds. The TIA indicates that the number of truck movements and lighter vehicle movements to and from the subject site is acceptable. It is noted that the largest impact will be during the construction phase of the project and that post construction there will be minimal light vehicle movements to and from the subject site. It is also noted that some existing crossovers may need to be upgraded to meet Main Roads and Local Government standards, this requirement can be implemented through a condition on the development application.
u) The availability and adequacy for the development of the following – I. Public transport services II. Public utility services III. Storage, management, and collection of waste IV. Access for pedestrians and cyclists (including end of trip storage, toilet and shower facilities) V. Access by older people with disability	There are no public transport options to the subject site as it is located remotely outside the town of Narrogin. As part of the Construction Management Plan details can be included in relation to the removal of waste and other matters over the subject site.
v) The potential loss of any community service or benefit resulting from the development other that the potential loss that may result from economic competition between new and existing businesses	NA – Rather than a loss of any community service or benefit, the proposed development will, during the construction phase provide opportunities for a significant number of workers and this will have a flow on effect to the town where these workers will be able to purchase goods and services within the town. Upon completion and operation, it will be of benefit to the residents and businesses of Narrogin who will be able to source clean energy to power their homes and businesses.
w) The history of the site where development is to be located	The site has been historically significantly cleared for grazing and cropping purposes. It is not of significance as productive agricultural land but can continue in rural uses collaterally with the solar farm and battery storage.

TABLE 4.6 – CLAUSE 67(2) – OTHER MATTERS TO BE CONSIDERED MATTERS TO BE CONSIDERED	RESPONSE
x) The impact of the development on the community as a whole notwithstanding the impact of the development on particular individuals	The proposed development will not have a detrimental effect on the community or any particular individuals. The development is seen as adding value to the community with the Shire potentially becoming a green hub in the wheatbelt region.
y) Any submissions received on the application	This will be dealt with as part of the application process.
Za) the comments or submissions received from an authority consulted under clause 66	This will be dealt with as part of the application process.
Za) any other planning consideration the local government considers appropriate	All planning considerations have been addressed as part of this application.

4.7 Shire of Narrogin Planning Framework

Shire of Narrogin Local Planning Scheme No.3 (LPS3)

The Shire of Narrogin's Local Planning Scheme (LPS3) was endorsed by the Minister for Planning in April of 2023 and gazetted on the 3 May 2023. The site retains the same zoning as the previous Scheme being Rural as shown in **Figure 3 – Local Planning Scheme zones** below. This newly endorsed Scheme introduces a class of use called Renewable Energy Facility, specifically to allow for the consideration of proposals such as the Narrogin Solar Pty Ltd project.

The objectives for the Rural zone under LPS3 are:

- To provide for the maintenance or enhancement of specific local rural character.
- To protect broad acre agricultural activities such as cropping and grazing and intensive uses such as horticulture as primary uses, with other rural pursuits and rural industries as secondary uses in circumstances where they demonstrate compatibility with the primary use.
- To maintain and enhance the environmental qualities of the landscape, vegetation, soils, and water bodies, to protect sensitive areas especially the natural valley and watercourse systems from damage.
- To provide for the operation and development of existing, future, and potential rural land uses by limiting the introduction of sensitive land uses in the Rural zone.
- To provide for a range of non-rural land uses where they have demonstrated benefit and are compatible with surrounding rural uses.

The proposed Project is consistent with the objectives of the Rural zone in that the proposal will:

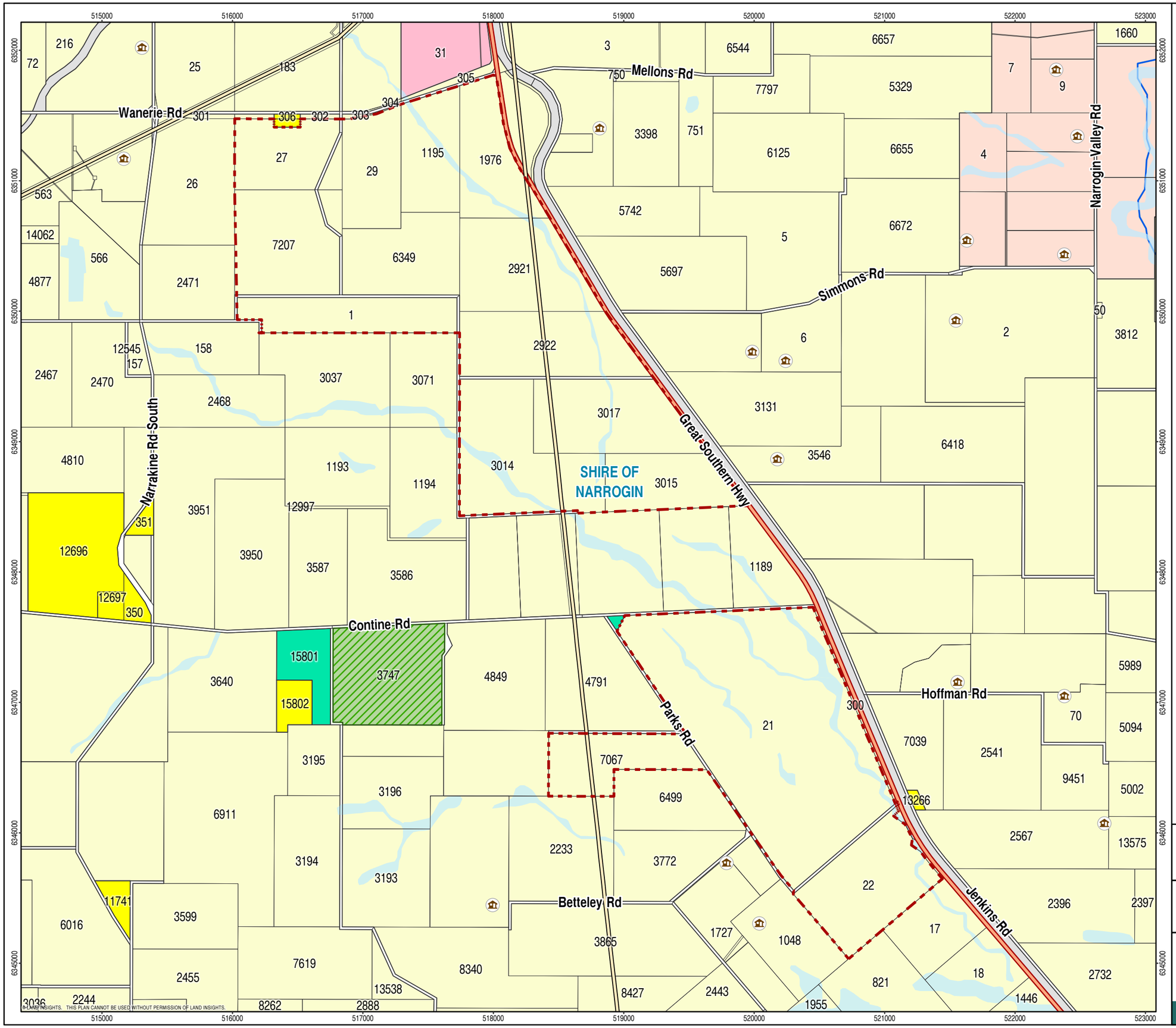
- Protect broad acre agricultural activities by allowing grazing to occur over the site under the installed panels.
- Through careful design the Project has managed to avoid areas of significant remnant vegetation over the site and in some cases may undertake further tree planting to screen houses that may adjoin the site and as a screen to Great Southern Highway.
- The proposal is not introducing a sensitive land use into the Rural zone, it is a 'A' use within the Rural zone and therefore is an allowable use on the site.
- The proposal is a non-rural land use however it has a demonstrated benefit for the Shire of Narrogin and is compatible with surrounding land uses. Further, at the end of the facilities life cycle the subject site can be returned to its original use being Rural land used for cropping and grazing.

The zoning table of LPS3 lists **A** renewable energy facility as an A use within the Rural zone. This means that the use can be permitted only where the local government has exercised its discretion by granting development approval, and then only after advertising the application in accordance with Clause 64 of the deemed provisions (Model Scheme Text – MST).

The definition of a renewable energy facility as adopted for LPS3 is as follows:

> **Renewable Energy Facility - Means premises used to generate energy from a renewable energy source and includes any building or other structure used in, or relating to, the generation of energy by a renewable resource. It does not include renewable electricity generation where the energy ***

* The last line excludes domestic and small business scale rooftop solar from a requirement of planning approval.



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- Houses
- Extent
- Transmission Overhead Powerlines
- Rail
- State road
- Major river
- Wheatbelt wetlands
- DBCA - Legislated Lands and Waters (DBCA-011)
- Cadastre

Local Planning Scheme - Zones and Reserves (Narrogin)

- Conservation reserve
- Public open space
- Public purposes
- Railways
- Rural
- Rural residential
- Special use

0 250 500 750 1,000
Metres
1:28,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 7/11/2024 3:17 PM
Layout Name: ARP 1121-001-01-01 Narrogin Zones

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Local Planning Scheme
Narrogin Solar and Battery Hybrid Project
NARROGIN
Narrogin Solar Pty Ltd

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This definition aligns with the definition in the position statement on renewable energy produced by the WAPC. The proposed Project is also in line with the definition and can therefore be considered as being suitable and an appropriate use in the Rural zone over the subject site.

Table 5: Development Table – General in LPS3 outlines the setbacks for the Rural zone within the Shire. It states that a 50m setback is required to a primary distributor road. The Great Southern Highway is such a road and therefore the proposed development is set back from Great Southern Highway by 50m to comply with this requirement.

The table identifies setbacks of 20m are required from Rear and Side boundaries. The proposed solar farm extends development across several lot boundaries within the overall site boundary so as to maximise the number of solar panels that can be located on the site and to streamline the design and, ensure that remnant vegetation is protected. Some discretion is therefore requested to relax side and rear setbacks given they are intended for buildings rather than solar panels and land use as a solar farm and battery facility.

The requirement for provision of a Bushfire Management Plan and a Risk Assessment for the whole of the subject site means that although the development is not setback to all the lot boundaries, appropriate risk assessment measures have been undertaken to ensure that the proposed development as a whole complies with all applicable policy and legislation.

Clause 4.10 of LPS3 relates to variations to site and development requirements. Clause 4.10.1 further states that

> **In this clause –**
>
> **Additional site and development requirements means requirements set out in clauses 4.8 to 4.41.**

LPS3 further states under Clause 4.10.2 that

> **The local government may approve an application for a development approval that does not comply with additional site and development requirement.**
>
> **Clause 4.10.5 of LPS 3 further states that:**
>
> **The local government may only approve an application for development approval under this clause if the local government is satisfied that –**
>
> **a) Approval of the proposed development would be appropriate having regard to the matters that the local government is to have regard to in considering an application for development approval set out in clause 67(2) of the deemed provisions; and**
>
> **b) The non-compliance with additional site and development requirement will not have a significant adverse effect upon the occupiers or users of the development, the inhabitants of the locality, or the likely future development of the locality.**

The proposed solar farm has array of solar panels and tracking systems and associated infrastructure to be developed across internal adjoining lot boundaries. It therefore does not comply with the rear and side setbacks for each individual lot as prescribed under Table 5 of LPS 3.

Discretion is therefore sought in relation to the application of the setbacks for the proposed development, because this would produce a larger expanded footprint of the solar panels and tracking systems and associated infrastructure to be developed across lot boundaries and would be of no practical purpose. It is requested that the Shire consider the site as a whole rather than individual lots – there will be some separation between rows of panels where this is needed for access and maintenance purposes.

This proposal is advanced on this basis because all landowners have agreed to be party to this application with the understanding that the site will be developed interconnected over the many lots rather than as individual solar farms with boundary setbacks.

Table 4.6 above summarises how the proposed development meets all applicable matters as outlined under Clause 67(2) of the deemed provisions.

All the site landowners have agreed to be part of the proposed development for the entire site. There would be no advantage for the landscape or the management of the facility to enforce boundary setbacks and it would create a less efficient facility.

The proposed development will have no adverse impact on the inhabitants of the locality or the future development of the locality because the solar farm advances the Shire towards a more sustainable development future as identified in the adopted planning framework and the State of Western Australia's move towards a more sustainable future and to achieve net zero greenhouse gas emissions by 2050 (Western Australian Climate Policy 2020).

Assuming there will be a time where the proposed development reaches the end of its functional lifetime, and given the minimal footprint in terms of site works, (40 years) the site can be easily cleared of the development, restored and returned to the landowners to operate as viable farmland again. The proposed development will have a positive economic impact on the local economy especially during the construction phase. Employment of local businesses and the introduction of external workers into the Shire through the 12-18 month construction period, will stimulate the Narrogin economy through the purchasing of local goods and services within the town and Shire. The supply of green energy to local business will also benefit productivity and advantage entry to green energy oriented markets.

4.8 Shire of Narrogin Strategic Community Plan 2017 - 2027

The Shire of Narrogin Strategic Community Plan has been produced to guide development over the 10 years from 2017 when it was endorsed. A strategic objective has been developed for each of the four key themes of community interest with the objective of the economic theme being:

> **Support growth and progress, locally and regionally:**

Under the Economic Objective of the community plan outcomes and strategies have been identified to achieve the objective. Outcome 1.1 relates to Growth in revenue opportunities with point 1.1.1 stating:

> **Attract new industry, business, investment and encourage diversity whilst encouraging growth of local businesses.**

The proposed solar power and BESS generation facility achieves this outcome of the community plan because the new industry and business is attracted to the Shire that will encourage diversity and possible employment opportunities within the Shire and will start a clean energy transformation.

4.9 Shire of Narrogin Local Planning Strategy

Clause 1.5.1 outlines the **Strategic Plan and Mission Statement** for the Shire and states that the Shire's vision is to:

> **Be a leading regional economic driver and a socially interactive and inclusive community.**

The proposed development meets this vision in that the solar farm and BESS facility will be a leading economic driver in growing local employment during both the construction and post construction phases and by providing a sustainable source of power to the grid for community and business use.

Regarding the objectives of the LPS the following relate to the economic objectives of the Shire which is to support growth and progress locally and regionally. The proposed development aligns with this objective and will support growth and progress within the Shire with the opportunity to become a green hub within the region further attracting a diverse range of green-tech aware industries to the region.

Clause 3 of the LPS relates to the **Economic Development Strategy** of the Shire and clause 3.1 relates specifically to Agriculture.

The vision/objectives for Agriculture are to:

> **Protect and achieve ecologically sustainable use of all productive agricultural land in the Shire whilst providing diverse and compatible development opportunities in agricultural areas which promote the local economy.**

The proposed development meets this vision/objective that development be ecologically sustainable because agricultural land use of grazing can occur alongside the solar panels. Further, the development is a diverse and compatible development opportunity within the agricultural area and will provide a sustainable energy source to the community.

One of the strategies for the Agriculture area relates to the proposed development states that a development should:

> **Ensure that Local Planning Scheme No.3 is sufficiently flexible and applied accordingly so that it effectively contributes to the diversification of the Shire's economy by providing opportunity for the timely establishment of new commerce, industry and agricultural uses in appropriate locations.**

The proposed development aligns with this strategy in that renewable energy such as the proposed solar farm is an A use within the Rural zone in LPS3. As such the Shire can favourably consider the type of development on agricultural land especially where it will diversify the Shire's economy with the establishment of the solar farm and the introduction of a new industry within the Shire.

A further strategy outlined under the LPS is to:

> **Promote the diversification of the Shire's economy by encouraging the development of intensive agriculture, downstream processing of primary produce, diversified industries and further tourism opportunities including farm stay accommodation and ecotourism subject to adequate buffers being maintained between such uses and broadacre agricultural activities in order to minimise potential land use conflicts.**

The proposed development meets this strategy in that solar farm and battery can lead to a diversified trend in industry within the area in a manner which will have minimal impact on surrounding broadacre faming uses and will not cause conflict with current farming practices.

Clause 3.2 of the Strategy relates to **Commerce and Industry** and the Shire vision/objective for this sector is to:

> **Development of a diversified range of commerce and industry in appropriate locations which provides significant employment opportunities, reduces the local economy's dependency upon the agricultural sector and minimises the potential for future land use conflicts.**

The proposed Project will diversify industry in an appropriate location within the Shire, one that proposes an employment opportunity and will not conflict with surrounding land uses meets the vision/objectives.

Clause 4.4 of the LPS relates to **Power and Energy** within the Shire with one of the key issues being identified that:

> **The high cost of providing electricity is proving to be a significant constraint to new development in the Shire.**

The proposed development of the Project facility will allow for further development within the Shire as it increases the availability of green energy generated locally within the Shire.

The vision/objective of the LPS in relation to power and energy is:

> **To ensure that all future development in the Shire is energy efficient and served by a reliable, affordable and sustainable power supply.**

The strategies that are in place under the LPS that are applicable to this development are outlined below:

> **Encourage and support in so far as possible the development of alternative power supply schemes such as solar/battery micro-grids, try to ensure that power supplies in the Shire are sustainable and affordable.**

The proposed Project delivers the LPS as it is the development of an alternative power supply that will supply the Shire and will be sustainable and affordable.

Clause 5.1 of the LPS relates to the **Environment and Natural Resources** and the vision/objective for the Shire is to:

Identify, protect, conserve and enhance the environmental and natural resources of the Shire for the benefit of current and future generations while providing appropriate development opportunities to promote the local economy.

Most of the site has already been cleared for broadacre cropping and grazing uses and given the size of the proposed development no clearing is proposed over the site. All areas of significant remnant vegetation are proposed to be retained on site and no clearing permits will be required during the development construction phase.

Clause 5.2 relates to **Bushfire** with the vision/ objective being:

> **Implement effective, risk based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure.**

Clause 5.2 of the LPS states that:

> **Ensure that all planning and development proposals are consistent with and address the requirements of State Planning Policy 3.7 Planning in Bushfire Prone Areas.**

This report confirms much of the site is identified as bushfire prone land, and so a full assessment of the subject site has been undertaken and a Bushfire Management Plan has been prepared to meet the requirements outlined under SPP 3.7. Further, given the proposed construction of the BESS facility on site also a formal Risk Assessment is also being undertaken in line with appropriate guidelines.

Clause 5.3 of the LPS relates to **Visual Landscape Protection** and the vision/ objective for the Shire is to:

> **Protect, conserve, and enhance landscapes in the Shire with high scenic qualities for the benefit of current and future generations and encourage development which is sensitive to local landscape character and quality.**

The site is historically cleared farmland, and the majority of the site has already been cleared of vegetation. It is surrounded by other areas of farmland that have also been cleared. Any remnant vegetation that currently exists on the site will be retained and managed for conservation purposes. The landscape character of the locality is assessed to hold low to moderate scenic qualities which reflect typical broadacre farming nature of the Narrogin district. It is highly unlikely that the area would possess high scenic qualities to be impacted by the development. Any impacts are described as low and can be managed with careful re-planting and edge landscaping.

Some of the strategies to be used under the LPS that are applicable to this application are as follows:

> **Consider the capacity of landscapes to absorb development and the need for careful planning, siting, and design of new development in a way which is sensitive to local landscape character.**

A site assessment has determined that whilst the project is going to be visible to the public from several public road corridors, many of the solar panels will be screened from direct view through proposed edge planting and retention of the existing remnant vegetation that exists along the road and within the site. Further, given that under Table 5 – Development requirements under the Shire's LPS3 the solar panels will be setback 50 metres from the road reserve leaving a good separation distance between the road and the proposed development.

The large overall project site area has allowed the design more flexibility to be designed around landform, vegetation, and other important natural features such as watercourses and wetlands. This development application reflects a considered approach in relation to the design and siting of the array of solar panels and all the ancillary buildings and infrastructure.

The BESS will be in a secure and yet accessible site in the northeast corner of the site next to Wanerie Road. It will be designed and constructed to be unobtrusive to passing traffic and could prove an interesting and engaging insight into the generation and storage of renewable power for regional communities.

5. Site conditions and assessment

5.1 Topography and landscape

The topography of the site varies in height, with the northern section markedly higher in elevation compared to the southern portion. Within the northern area, the topography ranges from approximately 250 metres above height datum (mAHD) near the site's southern edge to around 400 mAHD closer to Wanerie Road.

It is important to note that the Narrogin townsite itself is situated at an even higher elevation, which becomes a pertinent factor when devising strategies to mitigate visual impact associated with the project. Considering this context, a comprehensive viewshed analysis has been conducted to identify areas, if any, that are visible from key locations surrounding the site. To conduct this analysis, viewpoints were strategically established at key public locations, including the southern exit from Narrogin and the northern exit of Highbury, as well as various locations on public roads to the east and west of the proposed site. The analysis delineates areas likely to be visible without any screening. It is crucial to acknowledge that this assessment relies on a surface model and does not consider other landscape features such as vegetation, houses, and infrastructure. Therefore, it serves as a preliminary guide for subsequent, more detailed visual assessments, analyses, and mitigation strategies.

5.2 Soils

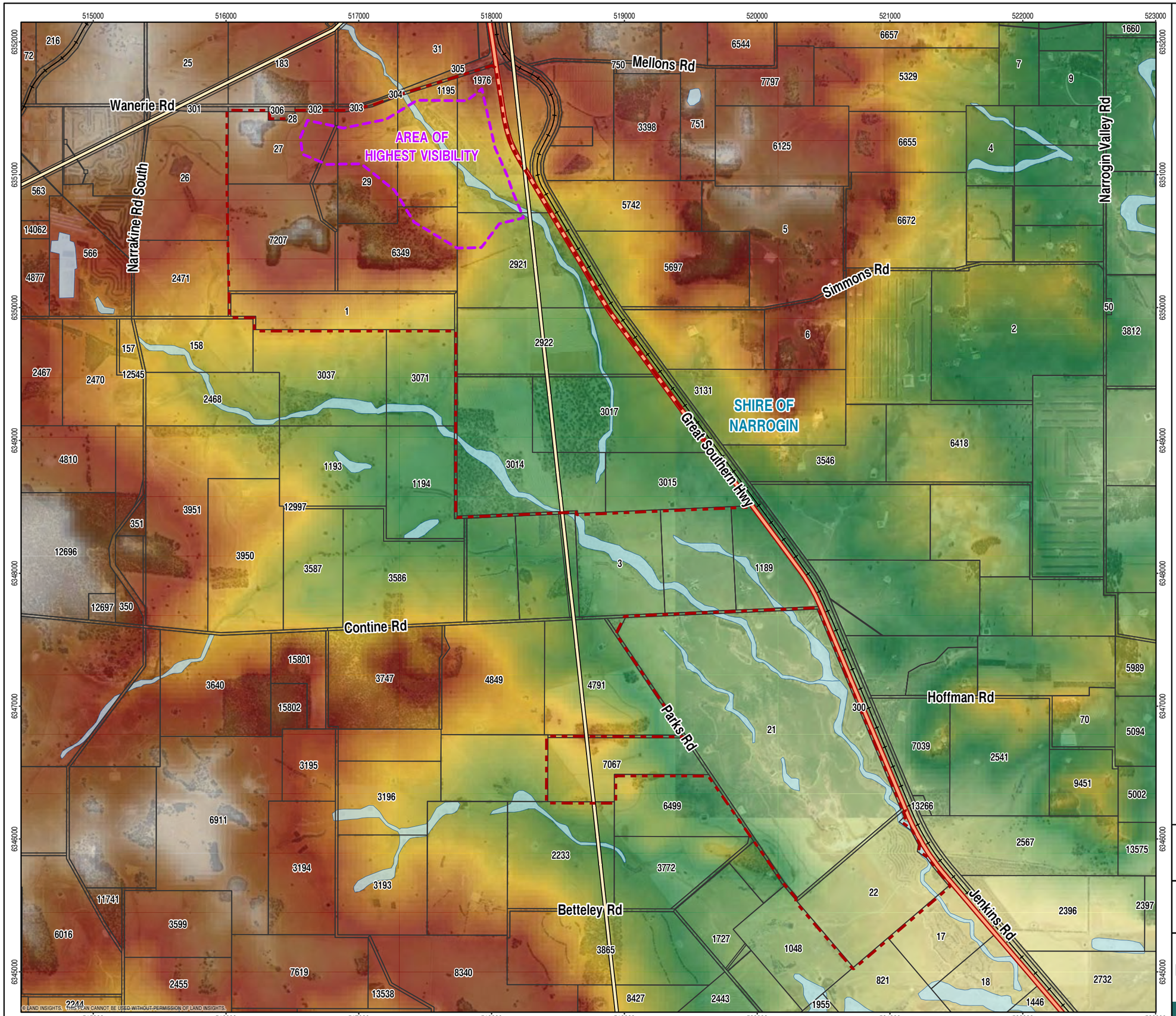
Soil landscape units, soil types and soil qualities are mapped by Department of Primary Industries and Regional Development (DPIRD) and can be accessed on their online data system.

The soil landscape unit across the site is identified as 257De Dellyanine system which is described as Grey Sandy duplex (shallow and deep), sandy gravel and red deep sandy duplex, Wandoo-Sheoak Woodland.

5.3 Land qualities

As shown below in Figure 5.6 – Land Qualities – Wind Erosion hazard it shows that this hazard varies over the site from based on the associated key that during the construction phase some management measures will require to be included within the construction management plan to remediate the possibility of dust and other matters during the construction phase. Post construction the land under the panels will be used for grazing and it is not expected that dust will be a problem as the use will be in line with normal agricultural practices.

During the construction phase of the project it is not expected that a large amount of erosion of the site will take place. No clearing of the land is proposed and it is not expected that wind erosion will be worse than what exists on the site currently along with the current farming practices undertaken over the site.



Site Extent
Cadastre
Wheatbelt wetlands
State road
Rail Line
Transmission Overhead Powerlines

Elevation Shade Value
Metres
418
282

0 250 500 750 1,000
Metres
1:27,500 @ A3

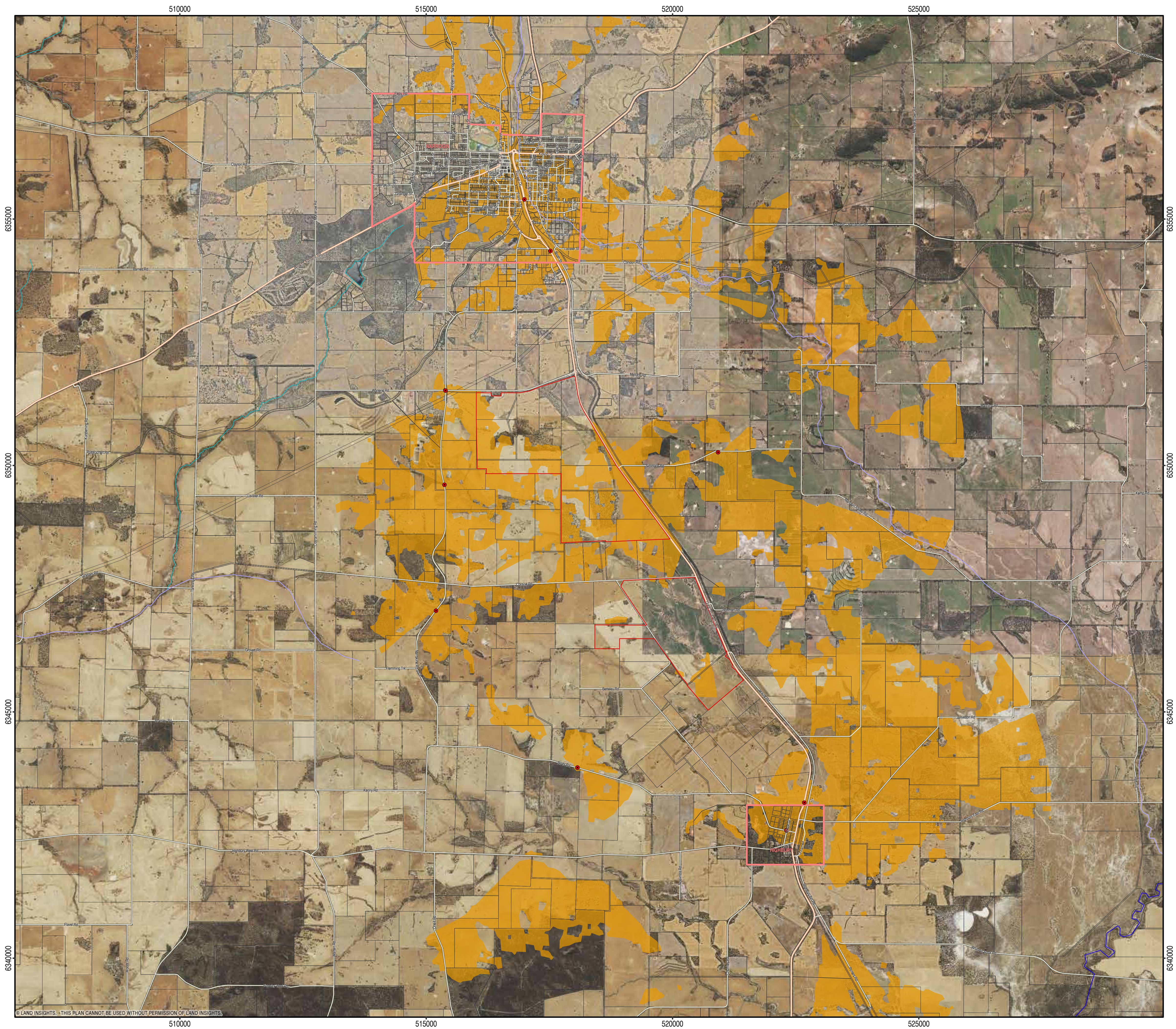
NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 7/11/2024 2:40 PM
Layout Name: ARP 1121-007-01-02 Narrogin Elevation

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Topographic Elevation
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NARROGIN
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Site Extent

Cadastre

Townsite Extents

Local Road

State Road

Rail

Viewing Points

Visible areas from Viewing Points

0 0.5 1 1.5 2

Kilometers

1:75,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 12/11/2024 1:38 PM
Layout Name: Viewshed_Broad

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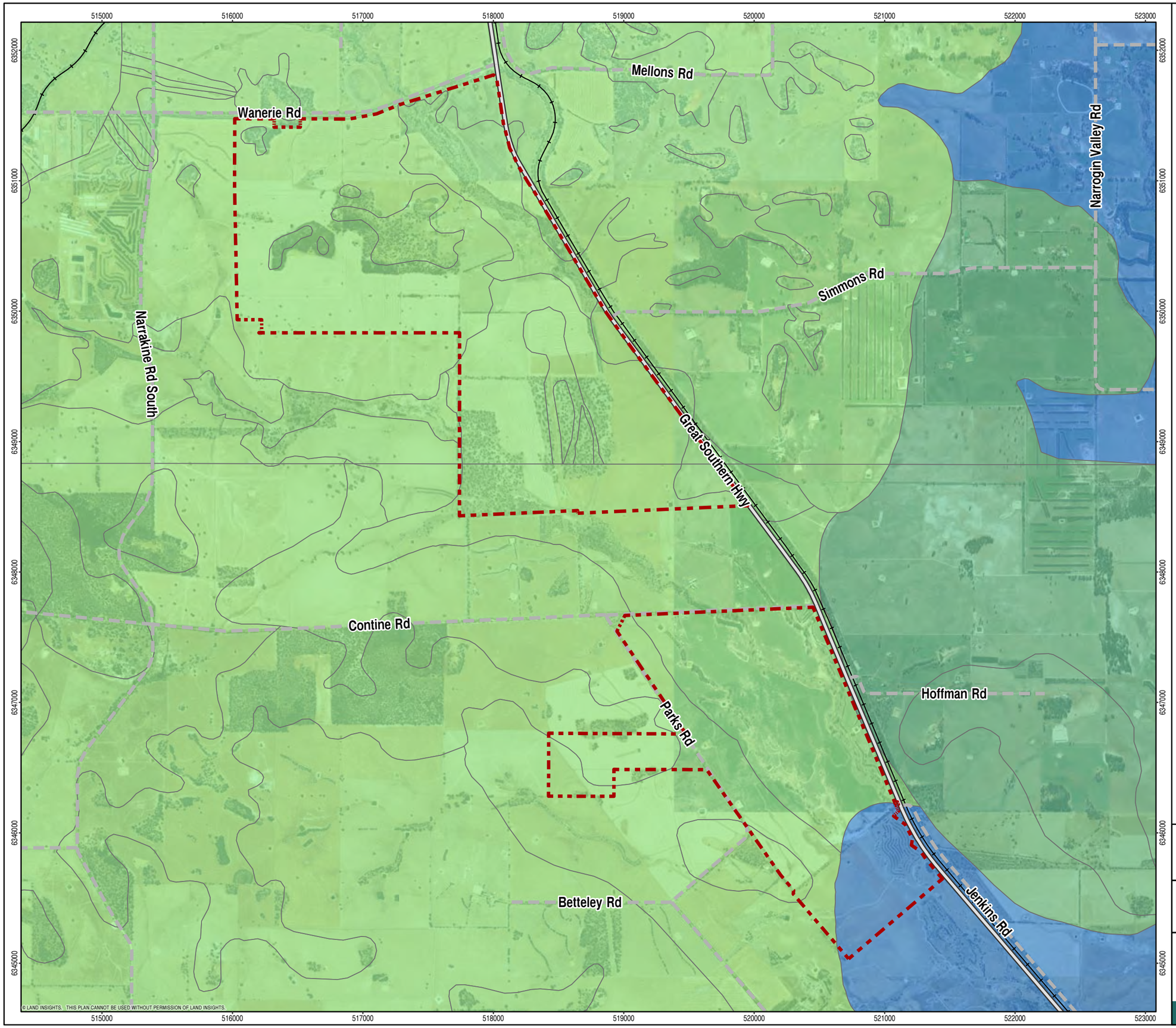
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Viewshed

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Site Location

Rail

Road Network

State road

Local Road

Soil Landscape Systems

82 - Arthur River 1 subsystem

128 - Dellyanine 5 subsystem

145 - Whinbin 2 subsystem

0 250 500 750 1,000

Metres

1:28,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121

Projection: GDA 1994 MGA Zone 50

Date Exported: 7/11/2024 3:59 PM

Layout Name: ARP 1121-001-07-01 Narrogin Soil Landscape

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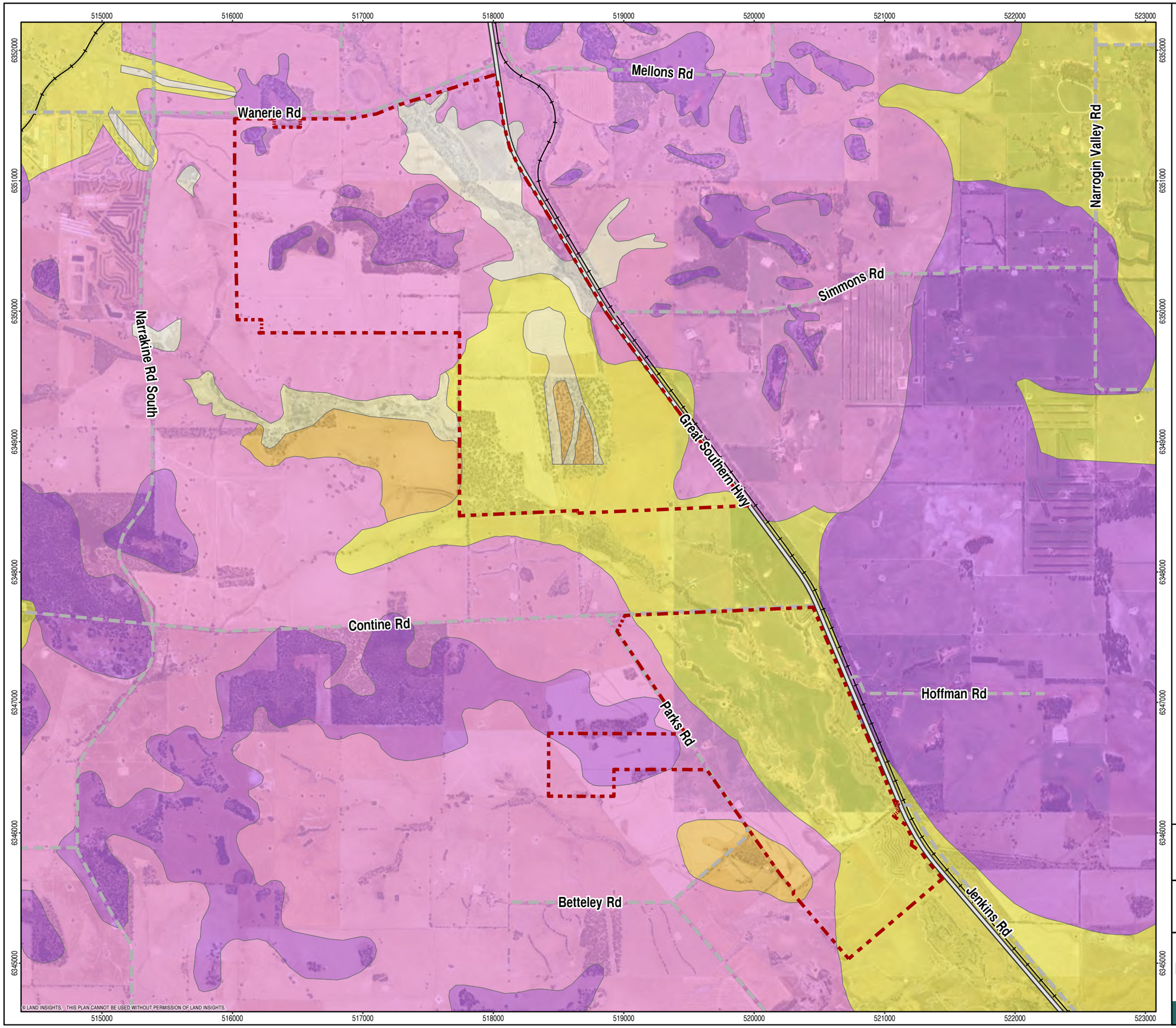
Soil Landscape Systems

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Site Location

Rail

Road Network

State road

Local Road

Wind Erosion - Shire of Narrogin

H1 - 50-70% of the map unit has a high to extreme hazard

H2 - >70% of the map unit has a high to extrememe hazard

L1 - <3% of the map unit has a high to extreme hazard

L2 - 3-10% of the map unit has a high to extreme hazard

M1 - 10-30% of the map unit has a high to extreme hazard

M2 - 30-50% of the map unit has a high to extreme hazard

0 250 500 750 1,000

Metres

1:28,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121

Projection: GDA 1994 MGA Zone 50

Date Exported: 7/11/2024 3:50 PM

Layout Name: ARP 1121-001-06-01 Narrogin LQ - Wind Erosion

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Land Quality - Wind Erosion

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5.4 Agricultural land use

The current utilisation of the site for cropping aligns with the prevalent agricultural practices in the broader Narrogin area. A comprehensive analysis of available land capability data has been conducted to gauge the potential impact of establishing the proposed solar power generation and BESS facility on the existing agricultural land. The analysis reveals that the majority of the land is marginally suitable for grazing, predominantly falling within categories C1 and C2, with a minor portion classified as B1. Similarly, the land demonstrates low capability for cropping, primarily falling under categories C1 and C2, as depicted in Figure 5.5 and Figure 5.6. These categories indicate that the land is at the lower end of the capability range for these land uses, and thus would not be considered prime agricultural land.

In addition to assessing the land within the proposed facility site, an analysis of land capacity classes in the broader region has been undertaken. The broader region encompasses over 324,000 hectares of agricultural land, while the designated area for the proposed Project is a mere 962.4 hectares, accounting for approximately 0.3% of the available agricultural land.

Based on this comprehensive assessment, it is concluded that the development of the proposed facility will not result in a detrimental loss of high-quality agricultural land within the broader region.

5.5 Vegetation

The site encompasses various remnants of vegetation that hold ecological importance. Given the extensive clearing of vegetation in the Wheatbelt region over the past century, the remaining vegetation complexes are classified as Threatened Ecological Communities (TECs) and, consequently, are considered Matters of National Environmental Significance. The distribution of native vegetation and TECs is illustrated in Figure 5.77.

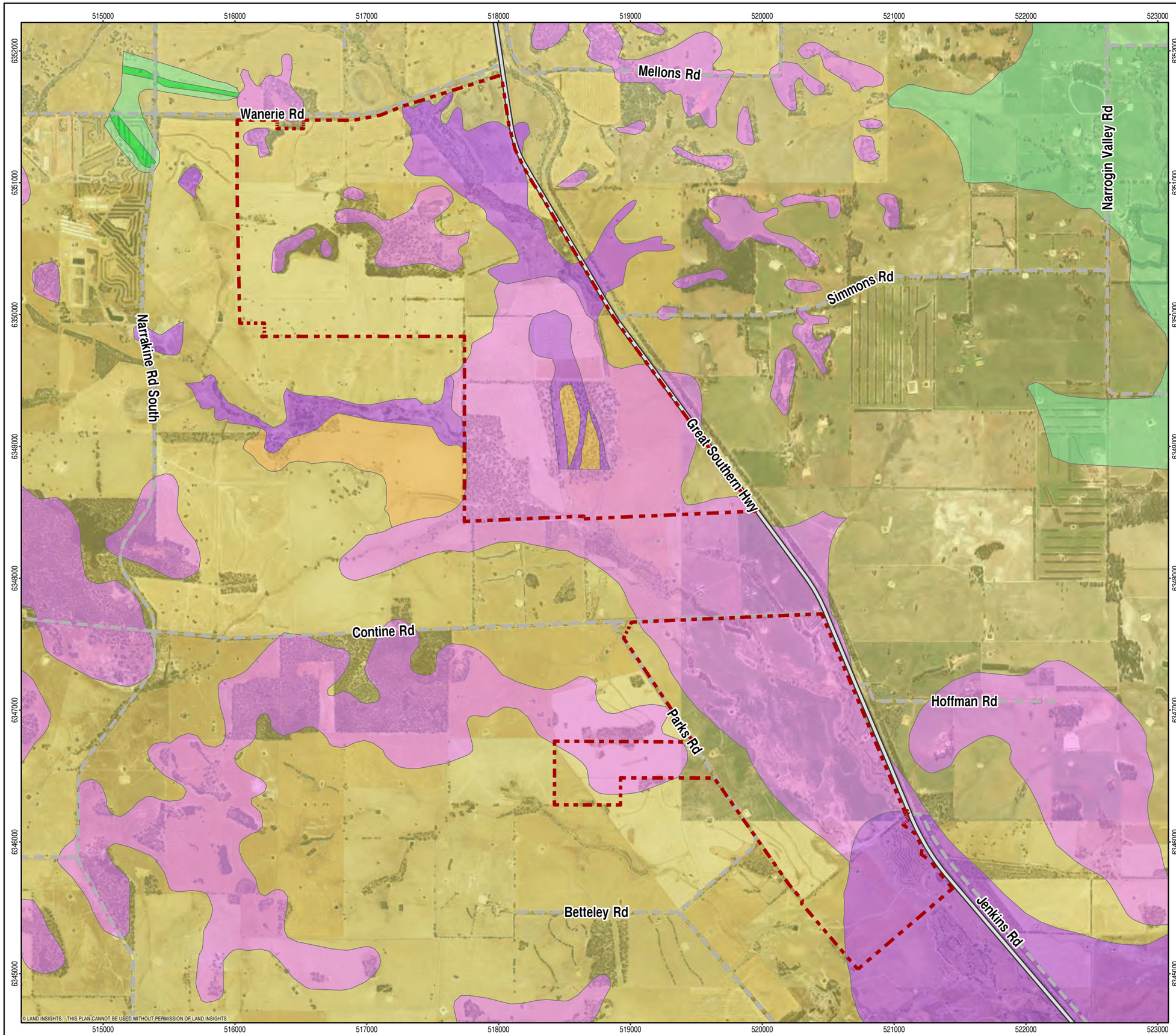
To understand the environmental significance of the remaining vegetation, thorough vegetation and flora surveys have now been undertaken. The southern section of the site underwent a survey in 2022 and the results are contained within the Basic Fauna and Targeted Black Cockatoo report produced by Aurecon (appendix Eto this report). The northern portion of the site including the proposed connection route to the Narrogin substation, was surveyed in Spring 2023 the results of which form part of this report. These surveys were undertaken separately as the project has expanded to include additional landowners.

The survey for the northern portion of the site concluded that the:

Vegetation condition across the site is 'Completely Degraded – Good'

With the final recommendations being:

- Undertake a Black Cockatoo Habitat Assessment
- Where possible retain vegetation in Good or better condition; and
- Retain the Threatened Ecological Community Eucalypt woodlands of the Western Australian Wheatbelt



Site Location

Rail

Road Network

State road

Local Road

Grazing Land - Shire of Narrogin

A1 - >70% of the land has high to very high capability

A2 - 50-70% of the land has high to very high capability

B1 - >70% of the land has moderate to very high capability

B2 - 50-70% of the land has moderate to very high capability

C1 - 50-70% of the land has low to very low capability

C2 - >70% of the land has low to very low capability

Solar Farm-Grazing Area Percentage

Land Type	Section	Area (ha)	Total Area (ha)	Area %
Solar Farm	1	655.64	**1015.47**	
	2	359.83		
Agricultural land		162371.00		0.625
B1/B2 land		95827.26		1.060
C1/C2 land		35015.69		2.900

0 250 500 750 1,000

Metres

1:28,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 7/11/2024 3:41 PM
Layout Name: ARP 1121-001-04-02 Narrogin LC-Grazing

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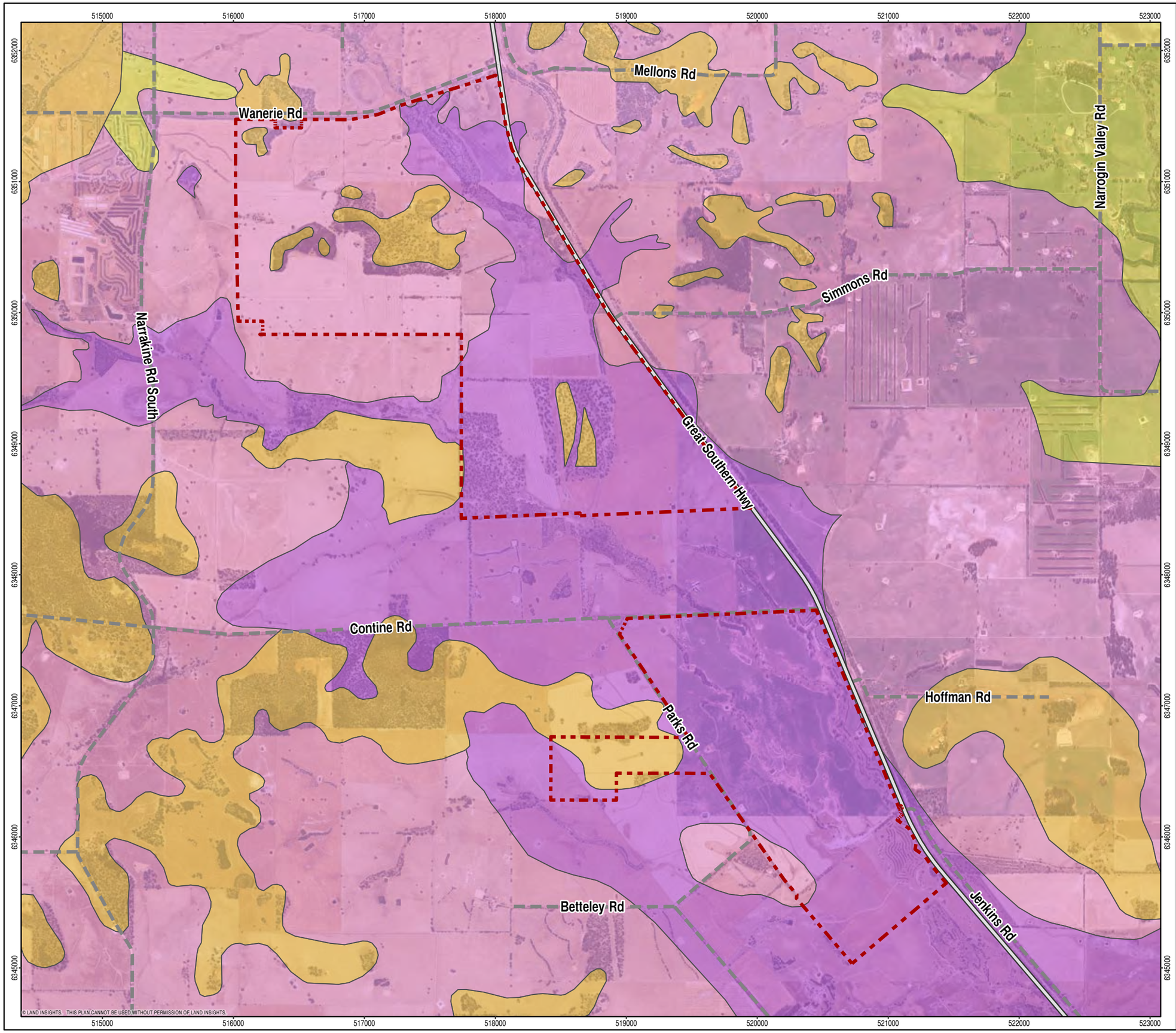
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Land Capacity - Grazing

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Site Location

Rail

Road Network

State road

Local Road

Cropping Land - Shire of Narrogin

B1 - >70% of the land has moderate to very high capability

B2 - 50-70% of the land has moderate to very high capability

C1 - 50-70% of the land has low to very low capability

C2 - >70% of the land has low to very low capability

Solar Farm-Cropping Area Percentage

Land Type	Section	Area (ha)	Total Area (ha)	Area %
Solar Farm	1	655.64	**1015.47**	
	2	359.83		
Agricultural land		162371.00		0.625
B1/B2 land		93076.01		1.091
C1/C2 land		69294.99		1.465

0 250 500 750 1,000

Metres

1:28,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

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Projection: GDA 1994 MGA Zone 50
Date Exported: 7/11/2024 3:47 PM
Layout Name: ARP 1121-001-05-01 Narrogin LC-Cropping

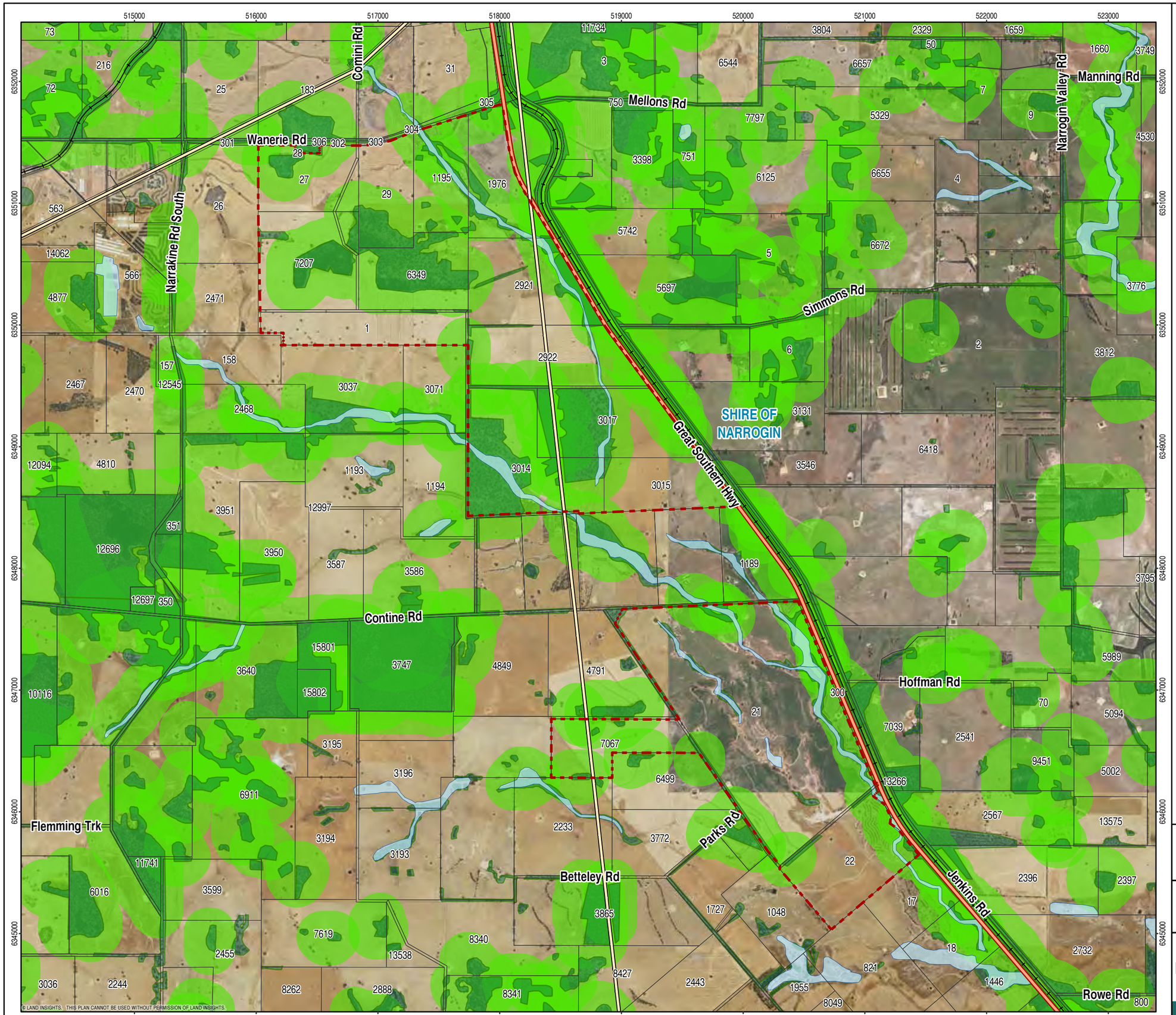
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Land Capacity - Cropping

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- Site Extent
- Cadastre
- Native Vegetation Extent
- Threatened Ecological Community
- Wheatbelt Wetlands
- Transmission Overhead Powerlines
- State road
- Rail Line

0 250 500 750 1,000
Metres
1:30,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 7/11/2024 3:09 PM
Layout Name: ARP 1121-006-02-02 Narrogin Remnant Veg

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Overview - Remnant Vegetation

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This project does not propose the clearing of any trees so the need to undertake a Black Cockatoo Assessment is not required as no trees will be removed and all other vegetation on the site maintained.

The survey for the southern portion of the site found that:

- The majority of the site (92.69%) supports highly disturbed grassland habitat which provides limited value to fauna species of conservation significance.
- The site contains 313 habitat trees of which 16 contained hollows suitable for use by black cockatoos.

As outlined above the project does not propose the clearing of any remnant vegetation across the site.

In response to these findings, the design of the project prioritises measures to minimise the disturbance of vegetation and is and is in line with the preferred 'avoid' stage of the EPA vegetation clearing mitigation hierarchy. Given the size of the site there is sufficient cleared area.

A copy of the environmental surveys are provided at **Appendix E** of this report.

5.6 Water resources

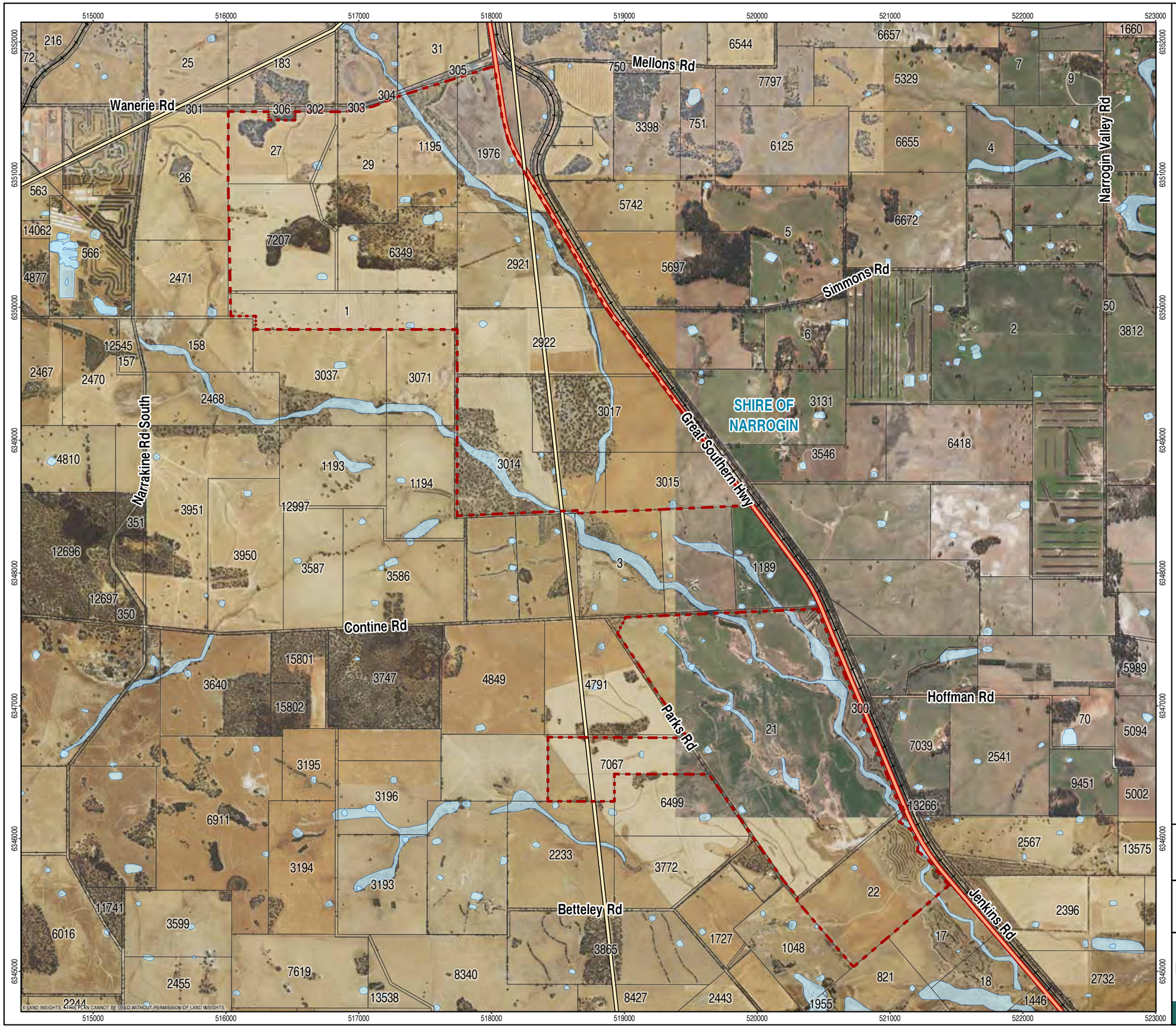
Figure 5.88 below shows the wheatbelt wetlands that are contained on the subject site and through detailed design these areas of land will be avoided where possible during the construction of the proposed project.

The site is generally well drained, with the lower wetland areas acting as seasonal drainage lines. Drainage lines are ubiquitous across the Wheatbelt and are important for collecting and moving water on a seasonal basis. The development has been designed in a manner that that will not impact on the identified wetlands.

The remainder of the site is relatively well drained. Analysis of land quality data suggests that there is minimal waterlogging risk across the majority of the site, good site drainage across most soil-landscape types, and low flood risk. This is evidenced by the existing use of the land for cropping purposes.

Development of the project will not significantly increase runoff as the panels are not contiguous and will allow stormwater to penetrate the ground in a similar way to what currently occurs. There will be some hardstand areas constructed, and once full technical details of the project site are finalised, a detailed Stormwater Management Plan will be prepared. Key commitments to be considered in the development of the Stormwater Management Plan include:

- Managing surface water so that existing uses and ecological systems are protected:
  - Manage sediments
  - Revegetate disturbed areas as soon as possible to limit water based erosion
  - Locate any stockpiles away from water courses
  - Maintain existing water flows where possible, particularly in any undeveloped areas of the site
  - Undertake water quality sampling as required
  - Controlling, treating and retaining water runoff on-site as required.



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Site Extent
Cadastre
Waterbodies and Dams
State road
Rail Line
Transmission Overhead Powerlines

0 250 500 750 1,000
Metres
1:27,500 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 7/11/2024 4:56 PM
Layout Name: ARP 1121-006-01-01 Narrogin Dams Waterbodies

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Overview - Dams and Waterbodies

Narrogin Solar and Battery Hybrid Project

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5.7 Heritage

There are no registered or identified heritage sites on the site, however there are two small local heritage sites nearby. These are:

- Site 13575: Old Narrogin School Site. There are no remaining built structures on this site. There is some community interest in this site.
- Site 13555: Trecarne House. This is located on the eastern side of the site adjacent to the railway. Some structures remain on this site and it has been recommended that it be protected under the Shire's Local Planning Scheme.

Neither site will be impacted by the proposed development.

There are no known or registered Aboriginal Heritage sites within the project area. Development that has the potential to impact on any Aboriginal heritage site (whether discovered or not) is currently governed by the Aboriginal Heritage Act 1972.

A heritage report has been undertaken for the site which did not identify any areas of cultural significance on the site and can be found at **Appendix I** of this report.

5.8 Separation distances

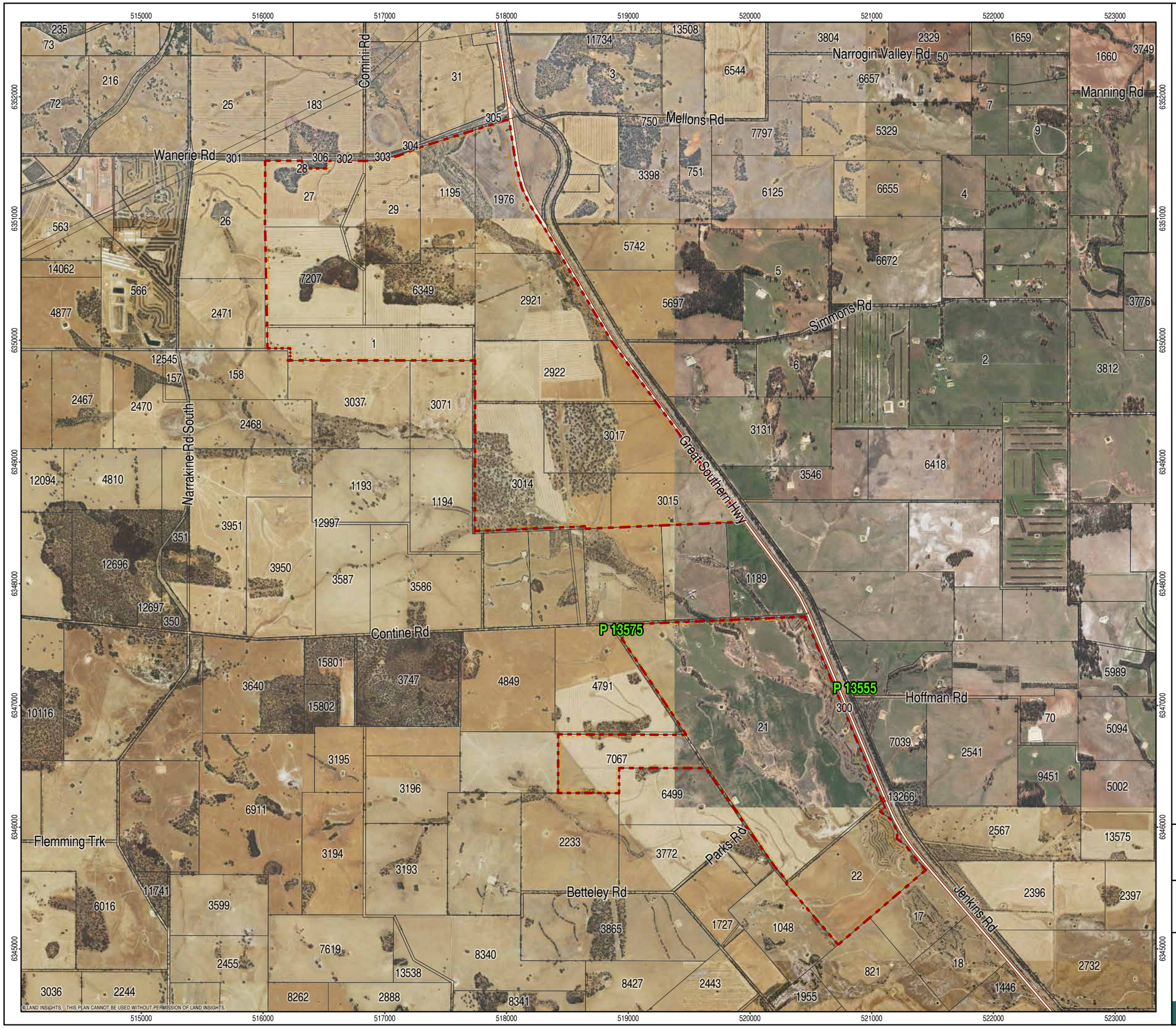
The development will comply with the separation distance as outlined under the Shire of Narrogin's development standards as outlined under Table 5 of their LPS3 which requires a 50 metre setback from Great Southern Highway and 20 metres to rear and side boundaries. The proposed solar power generation facility seeks that the site is seen as a whole rather than as several individual lots so that the infrastructure can go across individual lot boundaries internally and then setbacks applied at the periphery of the development as a whole.

As shown in Figure 1.3 of this report there are few sensitive receptors (houses) around the proposed facility. These houses were sent a letter outlining the project with an opportunity to meet with representatives from the proponents and Land Insights to discuss the project and ask questions. Currently in Western Australia there are no prescribed setbacks in relation to the development of facilities such as this. A glint and glare and visual impact assessment have been undertaken and concluded that there will be limited visual impact on the surrounds. Narrogin Solar Pty Ltd has also worked closely with an acoustic consultant to ensure that the Project is compliant with the required environmental noise standards

5.9 Bushfire

The site is partially affected by bushfire prone areas, as shown in Figure 4.9. These areas largely correspond to remaining remnant vegetation, with an appropriate buffer. The proposed project has been designed to minimise impact or removal of vegetation, and thus some of the proposal will fall within these bushfire prone areas. In addition, the proposed substation and BESS are likely to be classified as high-risk land uses for the purposes of State Planning Policy 3.7, warranting separate consideration.

A Bushfire Management Plan has been prepared to support the proposed development with several recommendations in relation to bushfire including the inclusion of several tanks over the site for firefighting purposes and the maintenance of the site in relation to appropriate firebreaks being maintained. The site will also be used for the grazing of sheep underneath the panels which will help reduce the amount of fuel over the site and the setbacks required under the development table under LPS3 will ensure that appropriate firebreaks are maintained around the site. The Bushfire Management Plan and Risk Assessment can be found at **Appendix D** of this report.



Cadastre

Rail

State Road

Heritage Council WA - Local Heritage Survey

0 0.25 0.5 0.75 1

Kilometres

1:30,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 12/11/2024 1:36 PM
Layout Name: Site Constraints

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Heritage Extent

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6. Environmental management

6.1 Overview

In Western Australia, the Environmental Protection Act 1986 (the Act) is the principal instrument for environmental protection and governs the environmental approvals process. All proposed projects and schemes that may have a significant impact on the environment are required to be assessed under Part IV of the Act.

The outcomes of an Environmental Impact Assessment (EIA) are described, as well as the proposals to avoid, mitigate and reduce environmental impacts through an Environmental Management Plan (EMP). Based on the outcomes of the EIA, it is considered that there are no significant environmental impacts as a result of the proposed development. The site is largely cleared farmland, has significant separation distances from nearby residences and minimal operational impacts (such as dust, noise and reflection).

Nevertheless, an Environmental Management Plan is presented below, outlining each environmental feature, the potential impact and the environmental management proposals against each one. The EMP has been prepared in accordance with the sequence of considerations designed to help manage adverse environmental impacts which includes avoidance, minimisation,, reduction and environmental offsets. In this situation, avoidance of impact has been the priority, followed by minimisation of impact. As can be seen from the assessment below, most potential environmental impacts have been avoided through careful site planning and management and minimisation of impact can also be achieved where impact cannot be avoided.

6.2 Environmental benefits

Solar energy has an additional overall environmental benefit by reducing reliance on fossil fuel power generation, the environmental impacts of which include the creation of greenhouse gases and other air pollution emissions such as sulphur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds. It also has the added benefit of creating economic and employment opportunities for the local area. In addition, the site will no longer be used for crop production, meaning that less fertilisers and pesticides will be used and circulated into the environment. This will have positive environmental benefits to nearby waterways and local flora and fauna.

6.3 Potential environmental risks

A risk assessment has been undertaken to review the environmental risk to the watercourse without active management and with access control. The assessment is based on the criteria in the Department of Water and Environmental Regulation's Guidance Statement: Risk Assessments (2017). The risk rating will be determined in accordance with the risk matrix below.

LIKELIHOOD	CONSEQUENCE				
	SLIGHT	MINOR	MODERATE	MAJOR	SEVERE
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

Source: DWER, 2017

The following criteria has been used to determine the likelihood and consequence of the risk occurring.

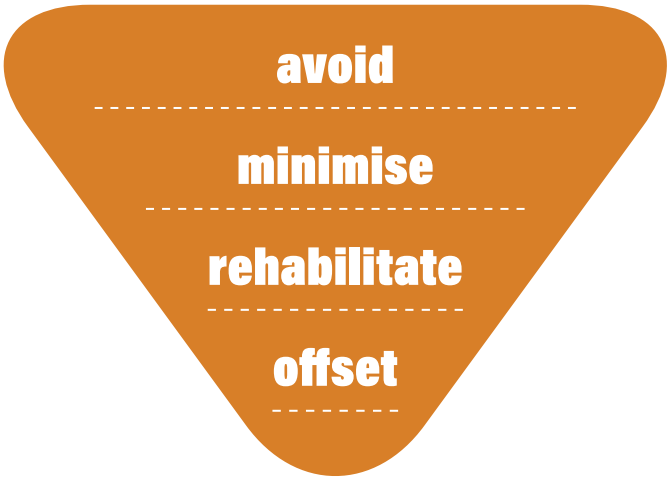
LIKELIHOOD		CONSEQUENCE	
Almost certain	The risk event is expected to occur in most circumstances.	Severe	On-site impacts: catastrophic (significant impact to the environment) Off-site impacts local scale: high level or above Off-site impacts wider scale: mid level or above Mid to long term or permanent impact to an area of high conservation value or special significance^ Significant long-term damage/loss of ecosystem function and loss of individuals of species locally
Likely	The risk event will probably occur in most circumstances.	Major	On-site impacts: high level (moderate impact to the environment) Off-site impacts local scale: mid level Off-site impacts wider scale: low level Short term impact to an area of high conservation value or special significance^ Moderate damage to ecosystem function and major loss of individuals of species locally.
Possible	The risk event could occur at some time.	Moderate	On-site impacts: mid level (Minor adverse affect to the environment) Off-site impacts local scale: low level Off-site impacts wider scale: minimal Moderate loss of individuals of species locally.
Unlikely	The risk event will probably not occur in most circumstances.	Minor	Off-site impacts local scale: minimal Off-site impacts wider scale: not detectable Minor number of individuals of species may be affected locally.
Rare	The risk event may only occur in exceptional circumstances.	Slight	On-site impact: minimal (No discernible adverse impact).

Source: DWER, 2017

^ Determination of areas of high conservation value or special significance should be informed by the Guidance Statement: Environmental Siting.

*'onsite' means within the Lot boundary.

The risk assessment below is based on consideration of the risk matrix, likelihood and consequence scales identified earlier in this section. In considering the managed risk associated with the project, the EPA mitigation hierarchy for environmental factors has been followed. This proposes the following:



1. Avoid the adverse environmental impact altogether. This may include reducing the footprint or changing the location of the footprint to avoid areas with high environmental values.
2. Limit the degree or magnitude of the adverse impact. This may include reducing the footprint or carefully selecting technologies, processes (such as re-use of waste products) and management measures (such as bunding or dust and noise control measures) to reduce the impact.
3. Repair, rehabilitate or restore the impacted site as soon as possible. Adequate rehabilitation information is integral to the mitigation hierarchy to ensure early identification of knowledge gaps and risk as well as development of criteria and research to meet objectives.
4. Undertake a measure or measures to provide a compensatory environmental benefit or reduction in environmental impact to counterbalance significant adverse environmental impacts from implementation of a proposal. The measure(s) are taken after all reasonable mitigation measures have been applied and a significant environmental risk or impact remains. Offsets are not appropriate for all proposals and will be determined on a proposal-by-proposal basis.

Table 6.1 - Environmental risks and response

ISSUE	UNMANAGED RISK			MANAGEMENT	MANAGED RISK		
	LIKELIHOOD	CONSEQUENCE	RISK		LIKELIHOOD	CONSEQUENCE	RISK
ENVIRONMENTAL FACTOR: Flora and Vegetation (Aim: Maintain vegetation values, diversity and ecological functions).							
Loss or degradation of vegetation, threatened flora, TECs	Possible	Major	High	Remnant vegetation has been avoided by siting the proposed development in already cleared areas.	Rare	Major	Medium
Weeds may be introduced to areas of native vegetation, become established and impact on the local environment.	Possible	Moderate	Medium	Development is largely in already cleared areas. Grazing will still occur over the site which will help reduce the spread of weeds into areas of native vegetation.	Rare	Minor	Low
Dieback may be introduced or become present and impact on the local and onsite vegetation.	Possible	Minor	Medium	Dieback hygiene practices will be in place at the site as required.	Rare	Minor	Low
Environmental Factor: Terrestrial Fauna (Aim: Maintain habitat and fauna communities).							
Native fauna (individuals and communities) significantly impacted by the operation through land clearing, introduction of weeds and disease and activities on site.	Unlikely	Moderate	Medium	Vegetated areas will be avoided	Rare	Minor	Low
Threatened and Priority Fauna disturbed and impacted by the operation (predominantly through clearing).	Rare	Slight	Low	The recommendations from the Fauna Study will be followed. There is no proposed clearing over the site.	Rare	Slight	Low

Environmental Factor: Inland waters

(Aims: Avoid impact to surface and ground water features and maintain hydrological regimes and water quality).

ISSUE	UNMANAGED RISK			MANAGEMENT	MANAGED RISK		
	LIKELIHOOD	CONSEQUENCE	RISK		LIKELIHOOD	CONSEQUENCE	RISK
Hydrological impact to surface water features (watercourses and/or wetlands) through draining/ flooding or changes to water regimes.	Possible	Slight	Medium	There will likely be some additional runoff and stormwater management required on the site. This will be addressed in a detailed Stormwater Management Plan to be prepared once technical details are known.	Rare	Slight	Low
Impact to groundwater through changes to hydrology (changes to recharge, pumping, alterations to flow etc.).	Rare	Slight	Low	The operation will not intersect or impact groundwater.	Rare	Slight	Low
Environmental Factor: Landforms and Terrestrial environmental quality (Aims: Maintain the integrity, safety of landform and soils).							
Soils subject to significant water and wind erosion.	Possible	Moderate	Medium	Soils have low wind erosion risk. Appropriate measures to control dust and limit wind erosion will be implemented as part of the Construction Management Plan.	Unlikely	Moderate	Medium
The development creating a visual impact	Possible	Moderate	Medium	A detailed VA has been undertaken (refer subsequent chapter). This proposes key visual amenity actions to minimise visual impact.	Possible	Minor	Medium
Environmental Factor: Social surroundings (Aims: Protection of known heritage sites).							

ISSUE	UNMANAGED RISK			MANAGEMENT	MANAGED RISK		
	LIKELIHOOD	CONSEQUENCE	RISK		LIKELIHOOD	CONSEQUENCE	RISK
Impact to Aboriginal Heritage Sites.	Rare	Minor	Low	No Aboriginal Heritage sites are located on or adjoining the site. A heritage study has been undertaken and demonstrates that there are no significant Heritage sites over the site and has made recommendations in line with best practices should during the construction phase any sites be found. Procedures are outlined in the Aboriginal Heritage Act 1972.	Rare	Slight	Low
Impact to sites of European heritage.	Unlikely	Slight.	Low	There are two local heritage sites within the vicinity of the project location. No management of these is proposed.	Unlikely	Slight	Low
Environmental Factor: Social Surroundings **(Aims: Ensure that operations have minimal off-site impact from noise, dust and traffic and minimise impact to the local community)**							
Noise levels cause impact to sensitive land uses (such as residential properties).	Possible	Minor	Medium	An acoustic assessment has been undertaken for the battery facility with detailed design ensuring that the facility meets the required environmental standards in relation to noise to the nearest sensitive receptors. Appropriate management has been implemented.	Rare	Slight	Low

ISSUE	UNMANAGED RISK			MANAGEMENT	MANAGED RISK		
	LIKELIHOOD	CONSEQUENCE	RISK		LIKELIHOOD	CONSEQUENCE	RISK
Dust emissions cause impact to sensitive land uses (such as residential properties) and cause impact off-site.	Possible	Minor	Medium	A dust management plan will form part of the Construction Management Plan.	Rare	Slight	Low
Buffers and separation distances are not adequate enough to reduce impact on sensitive land uses.	Unlikely	Slight	Low	The proposed development will be set back from site boundaries under the applicable development requirements of the Shire's LPS3. Under current legislation in WA there are no applicable buffers or separation distances that apply to solar panels with noise levels being applicable to the battery facility.	Unlikely	Slight	Low
Impact of truck use on local and regional roads and traffic.	Possible	Moderate	Medium	The Traffic Impact Statement has confirmed outcomes to minimise impacts. The site contains more than enough space for manoeuvring on site and for laydown areas.	Possible	Minor	Low

6.4 Environmental Management – response to risk

FEATURE	POTENTIAL IMPACT	ASSESSMENT	MANAGEMENT
Landscape and Visual Impact	Potential for impact on visual amenity for nearby sensitive land uses (houses) and the surrounding rural area.	The site has an undulating topography which means that the site will be able to be seen from some areas from a distance. The nearest closest residence is located approximately 40 metres to the west of the site.	Refer to the Visual Analysis (Chapter 6). Discussions have been undertaken with the landowner with additional tree planting proposed to reduce the impact of the proposed development on the house. It should also be noted that the development will be set back a further 20 metres from the site boundary so the distance from the house to the start of the development will be approximately 60 metres.
Soil management	Potential for erosion and degradation of soil qualities.	Construction of the solar farm will result in some soil disturbance through movement of machinery across the land and digging/backfilling of trenches for the cabling, also small civil works will be required for the substation and inverter/transformer station foundations. There may be some potential for soil erosion as the soil becomes disturbed, however the soil types on the property have low potential for wind and water erosion and instability which will help manage this issue. Following construction, the site will naturally continue to grow pasture which will help bind the soil and decrease erosion.	Soil disturbance and erosion can be managed during the construction phase using water to suppress the creation of dust (and wind erosion). Following construction, the likelihood of soil disturbance will be low. The growth of pasture across the site will help manage soil erosion.
Vegetation and habitat	Removal and degradation of native vegetation and habitat for native fauna. Potential impact to threatened species including Threatened and Priority Flora, Threatened and Priority Fauna and Threatened Ecological Communities.	The site is already largely cleared of native vegetation. Vegetation across the site has been earmarked for retention. This is based on the fact that the site contains a substantial amount of already cleared land that is suitable for the installation of the solar array. Vegetation along the property boundaries will be retained Therefore, it is concluded that the proposed development will not have a significant impact to native flora and fauna.	This site was selected for the development because it is largely cleared of native vegetation. Areas of native vegetation have been identified for retention. A clearing permit will be applied for with the DWER in accordance with the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004.* Given that there is no proposed clearing as part of the proposed development there will be no impact on the existing threatened ecological communities.
Water resources and drainage	Modification and degradation of surface and groundwater features and modification to drainage flow (either increase or decrease in flow) which can have impacts downstream.	There are no concerns about flooding on the property (flood risk and waterlogging risk is low) and natural flow of water will continue in the existing arrangements, utilising the existing drainage lines across the site. The solar panels will not disturb the existing drainage lines across the site. The drainage channels are severely disturbed and do not have any native vegetation associated with them. Any minor modifications to the drainage lines will not have a significant environmental impact.	The solar panels will be placed to avoid the existing drainage channels as outlined on the project plans.

FEATURE	POTENTIAL IMPACT	ASSESSMENT	MANAGEMENT
Separation distances	Small separation distances can affect nearby sensitive land uses (such as residential dwellings).	The nearest closest residence is located 40m to the west and is separated by an unconstructed road reserve and a decent vegetation buffer the development will then be set back a further 20m from the edge of the road reserve so a total distance of 60m from the house to the start of the development. This is considered to be sufficient separation distance. As can be seen below, the potential impacts associated with noise, dust, visual amenity, odour and reflection will be minimal and, as such, impacts to nearby sensitive land uses will be low.	The vegetation between the proposed solar farm and the nearest closest residence located to the west should be maintained to provide a visual buffer with additional planting put in place during the construction period. Vegetation around the perimeter of the property will be maintained to provide a visual buffer from the road. Impacts typically associated with noise, dust, odour, reflection and visual amenity will be negligible. The proponent has worked closely with the acoustic co-consultant and as demonstrated within the attached acoustic report the noise associated with the battery facility is compliant with the applicable environmental regulations.
Dust	The potential for the creation of dust from the operation which may reach adjoining properties and sensitive land uses.	Some dust may be created during the construction phase as holes are dug and machinery moves across the site. However, as the site is relatively large, it is expected that the likelihood of dust leaving the boundary of the property is low. It should also be noted that current agricultural practices over the site create dust as part of normal farming practices so it is envisaged that during the construction phase the creation of dust will be no more than normal farming practices. Once the site is fully constructed there will be minimal to no dust creation. Dust may only be created when maintenance is being undertaken on the site which will take place on an ad hoc basis.	Dust can be managed using water. A watercart can wet the soil if dust levels are high. Refer to suggested dust management actions in Section 5.5 below. Once the site is operational grass will naturally grow in between solar panels which will assist with the reduction of soil erosion and dust suppression. The nearest closest residence is located 40m to the west and is separated by a decent vegetation buffer that will be improved during the construction phase of the project.
Noise	The potential for the creation of noise from the operation which may reach adjoining properties and sensitive land uses.	Some noise will be emitted during construction, largely from piling rigs, machinery and vehicles. Once the site is fully constructed, there will be no audible noise from the boundary of the site. The BESS located on the site generates noise through the use of fans contained within the battery packs.	The nature of a solar farm installation ensures that there is no excess noise generated from the installation of the panels themselves. The proponent has liaised extensively with the acoustic consultant to ensure that noise generated by the overall Project is compliant with the applicable Noise Regulations and this is demonstrated in the Acoustic Report that forms part of this application.
Odour	The potential for the creation of odours which may reach adjoining properties.	There will be no odour generated from the solar farm. Temporary toilet facilities (portaloos) will be located on site during the construction phase, however they will be removed after this. Some agricultural activities will be continued including grazing which will have similar odour impacts as surrounding farmland.	Onsite temporary toilet facilities will be maintained as per the standard required. They will only be located on site for a short time (during the construction phase) and will be removed afterwards.

FEATURE	POTENTIAL IMPACT	ASSESSMENT	MANAGEMENT
Reflection	The potential for visual impact due to glare and reflection of sunlight as it falls on the solar panels.	Solar panels are designed to absorb light, and accordingly reflect only reflect a small amount of the sunlight that falls on them compared to most other everyday objects.	The Glint and Glare assessment undertaken for the proposal found the following: **Aviation Glare:** None of the working runways at Narrogin Aerodrome will receive glare from the proposed solar facility. This is primarily because of: – The distance separation of the runways relative to the project, and – The orientation of flight landing paths **Surrounding Residences** No surrounding residential receivers will receive Any reflection from the proposed solar facility. This is primarily because of: Either – the distance separation of the receivers relative to the project; Or – the extensive existing vegetation close to may of the surrounding residences. Road and Rail Traffic When existing vegetation surrounding the site is taken into account, there will be no glare on Continue Road, Link Road, Mellons Road, Narrakine Road South, the N-K-W Rail Line and Wanerie Road. There is potential for glare along Parks Road and the Great Southern Highway. Two mitigation options are available to completely eliminate the above-mentioned remaining glare potential: – Vegetation Screening – Back-Tracking Rest Angle Modification to PV Array 1 (limit the AFTERNOON Rest Angle to 5°) and PV array 11 (limit the MORNING Rest Angle to 5°) These mitigation measures will be taken into account through the detailed design phase and implemented through the construction and operation phase of the project.

6.5 Dust management

The potential for dust generation and the potential impact off-site has been considered. The assessment has considered in detail the activities associated with the operation, the risk factors and the proposed controls.

The Dust Management Plan actions, responsibilities and timing is presented in Table 5.2 below. A majority of the dust management procedures apply during the construction phase and are included under the heading 'general'. Specific actions relating to a certain activity are also listed in Table 5.1 below. These actions have also been considered in the overall dust risk assessment presented in Table 4.3. It is anticipated that that the dust management actions will be refined and incorporated into the Construction Management Plan prior to development on site occurring.

Table 6.2 – Dust Management Plan – during construction

INDICATIVE MANAGEMENT/ACTION	RESPONSIBILITY
When winds are sufficiently strong to negate the effects of dust management, operations will cease until conditions improve and compliance can be achieved. The team have authority to stop work if they see visible dust issues, especially if wind conditions deteriorate.	Construction Project Manager
Maintain all equipment in good condition.	Construction Project Manager
Keep vehicle speed limits low throughout the site.	Construction Project Manager
Continue training programmes on dust control requirements to all workers and contractors.	Construction Project Manager
All non-conformances and dust related complaints immediately reported to the CPM.	Construction Project Manager
Following complaints, the source of any excessive dust will be identified and work practices will be modified or re-scheduled to reduce or eliminate the risk of future events.	Construction Project Manager
A notice is placed on site with contact details of the CPM and details as to where dust complaints are to be addressed. It will be displayed at all times.	Construction Project Manager
Maintain regular communication with the owners of the nearest sensitive receptors.	Construction Project Manager
Ensure that all site operators are trained to observe whether dust is leaving the property boundary or if adverse weather conditions are present.	Construction Project Manager
Ensure that all site operators are trained in procedures should dust be observed leaving the boundary or if there are adverse weather conditions such as when to stop operations or when to increase dust management measures (such as wetting down areas etc.)	Construction Project Manager

INDICATIVE MANAGEMENT/ACTION	RESPONSIBILITY
Should dust visibly cross the site boundary at any time, dust suppression measures shall be increased immediately and if works are taking place they shall be modified accordingly. Should dust continue to be generated all works shall cease immediately and the site shall be sufficiently stabilised by application of water until the wind conditions are appropriate to resume works.	Construction Project Manager
Watercarts will be utilised to wet down access tracks to prevent dust generation. Water for the carts should be obtained from the pond onsite.	Construction Project Manager
Chemical dust suppressants (such as Dustex) can be used on unsealed areas if they are planned to be unused for extended periods.	Construction Project Manager
Maintain sealed bitumen at the main site entrance.	Construction Project Manager
Train and discuss the impacts of vehicle speeds on dust generation.	Construction Project Manager

6.6 Weed management

The Commonwealth Department of Climate Change, Energy, the Environment and Water recommends in the Australian Weeds Strategy 2017 to 2027 that there are four weed management options depending on the stage of invasion, as follows:

1. Prevention
2. Eradication
3. Containment
4. Asset protection

While the Australian Weeds Strategy is aimed at addressing weeds at a national level, the principles can also apply at a regional or local level.

Prevention of weed spread is largely addressed at a national and state/territory level through border controls and biosecurity.

Prevention is recommended where there is minimal weed invasion.

Eradication of weeds is possible if weed populations are small or if the weed has only recently been introduced to the country, state or region. As is stated in the Australian Weeds Strategy (Invasive Plants and Animals Committee, 2016), "eradication at the local level tends to be less feasible, since on-going invasion tends to occur from adjacent areas, where the weed is not subject to the same high level of control". This needs to be taken into consideration as, although one aim of weed management is to eradicate certain from the property (such as Declared Pests and Weeds of National Significance), there is the risk that they will return or that they will not be entirely eradicated as invasion can occur from adjoining areas.

Containment of weeds aims to completely prevent further spread of a weed species beyond the boundary of existing infestations or to slow the spread. It may include reduction of the density or area of the infestation. Containment is recommended when there is a rapid increase in weed distribution and abundance.

Asset protection is generally applied to weed species that are widespread and abundant. Most likely they have existed in Australia for many decades and, over this time, have spread across large portions of their potential range. Eradication or containment of these species is considered to be impractical (Invasive Plants and Animals Committee, 2016). Instead, the goal becomes effectively managing weed threats to protect certain high-value assets. This form of weed management is a cost/benefit approach in which the feasibility and cost-effectiveness of controlling the weed needs to be considered. This is largely the case on properties which have a high number of agricultural weeds. These weeds exist on agricultural properties which have been previously cleared and used for rural purposes. Therefore, control and elimination of these weeds is not considered practical.

Weed management with a focus on asset protection is likely the most appropriate focus of management on this site, given the large and historical nature of agricultural use being prevalent. Limiting further introduction of weed species and protecting the remnant vegetation from increased weed infestation is the key focus.

Table 6.3 – Weed Management

INDICATIVE MANAGEMENT/ACTION	RESPONSIBILITY
Ensure no weed contaminated or suspect soil or plant particles is brought to the operation area.	Construction Project Manager
Ensure the operation is kept secure with perimeter fencing, signs and locked gates to avoid rubbish dumping from trespassers.	Construction Project Manager
Keep vehicles to tracks and operational areas to reduce the risk of spreading weeds around the property and vegetation adjoining the operation.	Construction Project Manager
Remove all rubbish promptly from the operational area.	Construction Project Manager
Weed affected soils are not to be used for construction or other purposes on site..	Construction Project Manager
Declared Plants and Weeds of National Significance, if identified, will be removed as appropriate (according to the control methods listed by DPIRD and Weeds Australia).	Construction Project Manager
Any Declared Plants or Weeds of National Significance will be controlled as a priority if found within the operation area.	Construction Project Manager

6.7 Dieback management

Management of dieback involves hygiene management to reduce the spread of the pathogen from infested areas to uninfested areas. If the occurrence of dieback has not been confirmed, the construction process is managed to reduce the risk of introducing dieback to the site and removing dieback from the site.

Dieback can spread through the movement of infected material, including soil, plant material and water, and as such, the actions that will allow these to occur are the focus areas for management. As dieback can infect vegetation if soil or plant material is brought onto the site from vehicles and footwear. This can be managed by ensuring that vehicles and machinery arrive to the site clean and free of soil and plant material and that staff do not walk-through areas of native vegetation.

The main construction entrance to the operation should be a "clean on entry" (COE) point for any machinery operating near remnant vegetation and for maintaining firebreaks. Vehicles should not be carrying any clods/slurry of soil or plant material, however it should be noted that a thin, dry film of grime/dust is not considered to present a risk and does not need to be removed.

As good practice, trucks and vehicles should also be cleaned before leaving the site. This serves to reduce the spread of dieback to other locations and helps to reduce dust on the roads.

Firebreak maintenance should be done when the soil is dry and avoid wet weather. As is mentioned above, machinery should be clean-on-entry and cleaned of clods of soil and plant material before entering the property.

The dry brush-down method of cleaning is the preferred method for machinery. The wash-down method increases soil moisture levels in the immediate area, creating more favourable conditions for dieback.



Indicative dieback management procedures are summarised in Table 5.4 below.

Table 6.4 – Dieback Management

INDICATIVE MANAGEMENT/ACTION	RESPONSIBILITY
Inspect machinery used for clearing, stripping, and grading firebreaks when arriving at the site to ensure they are clean from clods of soil and free of plant material. The entrance to the site should be a "clean on entry" point.	Construction Project Manager
Maintain firebreaks when the soil is dry and avoid wet weather.	Construction Project Manager
Ensure that site workers and contractors do not walk-through areas of native vegetation located outside of the construction area.	Construction Project Manager
Ensure that vehicles, trucks, and machinery keep to existing access tracks and construction areas and are not permitted to enter areas of native vegetation.	Construction Project Manager
Inspect all vehicles, trucks, and machinery before exiting the site to ensure they are clean from clods of soil and plant material.	Construction Project Manager
Ensure that the site is secured from public access with fences, locked gates, and signage to discourage trespassers.	Construction Project Manager
Ensure that any plants brought onto the site for screening or other purposes (i.e. seedlings) are obtained by nurseries free of dieback.	Construction Project Manager
Provide training (including vehicle cleaning) during site inductions to all relevant personnel working on the site.	Construction Project Manager
Should an area be identified as being infested with dieback (through testing etc) procedures will be followed in accordance with the DWER guidelines.	Construction Project Manager

6.8 Construction Management Plan

It is suggested that a Construction Management Plan be prepared prior to on-site work commencing. This will ensure that the management of the site is appropriate for the construction phases and methodologies required to implement the project. The Construction Management will review the management actions identified as part of the Development Assessment process, and provide further details on site-specific management as required.

7. Visual assessment

7.1 Visual Landscape as a Planning Tool in Western Australia.

The WAPC has developed a series of guidelines (2007) in the form of a manual which explains the purpose, approach and methods of conducting assessment of visual impact on landscapes for the purposes of informing planning decisions.

WAPC – Landscape Impact – Using Visual Analysis

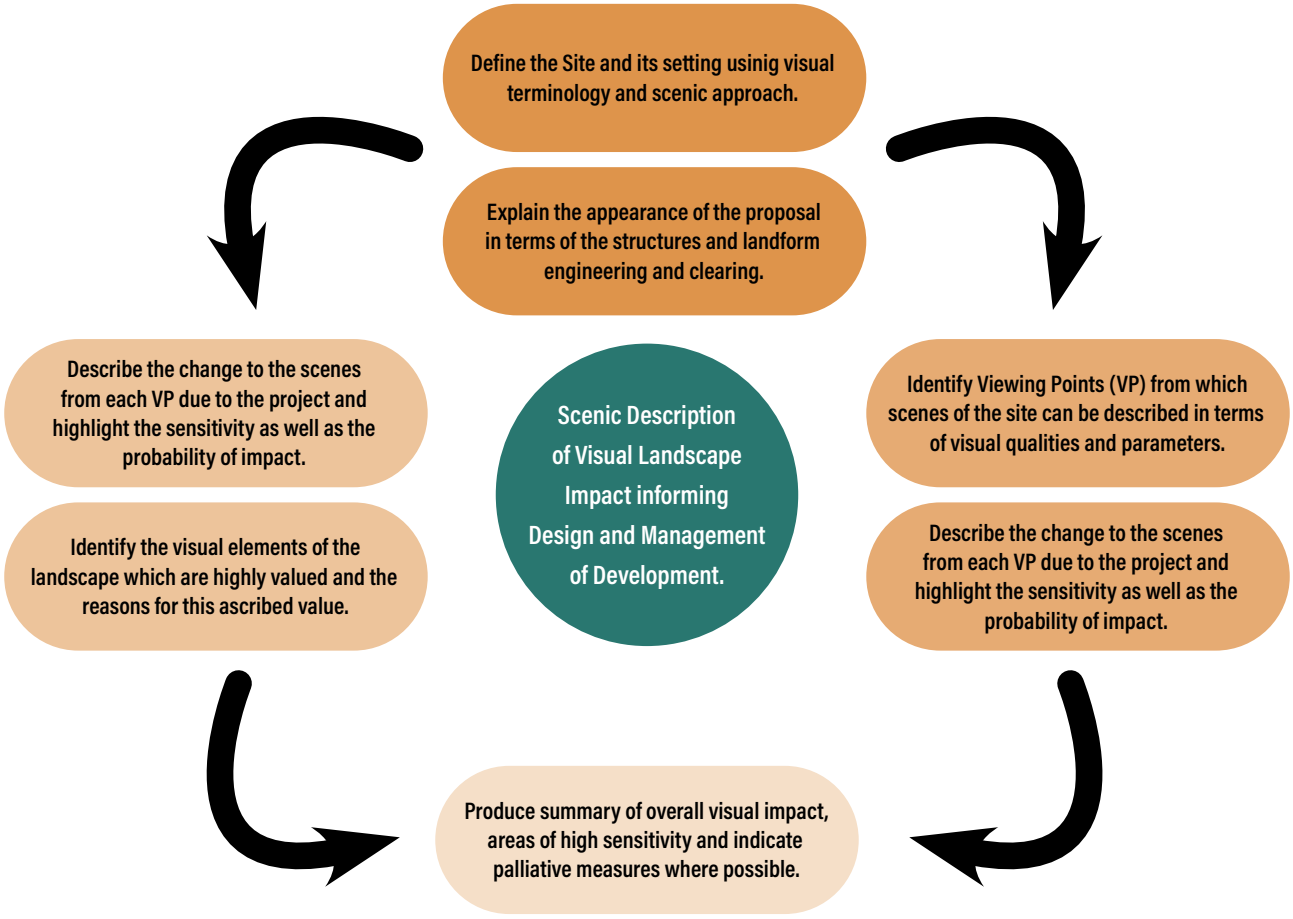


Figure - Visual Landscape Planning in Western Australia (DPI 2007)

The outcome of such a methodology is to identify the overall extent and location of visual impacts on the landscape, and to inform design, assessment, and implementation management for projects within a landscape setting.

7.2 Visual Analysis – Landscape Impact

Introduction

The Project will be located on various lots to the south of Wanerie Road and to the west of Great Southern Highway just south of the town of Narrogin. A digital visualisation of the project can be found at **Appendix K** of this report.

The land is in a valley which has two watercourses. The landform is concave with a slope towards the southwest from the northeast. The solar farm component of the Project covers a large site which extends more than 2 km north to south.

The road corridors surrounding the site provide the main visual referencing points for this scenic analysis.

The site is made up of numerous properties in the area bounded by Wanerie Road to the north, Great Southern Highway to the east, Narrakine road to the west and is north of Contine Road and to the east of Parks Road. Hills at 370m AHD are located in the northwest and to the east of the Great Southern Highway.

These landforms dominate the skyline of views within the site outwards to the north and east.

Views and Change

There is an apparent change in landscape whereby a solar farm imposes a different aesthetic to what is currently partially cleared and open farmland. Within the site there are local tracks and roads and some buildings and dams.

The solar panels will introduce a very human and non-naturalistic appearance to the landscape, with the array of solar panels distributed across the landform all oriented to capture optimum solar radiation. The views towards this installation will be direct but with some parts obscured by intervening landforms and treed areas.

The views into the site will change, and this change will carry a new set of values – those associated with renewable energy and its promise and will replace the values associated with farming land or open fields. Some natural elements will remain such as watercourses, tree belts and remnant pockets of native flora. There is a lot which can be done to ameliorate the visual starkness of solar panels and any large structures associated with their operation and battery storage of generated electricity. It might be argued that rows of solar panels introduce a visual order of geometry over the terrain similar to that of shade houses, vines or an orchard. A rhythm of replicated forms can assist in reading slope and fall of land and might offer appeal to viewers as a point of interest and difference to surrounding farmlands.

In accepting the proposal will change the views into the property, this assessment will focus on providing:

a) A description of the view and its elements
b) The likely visual experience from selected viewing points outside of the site (adjacent private and public areas)
c) A recommendation as to the way impacts from the new view scape might be managed to reduce discordant elements or to mute the overall visual impact to blend with the context and surroundings.

Technique

This visual analysis will use a scenic appraisal technique. This involves the following steps:

4. Identify the key viewing points surrounding the site and to represent the points from which to describe the view, its experience and potential management or mitigative measures.
5. Describe the view from each Viewing Point (VP) in terms of the natural and cultural landscape and its visible elements; A scenic description will describe each view in terms of the background, middle ground and foreground components, and what is seen and recognized as visually forming the landscape.
6. Experiential viewing analysis is the explanation of how the view is perceived and this takes into account the height of the viewing point, the elements which are dominant (referenced to scenic approach);
7. Identification of visual impacts which may require attention to manage or mitigate.
8. Recommendation as to the management and mitigation of elements regarding the proposal design and its implementation.

This technique is useful because it can be easily used to explain visual experience and change in terms of technical and non-technical parameters.

Viewing Points

Viewing Points are precise visual checkpoints from which views towards a property can be described and relative visual impacts gauged and reported.

The solar farm covers a very large area or what is cleared and open terrain. The valley form allows for maximum views from the perimeter into the site.

The project will be visible from outside the site and from several different locations. Eleven Viewing Points have been selected to serve the purpose of reporting the visual impact of the project on the surrounding area.

The selected viewing points are on Great Southern Highway, Wanerie road (also at the intersection) and along Narrakine Road (South).

Photographs are taken from these sites and are used as the basis for the Scenic analysis of the project, the siting, and its impact on views.

View description, Assessment and Assumption.

The assumption for each selected VP is there can be open line-of-sight views into the property, or where there are intervening landforms, trees, or buildings, then these can be noted, and a comment made as to the impact of the proposal on that scene.

The view is described in terms of the combination of foreground, middle ground, and background. The skyline is also described to illustrate the length of view and proportion of view distributed between the three grounds.

A continuous skyline is generally considered an important mitigation to an otherwise visually dominant introduction into a landscape. The horizon unites and frames the view.

A foreground is also a dominant aspect of most views. Generally, if the foreground is benign and the skyline is intact – any development within these two may be likely to have a moderated visibility and therefore impact. This is the method of scenic analysis applied for these projects in an open landscape view.

In the case of solar panels, these are usually elevated up 1 – 2 m from the terrain surface and located in a near-horizontal plane thereby presenting a sidelong aspect to the viewer. This is as minimal an exposure to view as it possible. Where the viewer is elevated, it is likely there will be a greater aspect of the panels to be viewed and glint and glare may also attract attention in an otherwise open rural landscape. Given their scale and coverage of land it may be surprising that the visual impact of solar farm panels is not severe, and in cases where it is set back from the viewing point, the perception of the panels is often as a benign element of a rural scene. This can be screened by vegetation or intervening landforms.

View Corridors

Main roads are identified to be the main view corridors of value – mainly because of their high levels of public thoroughfare, and therefore exposure.

Major highways carry more traffic and so they are rated to be more likely to register a visual impact for more people than a view from an adjoining property, or a low-volume rural road.

In addition, the length of exposure to any impact is also part of the evaluation. A residential property which is directly impacted by glint and glare has a higher level of expected amenity than that of a major road that takes high-speed traffic. Although subjective, this explanation of assumptions will lead to clearer management imperatives to mitigate any visual impacts, including glint and glare.

The main view corridors are Great Southern highway to the east of the project site, and Wanerie Road to the north of the site. Both routes carry moderate to high numbers of vehicles at moderate to high speed. Attention to driving on these roads should not be distracted by visual cues such as reflecting or otherwise alarming visual impacts.

For this project views from within the boundaries of the site are not considered relevant given there are no houses or public viewing points which might have expectation of high visual amenity.

7.3 Viewing Points (VP)

The viewpoints are shown on Figure 7.1 below.

The following survey describes the view experienced from each of the Viewing Points of the landscape.

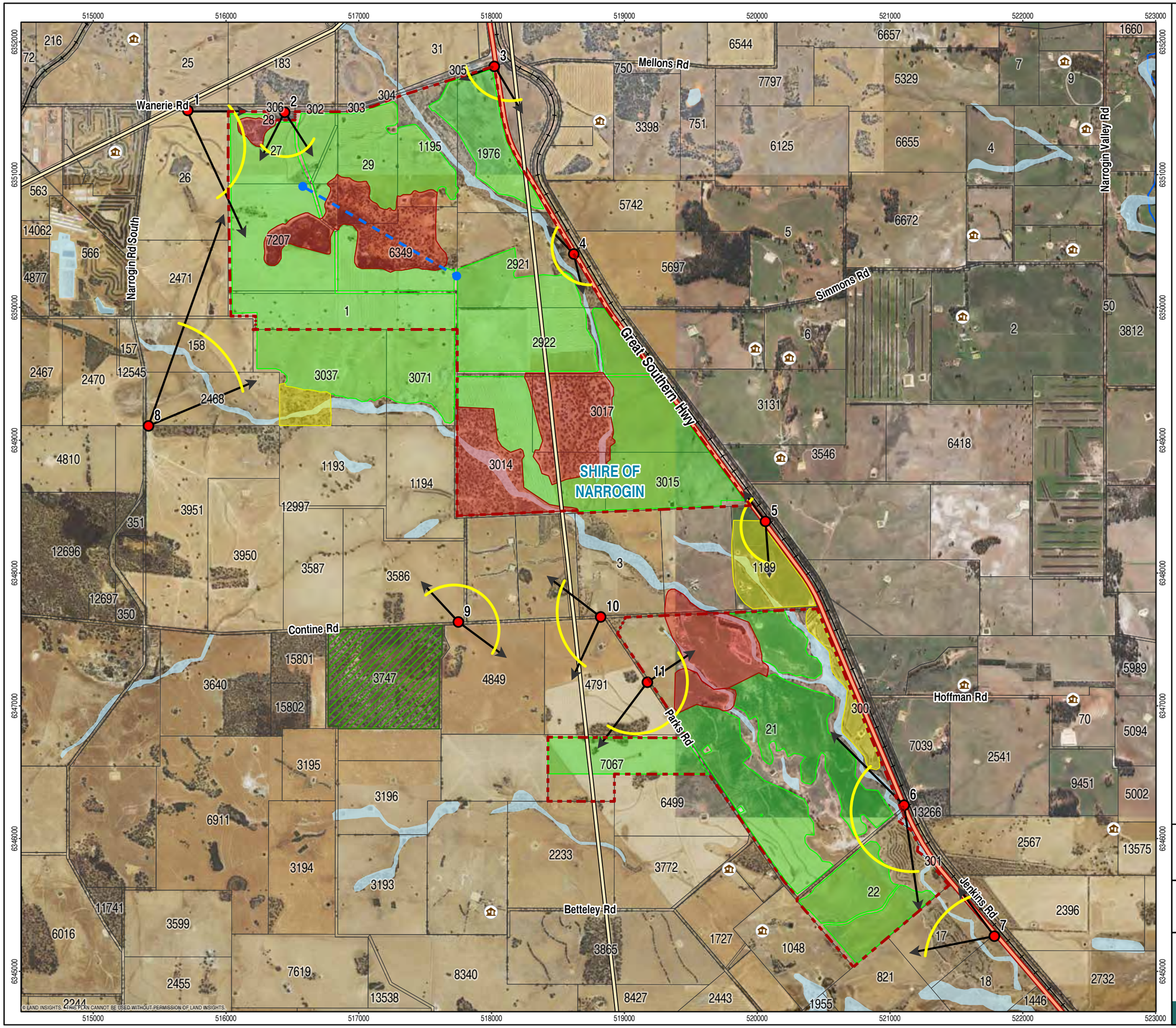
VP1 - Wanerie Road (west).

The road approaches the site from the north-west in a long and sweeping series of curves. The road heads into a valley before climbing back towards the intersection with Great Southern Highway.

From VP1 the approach to the solar farm site is screened by landforms (hills) and vegetation (moderately dense remnant native woodland).

The views possible are long towards a skyline, and this combined with the speed of travel at this point would reduce the time and capability to scan in detail the landscape view from tis VP1. The section of road is limited at 80 – 110 kmph then decelerating as nearing the intersection. VP1 has a short view towards the site, and the skyline would be a mixture of distant hills and intervening woodland and hills.

This VP provides an approach view of the site.


Houses
Extent
Site area
Transmission Overhead Powerlines
State road
Rail
Wheatbelt wetlands
DBCA - Legislated Lands and Waters (DBCA-011)
Cadastre
View Description
Scene shed
Screen diffuse
View blocked
Viewing point
Wanerie Rd
Narrogin Rd South
Mellons Rd
Narrogin Valley Rd
Simmons Rd
Great Southern Hwy
SHIRE OF NARROGIN
Contine Rd
Parks Rd
Hoffman Rd
Betteley Rd
Jenkins Rd
0 250 500 750 1,000
Metres
1:27,500 @ A3
NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY
Project: 1121
Projection: GDA2020 MGA Zone 50
Date Exported: 7/11/2024 4:04 PM
Layout Name: ARP 1121-002-01-01 Narrogin Viewing Points
PO Box 289 Mt Lawley WA 6929
Ph: 9271 8506
admin@landinsights.com.au
landinsights.com.au
Viewing Points
Narrogin Solar and Battery Hybrid Project
NARROGIN
Narrogin Solar Pty Ltd
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VP2 - Wanerie Road (center)

Wanerie Road dips into the valley and from this point is exposed to long views down the valley and across the site. The fall of the land means the site is slightly below line of eyesight for most drivers, however the rolling landform into the valley and pockets of woodland and remnant trees and scrub presents a rural farming landscape view; one typical of the area and generally valued for its appearance and connected values as a productive area.

The rise of the land to the north of the road focusses views towards the east and south-east (or west and southwest) depending on the direction of traffic.

It is noted there would be a 20-meter development setback/development buffer to the road and within the road reserve and adjacent to this area is currently occupied planted with trees. The skyline view of this VP southwards is distant almost to the point of infinity.

VP3 - Intersection of Wanerie Road and Great Southern Highway (GSH).

The intersection of the Highway and Wanerie Road occurs at a T junction whereby Wanerie Road traffic is stopped facing away from the site. The land immediately adjacent to the intersection is vegetated with mature trees and this screens views down into the valley and the site.

Traffic heading south on the highway would be continuing south at high speed. Traffic turning into Wanerie Road would be glimpsing the site and seeing more of the valley as they head westwards along Wanerie Road.

The most visual exposure of the site occurs from 200 m west of the intersection.

The northeast corner of the site is visually prominent, and this will be most subject to visual impact and perception by road users at V3.

There is a 50 m buffer for the GSH and so that portion of the site will be a significant part of the foreground view for vehicles heading along the GSH.

VP4 - GSH just south from intersection with Wanerie Road.

Views of the east from this point are curtailed by the railway line embankment and trees within the rail reserve.

The view of the landscape is down into a shallow gully/valley which is open and contains cleared fields, but these views are curtailed by some intervening hillocks and remaining trees and vegetation.

Views for travelers north will see a shorter view of the valley with a backdrop of the bushland and trees just south of Wanerie Road.

The terrain is relatively flat and the skyline to the west is prescribed either by the intervening screen or glimpses of the very distant horizon. The 50m buffer for the Great Southern Highway is a place of remnant vegetation and trees – but this can screen a view diffusely rather than completely blank views.

This viewing point is on one of the main transport corridors and so the aspect will be exposed to a higher number of viewers (and non-local persons) than for VP to the west.

VP5 - GSH near intersection with Contine Road.

This viewing point has more open and direct views across the valley than VP4 and will overview both of the two installation sites for the solar farm.

The landform is very flat and so views are oblique rather than from elevated vantage.

VP6 - GSH near intersection with Parks Road.

This VP is in a flat area of the valley and is therefore not able to view surrounding land other than by an oblique or flat aspect.

Landscape in this location is low-lying flood prone basin, and the use is, mainly pasture and drainage for ecological purposes. There are some remnant areas of vegetation, mainly low scrubby cover with some taller trees growing in gully depressions.

VP7 - GSH to the south of the site.

This VP offers northwesterly views towards the southern areas of the site of the solar farm.

The aspect of these views is low and screened by trees growing along the highway road reserve and within the watercourse lines.

VP 8 – 11 are considered to have a minimal opportunity for the views of scenery to be impacted by the solar panels. Description of the likely affected scene follows:

VP 8 - Narrakine Road and Contine Road intersection.

This VP is located some distance to the west from the solar farm sites and is elevated but screened from overview by higher land to the north and east. A gully with remnant trees and vegetation runs to the east of the VP. This VP is relevant because Narrakine Road is a well-used local road connecting back to Narrogin.

VP 9 - Contine Road west.

This viewing point is located within the farming area some distance from either of the solar farm sites. This VP provides slightly elevated views towards the east and northeast. The view to the north and north-west are screened by intervening landform and vegetation.

VP10 - Parks Road at intersection with Contine Road.

This VP offers views to the north-east across the land between the two solar farm sites. The landscape is flat and undulating with drain lines characterized by several creeks. To the north of the VP is an area of remnant woodland extending south-easterly along the creek line to curtail views to the east. The visibility of the two sites for the solar farm are likely to be screened from views taken from VP10.

VP11 - Parks Road south.

This VP is west and south of the two project sites.

The views from this point are in a flat area of the valley. Views of surrounding land are limited other than by an oblique or flat aspect. Landscape terrain in this location is low-lying flood prone basin, and the use is, pasture and drainage for ecological purposes. There are some remnant areas of vegetation, low scrubby cover with some taller trees growing in gully depressions. Views to the east would glimpse the site.

Post Construction View Experience Management. (refer to photographs in Appendix VI 1)

The following appraisal summarizes the expected visual experience of the solar farm, battery and associated site installation and transmission line works.

VP	VISUAL EXPERIENCE	PUBLIC SENSITIVITY	ACCEPTABILITY L, M, H	MANAGEMENT/MITIGATION
1	Possible glimpses of solar panels	Low	Unlikely to cause visual impact issues. L	Road reserve screen planting
2	Direct views of the solar panels likely	High	Visible in foreground onwards and potential for glare and reflection H	Road reserve screen planting
3	Direct views of solar panels and battery structures	High	Solar panels visible and potential for glare and reflection. Battery to be visible H	Road reserve screen planting. Possibility to lower battery or to bund and landscape road edges.
4	Direct views of the solar panels, distant glimpse of battery.	High	Solar panels visible in middle ground beyond highway screen, battery glimpse possible M	Improve the density of planting along the highway.
5	Glimpses of the solar array to the north, and distant view of array to south.	Medium	Solar panels visible in middle ground beyond highway screening vegetation. M	Improve the density of planting along the highway
6	Direct and glimpses of the solar panels in the middle ground to the west of the VP.	Medium	Views of solar panels will be lateral rather than from an elevated position. L	Improve density of tree screening along the highway.
7	Distant glimpses of the solar panels to the north west of the VP.	Low	Glimpse views will be in a narrow arc of the overall vista. L	No management required.
8	Unlikely distant glimpses of the solar panels	Low	Unlikely glimpses would register from this VP Negligible impact-. L	No management required.
9	No likely glimpses of the solar panels to the north of the VP.	Low	Negligible impact- L	No management required.
10	Some glimpses of the solar panels to the north of the VP.	Low	Negligible impact. - L	No management required.
11	Glimpses of the solar array to the east, and distant view of array to north.	Low	Negligible impact. - L	No management required.

7.4 Management and Impact Mitigation

Based upon the above appraisal there are four out of eleven VP that raise visual impact most likely to require some form of management to mitigate and reduce the impact.

The appraisal is thereby considered to indicate the proposal would create medium to high impacts in a couple of focused viewing points, however those impacts are not so severe as to not be rectified by management actions. A transmission line needed to connect the project to the Western Power network is expected to be visible, but not as a remarkable or disruptive visual element of the rural landscape.

The proposed measure to manage a reduction in visual impact is to install tree screen planting along the boundaries solar farm west of Great Southern highway and to the south of Wanerie Road.

In the case of the battery at the northeastern corner of the site, it is suggested the structure either be submerged into the ground, or else a bund and planting installed to screen direct views from the VP3 and VP4.

7.5 Conclusion

The Narrogin Solar and Battery Hybrid project can be installed in a manner that is visually sympathetic to the overall cleared rural farmland landscape. The Panels themselves are translucent and thereby do not cast a dense shadow onto the ground surface.

A array of solar PV Panels is reminiscent of a vineyard or orchard in symmetry and pattern of arrangement across a landscape's surface. Likewise, flocks of sheep or herds of cattle can also arrange in form across a field, to describe a pattern over the terrain not too different to the arrangement of solar panels.

The potential for glare or reflection to intrude is best managed via screening of sensitive viewing points either by the planting of screen trees or similar direct line of sight intervention.

The positive values ascribed by the community to solar energy is such that the change in the visual appearance of the landscape may be acceptable due to the perceived environmental and societal benefits of proactive greenhouse gas emissions reduction as demonstrated in a solar farm and storage battery.

8. Conclusion

This application and supporting Planning Report presents the merits and suitability of the Narrogin solar and battery project for the location on the site south of Wanerie Road and along Great Southern Highway in Narrogin.

This report and its appendices comprehensively demonstrate that the proposed development is consistent with the applicable planning framework and will not be out of place within the Rural zoned area of the Shire.

The proposal warrants approval for the following reasons:

- The proposed development is consistent with the intent and provisions of current LPS3 and will be advertised post lodgement. The proponent and Land Insights will address any matters that are raised through submissions in due course.
- The proposed solar battery storage facility design has been carefully refined through considered design and a walk through of the site so as not to have a detrimental visual impact over the site or its surrounds.
- The Project design and proposed implementation is informed and supported by specialist technical consultant appraisal of the project and the site plus its context. These demonstrate that the proposed development is suitable in terms of design, traffic, bushfire and the glint and glare and acoustic study.

The proposed development is therefore recommended for the consideration of its substantial merit, to meet both state and local planning frameworks objectives and requirements, especially those relating to sustainability in energy generation and regional development.

The project should be supported and the development application approved with appropriate conditions.



appendix a
– signed form 1

Government of **Western Australia**
Development Assessment Panels

DAP FORM 1

Notice of Development Application to be Determined by a Development Assessment Panel

Planning and Development Act 2005
Planning and Development (Development Assessment Panel) Regulations 2011 – regulations 7, 10 and 21

Application Details

To	*Name of local government and/or Western Australian Planning Commission* Shire of Narrogin	
Planning Scheme(s)	*Name of planning scheme(s) that applies to the prescribed land* Local Planning Scheme No.3	
Land	*Lot number, street name, town/suburb* See attached list	
Certificate of Title (provide copy)	*Volume Number* See attached list	*Folio* See attached list
	Location Number See attached list	*Plan / Diagram Number* See attached list
Details of development application made to responsible authority	*Summary of Proposal* Proposed solar power generation facility	
Development Use	*Residential / Commercial / Industrial / Rural / Mixed Use / Other* Other	
Estimated cost of development (GST Exc)	$	

Part A – Acknowledgement by Applicant and Landowner

Mandatory Application	☑ I give notice that I understand that this is a mandatory Development Assessment Panel application *(regulation 5)*
Optional Application	☐ I give notice that I have elected to have the development application that accompanies this form determined by a Development Assessment Panel *(regulation 6)*
Delegated Application	☐ I give notice that I understand that this is an application of a class delegated to a Development Assessment Panel for determination *(regulation 9)*

Applicant Details (to be completed and signed by applicant)

- By completing this notice, I declare that all the information provided in this application is true and correct.
- I understand that the information provided in this notice, and attached forming part of the development application will be made available to the public on the Development Assessment Panel and local government websites.

Name	Ross Montgomery	
Company	Land Insights	
Address	*Street Number/PO Box number, street name, suburb, state, postcode* Level 6, 191 St Georges Tce, Perth WA 6000	
Contact Details	*Email* ross@landinsights.com.au	*Phone* 1300 725 522
Signature		*Date*

Landowner Details (to be completed and signed if landowner is different from applicant)

- By completing this notice, consent is provided to submitting this application.
- If there are more than two landowners, please provide all relevant information on a separate page.
- Signatures must be provided by all registered proprietors or by an authorised agent as shown on the Certificate of Title.
- Alternatively, a letter of consent, which is signed by all registered proprietors or by the authorised agent, can be provided.
- Companies, apart from sole directors, are required to provide signatories for two directors, a director and the company seal or a director and a company secretary.

Company (if applicable)		
Contact Details	*Email*	*Phone*
Address	*Street Number/PO Box number, street name, suburb, state, postcode* See attached list	
Name/s	Graeme David Steele	
Title/s	*Landowner/Sole Director/Director (2 signatures required)* Mr Graeme David Steele	*Additional Landowner/ Director/Secretary (if applicable)*
Signature/s	G.D. Steele	
Date	28·11·2023	

Part B – Acknowledgement by Local Government

Responsible Authority	☐ Local Government (LG) ☐ * Western Australian Planning Commission (WAPC) ☐ * Dual – Local Government and Western Australian Planning Commission ☐ Department of Finance – *Public Primary School Applications*	
* WAPC/DUAL reporting details	*If WAPC or DUAL is selected, please provide details of relevant provision (or within covering letter)*	
Fees for applications *(DAP Regulations - Schedule 1)*	$ Amount that has been paid by the applicant $ Amount to be paid by local government *(delegated applications only - regulation 22)*	
Statutory Timeframe *(regulation 12)*	☐ 60 days (advertising not required) ☐ 90 days (advertising required or other scheme provision)	
LG Reference Number		
Name of planning officer *(Report Writer)*		
Position/Title		
Contact Details	*Email*	*Phone*
Planning Officer's Signature		*Date*

Please refer to the Guidance Note: Lodging a DAP Application for further information.

Lot No.	Street	Town/Suburb	Volume/Folio	Location No.	Plan/Diagram No.	Owner
21	101 Contine Rd, Highbury	Narrogin	2848/970		DP 4006863	Graeme David Steele.
22	N/A	Narrogin	2848/971		DP400863	
This is a Multi-Lot Title						
2233	N/A	Narrogin	1352/519		DP109496	
4791	N/A	Narrogin	1352/519		DP115824	
7067	N/A	Narrogin	1352/519		DP126439	

Government of **Western Australia**
Development Assessment Panels

DAP FORM 1

Notice of Development Application to be Determined by a Development Assessment Panel

Planning and Development Act 2005
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Application Details

To	*Name of local government and/or Western Australian Planning Commission* Shire of Narrogin	
Planning Scheme(s)	*Name of planning scheme(s) that applies to the prescribed land* Shire of Narrogin Local Planning Scheme No.3	
Land	*Lot number, street name, town/suburb* 1189 (52) Contine Road, Dumberning	
Certificate of Title (provide copy)	*Volume Number* 2114	*Folio* 145
	Location Number	*Plan / Diagram Number* DP104028
Details of development application made to responsible authority	*Summary of Proposal* Proposed solar energy generation facility	
Development Use	*Residential / Commercial / Industrial / Rural / Mixed Use / Other* Other	
Estimated cost of development (GST Exc)	$	

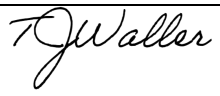
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Applicant Details (to be completed and signed by applicant)

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Name	Ross Montgomery	
Company	Land Insights	
Address	*Street Number/PO Box number, street name, suburb, state, postcode* Level 6, 191 St Georges Tce, Perth WA 6000	
Contact Details	*Email* ross@landinsights.com.au	*Phone* 1300 725 522
Signature		*Date*

Landowner Details (to be completed and signed if landowner is different from applicant) • By completing this notice, consent is provided to submitting this application. • If there are more than two landowners, please provide all relevant information on a separate page. • Signatures must be provided by all registered proprietors or by an authorised agent as shown on the Certificate of Title. • Alternatively, a letter of consent, which is signed by all registered proprietors or by the authorised agent, can be provided. • Companies, apart from sole directors, are required to provide signatories for two directors, a director and the company seal or a director and a company secretary.		
Company (if applicable)		
Contact Details	*Email* twaller1@bigpond.com	*Phone* 0407982358
Address	*Street Number/PO Box number, street name, suburb, state, postcode*	
Name/s	Mr Travis John Waller	
Title/s	*Landowner/Sole Director/Director (2 signatures required)* Mr Travis John Waller	*Additional Landowner/ Director/Secretary (if applicable)*
Signature/s		
Date	27/11/2023	

Part B – Acknowledgement by Local Government

Responsible Authority	☐ Local Government (LG) ☐ * Western Australian Planning Commission (WAPC) ☐ * Dual – Local Government and Western Australian Planning Commission ☐ Department of Finance – *Public Primary School Applications*	
* WAPC/DUAL reporting details	*If WAPC or DUAL is selected, please provide details of relevant provision (or within covering letter)*	
Fees for applications *(DAP Regulations - Schedule 1)*	$ Amount that has been paid by the applicant $ Amount to be paid by local government *(delegated applications only - regulation 22)*	
Statutory Timeframe *(regulation 12)*	☐ 60 days (advertising not required) ☐ 90 days (advertising required or other scheme provision)	
LG Reference Number		
Name of planning officer *(Report Writer)*		
Position/Title		
Contact Details	*Email*	*Phone*
Planning Officer's Signature		*Date*

Please refer to the Guidance Note: Lodging a DAP Application for further information.



appendix b

– proposal plans and specifications

Narrogin Solar Farm Overview

- Project Boundary
- Restricted Area
- Site Access
- Access Roads
- Switchyard

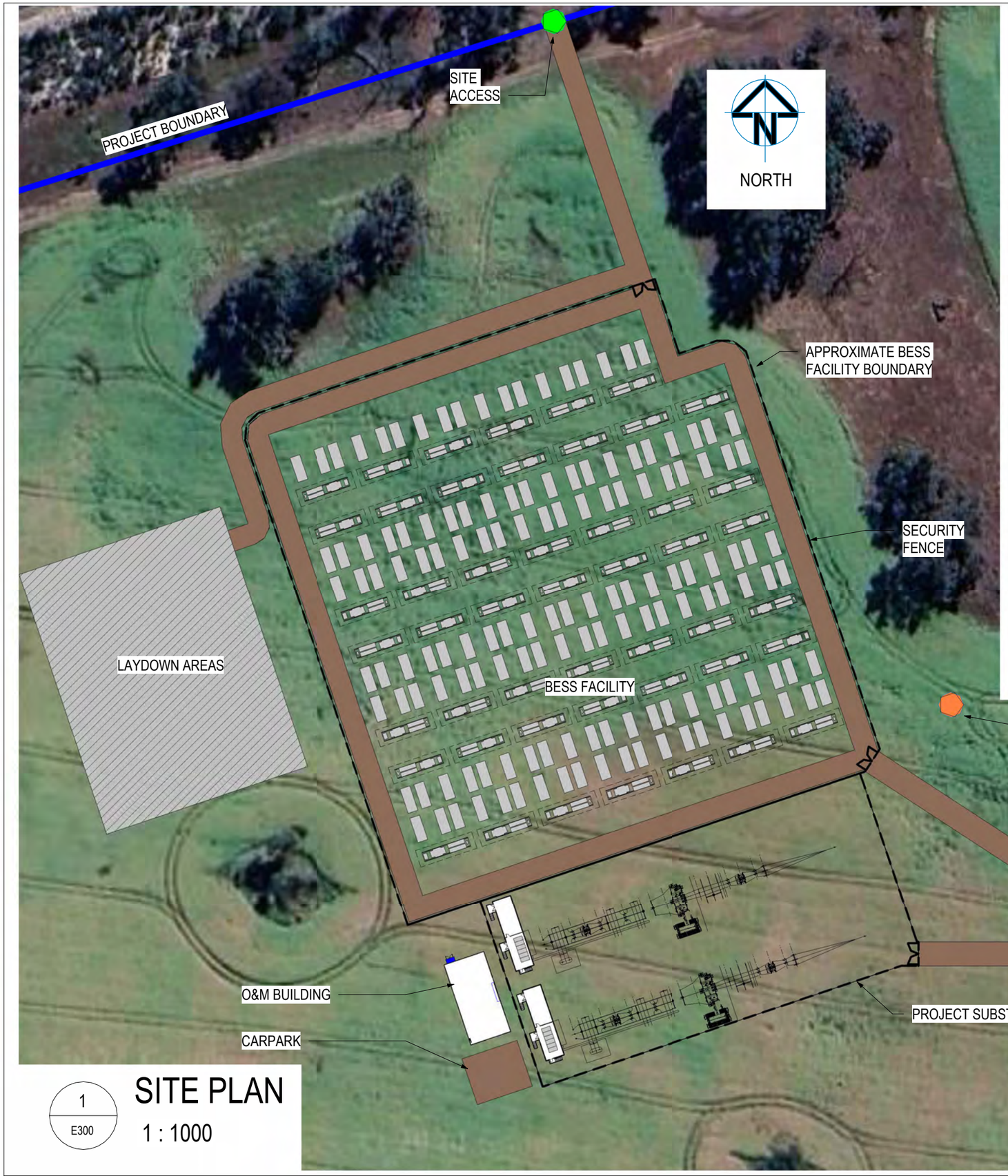
BESS Layout

- Inverter
- Battery Container
- Solar Array
- Proposed Substation Easement Route
- Project Connection Easement
- Fences
- Construction Laydown Areas
- O&M Building
- Parking Area
- Water Tank

Prepared by: Juan Nasta
Date: 17/10/2024
References: OpenStreetMap and its contributors, Western Australia Land Information Authority, Google Satellite, RenewMap.

PRIVATE AND CONFIDENTIAL

0 500 1,000 m



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SITE PLAN

1 : 1000



2

3D VIEW

SHEET LIST	
NO.	TITLE
E000	GENERAL ARRANGEMENT
E050	BESS PLAN
E100	PROJECT SUBSTATION
E200	FENCING DETAILS
E300	BESS SECTIONS
E400	SUBSTATION SECTIONS SHEET 1
E401	SUBSTATION SECTIONS SHEET 2
E402	SUBSTATION SECTIONS SHEET 3
E500	SOLAR SECTIONS

Grand total: 9

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3. FOUNDATION DESIGN TO BE COMPLETED FOLLOWING COMPLETION OF GEOTECHNICAL TESTING.
4. ALL FENCING COMPLIANT WITH AS2067.
5. CONCRETE KERBING MAY BE USED, NOT SHOWN.
6. ALL GATES TO SWING INWARDS.
7. CAR PARKING,EARTHWORKS, INTERSECTION UPGRADES, DRAINAGE, EARTHING, PITS , CULVERTS, SPARE PARTS STORAGE AND TEMP CONSTRUCTION COMPOUND NOT SHOWN.

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Narrogin Solar Pty Ltd

PROJECT

Narrogin Solar and BESS

Narrogin, WA 6312

Lot 1976 and Volume/folio 1306/31

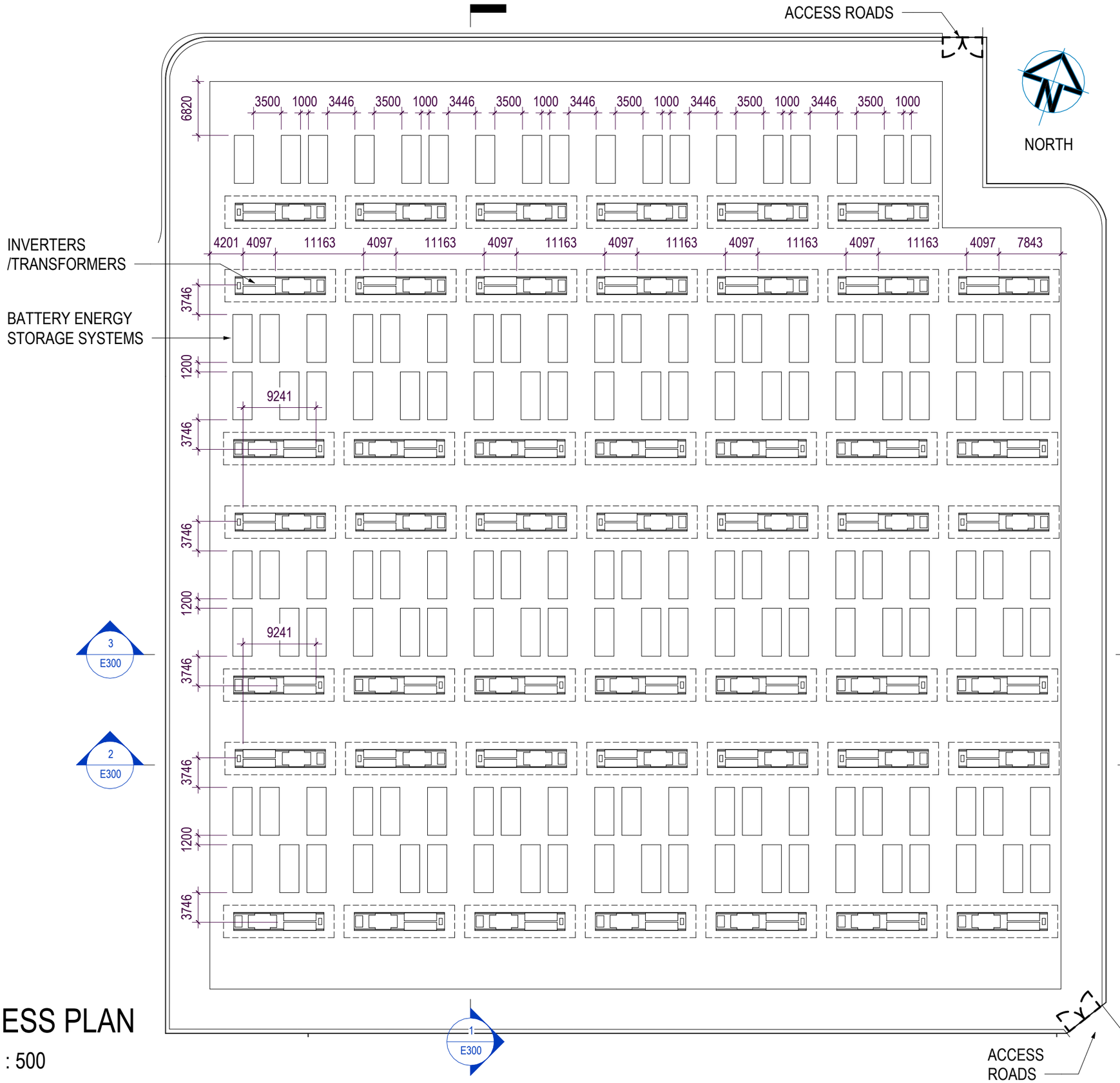
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BESS PLAN

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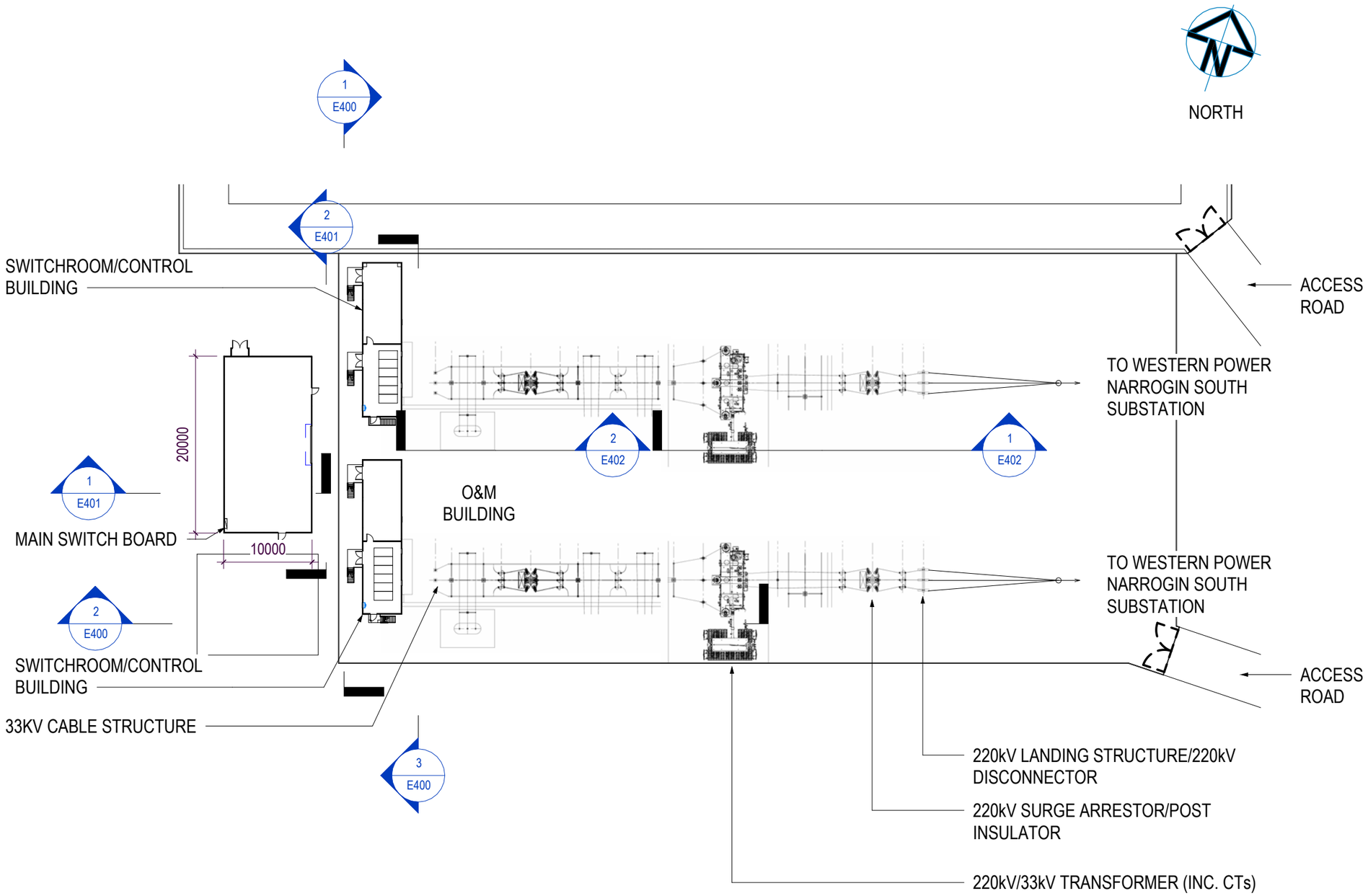
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SUBSTATION PLAN

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4. TRANSFORMER BUND AND OIL/WATER SEPARATION REQUIREMENTS SUBJECT TO CHANGE AFTER AS1940/AS2067 STUDY. BELOW GROUND OR ABOVE GROUND OIL/WATER SEPARATION UNIT MAY BE USED.
5. BUS HEIGHT DESIGN TO ALLOW SECTION SAFETY CLEARANCE FOR INSTALLATION OF FUTURE EQUIPMENT.
6. LIGHT/LIGHTENING POLE PLACEMENT AND QUANTITY SUBJECT TO CHANGE AFTER LIGHT/LIGHTENING STUDY.
7. AERIAL 33kV BUS FROM TX TO SWITCHROOM MAY BE REPLACED WITH CABLES.
8. SEPARATE WESTERN POWER PROTECTION/COMMS BUILDING OR O&M BUILDING IF REQUIRED OTHERWISE COMBINED WITH MV SWITCHROOM/CONTROL BUILDING.
9. CAR PARKING,EARTHWORKS, INTERSECTION UPGRADES, DRAINAGE, EARTHING, PITS , CULVERTS, SPARE PARTS STORAGE AND TEMP CONSTRUCTION COMPOUND NOT SHOWN.

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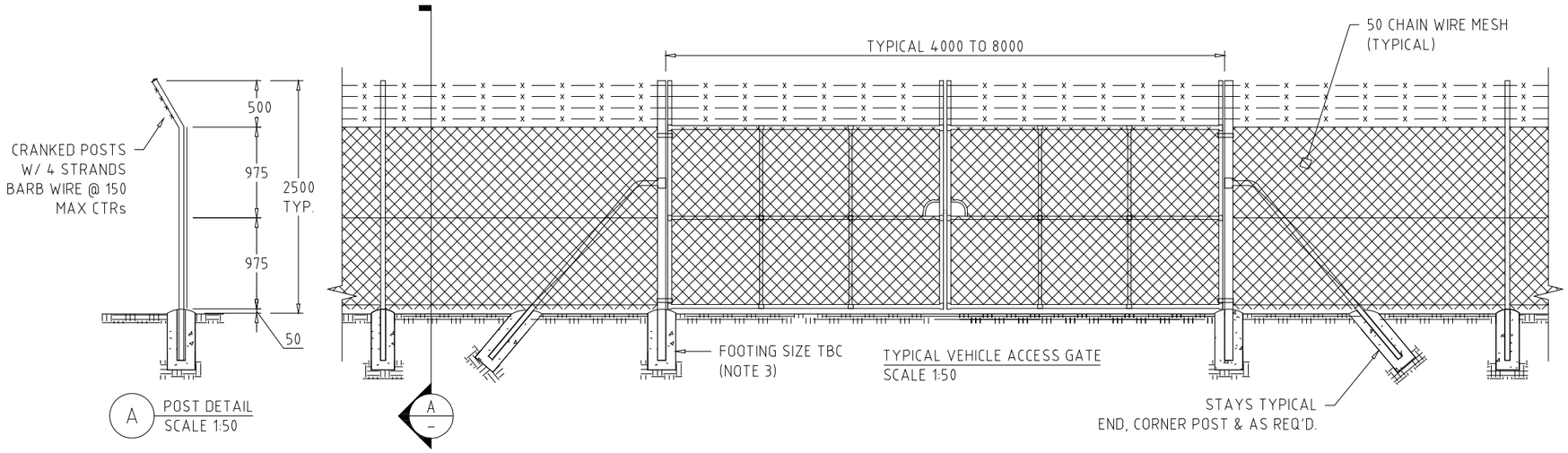
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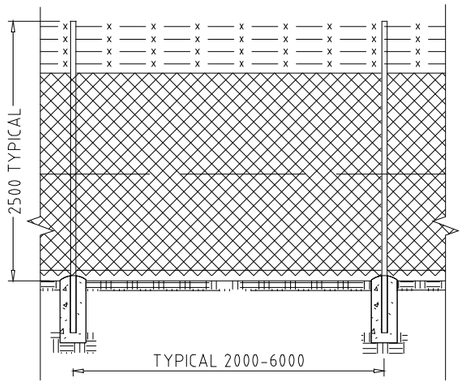
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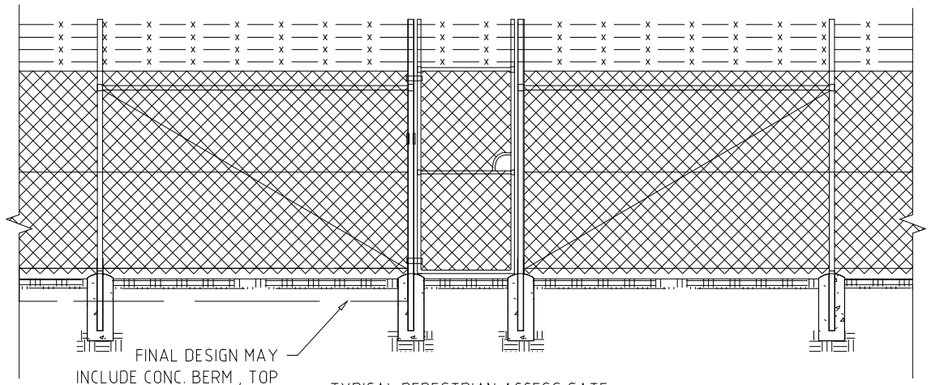
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NON-SUPPORTED INTERMEDIATE PANEL
SCALE 1:50



TYPICAL PEDESTRIAN ACCESS GATE
SCALE 1:50

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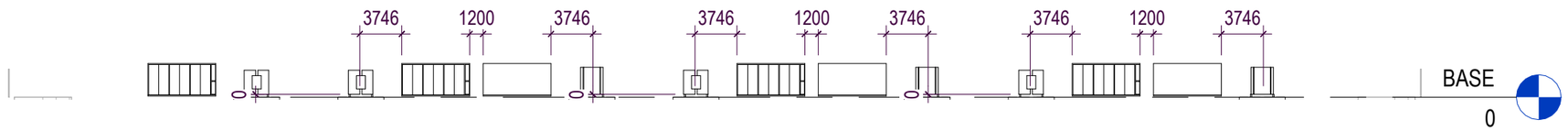
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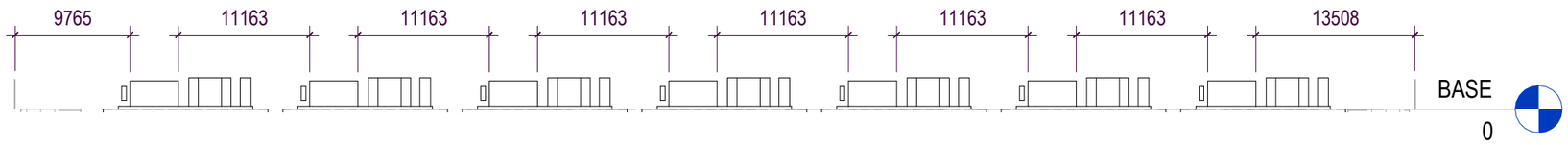
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SECTION 1

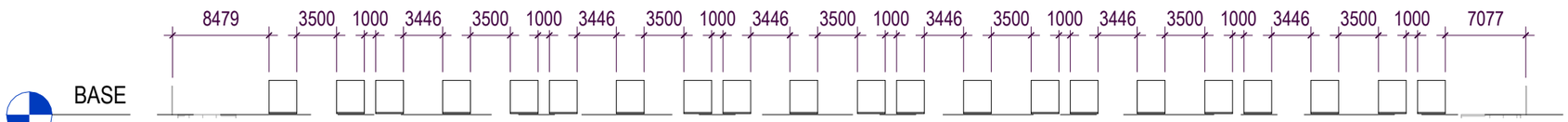
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SECTION 2

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SECTION 3

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Narrogin Solar and BESS
Narrogin, WA 6312
Lot 1976 and Volume/folio 1306/31

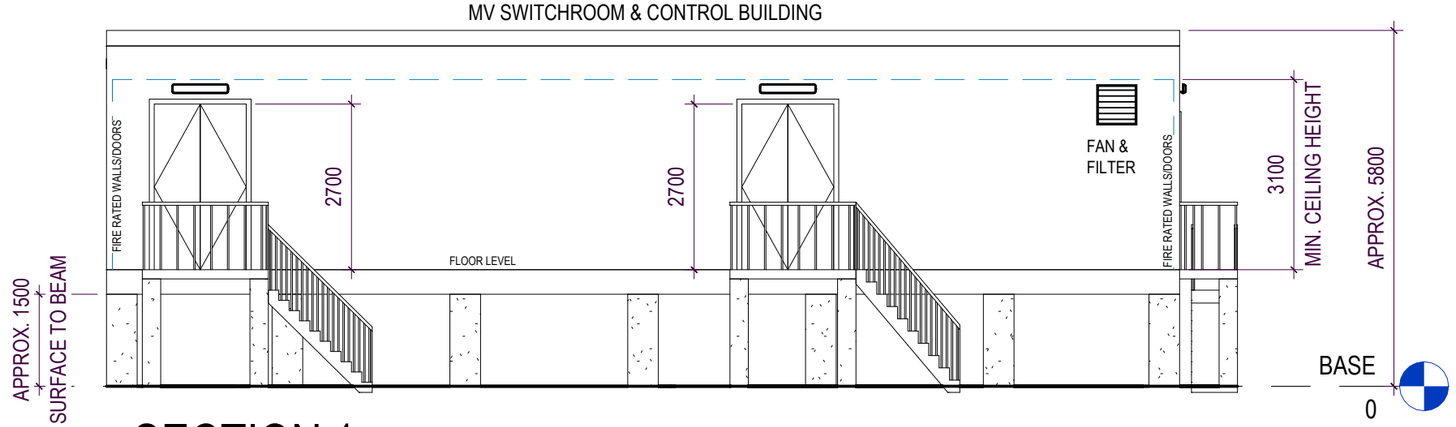
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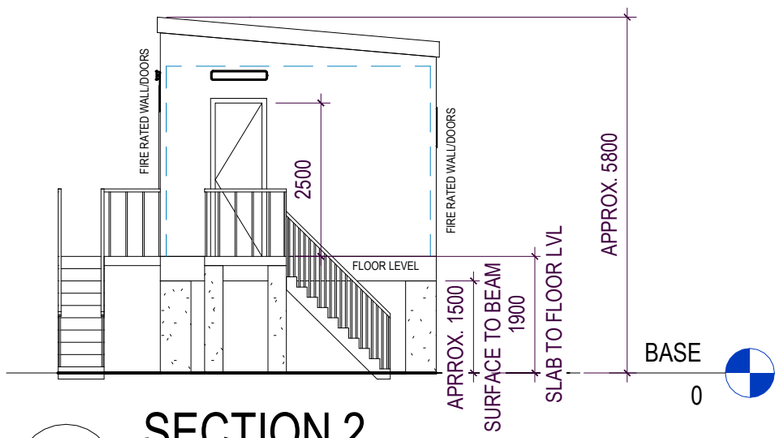
MV SWITCHROOM & CONTROL BUILDING



SECTION 1

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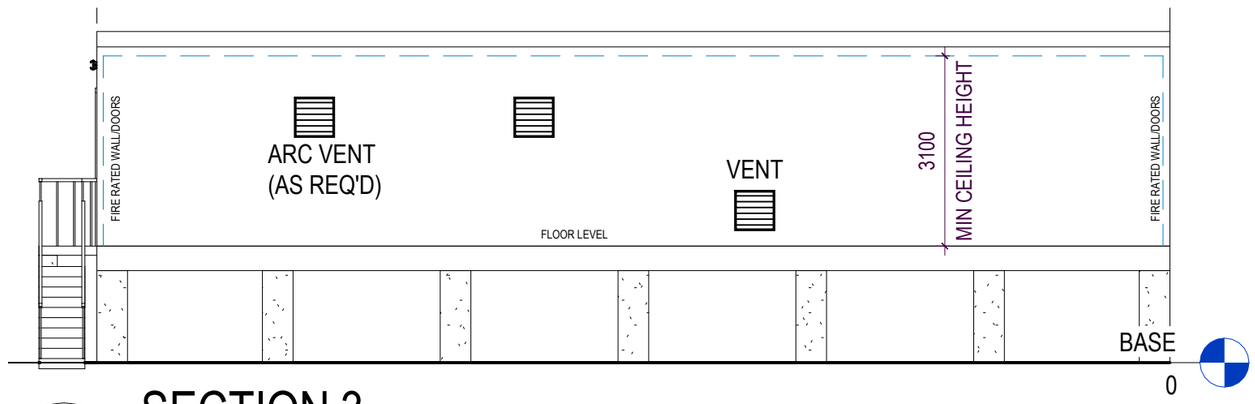


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MV SWITCHROOM & CONTROL BUILDING



SECTION 3

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NOTES:
1. SUBJECT TO AMENDMENT DURING DETAIL DESIGN AND FOLLOWING SELECTION OF EPC CONTRACTOR.
2. HVAC AND FIRE PROTECTION PLANT NOT SHOWN.
3. MAY BE ELEVATED FOUNDATIONS AND/OR DELIVERED IN MULTIPLE SECTIONS
4. TO BE LOCATED WITHIN SWITCH YARD AND SUBSTATION FACILITIES.
5. QUANTITIES OF DOORS AND ARRANGEMENTS SUBJECT TO CHANGE.
6. FOUNDATION DESIGN TO BE COMPLETED FOLLOWING COMPLETION OF GEOTECHNICAL TESTING.

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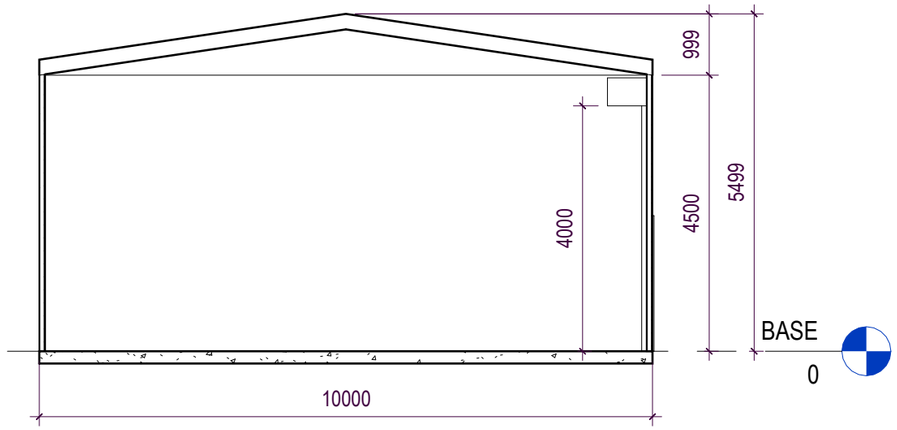
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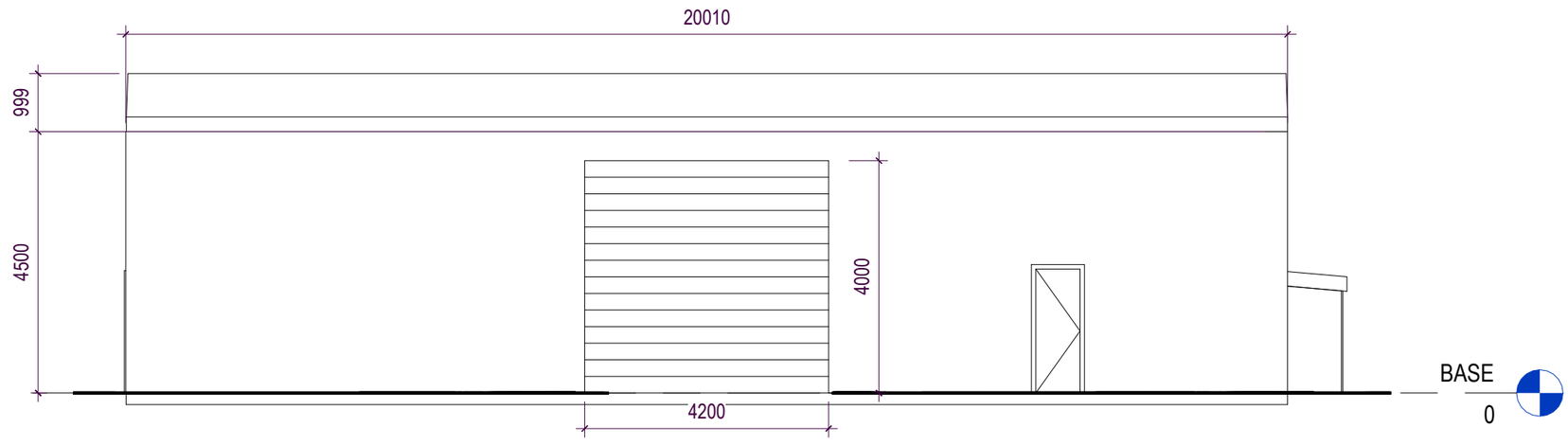
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SECTION 1

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SECTION 2

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NOTES:
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2. HVAC AND FIRE PROTECTION PLANT NOT SHOWN.
3. MAY BE ELEVATED FOUNDATIONS AND/OR DELIVERED IN MULTIPLE SECTIONS
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5. QUANTITIES OF DOORS AND ARRANGEMENTS SUBJECT TO CHANGE.
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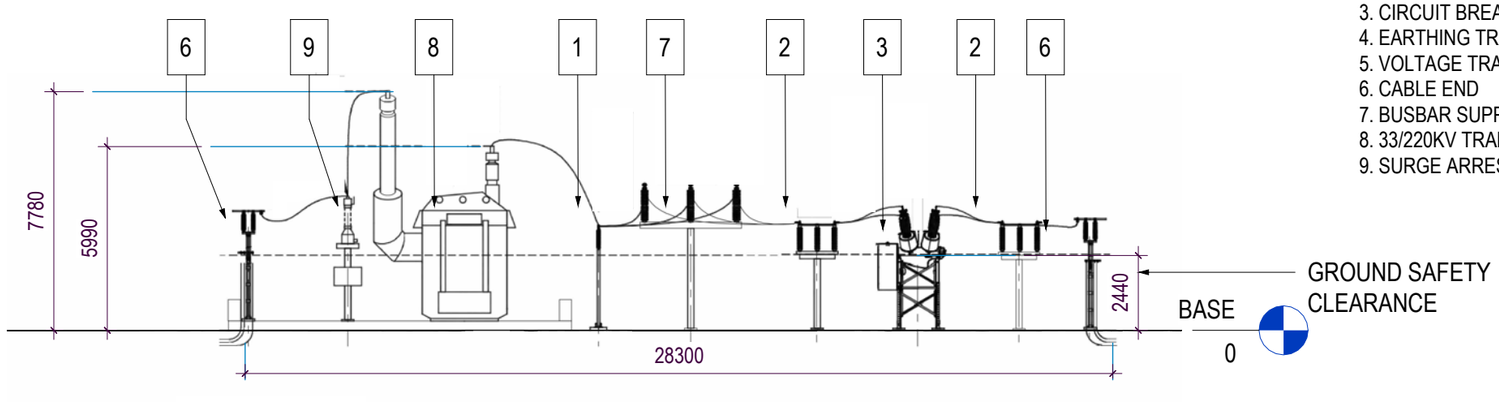
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SUBSTATION SECTIONS SHEET 2

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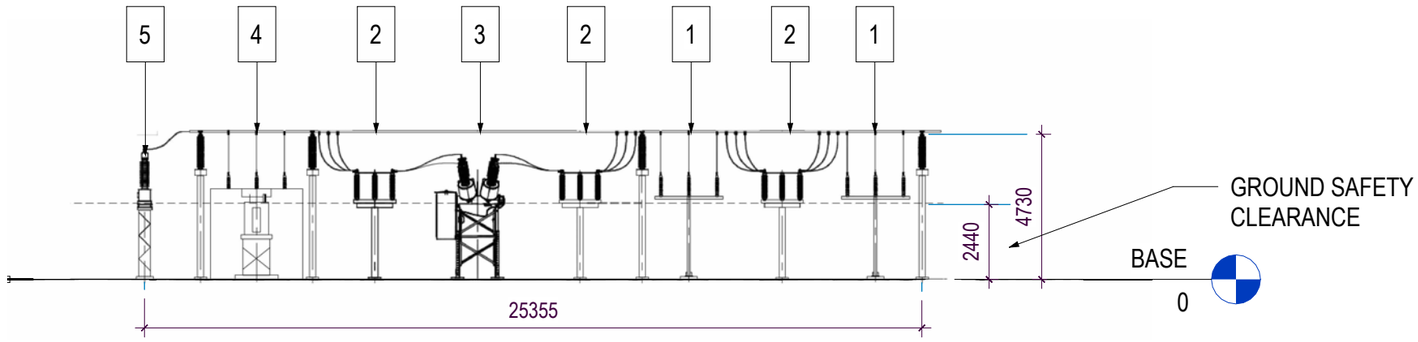


LEGEND
1. BUSBAR SUPPORT STRUCTURE
2. DISCONNECTOR
3. CIRCUIT BREAKER
4. EARTHING TRANSFORMER
5. VOLTAGE TRANSFORMER 3/220KV/110V
6. CABLE END
7. BUSBAR SUPPORT STRUCTURE 220KV
8. 33/220KV TRANSFORMER
9. SURGE ARRESTOR

1
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SECTION 1

1 : 200



2
E100

SECTION 2

1 : 200

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NOTES:
1. CONCEPT ONLY, FOR DEVELOPMENT APPROVAL PURPOSES, NOT FOR CONSTRUCTION.
2. PLANT AND EQUIPMENT DIMENSIONS INDICATIVE.
3. PROJECT AREA MAY CHANGE AND SETBACKS ADJUSTED FOLLOWING DETAILED FIRE STUDY.
4. TRANSFORMER BUND AND OIL/WATER SEPARATION REQUIREMENTS SUBJECT TO CHANGE AFTER AS1940/AS2067 STUDY. BELOW GROUND OR ABOVE GROUND OIL/WATER SEPARATION UNIT MAY BE USED.
5. BUS HEIGHT DESIGN TO ALLOW SECTION SAFETY CLEARANCE FOR INSTALLATION OF FUTURE EQUIPMENT.
6. LIGHT/LIGHTENING POLE PLACEMENT AND QUANTITY SUBJECT TO CHANGE AFTER LIGHT/LIGHTENING STUDY.
7. AERIAL 33kV BUS FROM TX TO SWITCHROOM MAY BE REPLACED WITH CABLES.
8. SEPARATE WESTERN POWER PROTECTION/COMMS BUILDING OR O&M BUILDING IF REQUIRED OTHERWISE COMBINED WITH MV SWITCHROOM/CONTROL BUILDING.
9. CAR PARKING,EARTHWORKS, INTERSECTION UPGRADES, DRAINAGE, EARTHING, PITS , CULVERTS, SPARE PARTS STORAGE AND TEMP CONSTRUCTION COMPOUND NOT SHOWN.

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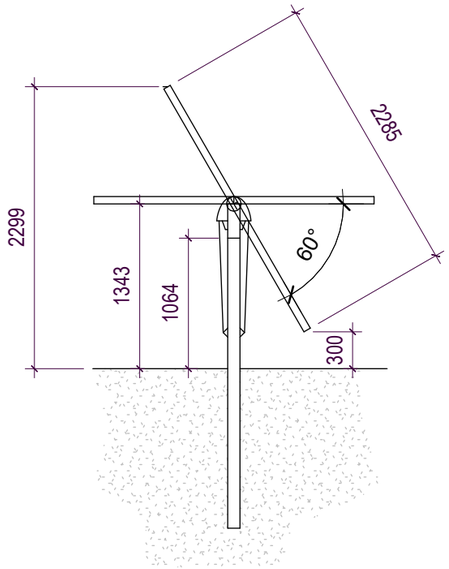
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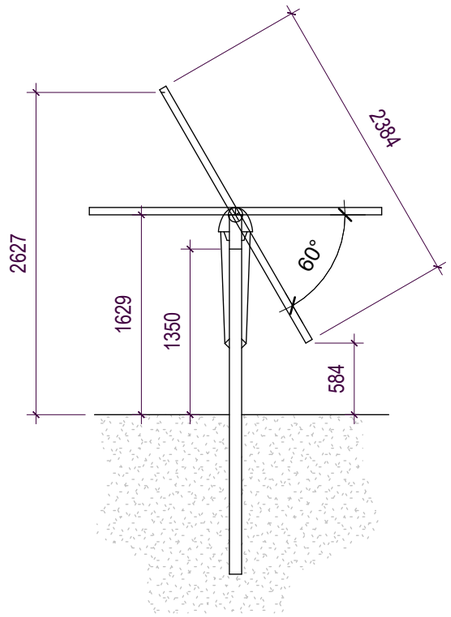
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TYPICAL MINIMUM PIER HEIGHT



TYPICAL MAXIMUM PIER HEIGHT

ELEVATION VIEW

1 SOLAR PANEL DETAIL

NTS

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NOTES:
1. CONCEPT ONLY, FOR DEVELOPMENT APPROVAL PURPOSES, NOT FOR CONSTRUCTION.
2. PLANT AND EQUIPMENT DIMENSIONS INDICATIVE.
3. PROJECT AREA MAY EXPAND AND SETBACKS ADJUSTED FOLLOWING DETAILED FIRE STUDY.
4. ASSUME BESS TRANSFORMERS ARE SELF BUNDED.
5. LIGHT/LIGHTENING POLE PLACEMENT AND QUANTITY SUBJECT TO CHANGE AFTER LIGHT/LIGHTENING STUDY.
6. CAR PARKING,EARTHWORKS, INTERSECTION UPGRADES, DRAINAGE, EARTHING, PITS , CULVERTS, SPARE PARTS STORAGE AND TEMP CONSTRUCTION COMPOUND NOT SHOWN.

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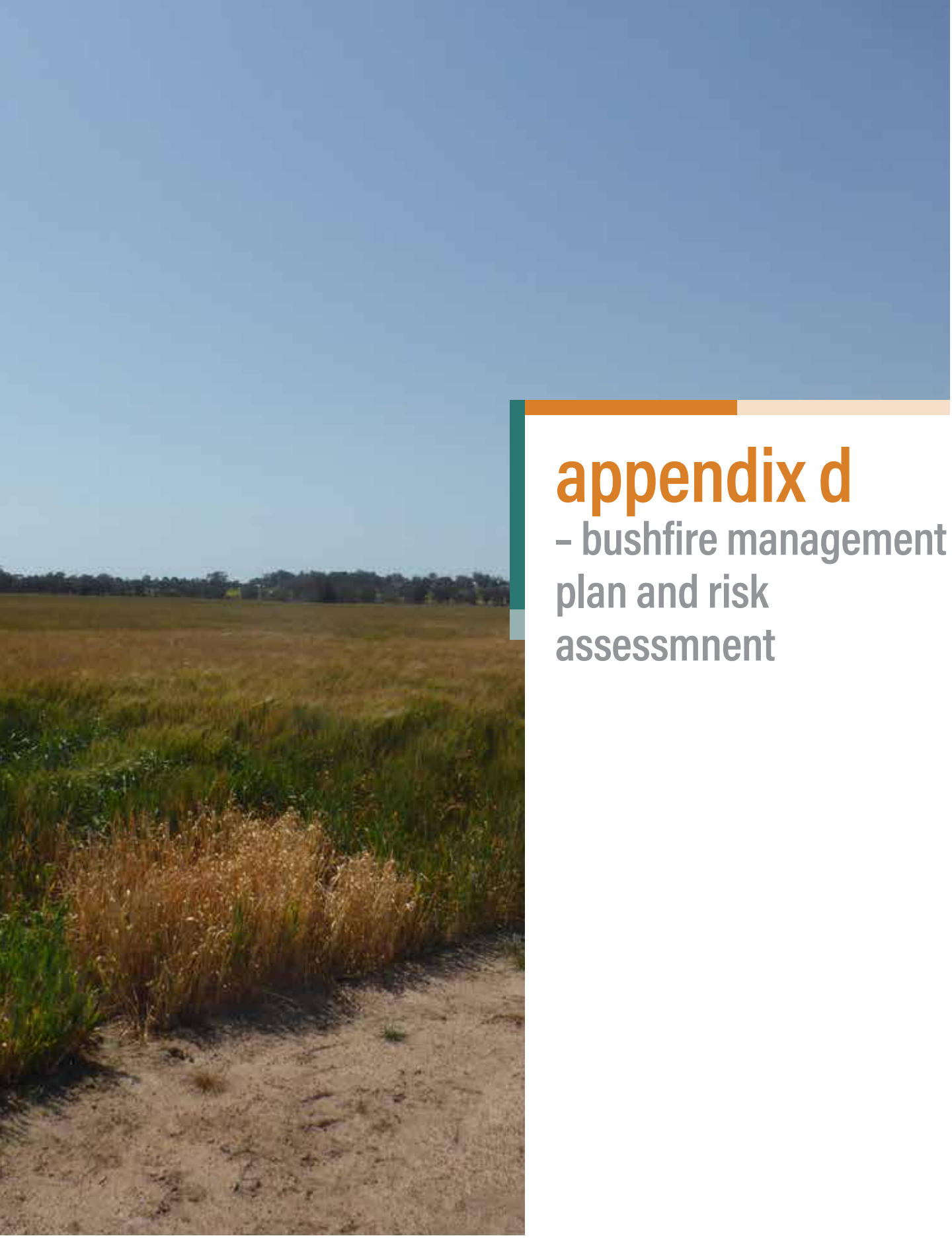
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SOLAR SECTIONS

PROJECT No.	DRAWN	SCALE	SHEET
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appendix c
– certificates of title



appendix d

– bushfire management plan and risk assessmnent

Bushfire Management Plan Coversheet

This Coversheet and accompanying Bushfire Management Plan has been prepared and issued by a person accredited by Fire Protection Association Australia under the Bushfire Planning and Design (BPAD) Accreditation Scheme.

Bushfire Management Plan and Site Details

Site Address / Plan Reference: 52 Contine Road		
Suburb: Dumberning	**State:** WA	**P/code:** 6312
Local government area: Shire of Narrogin		
Description of the planning proposal: Development Application		
BMP Plan / Reference Number: 231010	**Version:** v1.0	**Date of Issue:** 19/09/2024
Client / Business Name: Land insights		

Reason for referral to DFES	Yes	No
Has the BAL been calculated by a method other than method 1 as outlined in AS3959 (tick no if AS3959 method 1 has been used to calculate the BAL)?	☐	☒
Have any of the bushfire protection criteria elements been addressed through the use of a performance principle (tick no if only acceptable solutions have been used to address all of the BPC elements)?	☐	☒
Is the proposal any of the following special development types (see SPP 3.7 for definitions)?		
Unavoidable development (in BAL-40 or BAL-FZ)	☐	☒
Strategic planning proposal (including rezoning applications)	☐	☒
Minor development (in BAL-40 or BAL-FZ)	☐	☒
High risk land-use	☒	☐
Vulnerable land-use	☐	☒

If the development is a special development type as listed above, explain why the proposal is considered to be one of the above listed classifications (E.g. considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

The land use will store combustible materials and / or flammable hazardous materials on site that may be exposed and vulnerable to ignition from the direct attack mechanisms of brushfire (flame contact, radiant heat and embers).

Note: The decision maker (e.g. local government or the WAPC) should only refer the proposal to DFES for comment if one (or more) of the above answers are ticked "Yes".

BPAD Accredited Practitioner Details and Declaration

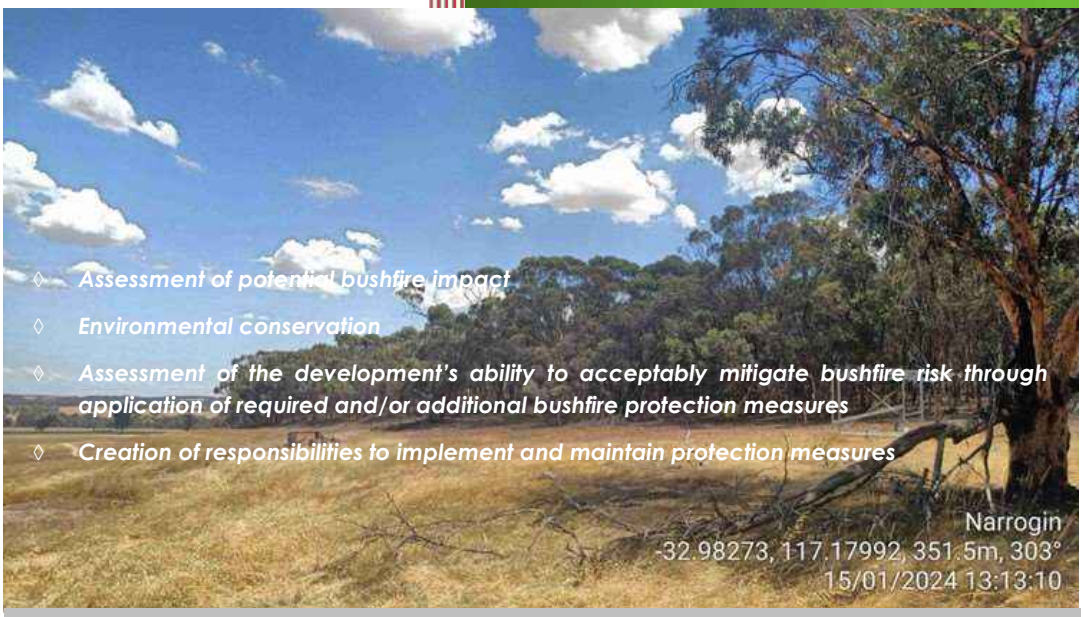
Name	Accreditation Level	Accreditation No.	Accreditation Expiry
Kathy Nastov	Level 3	BPAD 27794	01/08/2025
Company Bushfire Prone Planning		**Contact No.** 6477 1144	

I declare that the information provided within this bushfire management plan is to the best of my knowledge true and correct

Signature of Practitioner **Date** 19/09/2024

ARP Australian Solar
Narrogin Solar

Bushfire Management Plan (BMP)



Produced to meet the relevant requirements of STATE PLANNING POLICY 3.7 Planning in Bushfire Prone Areas & Guidelines

52 Contine Road, Dumberning

Shire of Narrogin

Development Application - High Risk Land Use

19 September 2024

Job Reference No: 231010

BPP GROUP PTY LTD T/A BUSHFIRE PRONE PLANNING

ACN: 39 166 551 784 | ABN: 39 166 551 784

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VERSION HISTORY		
Version	Status/Details	Date
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-	-	

BMP (Master) Template v9.17

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Limitations: *The protection measures that will be implemented based on information presented in this Bushfire Management Plan are minimum requirements and they do not guarantee that buildings or infrastructure will not be damaged in a bushfire, persons injured, or fatalities occur either on the subject site or off the site while evacuating.*

This is substantially due to the unpredictable nature and behaviour of fire and fire weather conditions. Additionally, the correct implementation of the required protection measures (including bushfire resistant construction) and any other required or recommended measures, will depend upon, among other things, the ongoing actions of the landowners and/or operators over which Bushfire Prone Planning has no control.

All surveys, forecasts, projections and recommendations made in this report associated with the proposed development are made in good faith based on information available to Bushfire Prone Planning at the time. All maps included herein are indicative in nature and are not to be used for accurate calculations.

Notwithstanding anything contained therein, Bushfire Prone Planning will not, except as the law may require, be liable for any loss or other consequences whether or not due to the negligence of their consultants, their servants or agents, arising out of the services provided by their consultants.

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SUMMARY STATEMENTS

THIS DOCUMENT – STATEMENT OF PURPOSE

The Bushfire Management Plan (BMP)

The BMP sets out the required package of bushfire protection measures to lessen the risks associated with a bushfire event. It establishes the responsibilities to implement and maintain these measures.

The BMP also identifies the potential for any negative impact on any environmental, biodiversity and conservation values that may result from the application of bushfire protection measures or that may limit their implementation.

Risks Associated with Bushfire Events

The relevant risks are the potential for loss of life, injury, or destroyed or damaged assets which results in personal loss and economic loss. For a given site, the level of that risk to persons and assets (the exposed elements) is a function of the potential threat levels generated by the bushfire hazard, and the level of exposure and vulnerability of the at risk elements to the threats.

Bushfire Protection Measures

The required package of protection measures is established by *State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP 3.7)*, its associated *Guidelines* and any other relevant guidelines or position statements published by the Department of Planning, Lands and Heritage. These measures are limited to those considered by the WA planning authorities as necessary to be addressed for the purpose of land use planning. They do not encompass all available bushfire protection measures as many are not directly relevant to the planning approval stage. For example:

- Protection measures to reduce the vulnerability of buildings to bushfire threats is primarily dealt with at the building application stage. They are implemented through the process of applying the Building Code of Australia (Volumes 1 and 2 of the national Construction Code) in accordance with WA building legislation and the application of construction requirements based on a building's level of exposure - determined as a Bushfire Attack Level (BAL) rating); or
- Protection measures to reduce the threat levels of consequential fire (ignited by bushfire and involving combustible materials surrounding and within buildings) and measures to reduce the exposure and vulnerability of elements at risk exposed to consequential fire, are not specifically considered.

The package of required bushfire protection measures established by the Guidelines includes:

- The requirements of the bushfire protection criteria which consist of:
    - Element 1: Location (addresses threat levels).
    - Element 2: Siting and Design of Development (addresses exposure levels of buildings).
    - Element 3: Vehicular Access (addresses exposure and vulnerability levels of persons).
    - Element 4: Water (addresses vulnerability levels of buildings).
    - Element 5: Vulnerable Tourism Land Uses (addresses exposure and vulnerability as per Elements 1-4 but in use specific ways and with additional considerations of persons exposure and vulnerability).
- The requirement to develop Bushfire Emergency Plans / Information for 'vulnerable' land uses for persons to prepare, respond and recover from a bushfire event (this addresses vulnerability levels).
- The requirement to assess bushfire risk and incorporate relevant protection measures into the site emergency plans for 'high risk' land uses (this addresses threat, exposure and vulnerability levels).

Compliance of the Proposed Development or Use with SPP 3.7 Requirements

The BMP assesses the capacity of the proposed development or use to implement and maintain the required 'acceptable' solutions and any additionally recommended bushfire protection measures - or its capacity to satisfy the policy intent through the justified application of additional bushfire protection measures as supportable 'alternative' solutions.

THE PROPOSED DEVELOPMENT/USE – BUSHFIRE PLANNING COMPLIANCE SUMMARY		
Environmental Considerations		**Assessment Outcome**
Will land with identified environmental, biodiversity and conservation values limit the full application of the required bushfire protection measures?		No
Will land with identified environmental, biodiversity and conservation values need to be managed in the implementation and maintenance of the bushfire protection measures - but not limit their application?		No
Required Bushfire Protection Measures The Acceptable Solutions of the Bushfire Protection Criteria (Guidelines)		**Assessment Outcome**
Element	The Acceptable Solutions	
1: Location	A1 Location	Fully Compliant
	A1.1 Development location	Fully Compliant
2: Siting and Design of Development	A2 Siting and Design of Development	Fully Compliant
	A2.1 Asset Protection Zone (APZ)	Fully Compliant
3: Vehicular Access	A3 Vehicular Access	Fully Compliant
	A3.1 Public roads	Fully Compliant
	A3.2a Multiple access routes	Fully Compliant
	A3.2b Emergency access way	N/A
	A3.3 Through-roads	N/A
	A3.4a Perimeter roads	N/A
	A3.4b Fire service access route	N/A
	A3.5 Battle-axe legs	N/A
	A3.6 Private driveways	Fully Compliant
4: Water	A4 Water	Fully Compliant
	A4.1 Identification of future water supply	N/A
	A4.2 Provision of water for firefighting purposes	Fully Compliant
Other Documents Establishing Bushfire Protection Measure Variations or Additions		**Assessment Outcome**

A 'Planning Approval' or a 'Notice of Determination' which contains 'Conditions' to be met.	N/A
A DPLH/WAPC 'Position Statement'	N/A
Bushfire Management Plan Guidance for the Dampier Peninsula (DPLH 2021 Rev B)	N/A
Other 'Bushfire Planning' Documents to Be Produced This necessity for additional documents is determined by the proposed development/use type and the requirements established by SPP 3.7 and the associated Guidelines (as amended). They may be produced concurrently or subsequent to the BMP. Relevant actions will be identified within Section 6 'Responsibilities for Implementation of Bushfire Protection Measures.	**Required**
Bushfire Emergency Plan: An operational document presenting prevent, prepare, respond and recover procedures and associated actions. As necessary, supporting information to justify determinations is included.	No
Bushfire Emergency Information (Poster): As a concise response information poster for certain vulnerable land uses.	No
Bushfire Emergency Information (Content): As content for inclusion into the Site's Emergency Plan for certain high risk land uses:	No
Bushfire Risk Assessment and Management Report:	Yes

Summary Statement: The proposed development is considered a 'high-risk' land use as defined by SPP 3.7 and its associated Guidelines.

This triggers the requirement, through the development of a Risk Assessment and Management Report to:

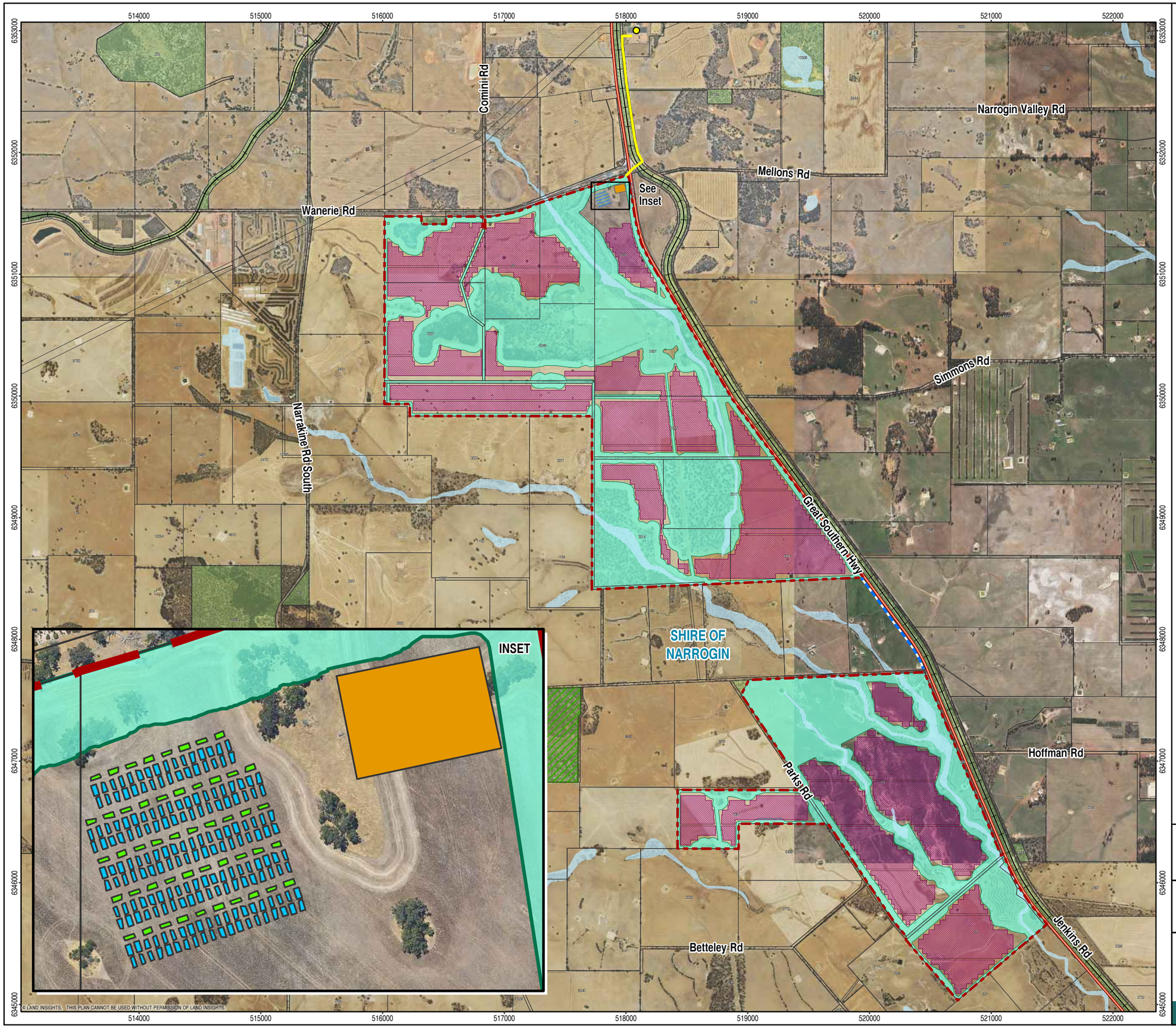
- Identify the level of exposure and vulnerability of any onsite stored materials and liquids to bushfire attack mechanisms (threats);
- Identify any potential source of ignition threat the use may present to adjoining and/or adjacent bushfire prone vegetation; and
- Recommend protection measures that can be incorporated into the site operations emergency plan as necessary.

The requirement for this report to be developed and any variation to content, can be decided by the planning approval decision maker (e.g., the local government). Otherwise, SPP 3.7 states it 'should' be produced.

1 PROPOSAL DETAILS AND THE BUSHFIRE MANAGEMENT PLAN

1.1 The Proposed Development/Use Details, Plans and Maps

The Proposal's Planning Stage For which certain bushfire planning documents are required to accompany the planning application.		Development Application
The Subject Land/Site		52 Contine Road, Dumberning. Shire of Narrogin
Total Area of Subject Lot/Site		356.2771 hectares (South) + 662.9806 hectares (North)
Number of Additional Lots Created		N/A
Primary Proposed Construction	**Type(s)**	Electricity generation
	NCC Classification	N/A
The 'Specific' Land Use Type for **Bushfire Planning** When applicable, this classification establishes a requirement to conduct assessments and develop documents that are additional to this Bushfire Management Plan.		High Risk Land Use
Factors Determining the 'Specific Bushfire Planning' Land Use Type		The land use will store combustible materials and/or flammable hazardous materials onsite that may be exposed and vulnerable to ignition from the direct attack mechanisms of bushfire (flame contact, radiant heat and embers). Business operations/activities may include those that are a potential source of ignition for onsite or offsite combustible/flammable materials, including bushfire prone vegetation.
Description of the Proposed Development/Use		
The project proposes the development of a solar farm. This includes the installation of Solar panels, a Substation and a Battery Energy Storage Systems (BESS). The solar farm is proposed to operate in conjunction with the current land use of livestock farming.		



- Narrogin South Substation
- Substation Easement
- Project Connection Easement
- Project Boundary
- Solar Footprint
- Restricted Area
- Substation Area
- Battery Container (BESS Layout)
- Inverter (BESS Layout)
- State road
- Rail
- Cadastre
- DBCA - Legislated Lands and Waters (DBCA-011)
- Reserves
- Wheatbelt wetlands

0 250 500 750 1,000 1,250 1,500

Metres

1:30,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 25/07/2024 10:14 AM
Layout Name: ARP 1121-004-06-02 Narrogin Solar Farm BESS Layout

landinsights
PLANNING DESIGN ENVIRONMENT
PO Box 289 Mt Lawley WA 6929
Ph: 9271 8506
admin@landinsights.com.au
landinsights.com.au

BESS Layout
PROPOSED SOLAR ENERGY FACILITY
NARROGIN
ARP Australian Solar

Path: C:\Users\ShirleyMcIntyre\OneDrive - Land Insights\Drafting Jobs\1121 ARP - Narrogin Solar Mapping\Map\1121 NarroginSolar.aprx

Figure 1.2.1

Proposed Development North

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

WANERIE RD
MELLONS RD
NOTTLE RD
SIMMONS RD
GREAT SOUTHERN HWY

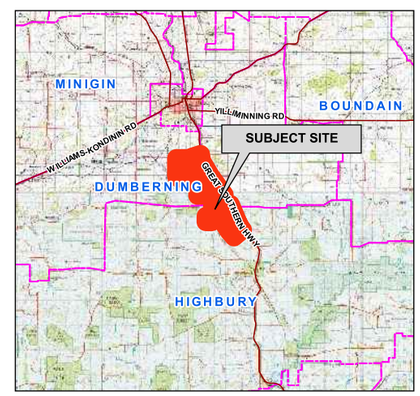
------ LEGEND ------

- Subject Site
- BESS Layout
- PVC Layout
- Substation

0 200 400 600 800 m

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 28-08-2024
SCALE (A3): 1 : 13000

BUSHFIRE PRONE PLANNING

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Figure 1.2.2

Proposed Development South

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

CONTINE RD

PARKS RD

BETTELEY RD

GREAT SOUTHERN HWY

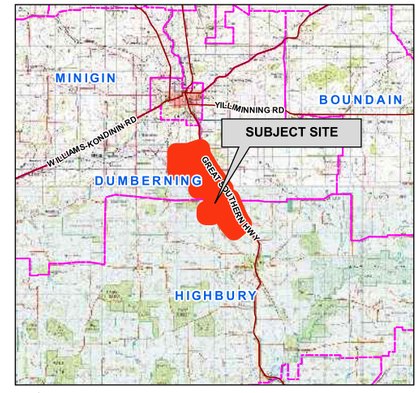
------ LEGEND ------

- Subject Site
- BESS Layout
- PVC Layout
- Substation

0 150 300 450 600 m

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 28-08-2024
SCALE (A3): 1 : 10000

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Figure 1.3

Location Map

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

------ LEGEND ------

- Subject Site
- LGA
- Localities

DFES Stations

- Bush Fire Brigade
- State Emergency Service Unit
- Volunteer Fire & Rescue Service

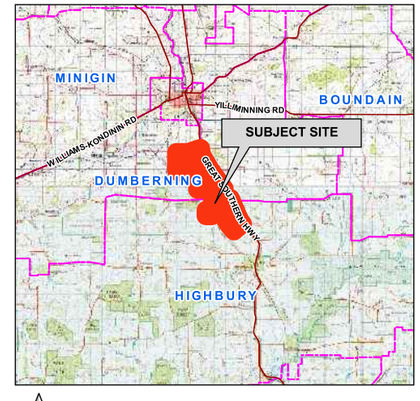
DBCA Legislated Lands and Waters

- State Forest

0 2 4 6 8 10 km

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 28-08-2024
SCALE (A3): 1 : 200000

BUSHFIRE PRONE PLANNING

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WHERE SPP 3.7 AND THE GUIDELINES ARE TO APPLY – DESIGNATED BUSHFIRE PRONE AREAS

All higher order strategic planning documents, strategic planning proposals, subdivisions and development applications located in designated bushfire prone areas need to address SPP 3.7 and its supporting Guidelines. This also applies where an area is not yet designated as bushfire prone but is proposed to be developed in a way that introduces a bushfire hazard.

For development applications where only part of a lot is designated as bushfire prone and the proposed development footprint is wholly outside of the designated area, the development application will not need to address SPP 3.7 or the Guidelines. (Guidelines DPLH 2021 v1.4, s1.2).

For subdivision applications, if all the proposed lots have a BAL-LOW indicated, a BMP is not required. (Guidelines DPLH 2021 v1.4, s5.3.1).

Figure 1.4

Bushfire Prone Area

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

WILLIAMS-KONDININ RD
GRAHAM RD
GRAHAM RD
BOOTH ST
CONDON RD
MCDOUGALLS RD
KATTA RD
MOKINE RD
COMINI RD
NARROGIN VALLEY RD
COOLGARDIE DR
MELLONS RD
MANNING RD
WANERIE RD
NOTTLE RD
SIMMONS RD
GREAT SOUTHERN HWY
LAVATER RD
NARRAKINE RD SOUTH
CONTINE RD
COORAMINNING RD
GROVES RD
BETTELEY RD
PARKS RD
JAMIESON RD
ROWE RD
BLIGHT RD
KENNY RD
CAMPBELL ST
HIGHBURY EAST RD
BURLEY ST
SCOTT ST
HIGHBURY RD WEST
WARREN RD
O'NEILL RD
CHOMLEY RD
GREAT SOUTHERN HWY

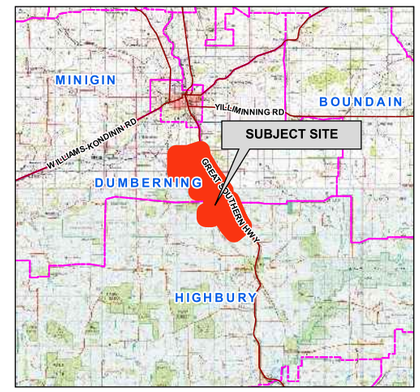
------ LEGEND ------

- Subject Site
- Cadastral
- Bush Fire Prone Areas

0 500 1,000 1,500 2,000

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 28-08-2024
SCALE (A3): 1 : 50000

BUSHFIRE PRONE PLANNING

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1.2 The Bushfire Management Plan (BMP)

1.2.1 Commissioning and Purpose

Landowner / proponent:	Land Insights
Bushfire Prone Planning commissioned to produce the BMP by:	Rebekah Hampson
Purpose of the BMP:	To assess the proposal's ability to meet all relevant requirements established by State Planning Policy 3.7: Planning in Bushfire Prone Areas (SPP 3.7), the associated 'Guidelines and any relevant Position Statements; and To satisfy the requirement for the provision of a Bushfire Management Plan to accompany the development application.
BMP to be submitted to:	Shire of Narrogin

1.2.1 Other Documents with Implications for Development of this BMP

This section identifies any known assessments, reports or plans that have been conducted and prepared previously, or are being prepared concurrently, and are relevant to the planned proposal for the subject. They potentially have implications for the assessment of bushfire threats and the identification and implementation of the protection measures that are established by this Bushfire Management Plan.

Table 1.4: Other relevant documents that may influence threat assessments and development of protection measures.

RELEVANT DOCUMENTS					
Document	Relevant	Currently Exists	To Be Developed	Copy Provided by Proponent / Developer	Title
Bushfire Risk Assessment and Management Report	Yes	Yes	N/A	N/A	231010 - Narrogin Solar Farm (BRR)v1.0 (Bushfire Prone Planning September 2024)
Implications for the BMP: The Bushfire Risk Report prepared alongside this BMP identifies the appropriate measures to reduce the risk of onsite and/or offsite ignition, asset damage, and harm to persons, environment, and community. Additional Bushfire Protection Measures are drawn from the BRR and provided in Section 5.7.					

2 BUSHFIRE PRONE VEGETATION – ENVIRONMENTAL & ASSESSMENT CONSIDERATIONS

2.1 Environmental Considerations – 'Desktop' Assessment

This 'desktop' assessment must not be considered as a replacement for a full Environmental Impact Assessment. It is a summary of potential environmental values at the subject site, inferred from information contained in listed datasets and/or reports, which are only current to the date of last modification.

These data sources must be considered indicative where the subject site has not previously received a site-specific environmental assessment by an appropriate professional.

Many bushfire prone areas also have high biodiversity values. Consideration of environmental priorities within the boundaries of the land being developed can avoid excessive or unnecessary modification or clearing of vegetation. Approval processes (and exemptions) apply at both Commonwealth and State levels.

Any 'modification' or 'clearing' of vegetation to reduce bushfire risk is considered 'clearing' under the ***Environmental Protection Act 1986*** (EP Act) and requires a clearing permit under the ***Environmental Protection (Clearing of Native Vegetation) Regulations 2004*** (Clearing Regulations) – unless for an exempt purpose.

Clearing native vegetation is an offence, unless done under a clearing permit or the clearing is for an exempt purpose. Exemptions are contained in the EP Act or are prescribed in the Clearing Regulations (note: these do not apply in environmentally sensitive areas).

The ***Department of Water and Environmental Regulation*** (DWER) is responsible for issuing 'clearing' permits and the framework for the regulation of clearing. Approvals under other legislation, from other agencies, may also be required, dependent on the type of flora or fauna present.

Local Planning Policy or Local Biodiversity Strategy: Natural areas that are not protected by the above Act and Regulation (or any other National or State Acts) may be protected by a local planning policy or local biodiversity strategy. Permission from the local government will be required for any modification or removal of native vegetation in these Local Natural Areas (LNA's). Refer to the relevant local government for detail.

For further Information refer to Guidelines v1.4, the Bushfire and Vegetation Factsheet - WAPC, Dec 2021 and https://www.der.wa.gov.au/our-work/clearing-permits

2.1.1 Declared Environmentally Sensitive Areas (ESA)

IDENTIFICATION OF RELEVANT ENVIRONMENTALLY SENSITIVE AREAS							
ESA Class	Relevant to Proposal	Influence on Bushfire Threat Levels and / or Application of Bushfire Protection Measures	Relevant Dataset	Information Source(s) Applied to Identification of Relevant Vegetation			Further Action Required
				Dataset	Landowner or Developer	Environmental Asset or Vegetation Survey	
Wetlands and their 50m Buffer (Ramsar, conservation category and nationally important)	No	No	DBCA-010 and 011, 019, 040, 043, 044	☒	☐	☐	None
Bush Forever	No	No	DPLH-022, SPP 2.8	☒	☐	☐	None
Threatened and Priority Flora + 50m Continuous Buffer	Unlikely	Unlikely	DBCA-036	Restricted Scale of Data Available (security)	☐	☐	Data not available - confirm with relevant agency
Threatened Ecological Community	Unlikely	Unlikely	DBCA-038		☐	☐	Data not available - confirm with relevant agency
Heritage Areas National / World	No	No	Relevant register or mapping	☒	☐	☐	None
Environmental Protection (Western Swamp Tortoise) Policy 2002	No	No	DWER-062	☒	☐	☐	None

DESCRIPTION OF THE IDENTIFIED ENVIRONMENTALLY SENSITIVE AREAS:

Further consultation with the relevant authorities may be required regarding accurate accounts of threatened and priority flora as well as threatened ecological communities within the site as this data has restricted access.

2.1.2 Other Protected Vegetation on Public Land

IDENTIFICATION OF PROTECTED VEGETATION ON PUBLIC LAND							
Land with Environmental, Biodiversity, Conservation and Social Values	Relevant to Proposal	Influence on Bushfire Threat Levels and / or Application of Bushfire Protection Measures	Relevant Dataset	Information Source(s) Applied to Identification of Relevant Vegetation			Further Action Required
				Dataset	Landowner or Developer	Environmental Asset or Vegetation Survey	
Legislated Lands (tenure includes national park/reserve, conservation park, crown reserve and state forest)	No	No	DBCA-011	☒	☐	☐	None
Conservation Covenants	Unlikely	Unlikely	DPIRD-023	Only Available to Govt.	☐	☐	Data not available - confirm with relevant agency
National World Heritage Areas	No	No	-	☒	☐	☐	None
Designated Public Open Space	No	No	-	☒	☐	☐	None

DESCRIPTION OF THE IDENTIFIED AREA(S) OF VEGETATION

Proponent may require further consultation with relevant authorities to obtain specific site information regarding Conservation Covenants within the site.

Figure 2.1

Environmental Considerations Map

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

------ LEGEND ------

- Subject Site
- Cadastral

DFES Stations

- Bush Fire Brigade
- State Emergency Service Unit
- Volunteer Fire & Rescue Service
- Reserves

DBCA Legislated Lands and Waters

- State Forest

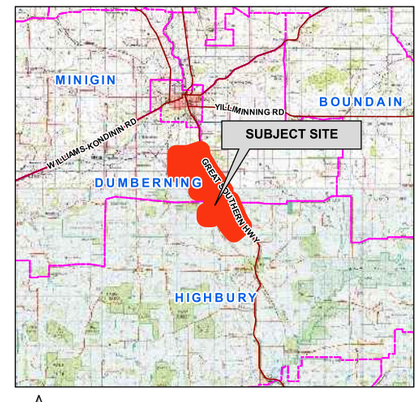
Environmentally Sensitive Areas

- Declared Rare Fauna
- Threatened Ecological Community

0 1 2 3 4 5 km

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 28-08-2024
SCALE (A3): 1 : 80000

BUSHFIRE PRONE PLANNING

231010_Fig2-1_ENV_Narrogin Solar Farm.qgz

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2.1.3 Response of Proposed Development to Identified Environmental Limitations

Consideration of the implications that identified protected areas of vegetation (i.e., those with environmental and subject to conservation) have for the proposed development.

PROPOSED DEVELOPMENT RESPONSE TO IDENTIFIED 'PROTECTED' VEGETATION	
The existence of 'protected' areas of vegetation has implications for the ability of the proposed development to reduce potential bushfire impact through modification or removal of vegetation.	No
Application of Design and/or Construction Responses to Limit Vegetation Modification or Removal	
Modify the development location to reduce exposure by increasing separation distance.	No
Redesign development, structure plan or subdivision.	No
Reduction of lot yield where this can increase available separation distances.	No
Cluster development to limit modification or removal of vegetation.	No
Construct building(s) to the requirements corresponding to higher BAL ratings to reduce required separation distances.	No

2.2 Bushfire Assessment Considerations

2.2.1 Planned Onsite Vegetation Landscaping

Identification of areas of the subject site planned to be landscaped, creating the potential for increased or decreased bushfire hazard for proposed development.

PLANNED LANDSCAPING	
Relevant to Proposal:	No

2.2.2 Planned / Potential Offsite Rehabilitation or Re-Vegetation

Identification of areas of land adjacent to the subject site on which re-vegetation (as distinct from natural re-generation) will or may occur and is likely to present a greater bushfire hazard for proposed development.

POTENTIAL RE-VEGETATION PROGRAMS		
Land with Environmental, Biodiversity, Conservation and Social Values	Relevant to Proposal	Description
Riparian Zones / Foreshore Areas	No	N/A
Wetland Buffers	No	
Legislated Lands	No	
Public Open Space	No	
Road Verges	No	
Other	No	

2.2.3 Identified Requirement to Manage, Modify or Remove Onsite or Offsite Vegetation

Identification of native vegetation subject to management, modification or removal.

REQUIREMENT TO MANAGE, MODIFY OR REMOVE NATIVE VEGETATION	
Has a requirement been identified to manage, modify or remove **onsite** native vegetation to establish the required bushfire protection measures on the subject site?	No
Is approval, from relevant state government agencies and/or the local government, to modify or remove **onsite** native vegetation required? (Note: if 'Yes' evidence of its existence should be provided in this BMP).	No
Has a requirement been identified to manage, modify or remove **offsite** native vegetation to establish the required bushfire protection measures on the subject site?	No
Is written approval required, from relevant state government agencies and/or the local government, that permits the landowner, or another identified party, to modify or remove **offsite** bushfire prone vegetation and/or conduct other works, to establish an identified bushfire protection measure(s)? If 'Yes', appropriate evidence of the approval or how it is to be established, shall be provided in this BMP as an addendum.	No

Is a written management agreement required that states the obligation of the landowner, or another responsible party, to manage defined areas of **offsite** bushfire prone vegetation, in perpetuity, to ensure the conditions of no fire fuels and/or low threat vegetation and/or vegetation managed in a minimal fuel condition, continue to be met? If 'Yes', appropriate evidence of the agreement or how it is to be established, shall be provided in this BMP as an addendum.	No

2.2.4 Variations to Assessed Areas of Classified Vegetation to be Applied

FOR THE PROPOSED DEVELOPMENT SITUATIONS TO BE ACCOUNTED FOR IN ASSESSING THE POTENTIAL BUSHFIRE IMPACT (BAL)	
Area(s) of land will be subject to future vegetation rehabilitation or re-vegetation that will require a change to a higher threat classification of vegetation on that land to. (Note: this is not regeneration to the mature natural state which is accounted for in the 'existing state' assessment in accordance with AS 3959:2018).	No
Modification of existing area(s) of classified vegetation due to the implementation of the proposed development and/or prior to the site's occupancy or use. This modification will require a change to a lower threat classification (or exclusion from classification) for that area of vegetation.	Yes
Refer to Figure 3.1.1 'Post Development Classified Vegetation' and Appendix A1.2 for justification details supporting the change.	
Complete removal of existing area(s) of classified vegetation due to the implementation of the proposed development and/or prior to the site's occupancy or use. This modification will require an exclusion from classification for that area of vegetation.	Yes
Refer to Figure 1.1 'Proposed Development Site Plan' and Figure 3.1.3 'Post Development Classified Vegetation North' and Figure 3.1.4 'Post Development Classified Vegetation South'	

3 BUSHFIRE ATTACK LEVEL (BAL) ASSESSMENT

BUSHFIRE ATTACK LEVELS (BAL) - UNDERSTANDING THE RESULTS

The potential transfer (flux/flow) of radiant heat from the bushfire to a receiving object is measured in kW/m^2. The AS 3959:2018 BAL determination methodology establishes the ranges of radiant heat flux that correspond to each bushfire attack level. These are identified as BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ.

The bushfire performance requirements for certain classes of buildings are established by the Building Code of Australia (Vol. 1 & 2 of the NCC). The BAL will establish the bushfire resistant construction requirements that are to apply in accordance with AS 3959:2018 - *Construction of buildings in bushfire prone areas* and the NASH Standard – *Steel framed construction in bushfire areas (NS 300 2021),* whose solutions are deemed to satisfy the NCC bushfire performance requirements.

DETERMINED BAL RATINGS

A BAL Certificate can be issued for a determined BAL. A BAL can only be classed as 'determined' for an existing or future building/structure when:

1. It's final design and position on the lot are known and the stated separation distance from classified bushfire prone vegetation exists and can justifiably be expected to remain in perpetuity; or

2. It will always remain subject to the same BAL regardless of its design or position on the lot after accounting for any regulatory or enforceable building setbacks from lot boundaries as relevant and necessary (e.g., R-codes, restrictive covenants, defined building envelopes) or the retention of any existing classified vegetation either onsite or offsite.

If the BMP derives determined BAL(s), the BAL Certificate(s) required for submission with building applications can be provided, using the BMP as the assessment evidence.

INDICATIVE BAL RATINGS

A BAL Certificate cannot be issued for an indicative BAL. A BAL will be classed as 'indicative' for an existing or future building/structure when the required conditions to derive a determined BAL are not met.

This class of BAL rating indicates what BAL(s) could be achieved and the conditions that need to be met are stated.

Converting the indicative BAL into a determined BAL is conditional upon the currently unconfirmed variable(s) being confirmed by a subsequent assessment and evidential documentation. These variables will include the future building(s) location(s) being established (or changed) and/or classified vegetation being modified or removed to establish the necessary vegetation separation distance. This may also be dependent on receiving approval from the relevant authority for that modification/removal.

BAL RATING APPLICATION – PLANNING APPROVAL VERSUS BUILDING APPROVAL

1. **Planning Approval**: SPP.3.7 establishes that where BAL- LOW to BAL-29 will apply to relevant future construction (or existing structures for proposed uses), the proposed development may be considered for approval (dependent on the other requirements of the relevant policy measures being met). That is, BAL40 or BAL-FZ are not acceptable on planning grounds (except for certain limited exceptions).

   Because planning is looking forward at what can be achieved, as well as looking at what may currently exist, both determined and indicative BAL ratings are acceptable assessment outcomes on which planning decisions can be made (including conditional approvals).

2. **Building Approval:** The Building Code of Australia (Vol. 1 & 2 of the NCC) establishes that relevant buildings in bushfire prone areas must be constructed to the bushfire resistant requirements corresponding to the BAL rating that is to apply to that building. Consequently, a determined BAL rating and the BAL Certificate is required for a building permit to be issued - an indicative BAL rating is not acceptable.

3.1 BAL Assessment Summary (Contour Map Format)

INTERPRETATION OF THE BAL CONTOUR MAP

The BAL contour map is a diagrammatic representation of the results of the bushfire attack level assessment.

The map presents different coloured contours extending out from the areas of classified vegetation. Each contour represents a set range of radiant heat flux that potentially will transfer to an exposed element (building, person or other defined element), when it is located within that contour.

Each of the set ranges of radiant heat flux corresponds to a different BAL rating as defined by the AS 3959:2018 BAL determination methodology.

The width of each shaded BAL contour will vary dependant on both the BAL rating and the relevant parameters (calculation inputs) for the subject site. Their width represents the minimum and maximum vegetation separation distances that correspond to each BAL rating (refer to the relevant table below for these distances).

The areas of classified vegetation to be considered in developing the BAL contours, are those that will remain at the intended end state of the subject development once earthworks, clearing and/or landscaping and re-vegetation have been completed. Variations to this statement that may apply include:

- Both pre and post development BAL contour maps are produced; and/or
- Each stage of a development is assessed independently.

3.1.1 BAL Determination Methodology and Location of Data and Results

<table>
<tr><th colspan="6">LOCATION OF DATA & RESULTS</th></tr>
<tr><td colspan="2">BAL Determination Methodology</td><td colspan="3">Location of the Site Assessment Data</td><td>Location of the Results</td></tr>
<tr><td rowspan="2">AS 3959:2018</td><td rowspan="2">Applied to Assessment</td><td rowspan="2">Classified Vegetation and Topography Map(s)</td><td colspan="2">Calculation Input Variables</td><td rowspan="2">Assessed Bushfire Attack Levels and/or Radiant Heat Levels</td></tr>
<tr><td>Summary Data</td><td>Detailed Data with Explanatory and Supporting Information</td></tr>
<tr><td>Method 1 (Simplified)</td><td>Yes</td><td rowspan="2">Figure 3.1.1, Figure 3.1.2, Figure 3.2.1 and Figure 3.2.2</td><td>Table 3.2</td><td>Appendix A1</td><td rowspan="2">Table 3.1
Table 3.3 / BAL Contour Map</td></tr>
<tr><td>Method 2 (Detailed)</td><td>Yes</td><td>Table 3.2</td><td>Appendix A2</td></tr>
<tr><td colspan="6">Reasons for the Application of the Method 2 Procedure</td></tr>
<tr><td>1.</td><td colspan="5">A more specific result is sought.</td></tr>
<tr><td colspan="6">Identification of the specific issues associated with the site and/or proposed development that have necessitated the use of the Method 2 procedure:
The Guidelines for Planning in Bushfire Prone Areas require a BAL-29 APZ regardless of the vulnerability of the asset or its ability to comply with AS 3959 construction standards.
A 10kW/m2 APZ has been applied as an appropriate maximum acceptable heat flux exposure for BESS cabinets and associated infrastructure.
A BAL-19 APZ has been applied as an appropriate maximum acceptable heat flux exposure has been applied to the Solar Arrays and HV Substation.</td></tr>
</table>

3.1.2 BAL Ratings Derived from the Contour Map

Table 3.1: Indicative and determined BAL(s) for existing and/or proposed building works.

BUSHFIRE ATTACK LEVEL FOR EXISTING/PLANNED BUILDINGS/STRUCTURE [1]		
Building/Structure Description	Indicative BAL [2] / Radiant heat exposure	Determined BAL [2]
HV Substation.	BAL-19	BAL-FZ
Solar Arrays and Associated Infrastructure.	BAL-19	BAL-FZ
BESS Cabinets and Associated Infrastructure.	<10kW/m2	BAL-FZ
[1] The assessment data used to derive the BAL ratings is sourced from Table 3.1 and Figure 3.2 'BAL Contour Map'. [2] Refer to the start of Section 3 for an explanation of indicative versus determined BAL ratings.		

3.1.3 Site Assessment Data Applied to Construction of the BAL Contour Map(s)

RELEVANT CLASSIFIED VEGETATION	
Identification of Classified Vegetation that is Relevant to the Production of the BAL Contour Map(s)	Relevant Vegetation Map
The relevant vegetation will be all areas of classified vegetation that exist at the time of the site assessment – both within the subject site (onsite) and external to the subject site (offsite).	Figure No.3.1.1 and Figure 3.1.2
The relevant vegetation for the post-development BAL contour map will be any area of classified vegetation - both within the subject site (onsite) and external to the subject site (offsite) - that will remain at the intended end state of the subject development once earthworks, any clearing and/or landscaping and re-vegetation have been completed.	Figure No.3.1.3 and Figure 3.1.4
Supporting Assessment Details: None required.	

Table 3.2: The calculation inputs applied to determining the site specific separation distances corresponding to levels of potential radiant heat transfer (including BAL's).

SUMMARY OF CALCULATION INPUT VARIABLES APPLIED TO THE DETERMINATION OF SEPARATION DISTANCES CORRESPONDING TO RADIANT HEAT LEVELS [1]												
Applied BAL Determination Method		METHOD 1 - SIMPLIFIED PROCEDURE (AS 3959:2018 CLAUSE 2.2) AND METHOD 2 - DETAILED PROCEDURE (AS 3959:2018 APPENDIX B)										
The Calculation Variables Corresponding to the BAL Determination Method Applied												
Methods 1 and 2		Method 1	Method 2									
Vegetation Classification		FDI	Effective Slope		Site Slope	FFDI or GFDI	Flame Temp.	Elevation of Receiver	Flame Width	Fireline Intensity	Flame Length	Modified View Factor
			Applied Range	Determined								
Area	Class		degree range	degrees	degrees		K	metres	metres	kW/m	metres	% Reduction
1	(A) Forest	80	Downslope >0-5	d/slope 5	upslope 5	80	Default	Default	Default	Default	Default	Default
2	(B) Woodland	80	Downslope >0-5	d/slope 5	upslope 5	80	Default	Default	Default	Default	Default	Default
3	(D) Scrub	80	Downslope >0-5	d/slope 5	upslope 5	80	Default	Default	Default	Default	Default	Default
4	(E) Mallee/Mulga	80	Downslope >0-5	d/slope 5	upslope 5	80	Default	Default	Default	Default	Default	Default
5	(G) Grassland	80	Downslope >0-5	d/slope 5	upslope 5	110	Default	Default	Default	Default	Default	Default
6	Excluded cl 2.2.3.2(e & f)	-	-	-	-	-	-	-	-	-	-	-

[1] All data and information supporting the determination of the classifications and values stated in this table and any associated justification, is presented in Appendix A.

Where the values are stated as 'default' these are either the values stated in AS 3959:2018, Table B1 or the values calculated as intermediate or final outputs through application of the equations of the AS 3959:2018 BAL determination methodology. They are not values derived by the assessor.

Table 3.3: Vegetation separation distances corresponding to the radiant heat levels illustrated as BAL contours in Figure 3.2.1 and Figure 3.2.2.

THE CALCULATED VEGETATION SEPARATION DISTANCES (METRES) CORRESPONDING TO THE STATED LEVEL OF RADIANT HEAT FLUX [1]									
Vegetation Classification		Bushfire Attack Levels						Specific Values	
		BAL-FZ	BAL-40	BAL-29	BAL-19	BAL12.5	BAL-LOW		
		Maximum Radiant Heat Flux							
Area	Class	>40 kW/m^2	40 kW/m^2	29 kW/m^2	19 kW/m^2	12.5 kW/m^2	N/A [2]	10 kW/m^2	2 kW/m^2
1	(A) Forest	<20	20-<27	27-<37	37-<50	50-<100	>100	60.4	-
2	(B) Woodland	<13	13-<17	17-<25	25-<35	35-<100	>100	43.2	-
3	(A) Forest	<20	20-<27	27-<37	37-<50	50-<100	>100	60.4	-
4	(E) Mallee/Mulga	<7	7-<9	9-<13	13-<20	20-<100	>100	24.8	-
5	(G) Grassland	<7	7-<9	9-<14	14-<20	20-<50	>50	25	-
6	Excluded cl 2.2.3.2(e & f)	-	-	-	-	-	-	-	-

[1] All calculation input variables are presented in Table 3.2. A copy of the radiant heat calculator output for each area of classified vegetation is presented in Appendix A3.

[2] The BAL-LOW rating is not defined by the level of radiant heat flux. It applies when the vegetation separation distance is 100m or 50m for the Grassland vegetation classification.

Note: 19kW/m^2 setbacks are required for the Solar Panels and Substation, 10kW/m^2 are required for the BESS.

Figure 3.1.1

Classified Vegetation & Topography (Existing) North

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

AREA 1 Class (A) Forest Effective Slope >0-5°
AREA 5 Class (G) Grassland Effective Slope >0-5°
AREA 2 Class (B) Woodland Effective Slope >0-5°
AREA 3 Class (A) Forest Effective Slope >0-5°
AREA 6 Excluded
MELLONS RD
NOTTLE RD
SIMMONS RD
GREAT SOUTHERN HWY

------ LEGEND ------

- Subject Site
- Cadastral
- Photo and Direction
- 150m Assessment Area
- BESS Layout
- Solar Layout
- Substation

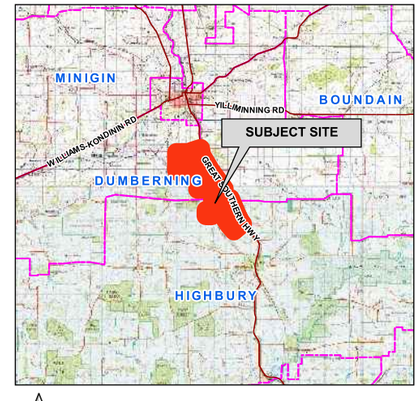
Classified Vegetation

- Class A - Forest
- Class B - Woodland
- Class E - Mallee-Mulga
- Class G - Grassland
- Exclusion 2.2.3.2

0 200 400 600 800

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 19-09-2024
SCALE (A3): 1 : 15000

BUSHFIRE PRONE PLANNING

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Figure 3.1.2

Classified Vegetation & Topography (Existing) South

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

CONTINE RD
PARKS RD
BETTELEY RD
GREAT SOUTHERN HWY

AREA 5 Class (G) Grassland Effective Slope >0-5°
AREA 1 Class (A) Forest Effective Slope >0-5°
AREA 5 Class (G) Grassland Effective Slope >0-5°
AREA 1 Class (A) Forest Effective Slope >0-5°
AREA 2 Class (B) Woodland Effective Slope >0-5°
AREA 4 Class (E) Mallee-Mulga Effective Slope >0-5°
AREA 5 Class (G) Grassland Effective Slope >0-5°
AREA 2 Class (B) Woodland Effective Slope >0-5°
AREA 1 Class (A) Forest Effective Slope >0-5°
AREA 2 Class (B) Woodland Effective Slope >0-5°
AREA 6 Excluded
AREA 5 Class (G) Grassland Effective Slope >0-5°
AREA 1 Class (A) Forest Effective Slope >0-5°
AREA 5 Class (G) Grassland Effective Slope >0-5°
AREA 1 Class (A) Forest Effective Slope >0-5°
AREA 4 Class (E) Mallee-Mulga Effective Slope >0-5°
AREA 2 Class (B) Woodland Effective Slope >0-5°
AREA 1 Class (A) Forest Effective Slope >0-5°
AREA 2 Class (B) Woodland Effective Slope >0-5°

1 2 3 4 5 6 7 21 22 23 27 30 31 32 33 34 35

------ LEGEND ------

- Subject Site
- Cadastral
- Photo and Direction
- 150m Assessment Area
- BESS Layout
- Solar Layout
- Substation

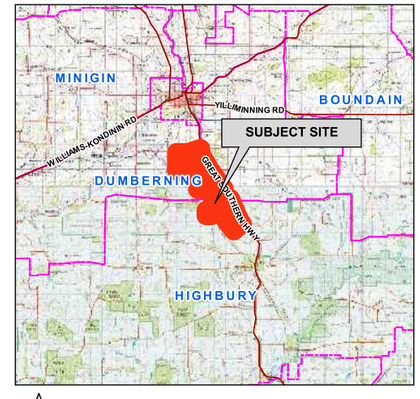
Classified Vegetation

- Class A - Forest
- Class B - Woodland
- Class E - Mallee-Mulga
- Class G - Grassland
- Exclusion 2.2.3.2

0 200 400 600

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 19-09-2024
SCALE (A3): 1 : 11000

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Figure 3.1.3

Classified Vegetation & Topography (Post Dev) North

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

COMINI RD
WANERIE RD
MELLONS RD
NOTTLE RD
SIMMONS RD
GREAT SOUTHERN HWY

AREA 1
Class (A) Forest
Effective Slope >0-5°

AREA 2
Class (B) Woodland
Effective Slope >0-5°

AREA 3
Class (A) Forest
Effective Slope >0-5°

AREA 5
Class (G) Grassland
Effective Slope >0-5°

AREA 6
Excluded

------ LEGEND ------

- Subject Site
- Cadastral
- 150m Assessment Area
- BESS Layout
- Solar Layout
- Substation

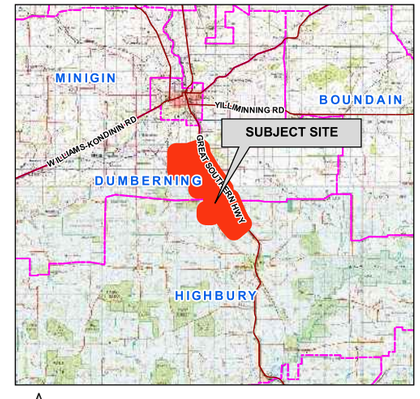
Classified Vegetation

- Class A - Forest
- Class B - Woodland
- Class E - Mallee-Mulga
- Class G - Grassland
- Exclusion 2.2.3.2

0 200 400 600 800

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 19-09-2024
SCALE (A3): 1 : 15000

BUSHFIRE PRONE PLANNING

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Figure 3.1.4

Classified Vegetation & Topography (Post Dev) South

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

CONTINE RD
BETTELEY RD
PARKS RD
GREAT SOUTHERN HWY

AREA 5
Class (G) Grassland
Effective Slope >0-5°

AREA 1
Class (A) Forest
Effective Slope >0-5°

AREA 5
Class (G) Grassland
Effective Slope >0-5°

AREA 1
Class (A) Forest
Effective Slope >0-5°

AREA 2
Class (B) Woodland
Effective Slope >0-5°

AREA 1
Class (A) Forest
Effective Slope >0-5°

AREA 4
Class (E) Mallee-Mulga
Effective Slope >0-5°

AREA 2
Class (B) Woodland
Effective Slope >0-5°

AREA 2
Class (B) Woodland
Effective Slope >0-5°

AREA 1
Class (A) Forest
Effective Slope >0-5°

AREA 5
Class (G) Grassland
Effective Slope >0-5°

AREA 6
Excluded

AREA 1
Class (A) Forest
Effective Slope >0-5°

AREA 5
Class (G) Grassland
Effective Slope >0-5°

AREA 2
Class (B) Woodland
Effective Slope >0-5°

AREA 1
Class (A) Forest
Effective Slope >0-5°

AREA 5
Class (G) Grassland
Effective Slope >0-5°

AREA 1
Class (A) Forest
Effective Slope >0-5°

AREA 4
Class (E) Mallee-Mulga
Effective Slope >0-5°

AREA 6
Excluded

AREA 2
Class (B) Woodland
Effective Slope >0-5°

------ LEGEND ------

- Subject Site
- Cadastral
- 150m Assessment Area
- BESS Layout
- Solar Layout
- Substation

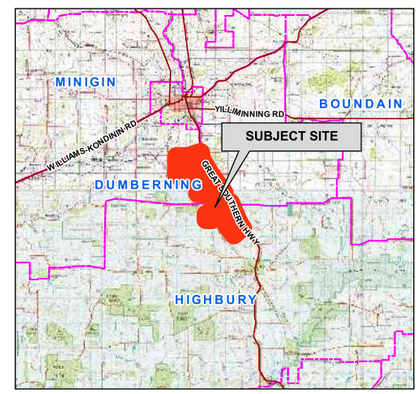
Classified Vegetation

- Class A - Forest
- Class B - Woodland
- Class E - Mallee-Mulga
- Class G - Grassland
- Exclusion 2.2.3.2

0 200 400 600 800

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 19-09-2024
SCALE (A3): 1 : 12000

BUSHFIRE PRONE PLANNING

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Figure 3.2.1

BAL Contour Map North

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

NARRAKINE RD SOUTH
COMINI RD
WANERIE RD
MELLONS RD
NOTTLE RD
SIMMONS RD
GREAT SOUTHERN HWY
NARRAKINE RD SOUTH

------ LEGEND ------

- Subject Site
- Cadastral
- 150m Assessment Area
- BESS Layout
- Solar Layout
- Substation
- 10kW APZ

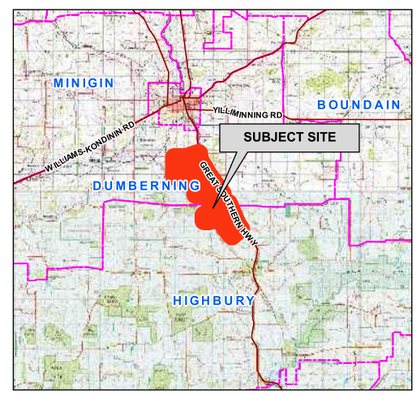
Bushfire Attack Levels

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

0 200 400 600 800

Metres

------ LOCALITY ------



N

AERIAL IMAGERY: Landgate/SLIP

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 28-08-2024
SCALE (A3): 1 : 15000

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Figure 3.2.2

BAL Contour Map South

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

CONTINE RD

BETTELEY RD

PARKS RD

GREAT SOUTHERN HWY

------ LEGEND ------

- Subject Site
- Cadastral
- 150m Assessment Area
- BESS Layout
- Solar Layout
- Substation

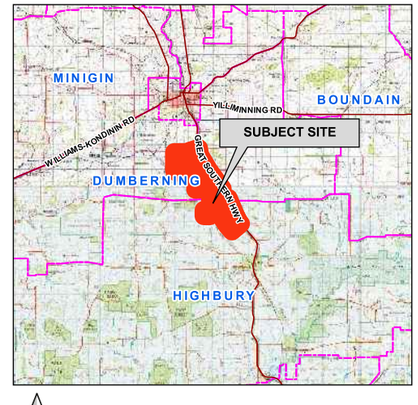
Bushfire Attack Levels

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

0 200 400 600

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 28-08-2024
SCALE (A3): 1 : 12000

BUSHFIRE PRONE PLANNING

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4 IDENTIFICATION OF BUSHFIRE HAZARD ISSUES

The Guidelines for Planning in Bushfire Prone Areas (WAPC 2021 v1.4), Appendix 5, establish that the application of this section of the BMP is intended to support ***strategic planning*** proposals. At the strategic planning stage there will typically be insufficient proposed development detail to enable all required assessments, including the assessment against the bushfire protection criteria.

Strategic Planning Proposals

For strategic planning proposals this section of the BMP will identify:

- Issues associated with the level of the threats presented by any identified bushfire hazard;
- Issues associated with the ability to implement sufficient and effective bushfire protection measures to reduce the exposure and vulnerability levels (of elements exposed to the hazard threats), to a tolerable or acceptable level; and
- Issues that will need to be considered at subsequent planning stages.

All Other Planning Proposals

For all other planning stages, this BMP will address what are effectively the same relevant issues but do it within the following sections:

- Section 2 – Bushfire Prone Vegetation - Environmental and Assessment Considerations: Assess environmental, biodiversity and conservation values;
- Section 3 – Potential Bushfire Impact: Assess the bushfire threats with the focus on flame contact and radiant heat; and
- Section 5 – Assessment Against the Bushfire Protection Criteria (including the guidance provided by the *Position Statement: 'Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2'):* Assess the ability of the proposed development to apply the required bushfire protection measures thereby enabling it to be considered for planning approval for these factors.

Is the proposed development a strategic planning proposal?	No

5 ASSESSMENT AGAINST THE BUSHFIRE PROTECTION CRITERIA (GUIDELINES V1.4)

5.1 Bushfire Protection Criteria Elements Applicable to the Proposed Development/Use

APPLICATION OF THE CRITERIA, ACCEPTABLE SOLUTIONS AND PERFORMANCE ASSESSMENT

The criteria are divided into five elements – location, siting and design, vehicular access, water and vulnerable tourism land uses. Each element has an intent outlining the desired outcome for the element and reflects identified planning and policy requirements in respect of each issue.

The example acceptable solutions (bushfire protection measures) provide one way of meeting the element's intent. Compliance with these automatically achieves the element's intent and provides a straightforward pathway for assessment and approval.

Where the acceptable solutions cannot be met, the ability to develop design responses (as alternative solutions that meet bushfire performance requirements) is an alternative pathway that is provided by addressing the applicable performance principles (as general statements of how best to achieve the intent of the element).

A merit based assessment is established by the SPP 3.7 and the Guidelines as an additional alternative pathway along with the ability of using discretion in making approval decisions (sections 2.5, 2.6 and 2.7). This is formally applied to certain development (minor and unavoidable – sections 5.4.1 and 5.7). Relevant decisions by the State Administrative Tribunal have also supported this approach more generally.

Elements 1 – 4 should be applied for all strategic planning proposals, subdivision or development applications, except for vulnerable tourism land uses which should refer to Element 5. Element 5 incorporates the bushfire protection criteria in Elements 1 – 4 but caters them specifically to tourism land uses. (Guidelines DPLH 2021v1.4)

The Bushfire Protection Criteria	Applicable to the Proposed Development/Use
Element 1: Location	Yes
Element 2: Siting and Design	Yes
Element 3: Vehicular Access	Yes
Element 4: Water	Yes
Element 5: Vulnerable Tourism Land Uses	No

5.2 Local Government Variations to Apply

Local governments may add to or modify the acceptable solutions to recognise special local or regional circumstances (e.g., topography / vegetation / climate). These are to be endorsed by both the WAPC and DFES before they can be considered in planning assessments. (Guidelines DPLH 2021v1.4).	
Do endorsed regional or local variations to the acceptable solutions apply to the assessments against the Bushfire Protection Criteria for the proposed development /use?	No

5.3 Assessment Statements for Element 1: Location

LOCATION	
Element Intent	To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.
Proposed Development/Use – Relevant Planning Stage	(Do) Development application other than for a single dwelling, ancillary dwelling or minor development
Element Compliance Statement	The proposed development/use achieves the intent of this element by being fully compliant with all applicable acceptable solutions.
Pathway Applied to Provide an Alternative Solution	N/A

Acceptable Solutions - Assessment Statements

All details of acceptable solution requirements are established in the Guidelines for Planning in Bushfire Prone Areas, DPLH v1.4 (Guidelines) and apply the guidance established by the Position Statement: 'Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design' (WAPC Nov 2019) and the 'Bushfire Management Plan Guidance for the Dampier Peninsula' (WA Department of Planning, Lands and Heritage, 2021 Rev B) as relevant. These documents are available at https://www.wa.gov.au/government/document-collections/state-planning-policy-37-planning-bushfire-prone-areas.

Solution Component Check Box Legend	☑ Relevant & met	☒ Relevant & not met	⃠ Not relevant	
E1 Location			**Compliant:**	Yes
A1.1 Development location	**Applicable:**	Yes	**Compliant:**	Yes

ASSESSMENT AGAINST THE REQUIREMENTS ESTABLISHED BY THE GUIDELINES

☑ ☐ ☐ The development application is located in an area that is or will, on completion, be subject to either a moderate or low bushfire hazard level, or BAL-29 or below.

Supporting Assessment Details:

On completion, all aspects of the development will be sited within an area subject to less than BAL-29 (Refer to Figure 3.2.1 and Figure 3.2.2 within this report). Due to the high-risk nature of this development, additional protection measures regarding radiant heat exposure have been identified in the Bushfire Risk Report produced in conjunction with this report. These can be found in section 5.7 of this report.

ASSESSMENTS APPLYING THE GUIDANCE ESTABLISHED BY THE WAPC ELEMENT 1 & 2 POSITION STATEMENT (2019)

"Consideration should be given to the site context where 'area' is the land both within and adjoining the subject site. The hazards remaining within the site should not be considered in isolation of the hazards adjoining the site, as the potential impact of a bushfire will be dependent on the wider risk context, including how a bushfire could affect the site and the conditions for a bushfire to occur within the site."

Strategic Planning Proposals: Consider the threat levels from any vegetation adjoining and within the subject site for which the potential intensity of a bushfire in that vegetation would result in it being classified as an Extreme Bushfire Hazard Level (BHL). Identify any proposed design strategies to reduce these threats.

Structure Plans (lot layout known) and Subdivision Applications: As for strategic planning proposals but within the subject site the relevant threat levels to consider are the radiant heat levels represented by BAL-FZ and BAL-40 ratings.

The planning proposal is a development application, consequently the referenced position statement is not applicable to the Element 1 assessment.

5.4 Assessment Statements for Element 2: Siting and Design

SITING AND DESIGN OF DEVELOPMENT	
Element Intent	To ensure that the siting and design of development minimises the level of bushfire impact. (BPP Note: not building/construction design)
Proposed Development/Use – Relevant Planning Stage	(Do) Development application other than for a single dwelling, ancillary dwelling or minor development
Element Compliance Statement	The proposed development/use achieves the intent of this element by being fully compliant with all applicable acceptable solutions.
Pathway Applied to Provide an Alternative Solution	N/A

Acceptable Solutions - Assessment Statements

All details of acceptable solution requirements are established in the Guidelines for Planning in Bushfire Prone Areas, DPLH v1.4 (Guidelines) and apply the guidance established by the Position Statement: 'Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design' (WAPC Nov 2019) and the 'Bushfire Management Plan Guidance for the Dampier Peninsula' (WA Department of Planning, Lands and Heritage, 2021 Rev B) as relevant. These documents are available at https://www.wa.gov.au/government/document-collections/state-planning-policy-37-planning-bushfire-prone-areas.

Solution Component Check Box Legend	☑ Relevant & met	☒ Relevant & not met	⃠ Not relevant

E2 Siting and Design of Development			**Compliant:**	Yes
A2.1 Asset Protection Zone (APZ)	**Applicable:**	Yes	**Compliant:**	Yes

APZ DIMENSIONS – DIFFERENCES IN REQUIREMENTS FOR PLANNING ASSESSMENTS COMPARED TO IMPLEMENTATION

A key required bushfire protection measure is to reduce the exposure of buildings/infrastructure (as exposed vulnerable elements at risk), to the direct bushfire threats of flame contact, radiant heat and embers and the indirect threat of consequential fires that result from the subsequent ignition of other combustible materials that may be constructed, stored or accumulate in the area surrounding these structures. This reduces the associated risks of damage or loss.

This is achieved by separating buildings (and consequential fire fuels as necessary) from areas of classified bushfire prone vegetation. This area of separation surrounding buildings is identified as the Asset Protection Zone (APZ) and consists of no vegetation and/or low threat vegetation or vegetation continually managed to a minimal fuel condition. The required separation distances will vary according to the site specific conditions and local government requirements.

The APZ dimensions stated and/or illustrated in this Report can vary dependent on the purpose for which they are being identified.

> *Note: Appendix B 'Onsite Vegetation Management' provides further information regarding the different APZ dimensions that can be referenced, their purpose and the specifications of the APZ that are to be established and maintained on the subject lot.*

THE 'PLANNING BAL-29' APZ DIMENSIONS

Purpose: To provide evidence of the development or use proposal's ability to achieve minimum vegetation separation distances. To achieve 'acceptable solution' planning approval for this factor, it must be demonstrated that the minimum separation distances corresponding to a maximum level of radiant transfer to a building of 29 kW/m^2, either exist or can be implemented (with certain exceptions). These separation distances are the 'Planning BAL-29' APZ dimensions.

The 'Planning BAL-29' APZ is not necessarily the size of the APZ that must be physically implemented and maintained by a landowner. Rather, its sole purpose is to identify if an acceptable solution for planning approval can be met.

THE 'REQUIRED' APZ DIMENSIONS

Purpose: Establishes the dimensions of the APZ to be physically implemented by the landowner on their lot: These will be the minimum required separation distances from the subject building(s) to surrounding bushfire prone vegetation (identified by type and associated ground slope). These are established by:

A. The 'BAL Rating APZ' of the subject building(s) when distances are greater than 'B' below (except when 'B' establishes a maximum distance); or

B. The 'Local Government' APZ' derived from the Firebreak/Hazard Reduction Notice when distances are greater than 'A' above, other than when a maximum distance is established, in which case this will apply; or

C. A combination of 'A' and 'B'.

> *Within this Report/Plan it is the **'Planning BAL-29' APZ** that will be identified on maps, diagrams and in tables as necessary – unless otherwise stated.*
>
> *The **'Required' APZ** dimension information will be presented in Appendix B1.1 and on the Property Bushfire Management Statement, when required to be included for a development application.*

ASSESSMENT AGAINST THE REQUIREMENTS ESTABLISHED BY THE GUIDELINES

☑ ☐ ☐	**APZ Width:** The proposed (or a future) habitable building(s) on the lot(s) of the proposed development - or an existing building for a proposed change of use – can be (or is) located within the developable portion of the lot and be surrounded by a 'Planning BAL-29' APZ of the required dimensions (measured from any external wall or supporting post or column to the edge of the classified vegetation), that will ensure their exposure to the potential radiant heat impact of a bushfire does not exceed 29 kW/m^2.
☐ ☐ ⦸	**Restriction on Building Location:** It has been identified that the current developable portion of a lot(s) provides for the proposed future (or a future) building/structure location that will result in that building/structure being subject to a BAL-40 or BAL-FZ rating. Consequently, it may be considered necessary to impose the condition that a restrictive covenant to the benefit of the local government pursuant to section 129BA of the Transfer of Land Act 1893, is to be placed on the certificate(s) of title of the proposed lot(s) advising of the existence of a restriction on the use of that portion of land (refer to Code F3 of Model Subdivision Conditions Schedule, WAPC June 2021 and Guidelines s5.3.2).
☑ ☐ ☐	**APZ Location:** The required dimensions for a 'Planning BAL-29' APZ can be contained solely within the boundaries of the lot(s) on which the proposed (or a future) habitable building(s) - or an existing building(s) for a proposed change of use – is situated.
☐ ☐ ⦸	**APZ Location:** The required dimensions for a 'Planning BAL-29' APZ can be partly established within the boundaries of the lot(s) on which the proposed (or a future) habitable building(s) - or an existing building(s) for a proposed change of use – is situated. The balance of the APZ would exist on adjoining land that satisfies the exclusion requirements of AS 3959:2018 cl 2.2.3.2 for non-vegetated areas and/or low threat vegetation and/or vegetation managed in a minimal fuel condition.
☐ ☐ ⦸	**APZ Location:** It can be justified that any adjoining (offsite) land forming part of a 'Planning BAL-29' APZ will: • If non-vegetated, remain in this condition in perpetuity; and/or • If vegetated, be low threat vegetation or vegetation managed in a minimal fuel condition in perpetuity.

☑ ☐ ☐	**APZ Management:** The area of land (within each lot boundary), that is to make up the required 'Landowner' APZ dimensions (refer to Appendix B, Part B1), can and will be managed in accordance with the requirements of the Guidelines Schedule 1 'Standards for Asset Protection Zones' (refer to Appendix B).
☐ ☐ ⊘	**Staged Subdivision:** The subdivision proposes development in stages and each stage is to comply with the relevant bushfire protection criteria. A balance lot is created or classified vegetation within a subsequent stage will be removed and/or modified and/or be subject to ongoing management, to ensure that proposed lots within the current stage of the subdivision achieve a development site subject to 29 kW/m^2 or below. The planned approach for achieving the required outcome is described in the supporting assessment details below.
☑ ☐ ☐	**Firebreak/Hazard Reduction Notice:** Any additional requirements established by the relevant local government's annual notice to install firebreaks and manage fuel loads (issued under s33 of the Bushfires Act 1954), can and will be complied with.

Supporting Assessment Details:

The Solar panels, BESS and substation have been sited in a way that allows the entirety of the planning BAL-29 APZ as well as the additional set back recommendations, to be solely located within the lot boundaries.

The proposed solar farm and the substation will be surrounded by an APZ that will ensure that the radiant heat impact of a bushfire does not exceed 19kW/m^2 (BAL-19). The minimum APZ dimensions applied exceed the minimum BAL-29 required for planning approval. This requirement is established in Section 5.7 and shown in Figure 3.2.1 and Figure 3.2.2 within this document.

The BESS Cabinets will be surrounded by an APZ that will ensure that the radiant heat impact of a bushfire does not exceed 10kW/m$^{2.}$ See section 5.7. The immediate 10m portion of the APZ around BESS cabinets will be entirely non-vegetated (sealed, developed, or mineral earth). The balance of the APZ will be managed in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines). The APZ specifications are also detailed in Appendix B and the Shire of Narrogin may have additional requirements established by their Firebreak Notice.

ASSESSMENTS APPLYING THE GUIDANCE ESTABLISHED BY THE WAPC ELEMENT 1 & 2 POSITION STATEMENT (2019)

Strategic Planning Proposals: "At this planning level there may not be enough detail to demonstrate compliance with this element. The decision-maker may consider this element is satisfied where A1.1 is met."

Structure Plans (lot layout known) and Subdivision Applications: "Provided that Element 1 is satisfied, the decision-maker may consider approving lot(s) containing BAL-40 or BAL-FZ under the following scenarios.

The planning proposal is a development application, consequently the referenced position statement is not applicable to the proposed development.

5.5 Assessment Statements for Element 3: Vehicular Access

VEHICULAR ACCESS	
Element Intent	To ensure that the vehicular access serving a subdivision/development is available and safe during a bushfire event.
Proposed Development/Use – Relevant Planning Stage	(Do) Development application other than for a single dwelling, ancillary dwelling or minor development
Element Compliance Statement	The proposed development/use achieves the intent of this element by being fully compliant with all applicable acceptable solutions.
Pathway Applied to Provide an Alternative Solution	N/A

Acceptable Solutions - Assessment Statements

All details of acceptable solution requirements are established in the Guidelines for Planning in Bushfire Prone Areas, DPLH v1.4 (Guidelines) and apply the guidance established by the Position Statement: 'Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design' (WAPC Nov 2019) and the 'Bushfire Management Plan Guidance for the Dampier Peninsula' (WA Department of Planning, Lands and Heritage, 2021 Rev B) as relevant. These documents are available at https://www.wa.gov.au/government/document-collections/state-planning-policy-37-planning-bushfire-prone-areas.

The technical construction requirements for access types and components, and for each firefighting water supply component, are also presented in Appendices C and D. The local government will advise the proponent where different requirements are to apply and when any additional specifications such as those for signage and gates are to apply (these are included in the relevant appendix if requested by the local government).

Solution Component Check Box Legend	☑ Relevant & met	☒ Relevant & not met	⃠ Not relevant

E3 Vehicular Access			**Compliant:**	Yes
A3.1 Public roads	**Applicable**:	Yes	**Compliant**:	Yes

☑ ☐ ☐	The technical construction requirements of vertical clearance and weight capacity (Guidelines, Table 6) can and will be complied with (Refer also to Appendix C in this BMP).
☑ ☐ ☐	All other applicable technical requirements of trafficable width, gradients and curves, are required to be in "accordance with the class of road as specified in the IPWEA Subdivision Guidelines, Liveable Neighbourhoods, Ausroad Standards and/or any applicable standard in the local government area" (Guidelines, Table 6 and E3.1. Refer also to Appendix C in this BMP). The assessment conducted for the bushfire management plan indicates that it is likely that the proposed development can and will comply with the requirements. However, the applicable class of road, the associated technical requirements and subsequent proposal compliance, will need to be confirmed with the relevant local government and/or Main Roads WA.
☑ ☐ ☐	A traversable verge is available adjacent to classified vegetation (Guidelines, E3.1), as recommended.

Supporting Assessment Details:

This development does not require the construction of any new public roads. However, the existing roads (Great Southern Highway, Continue Road and Wanerie Road) are likely to comply with the technical construction requirements of their class of road and the technical construction requirements outlined in the Guidelines.

A3.2a Multiple access routes	Applicable:	Yes	Compliant:	Yes

☑ ☐ ☐	For each lot, two-way public road access is provided in two different directions to at least two different suitable destinations with an all-weather surface.
☐ ☐ ⊘	The two-way access is available at an intersection no greater than 200m from the relevant boundary of each lot, via a no-through road.
☐ ☐ ⊘	The two-way access is not available at an intersection within 200m from the relevant boundary of each lot. However, the available no-through road satisfies the established exemption for the length limitation in every case. These requirements are: • Demonstration of no alternative access (refer to A3.3 below); • The no-through road travels towards a suitable destination; and • The balance of the no-through road that is greater than 200m from the relevant lot boundary is within a residential built-out area or is potentially subject to radiant heat levels from adjacent bushfire prone vegetation that correspond to the BAL-LOW rating (<12.5 kW/m^2).

Supporting Assessment Details:

The northern development area is bounded by Great Southern Highway and Wanerie Road, with access to both and both providing two-way access to two different destinations.

The southern development area is bounded by Parks Road and Continue Road, with access to both and both providing two-way access to two different destinations.

Within rural areas, lots are frequently 'landlocked' without approved crossovers onto public roads. These lots are instead accessed by adjoining lots, often with no boundary distinction and under the control of the same landowner.

The Guidelines do not consider:

- Development Applications over multiple subject lots, and;
- Multiple landholdings with the same landholder which share an access point.

The proposal meets the intent of A3.2a in that the internal access (private driveways) within the development exit onto two-way public road access.

A3.2b Emergency access way	Applicable:	No	Compliant:	N/A

☐ ☐ ⊘	The proposed or existing EAW provides a through connection to a public road.
☐ ☐ ⊘	The proposed or existing EAW is less than 500m in length and will be signposted and gated (remaining unlocked) to the specifications stated in the Guidelines and/or required by the relevant local government.
☐ ☐ ⊘	The technical construction requirements for widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.2b. Refer also to Appendix C in this BMP), can and will be complied with.
☐ ☐ ⊘	The subdivision proposes development in stages and each stage is to comply with the relevant bushfire protection criteria. A temporary EAW is planned to facilitate the staging arrangements of a subdivision as an interim second access route until the required second access route is constructed as a public road in a subsequent stage. The planned approach for achieving the required outcome is described in the supporting assessment details below.

Supporting Assessment Details: None required.				
A3.3 Through-roads	**Applicable**:	No	**Compliant**:	N/A
☐ ☐ ⊘	A no-through public road is necessary as no alternative road layout exists due to site constraints.			
☐ ☐ ⊘	The no-through public road length does not exceed the established maximum of 200m to an intersection providing two-way access (Guidelines, E3.3).			
☐ ☐ ⊘	The no-through public road exceeds 200m but satisfies the exemption provisions of A3.2a as demonstrated in A3.2a above.			
☐ ☐ ⊘	The public road technical construction requirements (Guidelines, Table 6 and E3.1. Refer also to Appendix C in this BMP), can and will be complied with as established in A3.1 above.			
☐ ☐ ⊘	The turnaround area requirements (Guidelines, Figure 24) can and will be complied with.			
Supporting Assessment Details: A no-through road is not required for accessing the site and no public roads are proposed for the development.				
A3.4a Perimeter roads	**Applicable**:	No	**Compliant**:	N/A
☐ ☐ ⊘	The proposed greenfield or infill development consists of 10 or more lots (including those that are part of a staged subdivision) and therefore should have a perimeter road. This is planned to be installed.			
☐ ☐ ⊘	The proposed greenfield or infill development consists of 10 or more lots (including those that are part of a staged subdivision). However, it is not required on the established basis of: • The vegetation adjoining the proposed lots is classified Class G Grassland; • Lots are zoned rural living or equivalent; • It is demonstrated that it cannot be provided due to site constraints; or • All lots have existing frontage to a public road.			
☐ ☐ ⊘	The technical construction requirements of widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.4a) can and will be complied with.			
Supporting Assessment Details: None required.				
A3.4b Fire service access route	**Applicable**:	No	**Compliant**:	N/A
☐ ☐ ⊘	The FSAR can be installed as a through-route with no dead ends, linked to the internal road system every 500m and is no further than 500m from a public road.			
☐ ☐ ⊘	The technical construction requirements of widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.4b. Refer also to Appendix C in this BMP), can and will be complied with.			
☐ ☐ ⊘	The FSAR can and will be signposted. Where gates are required by the relevant local government, the specifications can be complied with.			

☐ ☐ ⊘	Turnaround areas (to accommodate type 3.4 fire appliances) can and will be installed every 500m on the FSAR.
Supporting Assessment Details: None required.	

A3.5 Battle-axe access legs	**Applicable**:	No	**Compliant**:	N/A

☐ ☐ ⊘	A battle-axe leg cannot be avoided due to site constraints.
☐ ☐ ⊘	The proposed development is in a reticulated area and the battle-axe access leg length from a public road is no greater than 50m. No technical requirements need to be met.
☐ ☐ ⊘	The proposed development is not in a reticulated area. The technical construction requirements for widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.5. Refer also to Appendix C in this BMP), can and will be complied with.
☐ ☐ ⊘	Passing bays can and will be installed every 200m with a minimum length of 20m and a minimum additional trafficable width of 2m.
Supporting Assessment Details: None required.	

A3.6 Private driveways	**Applicable**:	Yes	**Compliant**:	Yes

☐ ☐ ⊘	The private driveway to the most distant external part of the development site is within a lot serviced by reticulated water, is accessed via a public road with a speed limit of 70 km/hr or less and has a length is no greater than 70m (measured as a hose lay). No technical requirements need to be met.
☑ ☐ ☐	The technical construction requirements for widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.6. Refer also to Appendix C in this BMP), can and will be complied with.
☑ ☐ ☐	Passing bays can and will be installed every 200m with a minimum length of 20m and a minimum additional trafficable width of 2m.
☑ ☐ ☐	The turnaround area requirements (Guidelines, Figure 28, and within 30m of the habitable building) can and will be complied with.

Supporting Assessment Details:

Solar panel banks, BESS infrastructure, and the HV substation, should meet the same requirements as for a 'habitable building,' for the purposes of Element 3 A3.6 Private Driveways.

All internal roads within the development area will comply with technical construction requirements as outlined in Table 6 of the Guidelines and Appendix C of this document. The internal roads will be looped around the site, with multiple loop designs as roads will run the perimeter solar panel banks.
Section 5.7, Item 7 requires that internal access roads are constructed to have 6m trafficable clearance.

5.6 Assessment Statements for Element 4: Water

WATER	
Element Intent	To ensure water is available to enable people, property and infrastructure to be defended from bushfire.
Proposed Development/Use – Relevant Planning Stage	(Do) Development application other than for a single dwelling, ancillary dwelling or minor development
Element Compliance Statement	The proposed development/use achieves the intent of this element by being fully compliant with all applicable acceptable solutions.
Pathway Applied to Provide an Alternative Solution	N/A

Acceptable Solutions - Assessment Statements

All details of acceptable solution requirements are established in the Guidelines for Planning in Bushfire Prone Areas, DPLH v1.4 (Guidelines) and apply the guidance established by the Position Statement: 'Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design' (WAPC Nov 2019) and the 'Bushfire Management Plan Guidance for the Dampier Peninsula' (WA Department of Planning, Lands and Heritage, 2021 Rev B) as relevant. These documents are available at https://www.wa.gov.au/government/document-collections/state-planning-policy-37-planning-bushfire-prone-areas.

The technical construction requirements for access types and components, and for each firefighting water supply component, are also presented in Appendices C and D. The local government will advise the proponent where different requirements are to apply and when any additional specifications such as those for signage and gates are to apply (these are included in the relevant appendix if requested by the local government).

Solution Component Check Box Legend ☑ Relevant & met ☒ Relevant & not met ⃠ Not relevant

E4 Water	**Compliant:**	Yes

A4.1 Identification of future firefighting water supply	**Applicable**:	No	**Compliant**:	N/A

☐ ☐ ⃠ It can be demonstrated that reticulated or sufficient non-reticulated water for firefighting can be provided at the subdivision and/or development application stage in accordance with the specifications of the relevant water supply authority or the requirements of Schedule 2.

Supporting Assessment Details:

None required.

A4.2 Provision of water for firefighting purposes	**Applicable**:	Yes	**Compliant**:	Yes

☐ ☐ ⃠ A reticulated water supply is available to the proposed development. The existing hydrant connection(s) are provided in accordance with the specifications of the relevant water supply authority.

☐ ☐ ⃠ A reticulated water supply will be available to the proposed development. Hydrant connection(s) can and will be provided in accordance with the specifications of the relevant water supply authority.

☐ ☐ ⃠ A static water supply (tank) for firefighting purposes will be installed on each lot that is additional to any water supply that is required for drinking and other domestic purposes.

☑ ☐ ☐ A strategic water supply (tank or tanks) for firefighting purposes will be installed within or adjacent to the proposed development that is additional to any water supply that is required for drinking and other domestic purposes. The required land will be ceded free of cost to the local government and the lot or road reserve where the tank is to be located will be identified on the plan of subdivision.

☑ ☐ ☐	The strategic static water supply (tank or tanks) will be located no more than 10 minutes travel time from a subject site (at legal road speeds).
☑ ☐ ☐	The technical requirements (location, number of tanks, volumes, design, construction materials, pipes and fittings), as established by the Guidelines (A4.2, E4 and Schedule 2) and/or the relevant local government, can and will be complied with.

Supporting Assessment Details:

The *Guidelines for Planning in Bushfire Prone Areas* does not establish a firefighting water supply for non-habitable structures, including high-risk uses. Battery Energy Storage Systems and Solar Farms do not have an applicable firefighting water supply under state or national requirements. A supply of 50,000L would meet the intent of planning requirements under SPP 3.7 and the *Guidelines for Planning in Bushfire Prone Areas* v1.4.

The Bushfire Risk Report prepared alongside this BMP, reviews the water supply and specifications for the proposed development. A reticulated water supply is not available, and thus a static water supply will be required.

The water supply will comply with the CFA Design Guidelines and Model Requirements for Renewable Energy Facilities (Victoria Country Fire Authority August 2023). See Section 6.1.1 Item 4.2.2 of the associated Bushfire Risk Report.

The Solar Farm development will require 4 tanks installed throughout the site, each with a minimum capacity of 50,000L. The specific location of water tanks will be determined once the internal access network is known at the detailed design phase. The following requirements will apply to the 4 tanks:

- Tanks must be installed adjacent to access points into solar farm areas, either from public road reserves or from other parts of the development area.
- Tanks ***may*** be installed within public road reserves in consultation with the Shire of Narrogin.
- All areas of the solar farm footprint must be within 5km travel of a water tank.

The BESS development static firefighting water supply must be calculated per AS 2419. Based on the approximately 12,800m2 footprint, the required supply will be 432,000L.

Water tanks will be installed within the development in accordance with the requirements established in the Bushfire Risk Report. These requirements have been outlined in Section 5.7 of this BMP.

Refer to information contained in Appendix D for the firefighting water supply specifications and technical requirements.

5.7 Additional Bushfire Protection Measures to be Implemented

The following bushfire protection measures are recommended to be implemented and maintained. They are additional to, or a variation of, those established by the relevant acceptable solutions applied to the proposed development/use within Sections 5 of this BMP (as applicable to the proposed development).

The intent of their application is to improve the bushfire performance of the proposed development/use and reduce residual risk levels to persons and property from a bushfire event.

The development of these additional and/or varied protection measures originates the following potential sources (not exhaustive):

1. Out of the relevant merit based assessment when the Section titled 'Non-compliance – Additional Assessments' has been used in this BMP;
2. Out of the relevant performance based assessment when Section titled 'Non-compliance – Additional Assessments' has been used in this BMP;
3. Out of the development of any other required bushfire planning documents. These include a Bushfire Emergency Plan and the Bushfire Risk Assessment and Management Report;
4. Out of any additional bushfire planning guidance documents or position statements issued by the WA Department of Planning, Lands and Heritage;
5. From any 'Conditions' which may be applied to a 'Planning Approval' or a 'Notice of Determination; or
6. As a recommendation from the bushfire consultant.

The following table summarises the requirements/recommendations with the detail provided in the following sections.

When necessary, the implementation responsibility for these additional protection measures will be stated in Section 6 of this BMP and included in other operational documents as relevant.

SUMMARY OF ADDITIONAL BUSHFIRE PROTECTION MEASURES TO BE IMPLEMENTED					
No.	Description of the Protection Measure to Apply to the Proposed Development	BRR Ref.	Risk Reducing Component Being Applied		Implementation Priority Rating
			Type	Protection Principle	
1	Contact Narrogin VFRS and Narrogin and Minigin BFB prior to commissioning and offer a familiarisation visit and explanation of emergency procedures, access, hazards, and fire detection and suppression systems. Contact DFES Built Environment Branch to determine if an Emergency Response Guide (FES-ERG) is required. A comprehensive Emergency Management Plan is to be prepared for the facility. This is to outline Prevention, Preparedness, Response, and Recovery (PPRR) procedures for potential emergencies, of which bushfire is one component. The following details have been identified for inclusion within the Emergency Management Plan (and/or the Site Operating Procedures, as appropriate to the document structure): **Details and Information** • A summary of fire hazards and risks to and from the site, specific to its location, infrastructure, activities and occupancy. • A facility description, including infrastructure details, operations, number of personnel, and operating hours. • A site plan depicting structures/built assets, operational areas, site access points and internal roads, firefighting infrastructure, drainage (as applicable), and neighbouring properties. • Up-to-date contact details for facility personnel, including for at least two persons who may be able to provide information or support during emergencies (24 hours a day). Update contact information when necessary. • Details of emergency resources, including fire detection and suppression systems and equipment; gas detection; emergency eye-wash and shower facilities; spill containment systems and equipment; emergency warning systems; communication systems; personal protective equipment; first aid. • Contact information for 24/7/365 specialist technical support for the battery energy storage system.	1.9	Threat Reduction	Prevent bushfire ignition by controlling heat energy sources.	High

	• Specifications for safe operating conditions for temperature. • Schematics and technical data for battery energy storage system containers/enclosures, the number of containers/enclosures on-site, and the number of battery racks or modules within each container/enclosure. • Details of the hazards for the battery energy storage system, including thermal events/runaway, electrical safety hazards, explosion hazards, dangerous goods hazards (including off-gassing), and the effects of fire on the battery energy storage system (eg., explosion, release of toxic gases). • Details of all provided battery failure/safety and protective systems, including a description, the activation process/automatic trigger, and any hazards associated with these systems. **Procedures** **Prevention** • Smoking restrictions or designated smoking locations. • Procedures regarding vegetation management and accidental ignition prevention. • The specifications of Schedule 1 of the Guidelines for Planning in Bushfire Prone Areas and the Shire of Narrogin Firebreak Notice can be achieved via livestock grazing. The vegetation must continue to be monitored for compliance with Schedule 1, and additional vegetation management works undertaken as required. • Heavy equipment is not to be operated where long grass (>100mm) or heavy leaf litter is present, particularly during the bushfire season (see the Local Government Prohibited Burning Period). • Servicing of battery energy storage systems should not take place on days of High, Extreme or Catastrophic Fire Danger Rating, except where the system is experiencing malfunction or abnormal behaviour. The following procedures should be completed prior to the bushfire season (see the Local Government Prohibited Burning Period): • Scheduled maintenance to assets, emergency equipment, or fire detection/prevention systems. • The ongoing requirements outlined in the Bushfire Management Plan. • Scheduled housekeeping inspections including:				

	○ Hazard identification - ensuring that infrastructure, plant, equipment, vehicles and safety/warning signs show no signs of damage or dilapidation. ○ Facility access - ensuring all vehicle site access points, including emergency access points, are clear and accessible. ○ Fire protection systems and equipment – ensuring that all equipment is unobstructed, clearly identifiable, in-service and performing optimally. ○ Vegetation management - ensuring that any accumulation of combustible materials is cleared from infrastructure, buildings and fire breaks, and removed from the site. ○ Security measures - ensuring that fences, gates, and security cameras are inspected for damage, and that any damage is immediately actioned (e.g., repaired or replaced). **Preparedness** • Evacuation and shelter-in-place triggers and procedures, unless included within a Bushfire Emergency Plan. • Procedures for review of the Emergency Management Plan, including the ongoing effectiveness of control measures. • An ongoing schedule of site familiarisation for Narrogin VFRS and Narrogin and Minigin BFB to account for changing personnel, facility infrastructure and hazards. • The Emergency Management Plan and any Emergency Response Guide (FES-ERG) should contain procedures for isolation, shut-down, fail safe or management of critical/high-risk plant, equipment, and utilities, and their advised triggers. • Visitors must provide mobile phone numbers to site management. Within the Emergency Management Plan, a key response will be to contact and advise all persons onsite. • A bushfire monitoring procedure for the Restricted/Prohibited Burning Period (see Shire of Narrogin Firebreak Notice), including: ○ Nominating a person/role in your Emergency Control Organisation to be responsible for identifying, responding to, and communicating Fire Danger Ratings in advance. ○ Identifying bushfire activity within 10km of the facility.				

	○ Communicating this information to everyone likely to be present on-site, and relevant off-site personnel. ○ An outline of site activities to be modified or cease as a response (if any). **Response** DFES Comcen should immediately be notified of: • Any shorts, faults, temperature increases above normal parameters (eg. precursor to thermal events/runaway). • Equipment failures with the potential to ignite or propagate fire. • Off-gassing, smoke or fire. • The monitoring personnel can determine if Emergency Services response is necessary. The notification is for awareness. Bushfire emergency response procedures must include: • A specific action to notify (or verify notification) the emergency services, at the earliest possible stage of the emergency. • The person or role responsible for making or verifying the notification. • The '000' number in the procedure. • Communicating with site personnel and supporting their physical relocation. • Ensuring all buildings and plant are adequately secured. • Initiating any bushfire protection measures such as sprinkler or deluge systems, or pre-emptive shut-down, prior to the arrival of the fire front. • Liaising with the emergency services where possible. Consider the following criteria for inclusion within the Emergency Management Plan. All criteria are for consideration only, being non-bushfire measures identified within The Design Guidelines and Model Requirements – Renewable Energy Facilities (CFA August 2023). • Emergency procedures based on identified risks and hazards of the battery energy storage system and related infrastructure, including but not limited to: i. Electrical infrastructure faults and fire.				

	ii. Battery energy storage system damage or faults, including battery monitoring faults, temperature increases above normal operating parameters, electrical faults, chemical spills or reactions, off-gassing, thermal events/runaway, smoke and fire. iii. The management of fire water runoff. • A plan for partial and full decommissioning of the battery energy storage system in the event of an emergency incident that renders the facility inoperable or unsafe, prior to its anticipated end-of-life. • The shut down and/or isolation procedures if the batteries are involved in fire, and appropriate personnel contact details for verifying that the battery enclosure/container system has been isolated/shut-down and de-energised during emergencies.				
2	Emergency muster points should be reasonably adjacent to large solar panel banks (>200m wide), as the central portion of the larger banks are subject to <2kW/m2 radiant heat flux. These areas are suitable for emergency onsite shelter during a bushfire event, where evacuation is no longer safe.	2.5	Exposure Reduction – Persons	Separation from Bushfire Threats	Lowest
3	<u>Class 1-10 Buildings</u> If the building type/design is not required to or cannot construct to AS 3959, they should be sited to ensure radiant heat flux exposure does not exceed 10kW/m2 radiant heat flux. Any future Class 1-10 buildings should be sited within previously cleared, managed areas to reduce the requirement for ongoing management. <u>BESS</u> The APZ for BESS cabinets and associated infrastructure will ensure exposure to the bushfire hazard threat of radiant heat will be limited to a maximum radiant heat flux of 10 kW/m2 (calculated with an assumed flame temperature of 1090K) by providing the required separation distances from the bushfire hazard. The 10m portion of the APZ immediately around the BESS cabinets must be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc). BESS cabinets are recommended to be sited on concrete slabs or other sealed, non-combustible surface. <u>Solar Panels</u> A 10kW/m2 APZ should be applied where possible to ensure cabling is not exposed to its critical threshold. BAL-19 has been adopted as site constraints limit the installation of a	4.3 6.3 7.3 8.3	Exposure Reduction – Structures/Assets	Separation from Bushfire Threats	Highest

	10kW/m2 APZ. It must be therefore recognised that exposed cabling (not shielded or buried underground) positioned within 10kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement, and PV panels will not ignite but may suffer damage. <u>Substation</u> A BAL-19 APZ is required for the HV substation. Exposed cabling (not shielded or buried underground) positioned within 12kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement. The substation footprint should be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc).				
4	Any future Landscape Management Plan should be reviewed by the Bushfire Consultant to provide additional advice on vegetation location, demographics, and structure.	6.4 7.4	Exposure Reduction – Structures/Assets	Separation from Bushfire Threats	Medium
5	All non-structural combustible materials are to be removed within 10m of assets. This includes but is not limited to; waste, leaf litter, machinery, grasses, vehicles, fuel, furniture, and timber. When storage of flammable items or materials are stored on site temporarily (for maintenance etc), separation distances must be complied with. This requirement is to be included in the Site Operating Procedures document. The Intensium Shift datasheet provides minimum clearances between BESS cabinets and other features. A >1hour intervention period should be assumed for determining the appropriate setbacks, as the proposed site is within a regional area. Where the manufacturer specification does not specify a distance between BESS cabinets and other structures, Class 1-10 buildings and solar arrays should be sited a minimum of 15m from BESS cabinets.	4.7 6.7 7.7	Exposure Reduction – Structures/Assets	Separation from Bushfire Threats	High
6	Cabling and plumbing subject to >10kW/m2 (not within the <10kW/m2 setback), or beyond footprint of buildings or constructed assets, are recommended to be installed underground, or shielded with non-combustible material (or enclosed) where practical.	4.12 6.12 7.12 8.12	Exposure Reduction – Structures/Assets	Shielding from Bushfire Threats	High
7	Internal access roads should be constructed to be 6m wide to ensure unrestricted two-way traffic.	10.1	Vulnerability Reduction - Persons	Lower risk road construction (design and materials)	Medium

8	At the detailed design stage, the internal access network should be reviewed by the Bushfire Consultant to provide additional advice. Access points are likely to be gated but should be openable in the same manner (the same key, keycard, access code, remote etc). Access points are to comply, at a minimum, with the specifications for Private Driveways within Table 6 of the *Guidelines for Planning in Bushfire Prone Areas v1.4*.	10.7	Vulnerability Reduction - Persons	Lower risk road construction (design and materials)	Medium
9	Any proposed or future Class 1-9 buildings should be constructed to their assessed BAL to a minimum of BAL-12.5 under AS3959 to reduce the vulnerability to ember attack, even if subject to BAL-LOW. This does not apply to Class 10 buildings which cannot comply with AS3959.	11.1	Vulnerability Reduction – Structures/Assets	Construction design and materials	Medium
10	<u>Class 1-10 Buildings</u> For any future Class 1-10 buildings, include non-combustible structural elements where practical. In particular, avoid: polycarbonate (sheeting and skylights), softwoods (<650 kg/m3 density at 12% moisture content), and fibrous materials. <u>BESS</u> Review compliance against NFPA 855 - Standard for the Installation of Stationary Energy Storage Systems (2023) noting that as a North American planning standard, all requirements may not be applicable. The Intensium Shift datasheet includes an ambient temperature range of -20°C to +45C, with an option for +55°C. The 55°C option should be investigated to account for high ambient temperature combining with heat generated from bushfire.	11.3 13.3 14.3 15.3	Vulnerability Reduction – Structures/Assets	Construction design and materials	Medium
11	It is recommended non-combustible elements are used for structural and supporting/associated constructions wherever practical. This includes sheds, lean-tos, verandas, shade screening, lattice, garden edging, fencing etc.	11.4 13.4 14.4 15.4	Vulnerability Reduction – Structures/Assets	Construction design and materials	Medium
12	Where electrical cabling, or gas or liquid piping, contacts the ground or any arrangement of associated structures creates a 'pocket' for accumulation of debris, this should be rectified by design or filling with non-combustible material such as mineral earth. Consideration should be given to making the arrangement self-cleaning through wind action to the greatest extent possible. These measures will reduce accumulation and/or make the management (clearing) of accumulated debris easier. E.g. cable raking to be 100mm above ground.	13.8 14.8 15.8	Vulnerability Reduction – Structures/Assets	Construction design and materials	Lowest

13	Any subfloor cavities must have exposed subfloor spaces enclosed, sealed with non-combustible material, or be ember screened. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium.	11.11 13.11 15.11	Vulnerability Reduction – Structures/Assets	Construction design and materials	Lowest
14	The detailed design of any Class 1-10 Buildings should be reviewed to ensure it is possible for them to be fully enclosed.	11.12	Vulnerability Reduction – Structures/Assets	Construction design and materials	Lowest
15	Class 1-10 Buildings Any Class 1-10 buildings (including non-habitable structures) must have ember screening/sealants installed on any gaps, penetrations, and external glazed elements. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium. BESS The manufacturer or appropriate engineers should be contacted to enquire if it is possible to apply ember screening to intake/exhaust/air conditioning vents and other paths of entry to the interior cavity or accessing any combustible elements of BESS cabinets. This ember screening would be applicable to the exterior of the battery cabinet, not internal components. The intention is to prevent both ember ingress and debris accumulation. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium. Substation Consider application of ember screening to the external vent interface of the control room, switchroom, terminal boxes etc. The intention is to prevent both ember ingress and debris accumulation. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium.	11.13 13.13 15.13	Vulnerability Reduction – Structures/Assets	Construction design and materials	High
16	External doors (if present) should be self-closing. Doors should be tightly fitting against the frame.	13.15 15.15	Vulnerability Reduction – Structures/Assets	Construction design and materials	Lowest
17	Review *FM Global Property Loss Prevention Data Sheet 5-33 (2020) Electrical Energy Storage Systems* for additional measures applicable to the development.	13.16	Vulnerability Reduction – Structures/Assets	Construction design and materials	Lowest

18	The following requirements apply to the firefighting water supply, via Measure 13.17 in the associated Bushfire Risk Report. The specifications will be confirmed at the detailed design stage. <u>Access</u> • Firefighting water access points (hydrants, hard suction, or drafting) must be clearly identifiable, visible from internal roads, and unobstructed. • An all-weather hardstand turnaround area meeting the requirements of the *Guidelines for Planning in Bushfire Prone Areas v1.4* (Explanatory Note E3.3) must be provided within 4 metres static water storage tank(s) and any independent hard suction points (hydrants). • Site Operating Procedures must include that access routes must be unobstructed at all times. <u>Siting and Capacity</u> • The Solar Farm development will require 4 tanks installed throughout the site, each with a minimum capacity of 50,000L. The specific location of water tanks will be determined once the internal access network is known at the detailed design phase. The following requirements will apply to the 4 tanks: o Tanks must be installed adjacent to access points into solar farm areas, either from public road reserves or from other parts of the development area. o Tanks ***may*** be installed within public road reserves in consultation with the Shire of Narrogin. o All areas of the solar farm footprint must be within 5km travel of a water tank. • The static firefighting water supply associated with the BESS development must be calculated per AS 2419. Based on the approximately 12,800m2 footprint, the required supply will be 432,000L. • Water tanks must be positioned >15m from BESS cabinets, solar panels, PCUs, inverters, etc. • The water tank(s) should apply a BAL-29 APZ at a minimum. <u>Construction</u> • The static water storage tank(s) must be an above-ground water tank constructed of concrete or steel.	11.16 13.17 14.17 15.17	Vulnerability Reduction – Structures/Assets	Availability of a firefighting response capability	Highest

	• An external water level indicator must be installed on static water storage tank(s) and be visible from internal roads and the adjoining turnaround area. • Signage indicating 'FIRE WATER' and the tank capacity must be fixed to each tank. • The hard-suction point must be protected from mechanical damage (eg. bollards) where vehicle contact is possible. • Couplings at hard suction points are required to be 125mm Storz fittings (*Guidelines v1.4* s2.2.2.1). DFES Built Environment and the local emergency services should be contacted for input on appropriate couplings and adaptors. • During the detailed design stage, the entity designing the firefighting water supply should provide information on compliance with AS2419.1-2021 (Open Yard Protection) and what variations are applied (if any).				
19	Two suitable fire extinguishers should be provided within 20m of each PCU.	13.18	Vulnerability Reduction – Structures/Assets	Availability of a firefighting response capability	Lowest
20	Automatic fire detection and suppression systems should be installed and maintained, as appropriate to the BESS details and recommended by the manufacturer. Consider the potential for arc flash due to smoke from a bushfire.	13.19 14.19 15.19	Vulnerability Reduction – Structures/Assets	Availability of a firefighting response capability	High
21	Any firefighting water pump will be either self-powered (diesel tank) or connected to a backup generator (if connected to mains power). Ensure the diesel tank capacity and pump itself is capable of operating for a period not less than the determined minimum water supply period (e.g. if a 4-hour water supply has been determined, the diesel tank must hold a 4-hour supply). All firefighting water tanks, pumps, connections, couplings, and pipes are to be metal or else non-combustible. As soon as practical before the arrival of the fire front, preparation systems/procedures should be engaged. Such systems/procedures should be determined in consultation with the manufacturer, but may include: • Orienting PV panels to the maximum vertical plane (estimated 50 degrees from the horizontal).	11.19 13.20 14.20	Vulnerability Reduction – Structures/Assets	Availability of a firefighting response capability	High

	• Orienting PV panels away from the sun (to reduce residual energy generation post-shutdown). • Disconnecting solar arrays from the electrical grid. • Engaging any appropriate automatic fire suppression systems.				
22	The decision maker should note that multiple international standards and guidelines exist, and full compliance with all may not be achievable. Australia lacks a guiding standard, as discussed in the *Battery Energy Storage Systems Guidance Report* (GHD March 2023, prepared for the Australian Energy Council). The decision maker may choose to review this report for an overview of context, concerns, and outcomes, for the construction and installation of BESS proposals. Ongoing requirements established in this Risk Assessment and Section 5.7 of the associated Bushfire Management Plan, must be included in operational documents. Site Operating Procedures must include the following information: <u>Maintenance</u> • Maintenance intervals. Scheduling can be detailed within a supporting document. • Assigned responsibilities of staff. • Maintenance procedures and servicing to manufacturer's specifications. • Testing procedures of the firefighting water supply and equipment. <u>Inspections</u> • Inspection intervals. Frequency of inspections are recommended to be increased during the bushfire season (see the Local Government Prohibited Burning Period) where practical. • Inspection triggers, including extreme weather events or seismic activity. • Established inspection criteria, including: o Accumulation of debris and vegetative material within 10m of battery modules. o Mechanical damage to exterior elements. o Vegetation regrowth within the Asset Protection Zone, particularly immediately prior to and during bushfire season (see the Local Government Prohibited Burning Period). o Obstruction of access routes including firebreaks.	11.21 13.22 14.22 15.22	Vulnerability Reduction – Structures/Assets	Manage and maintain effectiveness of applied protection measures	Highest

	○ Volume of the firefighting water supply.				

6 RESPONSIBILITY CHECKLISTS FOR THE IMPLEMENTATION AND MANAGEMENT OF BUSHFIRE PROTECTION MEASURES

The following sections and their associated tables establish:

- The bushfire protection measures that shall be initially implemented and those requiring ongoing maintenance to the stated requirements;
- The persons responsible for the implementation and maintenance of the required bushfire protection measures; and
- The persons responsible and the timing for compliance certification when required.

The necessity for the BMP to contain this information is established by the *Guidelines for Planning in Bushfire Prone Areas* (Version 1.4, WAPC 2021) in Appendices 3 and 5.

6.1 Developer / Operator Responsibilities Prior To Commencement of Operation

TABLE 6.2(A) REQUIRED BUSHFIRE PROTECTION MEASURES - IMPLEMENTATION ACTIONS (SUBJECT TO COMPLIANCE CHECK TO BE CONDUCTED BY A BUSHFIRE CONSULTANT)	
1	Prior to operation establish the 'Required' Asset Protection Zone (APZ) around habitable buildings (and other structures as required) to satisfy: • The minimum required dimensions established in Appendix B1; and • The standards established by the *Guidelines for planning in bushfire prone areas,* DPLH, 2021 v1.4, Schedule 1; or • The standards established for an Asset Protection Zone (APZ) by the relevant local government's requirements set out in a section 33 notice under the Bush Fires Act 1954 (annual firebreak/fuel load notice); or • An alternative standard in a gazetted local planning scheme; or If native vegetation is required to be modified or removed, ensure that approval has been received from the relevant authority (refer to the applicable local government for advice).
	Prior to operation, construct the private driveways to comply with the technical requirements referenced in the BMP.
	Prior to operation, install the required firefighting water supplies to comply with the technical requirements stated in the BMP.
	For the 'high risk land use' there is an outstanding obligation, created by Guidelines and consequently this Bushfire Management Plan, for a 'Bushfire Risk Assessment and Management Report' to be produced. Additional protection measures that have been identified in the Report, are to be incorporated into the operation's site emergency plan (produced by the operator to address all potential emergencies).

	Implement the additional bushfire protection measures that have been established within Section 5.7.1 of this BMP as measures additional to those established by the acceptable solutions.

TABLE 6.2(B) REQUIRED BUSHFIRE PROTECTION MEASURES - IMPLEMENTATION ACTIONS (SUBJECT TO COMPLIANCE BEING ESTABLISHED BY THE WAPC AND/OR LOCAL GOVERNMENT)	
1	[Relevant when stated as a condition of planning approval] The landowner/proponent is to register a notification onto the certificate of title and deposited plan (with the required wording stated by the local government). This will be done pursuant to *Section 70A Transfer of Land Act 1893 (as amended) as per 'Factors affecting use and enjoyment of land, notification on title'*. This is to notify owners and prospective purchasers of the land that: 1. The land is in a designated bushfire prone area as designated by an Order made by the Fire and Emergency Services Commissioner; 2. The land is subject to a Bushfire Management Plan that establishes certain protection measures to manage bushfire risk that are to be implemented and continue to be applied at the owner's cost; and 3. That additional planning and building requirements may apply to development on this land.
2	Prior to sale of a new lot(s), each lot is to be compliant with current version of the Shire of Narrogin Firebreak and Fuel Hazard Reduction Notice issued under s33 of the Bushfires Act 1954. Where the Notice includes a standard for asset protection zones, this may differ from the standards established for an Asset Protection Zone (APZ) by the Guidelines DPLH, 2021 v1.4, Schedule 1 (refer to Appendix B), with the intent to better satisfy local conditions. An alternative standard in a gazetted local planning scheme may also apply to the subject lot(s).

TABLE 6.2(C) REQUIRED BUSHFIRE PROTECTION MEASURES - IMPLEMENTATION ACTIONS (NOT SUBJECT TO COMPLIANCE CHECK)	
1	Prior to relevant building work, inform the builder of the existence of this approved Bushfire Management Plan (BMP). The plan identifies that the development site is within a designated bushfire prone area and states the indicative (or determined) BAL rating(s) that may (or will) be applied to buildings/structures. A BAL assessment report may be required to confirm determined ratings and will be required when ratings are indicative. BAL certificates will need to be issued to accompany building applications. The BMP may also establish, as an additional bushfire protection measure, that construction requirements to be applied will be those corresponding to a specified higher BAL rating. Compliance with the Building Code of Australia (Volumes 1 and 2 of the National Construction Code), will require certain bushfire resistant construction requirements be applied to residential buildings in bushfire prone areas (i.e., Class 1, 2 and 3 and associated Class 10a buildings and decks). Other classes of buildings may also be required to comply with these construction when established by the relevant authority or if identified as an additional bushfire protection measure within the BMP. The deemed to satisfy solutions that will meet the relevant bushfire performance requirements are found in AS 3959 – Construction of Building in Bushfire Prone Areas (as amended) and the NASH Standard - Steel Framed Construction in Bushfire Areas (as amended).

2	Each property owner on sale of the allotment is provided with a copy of the BMP and informed of their responsibilities. A copy of the approved BMP should be attached to all contracts of sale for the lot.

6.2 Operator Responsibilities – Ongoing Management

TABLE 6.3 REQUIRED BUSHFIRE PROTECTION MEASURES – ONGOING MANAGEMENT ACTIONS	
1	Maintain the 'Required' Asset Protection Zone (APZ) around habitable buildings (and other structures as required) to satisfy: • The minimum required dimensions established in Appendix B1; and • The standards established by the *Guidelines for planning in bushfire prone areas,* DPLH, 2021 v1.4, Schedule 1; or • The standards established for an Asset Protection Zone (APZ) by the relevant local government's requirements set out in a section 33 notice under the Bush Fires Act 1954 (annual firebreak/fuel load notice); or • An alternative standard in a gazetted local planning scheme; or
	Comply with the Shire of Narrogin Firebreak and Fuel Hazard Reduction Notice issued under s33 of the Bush Fires Act 1954. Check the notice annually for any changes.
	Maintain vehicular access routes within the lot to comply with the technical requirements referenced in the BMP and the relevant local government's annual firebreak / hazard reduction notice.
	Maintain the firefighting water supplies and associated pipes/fittings/pump and vehicle access and hardstand in good working condition.
	Where any strategic firefighting water supply tank(s) have been installed, be aware of the arrangement that is in place regarding who has responsibility for maintaining the emergency water supply at full capacity. This may be in the form of an agreement with the local government and the local fire service. Check that this is being complied with.
	Ensure that builders engaged to construct dwellings/additions and/or other relevant structures on the lot, are aware of the existence of this approved Bushfire Management Plan (BMP). The plan identifies that the development site is within a designated bushfire prone area and states the indicative (or determined) BAL rating(s) that may (or will) be applied to buildings/structures. A BAL assessment report may be required to confirm determined ratings and will be required when ratings are indicative. BAL certificates will need to be issued to accompany building applications. Compliance with the Building Code of Australia (Volumes 1 and 2 of the National Construction Code), will require certain bushfire resistant construction requirements be applied to residential buildings in bushfire prone areas (i.e., Class 1, 2 and 3 and associated Class 10a buildings and decks). The deemed to satisfy solutions that will meet the relevant bushfire performance requirements are found in AS 3959 – Construction of Building in Bushfire Prone Areas (as amended) and the NASH Standard - Steel Framed Construction in Bushfire Areas (as amended). As an additional bushfire protection measure, other classes of buildings may also be required to comply with these construction requirements when established by the relevant authority or if identified as an additional bushfire protection measure within the BMP. The BMP may also establish that construction requirements to be applied will be those corresponding to a specified higher BAL rating. When applicable, these requirements will be identified in Section 5.7.

	Ensure all future buildings the landowner has responsibility for, are designed and constructed in full compliance with: • The bushfire resistant construction requirements of the Building Code of Australia (Volumes 1 and 2 of the National Construction Code), as established by the Building Regulations 2012 (WA Building Act 2011); and • Any additional bushfire protection measures this Bushfire Management Plan has established are to be implemented.
	Maintain the bushfire protection measures that have been established within Section 5.7 of this BMP as measures additional to those established by the acceptable solutions.
	Ensure the ongoing implementation of the BMP, including providing successive landowners with a copy of the BMP and making them aware of the responsibilities it contains.

6.3 Local Government Responsibilities – Ongoing Management

TABLE 6.4 REQUIRED BUSHFIRE PROTECTION MEASURES – ONGOING MANAGEMENT ACTIONS	
1	To be aware of the potential consequences of any significant changes in the local government's management of land, of which they have vested control (including re-vegetation), that could have an adverse impact on the determined BAL ratings that apply to adjacent existing or future buildings and where: • The determined BAL ratings have been established by an existing BMP or a BAL Assessment; and • The BAL has been correctly determined with appropriate consideration of what might reasonably be expected to potentially change in the future with regards to the classification of the vegetation being altered and/or management of the relevant area of vegetation.
	Where any strategic firefighting water supply tank(s) have been installed, be aware of the arrangement that is in place regarding who has responsibility for maintaining the emergency water supply at full capacity. This may be in the form of an agreement with the local government and the local fire service. Check that this is being complied with.

APPENDIX A: DETAILED BAL ASSESSMENT DATA AND SUPPORTING INFORMATION

A1: BAL Assessment Inputs Common to the Method 1 and Method 2 Procedures

A1.1: FIRE DANGER INDICES (FDI/FDI/GFDI)

When using Method 1 the relevant FDI value required to be applied for each state and region is established by AS 3959:2018, Table 2.1. Each FDI value applied in Tables 2.4 – 2.7 represents both the Forest Fire Danger Index (FFDI) and a deemed equivalent for the Grassland Fire Danger Index (GFDI), as per Table B2 in Appendix B. When using Method 2, the relevant FFDI and GFDI are applied.

The values may be able to be refined within a jurisdiction, where sufficient climatological data is available and in consultation with the relevant authority.

Relevant Jurisdiction:	WA	Region:	Whole State	Method 1	Applied FDI:	80
				Method 2	Applied FFDI:	80
					Applied GFDI:	110

A1.2: VEGETATION ASSESSMENT AND CLASSIFICATION

Vegetation Types and Classification

In accordance with AS 3959:2018 Clauses 2.2.3 and C2.2.3.1, all vegetation types within 100 metres of the 'site' (defined as "the part of the allotment of land on which a building stands or is to be erected"), are identified and classified. Any vegetation more than 100 metres from the site that has influenced the classification of vegetation within 100 metres of the site, is identified and noted. The maximum excess distance is established by AS 3959: 2018 Clause 2.2.3.2 and is an additional 100 metres.

Classification is also guided by the Visual Guide for Bushfire Risk Assessment in WA (WA Department of Planning February 2016) and any relevant FPA Australia practice notes.

Modified Vegetation

The vegetation types have been assessed as they will be in their natural mature states, rather than what might be observed on the day. Vegetation destroyed or damaged by a bushfire or other natural disaster has been assessed on its expected re-generated mature state. Modified areas of vegetation can be excluded from classification if they consist of low threat vegetation or vegetation managed in a minimal fuel condition, satisfying AS 3959:2018 Clause 2.2.3.2(f), and there is sufficient justification to reasonable expect that this modified state will exist in perpetuity.

The Influence of Ground Slope

Where significant variation in effective slope exists under a consistent vegetation type, these will be delineated as separate vegetation areas to account for the difference in potential bushfire behaviour, in accordance with AS 3959:2018 Clauses 2.2.5 and C2.2.5.

THE INFLUENCE OF VEGETATION GREATER THAN 100 METRES FROM THE SUBJECT SITE	
Vegetation area(s) within 100m of the site whose classification has been influenced by the existence of bushfire prone vegetation from 100m – 200m from the site:	None
Assessment Statement:	No vegetation types exist close enough, or to a sufficient extent, within the relevant area to influence classification of vegetation within 100 metres of the subject site.

VEGETATION AREA 1						
Classification	**A. FOREST**					
Types Identified	Open forest A-03 Low open forest A-04					
Exclusion Clause	N/A					
Effective Slope	Measured	d/slope 5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	30-70%	Shrub/Heath Height	1-2m	Tree Height	Up to 30m	
Justification Comments:	Native forest found throughout the site and surrounds showing highly variable species composition. The vegetation may be of forest structure, or woodland structure with >30% canopy cover.					
Post Development Assumptions:	N/A					



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VEGETATION AREA 2						
Classification	**B. WOODLAND**					
Types Identified	Woodland B-05					
Exclusion Clause	N/A					
Effective Slope	Measured	d/slope 5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	<30%	Shrub/Heath Height	-	Tree Height	Up to 30m	
Justification Comments:	Scattered, tall trees with no understorey. Dry, grassy ground cover. Many standing, dead trees.					
Post Development Assumptions:	N/A					



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VEGETATION AREA 3						
Classification	**A. FOREST**					
Types Identified	Open forest A-03 Low open forest A-04					
Exclusion Clause	N/A					
Effective Slope	Measured	d/slope 5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	>30%	Shrub/Heath Height	Up to 6m	Tree Height	Up to 30m	
Justification Comments:	Road verge vegetation with greatly variable species assemblages and structures. The vegetation has been classified as Class A Forest as a precautionary measure.					
Post Development Assumptions:	N/A					



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VEGETATION AREA 4						
Classification	**E. MALLEE/MULGA**					
Types Identified	Tall shrubland E-15 Sown pasture G-26					
Exclusion Clause	N/A					
Effective Slope	Measured	d/slope 5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	<30%	Shrub/Heath Height	Up to 10m	Tree Height	-	
Justification Comments:	Mallee contained in plantations and arranged in rows with low overall canopy cover.					
Post Development Assumptions:	N/A					



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VEGETATION AREA 5						
Classification	**G. GRASSLAND**					
Types Identified	Sown pasture G-26		Open tussock G-23			
Exclusion Clause	N/A					
Effective Slope	Measured	d/slope 5 degrees		Applied Range (Method 1)	Downslope >0-5 degrees	
Foliage Cover (all layers)	<10%	Shrub/Heath Height	-	Tree Height	Up to 30m	
Justification Comments:	Paddocks or grassland used for livestock grazing or road verges. Some areas are private land with some scattered trees.					
Post Development Assumptions:	Portions of the vegetation will be managed or removed to install assets, access roads, and the required APZs. The balance of the vegetation is expected to be retained.					



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VEGETATION AREA 6	
Exclusion Clause	2.2.3.2 (e) Non-vegetated areas and (f) Low threat vegetation - minimal fuel condition.
Justification Comments:	Roads, structures, and low threat landscaping associated with existing structures.
Post Development Assumptions:	N/A

A1.3: EFFECTIVE SLOPE

EXPLAINING THE ASSESSMENT METHODOLOGY APPLIED BY BUSHFIRE PRONE PLANNING

DEFINITION: Effective slope is "the slope under that classified vegetation which most influences the bushfire attack" (AS 3959:2018, Clause 1.5.11).

"The effective slope under the classified vegetation is not the same as the average slope for the land surrounding the site of the proposed building. The effective slope is that slope which most significantly influences bushfire behaviour" (AS 3959:2018, Clause CB4).

The slope is described as upslope, flat or downslope when viewed from an exposed element (e.g., building) and looking towards the vegetation. It is measured in degrees.

[Note: Additional relevant guidance provided by AS 3959:2018 and NSW RFS, Planning for Bushfire Protection (2019) is incorporated into the applied assessment methodology and is presented at the end of this explanation.]

COMPOUND SLOPES UNDER VEGETATION AND DETERMINING SLOPE SIGNIFICANCE

Non-Linear Slopes: When the slope of ground under the vegetation out to the distance to be assessed (100 m or further if necessary), is not a straight line or nearly straight line slope, then it is made up of several different slopes i.e., it is a compound slope. The different slope angles and lengths must be factored into the determination of the effective slope value to be applied. Different slopes will potentially influence the bushfire rate of spread and intensity, both increasing and decreasing it.

Significant Slope: The AS 3959:2018 bushfire attack level determination methodology, with default inputs, models a fully developed bushfire. Therefore, a 'significant' slope is one that will significantly influence bushfire behaviour. To be 'significant' the length of the slope must be 'sufficient' to support a fully developed fire on that slope. The angle of a significant slope could be the determined effective slope for the area of classified vegetation if it is the one that 'most influences the bushfire attack'.

Sufficient Slope Length: Is a slope that will, as a minimum, allow the entire flame depth (flaming zone) of a fully developed fire (100m flame width) to exist on that slope.

The expected flame depth of a fully developed bushfire is a function of the length of time the flaming phase will exist on a section of the fuel bed (the 'residence time') and the bushfire's 'rate of spread'. For a given rate of spread, longer residence times result in greater flame depths. Greater flame depths are correlated with greater flame temperatures and greater flows of radiant heat.

The primary factors that will increase the residence time are:

- Heavier fine fuel loads of grass, leaf litter, twigs, bark etc less than 6mm in width and existing within the surface and near surface layers (and elevated fuel layers when contiguous with the base layers); and
- A greater percentage of larger fine fuels within the fuel load.

The primary factors that increase the rate of spread (apart from fire weather factors), include finer fuels, drier fuels, horizonal continuity of fuel and steeper upward ground slope in the direction of fire travel.

Example values:

- Residence Time: Grassfire 5 – 15 seconds, Forest fire 25 -50 seconds.
- Rate of Spread: Grassfires of a few km/hr are considered fast moving, 5-10 km/hr is common and fastest in the order of 25km/hr. Forest fire typically recorded in metres/hour with 1-1.5 km/hr being considered fast moving and fastest in the order of 3–4 km/hr.
- Flame Depth: More typically, a few metres for grasses to tens of metres for forest fires.

An Isolated Slope: For scenarios where there is a single significant slope (based on the above criteria) additional consideration would need to be given to the time and distance consumed by a bushfire still in its 'developing' phase. This will require due consideration be given to how it is potentially ignited i.e., from a single or multiple points, as this will influence the time and distance required to fully develop. For such scenarios, a normally significant slope may not be sufficiently long. It may be necessary to determine the potential bushfire impact more accurately by

justifying the application of a lesser effective slope, or a lower threat vegetation classification, or calculating a reduced headfire width (using short fire run modelling).

Determined Effective Slope: Only a 'significant' slope can potentially be the effective slope by itself. In which case, for a defined vegetation area, the worst significant slope under that vegetation is to apply.

The table below indicates Bushfire Prone Planning's considerations in assessing short and/or compound slopes to determine the effective slope.

Slope Length (m)	Considered a Significant Slope	Considerations in Determining the Effective Slope
< 5	No	The single length of slope can be ignored.
5-20	No	The influence of the slope, even though reduced, must still be recognised to an appropriate degree by the determined effective slope.
20-30	Possibly Not – But Requires Justification	Consider likely bushfire hazard threat levels (direct attack mechanisms) within the general assessment area as influenced by local topography, vegetation extents and types. Consider the potential for preheating and ignition source impacts from bushfire on adjoining or nearby land onto vegetation on the subject slope. Isolated slopes of this length are less likely to be considered significant. Consider if vegetation on the slope is likely be ignited by a single ignition point or is multipoint ignition possible from bushfire an adjoining slopes or the surrounding area. Single point ignition will require a fire to travel further before being fully developed (DFES considers less than 100m fire runs may be considered a short fire run for forest, woodland and scrub vegetation classifications). If considered not significant, the influence of the slope, even though reduced, must still be recognised to an appropriate degree by the determined effective slope.
>30	Yes	Will likely always be a significant slope (unless isolated – in which case, justifying the application of a lesser effective slope, or a lower threat vegetation classification, or calculating a reduced headfire width.

BPP Approach - Slope Variation Within Areas of Vegetation

Where a significant variation in effective slope exists under a consistent vegetation type, these will be delineated as separate vegetation areas to account for the difference in potential bushfire behaviour and impact, in accordance with AS 3959:2018 clauses 2.2.5 and C2.2.5.

Effective Slope Variation Due to Multiple Development Sites

When the effective slope, under a single area of bushfire prone vegetation, will vary significantly relative to multiple proposed development sites (exposed elements), then the effective slopes corresponding to each of the different locations, are separately identified. The relevant (worst case) effective slope is determined in the direction corresponding to the potential directions of fire spread towards the subject building(s).

AS 3959:2018 EFFECTIVE SLOPE DETERMINATION - GUIDANCE

The Standard presents a broad set of guidance statements that indicate the intent of deriving an effective slope value for use in calculations, rather than detailing the 'in the field' determination process. These include:

- Highlighting the importance of the value by stating "The slope of the land under the classified vegetation has a direct influence on the rate of fire spread, severity of the fire and the ultimate level of radiant heat flux" (Clause C2.2.5). [Note: A common rule of thumb is that for every 10 degrees of upslope, a fire will double its rate of spread if moving in the direction of the prevailing wind. Fires travel slower down a slope].
- It may be necessary to consider the slope under the classified vegetation for distances greater than 100 m in order to determine the effective slope for that vegetation classification.

- "Where there is more than one slope within the classified vegetation, each slope shall be individually assessed, and the worst case Bushfire Attack Level shall apply" (Clause 2.2.5).

NSW RFS 2019, PLANNING FOR BUSHFIRE PROTECTION - APPENDIX A1.5 - ADDITIONAL DETERMINATION GUIDANCE

- "In identifying the effective slope, it may be found that there are a variety of slopes covering different distances within the vegetation. The effective slope is considered to be the slope under the vegetation which will most significantly influence the bushfire behaviour for each aspect. This is usually the steepest slope. In situations where this is not the case, the proposed approach must be justified".
- "Vegetation located closest to an asset may not necessarily be located on the effective slope".

SITE ASSESSMENT DETAILS - EXPLANATION & JUSTIFICATION

The effective slopes determined from the site assessment are recorded in Table 3.2 of this Bushfire Management Plan.

The site is large-scale with generally flat to undulating terrain. It is not practical to correctly assign effective slopes to vegetation relative to assets across a large area. A 5-degree slope has been applied to all vegetation areas in establishing the appropriate APZs.

A1.4: SEPARATION DISTANCE

Measuring

The separation distance is the distance in the horizontal plane between the receiver (building/structure or area of land being considered) and the edge of the classified vegetation (AS 3959:2018, clause 2.2.4)

The relevant parts of a building/structure from which the measurement is taken is the nearest part of an external wall or where a wall does not exist, the supporting posts or columns. Certain parts of buildings are excluded including eaves and roof overhangs.

The edge of the vegetation, for forests and woodlands, will be determined by the unmanaged understorey rather than either the canopy (drip line) or the trunk (AS 3959:2018, clause C2.2.5).

Measured Separation Distance as a Calculation Input

If a separation distance can be measured because the location of the building/structure relative to the edge of the relevant classified vegetation is known, this figure can be entered into the BAL calculation. The result is a determined BAL rating.

Assumed Separation Distance as a Calculation Input

When the building/structure location within the lot is not known, an assumed building location may be applied that would establish the closest positioning of the building/structure relative to the relevant area of vegetation.

The assumed location would be based on a factor that puts a restriction on a building location such as:

- An established setback from the boundary of a lot, such as a residential design code setback or a restrictive covenant; or
- Within an established building envelope.

The resultant BAL rating would be indicative and require later confirmation (via a Compliance Report) of the building/structure actual location relative to the vegetation to establish the determined BAL rating.

Separation Distance as a Calculation Output

With the necessary site specific assessment inputs and using the AS 3959:2018 bushfire modelling equations, the range of separation distances that will correspond to each BAL rating (each of which represents a range of radiant heat flux), can be calculated. This has application for bushfire planning scenarios such as:

- When the separation distance cannot be measured because the exact location of the exposed element (i.e., the building, structure or area), relative to classified vegetation, is yet to be determined.

  In this scenario, the required information is the identification of building locations onsite that will correspond to each BAL rating. That is, indicative BAL ratings can be derived for a variety of potential building/structure locations; or

- The separation distance is known for a given building, structure or area (and a determined BAL rating can be derived), but additional information is required regarding the exposure levels (to the transfer of radiant heat from a bushfire), of buildings or persons, that will exist at different points within the subject site.

The calculated range of separation distances corresponding to each BAL rating can be presented in a table and/or illustrated as a BAL Contour Map – whichever is determined to best fit the purpose of the assessment.

For additional information refer to the information boxes in Section 3 'Bushfire Attack Levels (BAL) - Understanding the Results and Section 3.2. 'Interpretation of the BAL Contour Map'.

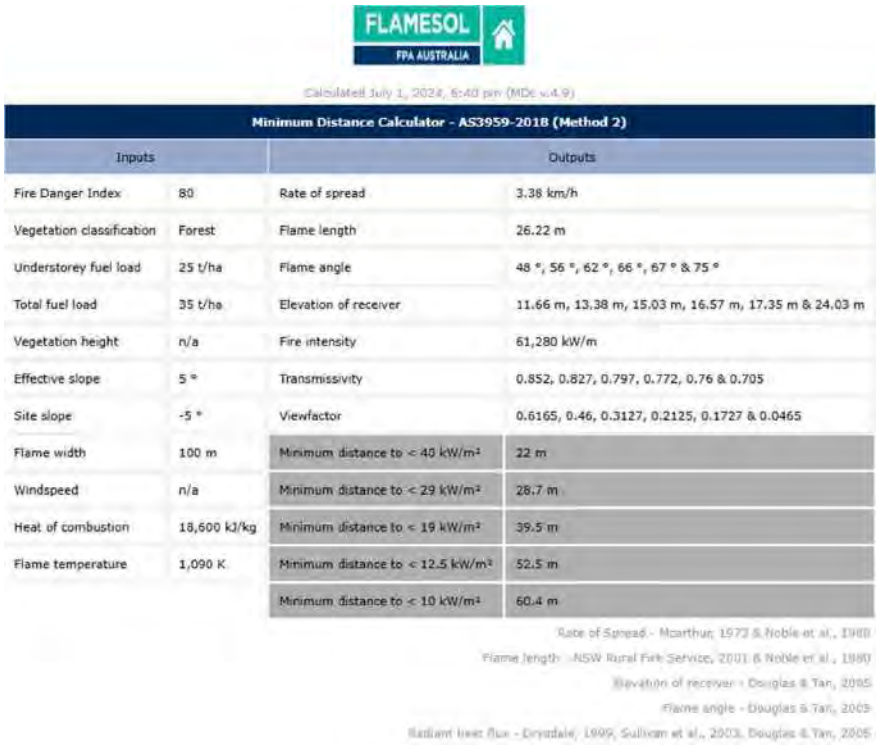
SITE ASSESSMENT DETAILS - EXPLANATION & JUSTIFICATION

For the subject development/use the applicable separation distances values are derived from calculations applying the assessed site data. They are an output value, not an input value and therefore are not presented or justified in this appendix.

The derived values are presented in Section 3, Table 3.1 and illustrated as a BAL contour map in Figure 3.2.1 and 3.2.2.

A3: BAL Calculator – Copy of Input/Output Values

DETERMINING 10 kW/m² SEPARATION DISTANCES



FLAMESOL
FPA AUSTRALIA

Calculated July 1, 2024, 6:40 pm (MDR v.4.9)

Minimum Distance Calculator - AS3959-2018 (Method 2)

Inputs		Outputs	
Fire Danger Index	80	Rate of spread	3.38 km/h
Vegetation classification	Forest	Flame length	26.22 m
Understorey fuel load	25 t/ha	Flame angle	48 °, 56 °, 62 °, 66 °, 67 ° & 75 °
Total fuel load	35 t/ha	Elevation of receiver	11.66 m, 13.38 m, 15.03 m, 16.57 m, 17.35 m & 24.03 m
Vegetation height	n/a	Fire intensity	61,280 kW/m
Effective slope	5 °	Transmissivity	0.852, 0.827, 0.797, 0.772, 0.76 & 0.705
Site slope	-5 °	Viewfactor	0.6165, 0.46, 0.3127, 0.2125, 0.1727 & 0.0465
Flame width	100 m	Minimum distance to < 40 kW/m²	22 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	28.7 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	39.5 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	52.5 m
		Minimum distance to < 10 kW/m²	60.4 m

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980
Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Class A Forest



FLAMESOL
FPA AUSTRALIA

Calculated September 13, 2024, 12:57 am (MDR v.4.9)

Minimum Distance Calculator - AS3959-2018 (Method 2)

Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.03 km/h
Vegetation classification	Woodland	Flame length	16.21 m
Understorey fuel load	15 t/ha	Flame angle	49 °, 58 °, 66 °, 70 °, 71 ° & 77 °
Total fuel load	25 t/ha	Elevation of receiver	7.34 m, 8.5 m, 9.720000000000001 m, 10.82 m, 11.44 m & 16.66 m
Vegetation height	n/a	Fire intensity	26,263 kW/m
Effective slope	5 °	Transmissivity	0.868, 0.848, 0.821, 0.796, 0.783 & 0.723
Site slope	-5 °	Viewfactor	0.6027, 0.4476, 0.3037, 0.2064, 0.1674 & 0.0454
Flame width	100 m	Minimum distance to < 40 kW/m²	13.9 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	18.5 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	26.5 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	36.7 m
		Minimum distance to < 10 kW/m²	43.2 m

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980
Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Class B Woodland

FLAMESOL
FPA AUSTRALIA

Calculated September 12, 2024, 11:37 am (MDc v4.9)

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	5.88 km/h
Vegetation classification	Mallee	Flame length	8.06 m
Understorey fuel load	8 t/ha	Flame angle	50 °, 60 °, 68 °, 73 °, 75 ° & 80 °
Total fuel load	8 t/ha	Elevation of receiver	3.71 m, 4.33 m, 4.97 m, 5.65 m, 6.06 m & 9.800000000000001 m
Vegetation height	m	Fire intensity	24,316 kW/m
Effective slope	5 °	Transmissivity	0.885, 0.873, 0.854, 0.833, 0.82 & 0.748
Site slope	-5 °	Viewfactor	0.5925, 0.4349, 0.2921, 0.1966, 0.1596 & 0.0438
Flame width	100 m	Minimum distance to < 40 kW/m²	7 m
Windspeed	45 km/h	Minimum distance to < 29 kW/m²	9.5 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	14 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	20.5 m
		Minimum distance to < 10 kW/m²	24.8 m

Rate of Spread - Catchpole et al. 1998
Flame length - Byram, 1959
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1998, Sullivan et al., 2003, Douglas & Tan, 2005

Class E Mallee

FLAMESOL
FPA AUSTRALIA

Calculated July 3, 2024, 6:21 pm (MDc v4.9)

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	110	Rate of spread	20.19 km/h
Vegetation classification	Grassland	Flame length	8.16 m
Understorey fuel load	4.5 t/ha	Flame angle	51 °, 60 °, 68 °, 73 °, 75 ° & 80 °
Total fuel load	4.5 t/ha	Elevation of receiver	3.8 m, 4.38 m, 5.03 m, 5.71 m, 6.13 m & 9.9 m
Vegetation height	n/a	Fire intensity	46,945 kW/m
Effective slope	5 °	Transmissivity	0.884, 0.872, 0.854, 0.832, 0.819 & 0.748
Site slope	-5 °	Viewfactor	0.5914, 0.4357, 0.2914, 0.1969, 0.1601 & 0.0438
Flame width	100 m	Minimum distance to < 40 kW/m²	7.1 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	9.6 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	14.2 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	20.7 m
		Minimum distance to < 10 kW/m²	25 m

Rate of Spread - Noble et al. 1980
Flame length - Purton, 1982
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Class G Grassland

APPENDIX B: ADVICE - ONSITE VEGETATION MANAGEMENT - THE APZ

THE ASSET PROTECTION ZONE (APZ) – DESCRIPTION AND OBJECTIVES

Description: The asset protection zone (APZ) is the area of land surrounding a building or structure on which any combustible materials will be located and/or managed to reduce the potential impact of the direct and indirect attack mechanisms (threats) of bushfire, and therefore reduce the associated risks of building/structure damage or loss, to acceptable levels.

When cultivated and/or natural vegetation exists within the zone it must present low potential threat levels from the direct fire attack mechanisms of flame contact, radiant heat and ember attack and fire driven wind, and the indirect attack mechanisms of debris accumulation, surface fire, tree strike and consequential fire.

The required low threat levels will be achieved as the result of factors that include persistent higher fuel moisture contents, lower flammability and/or minimal fuel loads, due to either limiting the existence of these fuels through removal and/or modification, and the subsequent ongoing management (reduction) of fuel loads.

When a bushfire attack level (BAL) is required to be determined for a building/structure to establish its bushfire construction requirements, the condition of the vegetation within the APZ must satisfy the requirements established by *clause 2.2.3.2 of AS 3959:2018 Construction of buildings in bushfire prone areas* - to be excluded from classification.

For other combustible structures/materials within the APZ, lower threat levels will be the result of factors such as their appropriate use, lowered vulnerability and location relative to the primary building/structure to be protected.

Objectives: The primary objectives of establishing a low threat area surrounding buildings/structures are to create that performs the following functions:

1. To establis an APZ of specified dimensions ensure the building is sufficiently separated from the identified bushfire hazard to limit the impact of its direct attack mechanisms. The required dimensions of the APZ must:
    - Remove the potential for direct flame contact on the building;
    - Reduce the level of radiant heat to which the building is exposed. The APZ dimensions should ensure that the potential level of radiant heat impact corresponds to the level of vulnerability of the building/structure - as determined by the degree to which bushfire resistant construction has been applied (or not). For example, when constructed to the requirements corresponding to its determined exposure to radiant heat (measured as a bushfire attack level) in accordance with AS 3959 or the NASH Standard.
    - Ensure some reduction in the threat level of the ember/burning debris attack mechanism when higher threat vegetation types are present in the vicinity. Note, the reduction in some scenarios will be minimal given the produced quantity, type, survival time and consequent distance that certain embers/burning debris can travel.

      Be aware of that research has identified that consequential fire, ignited by embers, is the primary cause (>80%) of building loss in past Australian bushfire events. In bushfire prone areas, the importance of applying protection measures to prevent ember entry to buildings/structures and minimising the existence of consequential fire fuels cannot be overstated.
2. To ensure any combustible fuels (debris and structures) or trees that remain within the APZ will be managed and located to limit the potential impact of the indirect attack mechanisms of bushfire by:
    - Minimising the accumulation of debris on, within and around buildings/structures to limit this source of fuel for consequential fires that will result in the direct fire attack mechanisms of flames and greater radiant heat existing closer to the buildings/structures, even though the bushfire hazard exists at a greater distance away;
    - To prevent surface fire moving through the APZ and closer to buildings/structures than the fire in the bushfire hazard itself can;

- Prevent fire weakened or windblown trees/branches impacting buildings/structures and allowing ember/burning debris entry;

- To ensure other combustible materials that can result in a consequential fire ignited by embers/burning debris), within both the APZ and parts of the building, are eliminated, minimised and/or appropriately located or protected (the explanatory notes in the Guidelines provide some guidance for achieving this objective and other sources are available); and

3. To provide a defendable space for firefighting activities.

B1: Asset Protection Zone (APZ) Dimensions

APZ DIMENSIONS – DIFFERENCES IN REQUIREMENTS FOR PLANNING ASSESSMENTS COMPARED TO IMPLEMENTATION

THE 'PLANNING BAL-29' APZ DIMENSIONS

The 'Planning BAL-29' APZ is not necessarily the size of the APZ that must be physically implemented and maintained by a landowner. Rather, its purpose is to identify if an acceptable solution for planning approval can be met i.e., can a specified minimum separation distance from bushfire prone vegetation exist.

An assessment against the Bushfire Protection Criteria is conducted for planning approval purposes. To satisfy 'A2.1: Asset Protection Zone', it must be demonstrated that certain minimum separation distances between the relevant building/structure and different classes of bushfire prone vegetation, either exist or can be created and will remain in perpetuity. These minimum separation distances determine the 'Planning BAL-29' APZ dimensions.

Dimensions: The minimum dimensions are those that will ensure the potential radiant heat impact on subject buildings does not exceed 29 kW/m^2. These dimensions will vary dependent on the vegetation classification, the slope of the land they are growing on and certain other factors specific to the subject site.

Note: For certain purposes associated with vulnerable land uses, the 'Planning BAL-29' APZ may be replaced with dimensions corresponding to radiant heat impact levels of 10 kW/m^2 and 2 kW/m^2 and calculated using 1200K flame temperature.

Location: The identified 'Planning BAL-29' APZ must not extend past lot boundaries onto land the landowner has no control over either now or potentially at some point in the future. Limited exceptions include:

- When adjoining land is not vegetated (e.g., built out, roads, carparks, drainage, rock, water body etc.);
- When adjoining land currently or, will in the short term, contain low threat vegetation and or vegetation managed in a minimal fuel condition as per AS 3959:2018 cl. 2.2.3.2. It must be reasonable (justifiable) to expect this low threat vegetation and/or level of management will continue to exist or be conducted in perpetuity and require no action from the owner of the subject lot.

  Such areas of land include formally managed areas of vegetation (e.g., public open space / recreation areas / services installed in a common section of land). For specific scenarios, evidence of the formal commitment to manage these areas to a certain standard may be required and would be included in the BMP.

  These areas of land can also be part of the required APZ on a neighbouring lot for which the owner of that lot has a recognised responsibility to establish and maintain; and
- When there is a formalised and enforceable capability and responsibility created for the subject lot owner, or any other third party, to manage vegetation on land they do not own in perpetuity. This would be rare, and evidence of the formal authority would be included in the BMP.

The bushfire consultant's 'Supporting Assessment Detail', that is presented in the assessment against the acceptable solution A2.1, will identify and justify how any adjoining land within the 'Planning BAL-29 APZ will meet the APZ standards. Or otherwise, explain how this condition cannot be met.

THE 'BAL RATING' APZ DIMENSIONS

The applicable BAL rating will have been stated in the BAL Assessment Data section of the BAL Assessment Report or BMP (as relevant). The BAL rating can be assessed as 'determined' or 'indicative' or be 'conditional', dependent of the specific conditions associated with the site and the stage of assessment or planning. It is the eventual assessment of the 'Determined' BAL that will establish both the BAL rating that is to apply and its corresponding 'BAL Rating' APZ dimensions.

Dimensions: The minimum dimensions of the 'BAL Rating' APZ to be established and maintained will be those that correspond to the determined BAL rating for the subject building/structure that has accounted for surrounding vegetation types, the slope of the land they are growing on and certain other factors specific to the subject site and surrounding land.

Establishing the 'BAL Rating' APZ will ensure that the potential radiant heat exposure of the building/structure will be limited to the level that the applied construction requirements are designed to resist when that building/structure is required to be constructed to the standard corresponding to the Determined BAL.

> *Note: For certain purposes associated with vulnerable land uses, the 'BAL Rating' APZ dimensions may be replaced with dimensions corresponding to the specific radiant heat impact levels of 10 kW/m^2 and 2 kW/m^2 and calculated using 1200K flame temperature.*

Location: The same conditions will apply as for the 'Planning BAL-29' APZ.

THE 'LOCAL GOVERNMENT' APZ DIMENSIONS

Some Local Government's establish the dimensions of the APZ that must be established surrounding buildings in their annual Firebreak/Hazard Reduction Notice. Or for a specific site they may establish a maximum allowable dimension (typically that corresponding to BAL-29). When established, the landowner will need to be comply with these.

THE 'REQUIRED' APZ DIMENSIONS

This is the APZ that is to be established and maintained by the landowner within the subject lot and surrounding the subject building(s). It will be identified on the Property Bushfire Management Statement when it is required to be included in this Report/Plan.

Dimensions: The 'Required APZ' dimensions are the minimum (or maximum when relevant) distances away from the subject building(s) that the APZ must extend. These distances will not necessarily be the same all around the building(s). They can vary and are dependent on the different vegetation types (and their associated ground slope) that can exist around the building(s), and specific local government requirements. The dimensions to implement are determined by:

A. The 'BAL Rating APZ' of the subject building(s) when distances are greater than 'B' below (except when 'B' establishes a maximum distance); or

B. The 'Local Government' APZ' derived from the Firebreak/Hazard Reduction Notice when distances are greater than 'A' above, other than when a maximum distance is established, in which case this will apply; or

C. A combination of 'A' and 'B'.

Location: The same conditions will apply as for the 'Planning BAL-29' APZ.

B1.1: THE APZ DIMENSIONS REQUIRED TO BE IMPLEMENTED BY THE LANDOWNER

DETERMINATION OF THE 'REQUIRED' APZ DIMENSIONS TO BE IMPLEMENTED AND MAINTAINED BY LANDOWNER WITHIN THEIR LOT											
Relevant Buildings(s)	Vegetation Classification [Refer to Fig 3.1]		Minimum Required Separation Distances from Building to Vegetation (metres)								
			Established by the 'BAL Rating' APZ Dimension						Established by the "Local Government' APZ Dimension		The 'Required' APZ Dimensions [see note]
			Determined Radiant Heat Impact		Stated 'Indicative' or 'Conditional' BAL				Firebreak / Hazard Reduction Notice	Maximum Allowed	
	Area	Class			BAL-29	BAL-19	BAL-12.5	BAL-LOW			
BESS Cabinets and Associated Infrastructure	1	(A) Forest	10 kW/m2	60.4	27-<37	37-<50	50-<100	>100	6	N/A	60.4
	2	(B) Woodland		43.2	17-<25	25-<35	35-<100	>100			43.2
	3	(A) Forest		60.4	27-<37	37-<50	50-<100	>100			60.4
	4	(E) Mallee/Mulga		24.8	9-<13	13-<20	20-<100	>100			24.8
	5	(G) Grassland		25	9-<14	14-<20	20-<50	>50			25
Solar Arrays and HV Substation	1	(A) Forest	BAL-19		27-<37	37-<50	50-<100	>100			37
	2	(B) Woodland			17-<25	25-<35	35-<100	>100			25
	3	(A) Forest			27-<37	37-<50	50-<100	>100			37
	4	(E) Mallee/Mulga			9-<13	13-<20	20-<100	>100			13
	5	(G) Grassland			9-<14	14-<20	20-<50	>50			14

Note: The 'Required' APZ Dimension corresponding to each area of vegetation is the greater of the 'BAL Rating' or the 'Firebreak/Hazard Reduction Notice' APZ dimensions - unless a local government maximum distance(s) is established as a result of their environmental assessment of the subject site. The area of the APZ will also be limited to the subject lot boundary unless otherwise justified in this Report/Plan. Final determination of the dimensions will require that any indicative or conditional BAL becomes a 'Determined' BAL.

Comments: Assets identified within this report have specific APZ requirements. See Section.5.7.

B2: The Standards for the APZ as Established by the Guidelines (DPLH, v1.4)

Within the Guidelines (source: https://www.wa.gov.au/government/document-collections/state-planning-policy-37-planning-bushfire-prone-areas), the management Standards are established by:

- Schedule 1: Standards for Asset Protection Zones (see extract below) established by the Guidelines; and
- The associated explanatory notes (Guidelines E2) that address (a) managing an asset protection zone (APZ) to a low threat state (b) landscaping and design of an asset protection zone and (c) plant flammability.

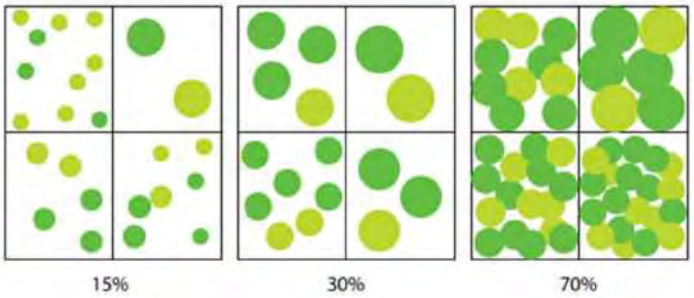


ELEMENT 2: SITING AND DESIGN OF DEVELOPMENT

SCHEDULE 1: STANDARDS FOR ASSET PROTECTION ZONES

OBJECT	REQUIREMENT
Fences within the APZ	• Should be constructed from non-combustible materials (for example, iron, brick, limestone, metal post and wire, or bushfire-resisting timber referenced in Appendix F of AS 3959).
Fine fuel load (Combustible, dead vegetation matter <6 millimetres in thickness)	• Should be managed and removed on a regular basis to maintain a low threat state. • Should be maintained at <2 tonnes per hectare (on average). • Mulches should be non-combustible such as stone, gravel or crushed mineral earth or wood mulch >6 millimetres in thickness.
Trees* (>6 metres in height)	• Trunks at maturity should be a minimum distance of six metres from all elevations of the building. • Branches at maturity should not touch or overhang a building or powerline. • Lower branches and loose bark should be removed to a height of two metres above the ground and/or surface vegetation. • Canopy cover within the APZ should be <15 per cent of the total APZ area. • Tree canopies at maturity should be at least five metres apart to avoid forming a continuous canopy. Stands of existing mature trees with interlocking canopies may be treated as an individual canopy provided that the total canopy cover within the APZ will not exceed 15 per cent and are not connected to the tree canopy outside the APZ.

Figure 19: Tree canopy cover – ranging from 15 to 70 per cent at maturity



Shrub* and scrub* (0.5 metres to six metres in height). Shrub and scrub >6 metres in height are to be treated as trees.	• Should not be located under trees or within three metres of buildings. • Should not be planted in clumps >5 square metres in area. • Clumps should be separated from each other and any exposed window or door by at least 10 metres.
Ground covers* (<0.5 metres in height. Ground covers >0.5 metres in height are to be treated as shrubs)	• Can be planted under trees but must be maintained to remove dead plant material, as prescribed in 'Fine fuel load' above. • Can be located within two metres of a structure, but three metres from windows or doors if >100 millimetres in height.
Grass	• Grass should be maintained at a height of 100 millimetres or less, at all times. • Wherever possible, perennial grasses should be used and well-hydrated with regular application of wetting agents and efficient irrigation.
Defendable space	• Within three metres of each wall or supporting post of a habitable building, the area is kept free from vegetation, but can include ground covers, grass and non-combustible mulches as prescribed above.
LP Gas Cylinders	• Should be located on the side of a building furthest from the likely direction of a bushfire or on the side of a building where surrounding classified vegetation is upslope, at least one metre from vulnerable parts of a building. • The pressure relief valve should point away from the house. • No flammable material within six metres from the front of the valve. • Must sit on a firm, level and non-combustible base and be secured to a solid structure.

** Plant flammability, landscaping design and maintenance should be considered – refer to explanatory notes*

B3: The Standards for the APZ as Established by the Local Government

Refer to the firebreak / hazard reduction notice issued annually (under s33 of the Bushfires Act 1954) by the relevant local government. It may state Standards that vary from those established by the Guidelines and that have been endorsed by the WAPC and DFES as per Section 4.5.3 of the Guidelines.

A copy of the applicable notice is not included here as they are subject to being reviewed and modified prior to issuing each year. Refer to ratepayers notices and/or the local government's website for the current version.

B4: Vegetation and Areas Excluded from Classification - Ensure Continued Exclusion

AS 3959:2018 establishes the methodology for determining a bushfire attack level (BAL). The methodology includes the classification of the subject site's surrounding vegetation according to their 'type' and the application of the corresponding relevant bushfire behaviour models to determine the BAL.

Certain vegetation can be considered as low threat or managed in a minimal fuel condition and can be excluded from classification. Where this has occurred in assessing the site, the extract from AS3959:2018 below states the requirements that must continue to exist for the vegetation on those areas of land to be excluded from classification (including the size of the vegetation area if relevant to the assessment).

2.2.3.2 *Exclusions—Low threat vegetation and non-vegetated areas*

The following vegetation shall be excluded from a BAL assessment:

(a) Vegetation of any type that is more than 100 m from the site.

(b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified vegetation.

(c) Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site, or each other or of other areas of vegetation being classified vegetation.

(d) Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified vegetation.

(e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.

(f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks.

NOTES:

1 Minimal fuel condition means there is insufficient fuel available to significantly increase the severity of the bushfire attack (recognizable as short-cropped grass for example, to a nominal height of 100 mm).

2 A windbreak is considered a single row of trees used as a screen or to reduce the effect of wind on the leeward side of the trees.

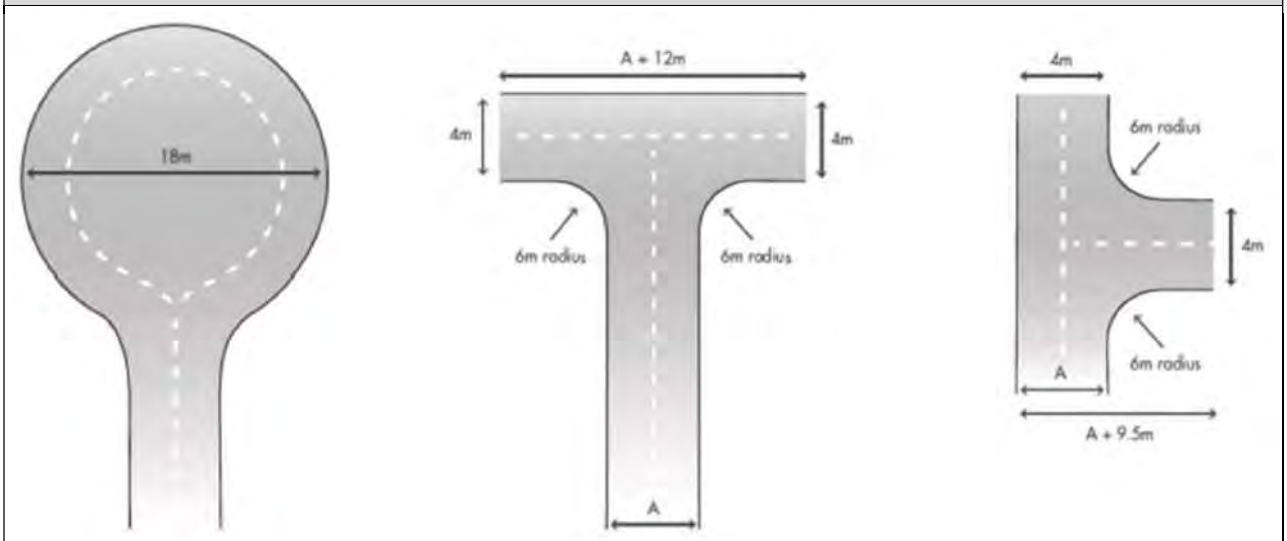
APPENDIX C: TECHNICAL REQUIREMENTS FOR VEHICULAR ACCESS

The design/layout requirements for access are established by the acceptable solutions of the Guidelines (DPLH, 2021 v1.4) Element 3 and vary dependent on the access component, the land use and the presence of 'vulnerable' persons. Consequently, the best reference source are the Guidelines. The technical requirements that are fixed for all components and uses are presented in this appendix.

GUIDELINES TABLE 6, EXPLANATORY NOTES E3.3 & E3.6 AND RELEVANT ACCEPTABLE SOLUTIONS

Technical Component	Vehicular Access Types / Components			
	Public Roads	Emergency Access Way [1]	Fire Service Access Route [1]	Battle-axe and Private Driveways [2]
Minimum trafficable surface (m)	In accordance with A3.1	6	6	4
Minimum Horizontal clearance (m)	N/A	6	6	6
Minimum Vertical clearance (m)	4.5			
Minimum weight capacity (t)	15			
Maximum Grade Unsealed Road [3]	As outlined in the IPWEA Subdivision Guidelines	1:10 (10%)		
Maximum Grade Sealed Road [3]		1:7 (14.3%)		
Maximum Average Grade Sealed Road		1:10 (10%)		
Minimum Inner Radius of Road Curves (m)		8.5		

Turnaround Area Dimensions for No-through Road, Battle-axe Legs and Private Driveways [4]



Passing Bay Requirements for Battle-axe leg and Private Driveway

When the access component length is greater than the stated maximum, passing bays are required every 200m with a minimum length of 20m and a minimum additional trafficable width of 2m (i.e. the combined trafficable width of the passing bay and constructed private driveway to be a minimum 6m).

Emergency Access Way – Additional Requirements

Provide a through connection to a public road, be no more than 500m in length, must be signposted and if gated, gates must be open the whole trafficable width and remain unlocked.

[1] To have crossfalls between 3 and 6%.

[2] Where driveways and battle-axe legs are not required to comply with the widths in A3.5 or A3.6, they are to comply with the Residential Design Codes and Development Control Policy 2.2 Residential Subdivision.

[3] Dips must have no more than a 1 in 8 (12.5% or 7.1 degree) entry and exit angle.

[4] The turnaround area should be within 30m of the main habitable building.

APPENDIX D: TECHNICAL REQUIREMENTS FOR FIREFIGHTING WATER SUPPLY

D1: Non-Reticulated Areas – Static Supply

For specified requirements, refer to the Guidelines Element 4: Water – Acceptable Solution A4.2 , Explanatory Notes E4 (that provide water supply establishment detail under the headings of water supply; independent water and power supply; strategic water supplies, alternative water sources and location of water tanks) and the technical requirements established by Schedule 2 (reproduced below).

SCHEDULE 2: WATER SUPPLY DEDICATED FOR BUSHFIRE FIREFIGHTING PURPOSES

2.1 Water supply requirements

Water dedicated for firefighting should be provided in accordance with Table 7 below, and be in addition to water required for drinking purposes.

Table 7: Water supply dedicated for bushfire firefighting purposes

PLANNING APPLICATION	NON-RETICULATED AREAS
Development application	10,000L per habitable building
Structure Plan / Subdivision: Creation of 1 additional lot	10,000L per lot
Structure Plan / Subdivision: Creation of 3 to 24 lots	10,000L tank per lot **or** 50,000L strategic water tank
Structure Plan / Subdivision: Creation of 25 lots or more	50,000L per 25 lots or part thereof Provided as a strategic water tank(s) or 10,000L tank per lot

2.2 Technical requirements

2.2.1 Construction and design

An above-ground tank and associated stand should be constructed of non-combustible material. The tank may need to comply with AS/NZS 3500.1:2018.

Below ground tanks should have a 200mm diameter access hole to allow tankers or emergency service vehicles to refill direct from the tank, with the outlet location clearly marked at the surface. The tank may need to comply with AS/NZS 3500.1:2018. An inspection opening may double as the access hole provided that the inspection opening meets the requirements of AS/NZS 3500.1:2018. If the tank is required under the BCA as part of fire hydrant installation, then the tank will also need to comply with AS 2419.

Where an outlet for an emergency service vehicle is provided, then an unobstructed, hardened ground surface is to be supplied within four metres of any water supply.

2.2.2 Pipes and fittings

All above-ground, exposed water supply pipes and fittings should be metal. Fittings should be located away from the source of bushfire attack and be in accordance with the applicable section below, unless otherwise specified by the local government.

2.2.2.1 Fittings for above-ground water tanks:

- Commercial land uses: 125mm Storz fitting; or
- Strategic water tanks: 50mm or 100mm (where applicable and adapters are available) male camlock coupling with full flow valve; or
- Standalone water tanks: 50mm male camlock coupling with full flow valve; or
- Combined water tanks: 50mm male camlock coupling with full flow valve or a domestic fitting, being a standard household tap that enables an occupant to access the water supply with domestic hoses or buckets for extinguishing minor fires.

2.2.2.2 Remote outlets

In certain circumstances, it may be beneficial to have the outlet located away from the water supply. In such instances in which a remote outlet is to be used, the applicant should consult the local government and DFES on their proposal.

EXAMPLE CONSTRUCTION AND FITTINGS	
	
Strategic 47,000 Litre Concrete Tank & Protected Fittings	
	
10,000 Litre Concrete Tank	Storz and Camlock Couplings
	
Full Flow 50mm Ball Valve	Full Flow 50mm Gate Valve and Male Camlock

ARP Australian Solar
Narrogin Solar

Bushfire Risk Report

Assessments of Risk Levels and Risk Management



52 Contine Road, Dumberning

Shire of Narrogin

19 September 2024

Job Reference No: 231010

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Limitations: The protection measures contained in this Bushfire Risk – Assessment and Management Report, are considered to be minimum requirements and they do not guarantee that buildings or infrastructure will not be damaged in a bushfire, persons injured, or fatalities occur either on the subject site or off the site while evacuating. This is substantially due to the unpredictable nature and behaviour of fire and fire weather conditions. Additionally, the correct implementation of the recommended protection measures will depend upon, among other things, the ongoing actions of the landowners and/or operators over which Bushfire Prone Planning has no control.

All surveys, forecasts, projections, and recommendations made in this report associated with the proposed development are made in good faith based on information available to Bushfire Prone Planning at the time. All maps included herein are indicative in nature and are not to be used for accurate calculations.

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1 REPORT USE GUIDANCE - FOR MANAGERS & DECISION MAKERS

LOCATION OF KEY INFORMATION	
The applied risk assessment process as pre-requisite reading to assist with understanding the assessments and the presentation of the results.	Section 2 and Appendices 1 & 2
The assessed bushfire risk levels and the relative contribution of each primary factor contributing to that risk.	Section 3
The BAL contour map illustrating the Bushfire Attack Levels (BAL's) impacting the site.	Section 4.3.1
The mandatory bushfire risk management actions to be addressed (current and future).	N/A
The recommended additional bushfire protection measures and their implementation priority rating.	Section 4.2.1
Identified additional issues and advice provided for consideration by management.	Section 4.2.2

SECTION 5 - THE ASSESSMENT OF BUSHFIRE RISK

For the Narrogin Solar development, the risk assessment derives defined levels of risk associated with a bushfire event within the immediate and broader surrounding landscape, to the identified elements at risk (i.e., relevant classes of persons and property).

The adopted assessment approach applies a methodology that considers bushfire risk levels to be determined due to the interaction of three factors:

1. The bushfire hazard (which presents varying threats and threat levels);
2. The levels of exposure of each element at risk to those threats; and
3. The levels of vulnerability of each element at risk to those threats.

The assessment considers both the current level of risk (inherent), and the potential level of risk (residual) should proactive management be able to implement the recommended additional bushfire protection measures.

The assessment is largely qualitative in nature but incorporates quantitative processes and information when relevant and available. This results in the derivation of 'indicative' bushfire risk levels.

The assessment is conducted by a bushfire planning consultant with practical bushfire event management experience and relevant accreditation. An important objective is to present understandable and practical protection measures that can be justifiably applied by management.

SECTION 6 - THE ASSESSMENT OF BUSHFIRE RISK MANAGEMENT

Assessments are conducted that consider how well two defined pathways for implementing both the required and any additionally recommended bushfire protection measures, are being applied. Guidance for best practice application of these measures is provided. The two pathways are:

1. The application of 'informative' risk management mechanisms which include:
    a. The organised application and maintenance of all applicable bushfire protection measures through a range of operational documents, as relevant to a site and its use; and
    b. The development and application of advice to inform management's planning of future modifications and/or development of a site and its use. This is necessary where bushfire risk mitigation measures are necessary inputs to design and construction.
2. The application of 'regulatory' risk management mechanisms that are to be complied with. These include operating and construction regulations and standards, and relevant planning authority guidelines/standards.

*****

2 INTRODUCTION

2.1 THE ASSESSED ASSET AND ITS USE

The Narrogin Solar Farm is proposed to be established across multiple Lots in the localities of Dumberning and Highbury. The development will be approximately 3.7km south of the Narrogin townsite at its nearest point.

The BESS development will be approximately 12,800m2, and the solar farm footprint will be approximately 410 ha. The following Lots are included within the development area:

- Lot 21 on Plan 400863
- Lot 22 on Plan 400863
- Lot 27 on Plan 404102
- Lot 29 on Plan 404102
- Lot 1195 on Plan 104528
- Lot 1976 on Plan 107706
- Lot 3014 on Plan 109497
- Lot 3017 on Plan 109498
- Lot 3015 on Plan 109499
- Lot 2921 on Plan 109500
- Lot 2922 on Plan 109501
- Lot 3071 on Plan 111382
- Lot 3037 on Plan 111403
- Lot 6349 on Plan 121779
- Lot 7207 on Plan 126403
- Lot 7067 on Plan 126439
- Lot 1 on Diagram 31647

The proposal includes:

- Solar arrays and associated power conversion units and inverters distributed throughout the subject lots;
- A centralised battery energy storage system with neighbouring substation straddling Lots 1195 and 1976 at the northern extent of the development;
- Associated HV transmission lines.

The site is intended to be unstaffed but will likely include regular visitation for inspection/maintenance due to the scale of the development. A site assessment was conducted on the 15th January 2024.

2.2 ESTABLISHING THE REPORT OBJECTIVES

The applied risk assessment process (refer to s2.3 and Appendix 1), and the methodology used to inform the management of risk (refer to s2.4), provide a flexible platform for producing the required evaluations and reporting.

It can account for all types of development and use and be constructed to deliver the required management and decision making information.

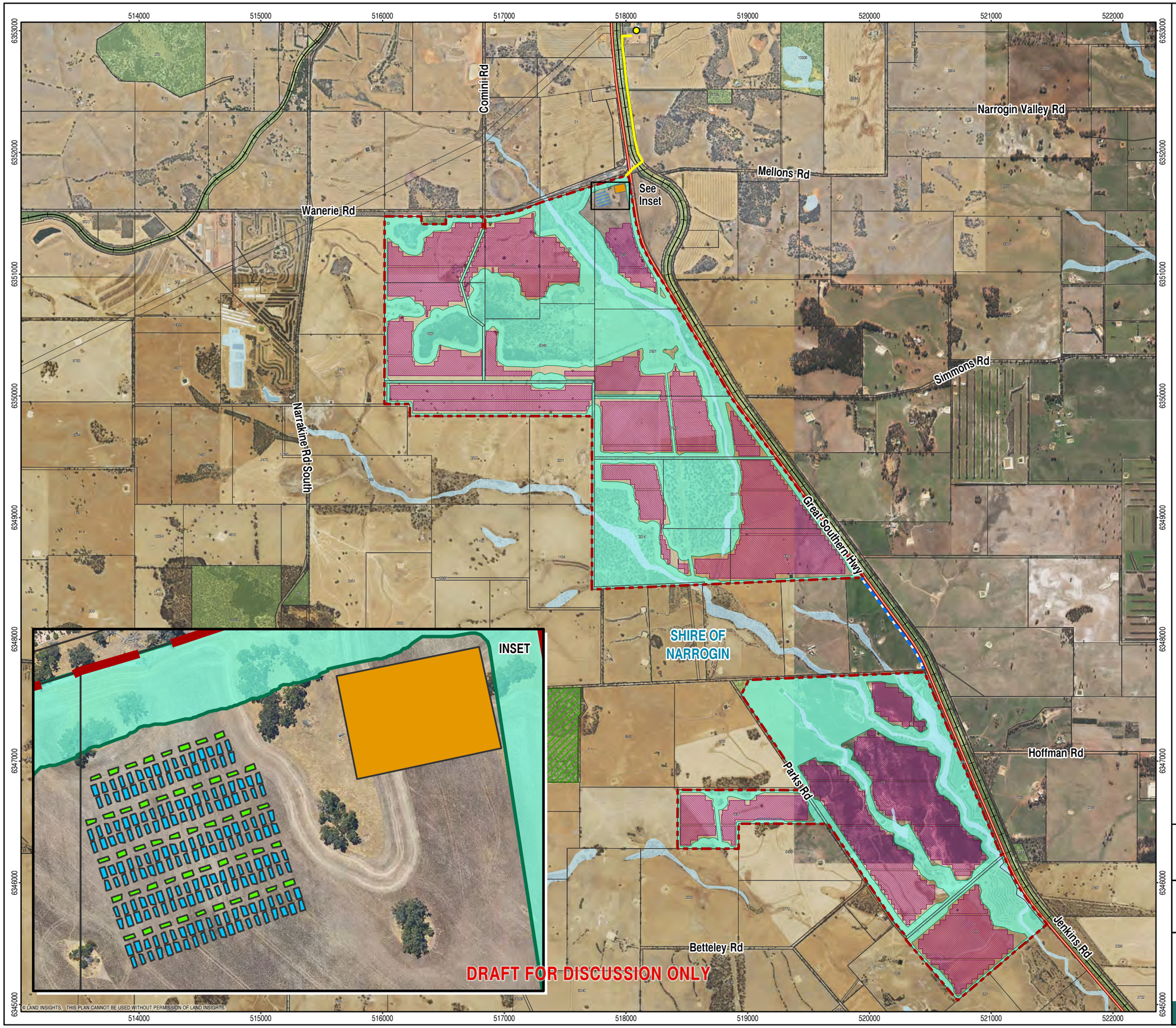
Consequently, to ensure the required information outcomes are met, the specific objectives for the subject site need to be identified to guide the report development.

These objectives are established in the checklist on the following page.

CHECKLIST ESTABLISHING THE REPORT OBJECTIVES TO BE MET FOR THE SUBJECT SITE					
AVAILABLE OBJECTIVES			THE OBJECTIVES TO BE MET	THE OBJECTIVES TO BE MET ARE ESTABLISHED BY	
				The Owner and/or Operator of Subject Site in Discussion with the Bushfire Consultant	The 'Planning' Bushfire Management Plan Being Concurrently Produced
RISK ASSESSMENT					
Hazard	Identify all bushfire hazards with potential to impact the subject site.		✓		✓
Risk Levels	Assess inherent bushfire risk levels, for each identified element at risk, by accounting for existing and/or planned implementation of bushfire protection measures, along with all other interacting factors.		✓	✓	
	Assess residual bushfire risk levels, for each identified element at risk, by additionally accounting for implementation of recommended bushfire protection measures, along with all other interacting factors.		✓	✓	
RISK MANAGEMENT					
Compliance	Assess current compliance and/or future compliance capability against the 'mandatory' bushfire risk management mechanisms. Note for operating standards, assessment is restricted to the requirements that have direct relevance to a bushfire event. These can include: • Separation from bushfire prone vegetation (APZ/firebreaks); • Access/egress for firefighting services/site occupants, including firebreaks; and • Firefighting water supply & delivery for structure and surrounds fire, not the bushfire.	Planning Guidelines/Standards - for development & uses on bushfire prone land	✓		✓
		Operating Standards / Regulations	✓	✓	
		Construction Standards - for buildings in bushfire areas	✓	✓	✓
Recommendations	Recommend additional bushfire protection measures to be implemented and their priority.		✓	✓	
	Identify the relevant planning and/or site operations documents in which the recommended bushfire protection measures should be included.		✓	✓	
Advice	Provide specific advice to inform planning for design and construction.		✓		✓
	Provide general advice that identifies issues for management to consider.		✓	✓	

OBJECTIVE VARIATIONS TO BE APPLIED: Planning advice regarding bushfire risks to/from large-scale battery facilities is not available in Western Australia. The most comprehensive and stringent guidance globally is provided in the *Guidelines and Model Requirements – Renewable Energy Facilities* v4 (Victorian Country Fire Authority August 2023).

Risk assessments are tenure-blind, and thus the capacity of the proposal to align with the CFA Guidelines has been assessed. The recommendations within the CFA Guidelines are integrated into the appropriate protection measures within the relevant section of this Report, as this allows a single 'package' of protection measures to be provided.



- Narrogin South Substation
- Substation Easement
- Project Connection Easement
- Project Boundary
- Solar Footprint
- Restricted Area
- Substation Area
- Battery Container (BESS Layout)
- Inverter (BESS Layout)
- State road
- Rail
- Cadastre
- DBCA - Legislated Lands and Waters (DBCA-011)
- Reserves
- Wheatbelt wetlands

0 250 500 750 1,000 1,250 1,500

Metres

1:30,000 @ A3

NOTE: AREAS AND DISTANCES SUBJECT TO SURVEY

Project: 1121
Projection: GDA 1994 MGA Zone 50
Date Exported: 25/07/2024 10:14 AM
Layout Name: ARP 1121-004-06-02 Narrogin Solar Farm BESS Layout

landinsights
PLANNING DESIGN ENVIRONMENT
PO Box 289 Mt Lawley WA 6929
Ph: 9271 8506
admin@landinsights.com.au
landinsights.com.au

BESS Layout
PROPOSED SOLAR ENERGY FACILITY
NARROGIN
ARP Australian Solar

Path: C:\Users\ShirleyMcIntyre\OneDrive - Land Insights\Drafting Jobs\1121 ARP - Narrogin Solar Mapping\Map\1121 NarroginSolar.aprx

2.3 BUSHFIRE RISK AND THE APPLIED ASSESSMENT PROCESS

THE RELEVANT RISKS

For this Bushfire Risk Report, the relevant risk is the potential for loss of life, injury, or destroyed or damaged assets which results in personal loss and economic loss due to disruption of services and/or repair or replacement of buildings and infrastructure. The source of the risk is a potential bushfire event as a natural hazard.

THE APPLIED RISK ASSESSMENT PROCESS

Bushfire Prone Planning (BPP) has adapted the concept for 'Understanding Disaster Risk' as recognised by the United Nations Office for Disaster Risk Reduction [46].

In applying this concept, bushfire risk can be considered a consequence of the interaction of bushfire hazard threats and the exposure and vulnerability of the elements at risk from those threats (i.e., the 'exposed elements' which can include various classes of persons and/or property).

The level of risk associated with bushfire will be reduced by applying bushfire protection measures that:

- Reduce the number and/or level of hazard threats; and/or
- Reduce the level of exposure and/or vulnerability of the elements at risk.

The risk assessment process framework is shown in Figure 2.2 and additional detail is presented in Appendix 1.

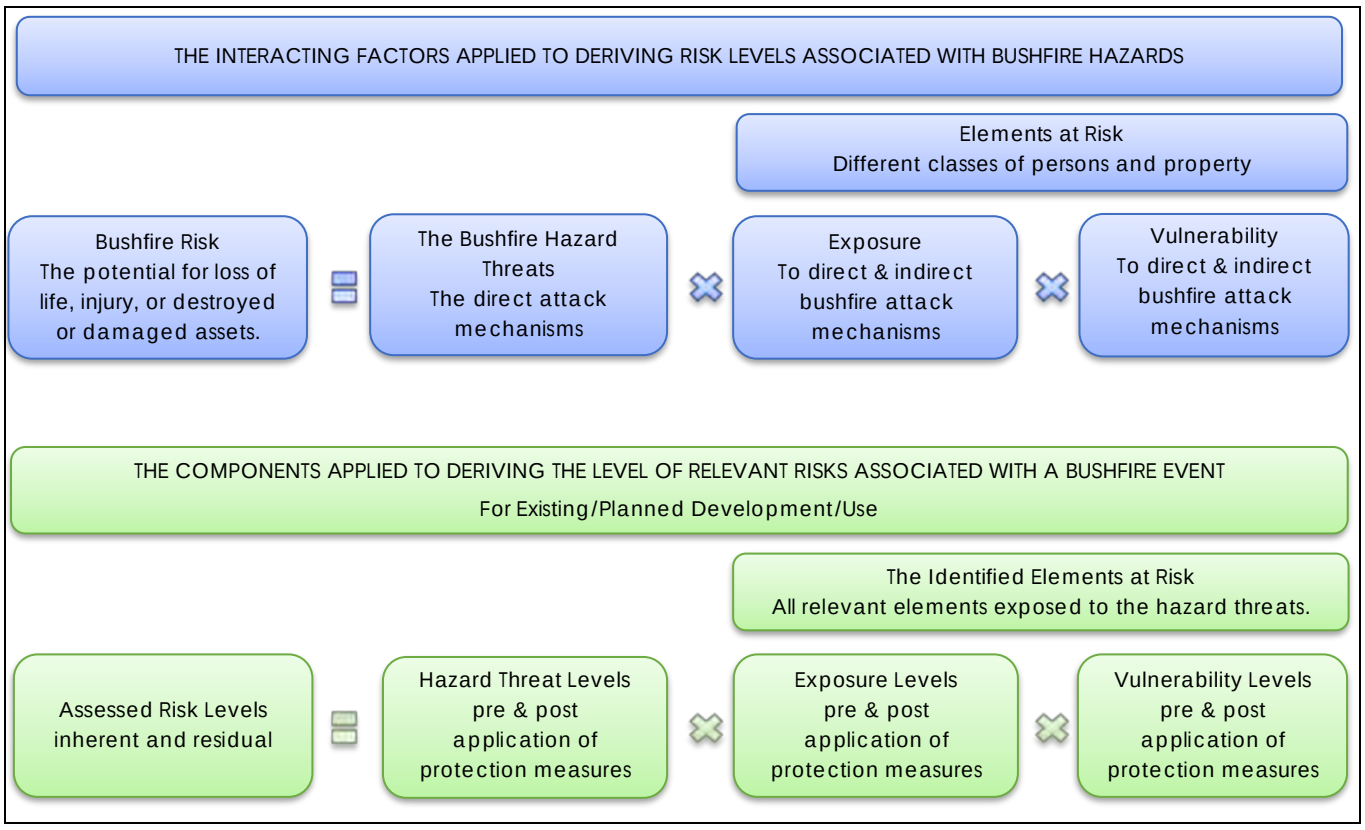
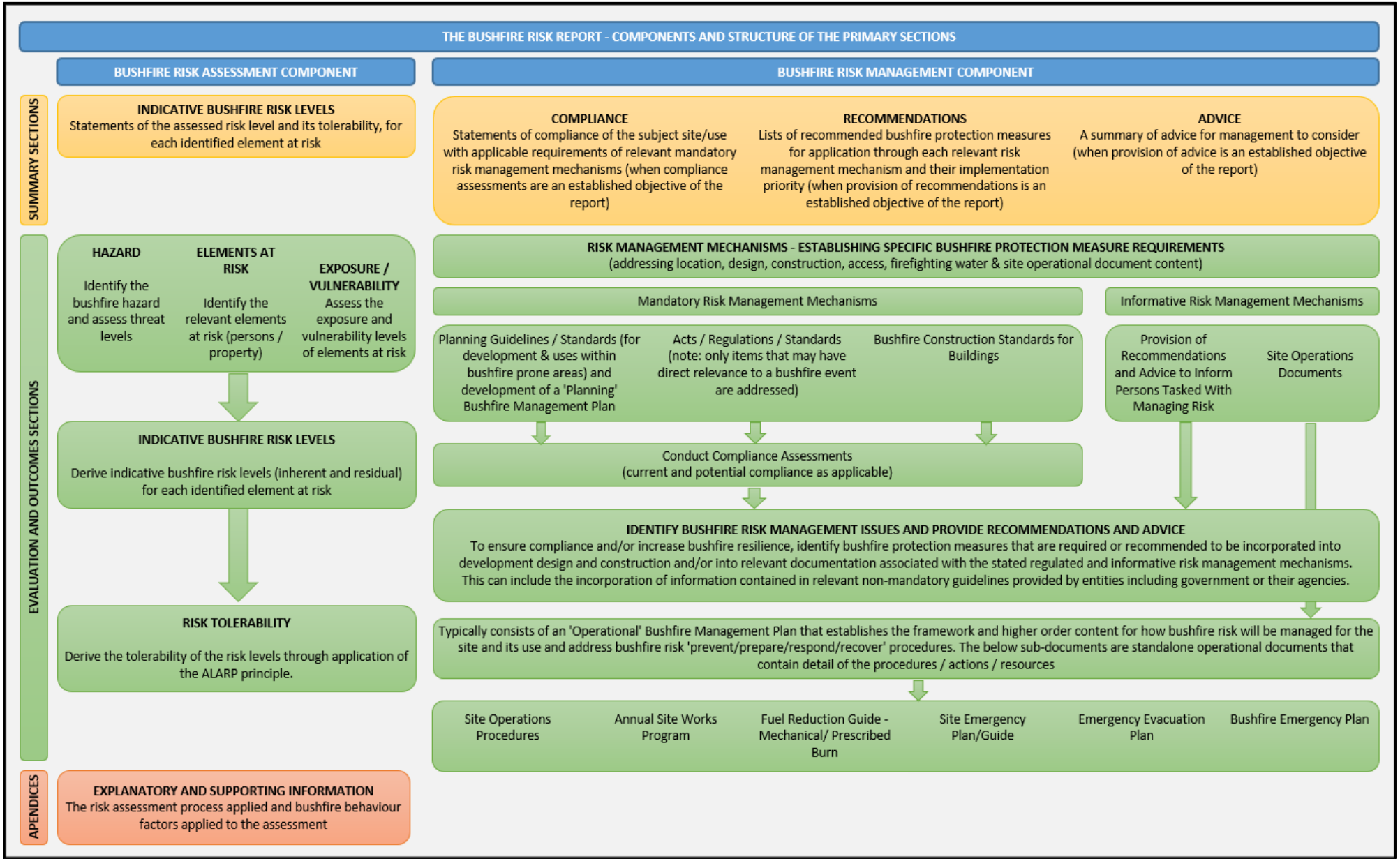


Figure 2.2: The framework of the applied bushfire risk assessment process.

2.4 REPORT STRUCTURE OVERVIEW



3 SUMMARY: BUSHFIRE RISK ASSESSMENT

The Summary: Presents the outcomes of the risk assessment process conducted for the subject site and use which is presented in Section 5.

The Worst Case: For each identified element at risk, the worst assessed risk level is stated, along with its tolerability. This will correspond to the worst levels of bushfire hazard threats, and exposure and vulnerability of the element to those threats. Refer to Section 3.2. for the relative contributions of each component that has been assessed as the primary drivers of the level of risk associated with a bushfire event.

Indicative Risk versus Determined Risk: When the assessed bushfire risk levels are stated as 'indicative', rather than 'determined', as they have been derived through the application of a largely qualitative assessment process that applies quantitative information when it exists exist. Refer to Appendix A1.3 for explanatory and supporting information.

Appendix 1: Explains the bushfire risk level analysis, the risk tolerance methodologies applied, and the terminology used.

3.1 THE ASSESSED BUSHFIRE RISK LEVELS (INDICATIVE) AND THEIR TOLERABILITY

THE ASSESSED BUSHFIRE RISK LEVEL AND ITS TOLERABILITY					
ASSESSED ELEMENTS AT RISK [1]	LEVEL OF RISKS ASSOCIATED WITH A BUSHFIRE EVENT [2]		TOLERABILITY OF THE BUSHFIRE RISK LEVEL (ALARP) [3]		
	Inherent Risk	Residual Risk	Inherent Risk Tolerability	Residual Risk Tolerability	Adjusted Residual Risk Tolerability
Persons Onsite and Temporarily Offsite	L5	L4	Acceptable BUT NOT ALARP	Acceptable	N/A
Persons on Access/Egress Routes in Vehicles	M8	M7	Tolerable but NOT ALARP	Acceptable as IS ALARP	Acceptable
Buildings/Structures - NCC Classes 1-10	M8	L6	Tolerable but NOT ALARP	Acceptable	N/A
BESS Cabinets and Associated Infrastructure.	M7	L4	Tolerable but NOT ALARP	Acceptable	N/A
Solar Arrays and Associated Infrastructure.	M7	L5	Tolerable but NOT ALARP	Acceptable	N/A
HV Substation and Transmission Lines.	M8	L5	Tolerable but NOT ALARP	Acceptable	N/A

Note 1: Refer to Section 5.2.

Note 2: Refer to Appendices A1.1 and A1.3.3 and the Glossary for explanatory and supporting information. The Bushfire Risk Level is not the risk of a bushfire event occurring. The relevant risks are those associated with a bushfire event and to which the assessed elements at risk are potentially subjected.

Inherent risk accounts for the risk reducing impact of bushfire protection measures already or planned to be implemented. Residual risk additionally accounts for any protection measures recommended for implementation by the bushfire consultant.

Note 3: Refer to Appendix A1.3.6 for explanatory and supporting information and adjustment justification when applicable.

3.2 THE DERIVATION OF THE BUSHFIRE RISK LEVELS (SUMMARISED)

BUSHFIRE HAZARD THREAT LEVEL AND EXPOSURE AND VULNERABILITY LEVELS OF ELEMENTS AT RISK						
ASSESSED ELEMENTS AT RISK [2]	THE INTERACTING FACTORS FROM WHICH THE BUSHFIRE RISK LEVEL IS DERIVED [1]					
	ASSESSED INHERENT LEVELS [3]			ASSESSED RESIDUAL LEVELS [3]		
	Bushfire Hazard Threat [Section 5.1]	Exposure of Element at Risk [Section 5.3]	Vulnerability of Element at Risk [Section 5.4]	Bushfire Hazard Threat [Section 5.1]	Exposure of Element at Risk [Section 5.3]	Vulnerability of Element at Risk [Section 5.4]
Persons Onsite and Temporarily Offsite	Moderate	Low	Low	Moderate	Low	Very Low
Persons on Access/Egress Routes in Vehicles		High	Moderate		High	Low
Buildings/Structures - NCC Classes 1-10		Moderate	High		Low	Moderate
BESS Cabinets and Associated Infrastructure.		Moderate	Moderate		Very Low	Low
Solar Arrays and Associated Infrastructure.		Moderate	Moderate		Low	Low
HV Substation and Transmission Lines.		High	Moderate		Low	Low

Note 1: Refer to Appendix 1 and Appendix 2 for explanatory and supporting information.

Note 2: Refer to Section 5.2.

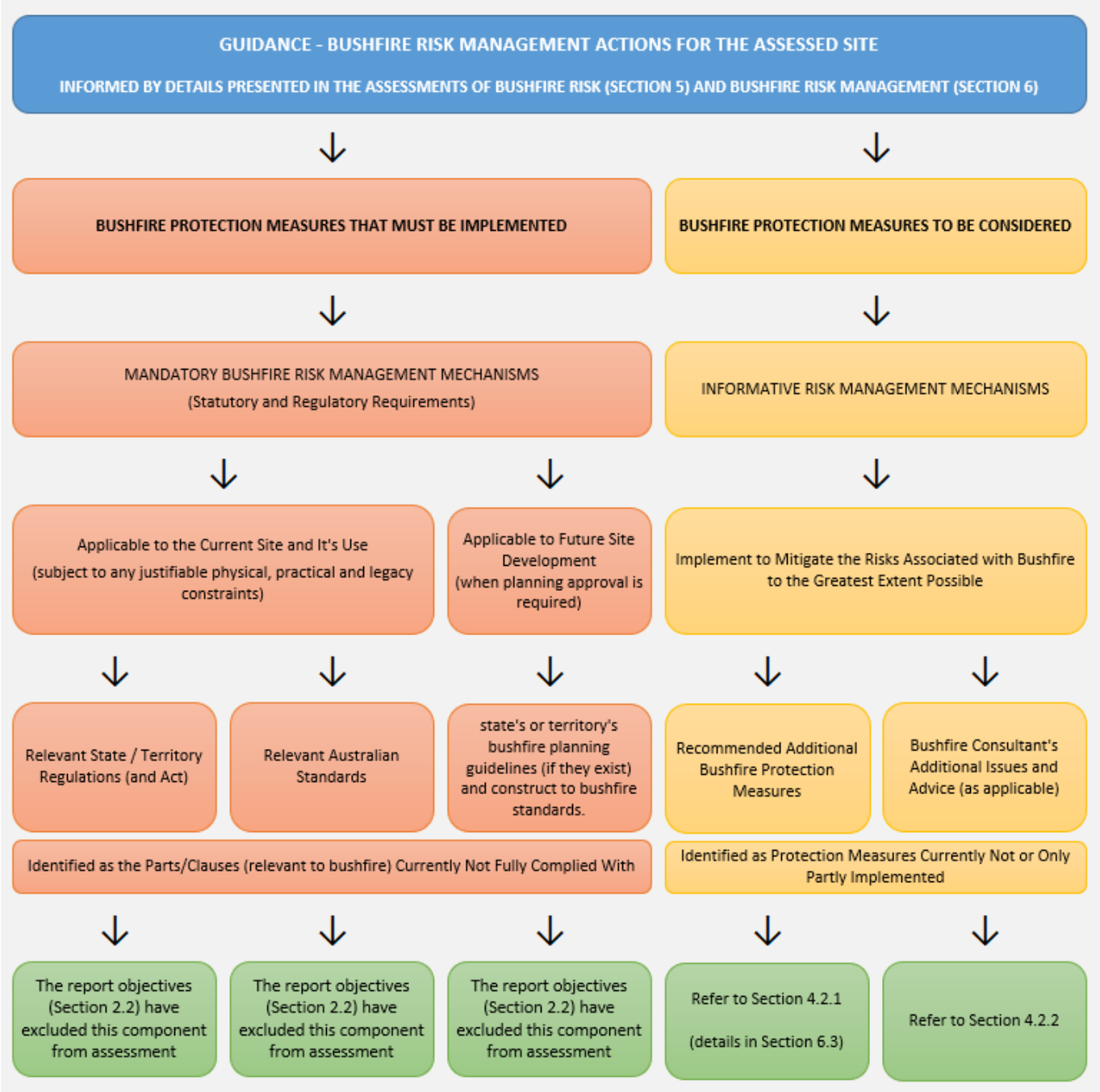
Note 3: Refer to Appendix A1.3.3. Inherent levels account for the threat/exposure/vulnerability reducing impact of applying existing and planned bushfire protection measures. Residual levels additionally account for any protection measures recommended by the bushfire consultant.

4 SUMMARY: BUSHFIRE RISK MANAGEMENT

4.1 MANAGEMENT ACTIONS TO BE ADDRESSED

The following diagram identifies:

1. The components associated with the mandatory and informative risk management mechanisms; and
2. The location within this summary that presents their corresponding bushfire protection measures as:
    a) Those currently not fully implemented that must be implemented; and
    b) Those that are recommended to be implemented.



4.2 INFORMATIVE MECHANISMS – RECOMMENDED ACTIONS

4.2.1 ADDITIONAL BUSHFIRE PROTECTION MEASURES - RECOMMENDED BY THE BUSHFIRE CONSULTANT

4.2.1.1 THREAT REDUCING MEASURES - BUSHFIRE HAZARD

BUSHFIRE HAZARD THREAT REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
Prevent bushfire ignition by managing heat energy sources	1.9	Robust and effective site operational procedures	Contact Narrogin VFRS and Narrogin and Minigin BFB prior to commissioning and offer a familiarisation visit and explanation of emergency procedures, access, hazards, and fire detection and suppression systems. Contact DFES Built Environment Branch to determine if an Emergency Response Guide (FES-ERG) is required. A comprehensive Emergency Management Plan is to be prepared for the facility. This is to outline Prevention, Preparedness, Response, and Recovery (PPRR) procedures for potential emergencies, of which bushfire is one component. The following details have been identified for inclusion within the Emergency Management Plan (and/or the Site Operating Procedures, as appropriate to the document structure): Details and Information • A summary of fire hazards and risks to and from the site, specific to its location, infrastructure, activities and occupancy. • A facility description, including infrastructure details, operations, number of personnel, and operating hours. • A site plan depicting structures/built assets, operational areas, site access points and internal roads, firefighting infrastructure, drainage (as applicable), and neighbouring properties. • Up-to-date contact details for facility personnel, including for at least two persons who may be able to provide information or support during emergencies (24 hours a day). Update contact information when necessary. • Details of emergency resources, including fire detection and suppression systems and equipment; gas detection; emergency eye-wash and shower facilities; spill containment systems and	High

BUSHFIRE HAZARD THREAT REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
			equipment; emergency warning systems; communication systems; personal protective equipment; first aid. • Contact information for 24/7/365 specialist technical support for the battery energy storage system. • Specifications for safe operating conditions for temperature. • Schematics and technical data for battery energy storage system containers/enclosures, the number of containers/enclosures on-site, and the number of battery racks or modules within each container/enclosure. • Details of the hazards for the battery energy storage system, including thermal events/runaway, electrical safety hazards, explosion hazards, dangerous goods hazards (including off-gassing), and the effects of fire on the battery energy storage system (eg., explosion, release of toxic gases). • Details of all provided battery failure/safety and protective systems, including a description, the activation process/automatic trigger, and any hazards associated with these systems. **Procedures** Prevention • Smoking restrictions or designated smoking locations. • Procedures regarding vegetation management and accidental ignition prevention. • The specifications of Schedule 1 of the Guidelines for Planning in Bushfire Prone Areas and the Shire of Narrogin Firebreak Notice can be achieved via livestock grazing. The vegetation must continue to be monitored for compliance with Schedule 1, and additional vegetation management works undertaken as required. • Heavy equipment is not to be operated where long grass (>100mm) or heavy leaf litter is present, particularly during the bushfire season (see the Local Government Prohibited Burning Period). • Servicing of battery energy storage systems should not take place on days of High, Extreme or Catastrophic Fire Danger Rating, except where the system is experiencing malfunction or abnormal behaviour.	

BUSHFIRE HAZARD THREAT REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
			The following procedures should be completed prior to the bushfire season (see the Local Government Prohibited Burning Period): • Scheduled maintenance to assets, emergency equipment, or fire detection/prevention systems. • The ongoing requirements outlined in the Bushfire Management Plan. • Scheduled housekeeping inspections including: o Hazard identification - ensuring that infrastructure, plant, equipment, vehicles and safety/warning signs show no signs of damage or dilapidation. o Facility access - ensuring all vehicle site access points, including emergency access points, are clear and accessible. o Fire protection systems and equipment – ensuring that all equipment is unobstructed, clearly identifiable, in-service and performing optimally. o Vegetation management - ensuring that any accumulation of combustible materials is cleared from infrastructure, buildings and fire breaks, and removed from the site. o Security measures - ensuring that fences, gates, and security cameras are inspected for damage, and that any damage is immediately actioned (e.g., repaired or replaced). Preparedness • Evacuation and shelter-in-place triggers and procedures, unless included within a Bushfire Emergency Plan. • Procedures for review of the Emergency Management Plan, including the ongoing effectiveness of control measures. • An ongoing schedule of site familiarisation for Narrogin VFRS and Narrogin and Minigin BFB to account for changing personnel, facility infrastructure and hazards. • The Emergency Management Plan and any Emergency Response Guide (FES-ERG) should contain procedures for isolation, shut-down, fail safe or management of critical/high-risk plant, equipment, and utilities, and their advised triggers. • Visitors must provide mobile phone numbers to site management. Within the Emergency Management Plan, a key response will be to contact and advise all persons onsite.	

BUSHFIRE HAZARD THREAT REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
			• A bushfire monitoring procedure for the Restricted/Prohibited Burning Period (see Shire of Narrogin Firebreak Notice), including: o Nominating a person/role in your Emergency Control Organisation to be responsible for identifying, responding to, and communicating Fire Danger Ratings in advance. o Identifying bushfire activity within 10km of the facility. o Communicating this information to everyone likely to be present on-site, and relevant off-site personnel. o An outline of site activities to be modified or cease as a response (if any). Response DFES Comcen should immediately be notified of: • Any shorts, faults, temperature increases above normal parameters (eg. precursor to thermal events/runaway). • Equipment failures with the potential to ignite or propagate fire. • Off-gassing, smoke or fire. • The monitoring personnel can determine if Emergency Services response is necessary. The notification is for awareness. Bushfire emergency response procedures must include: • A specific action to notify (or verify notification) the emergency services, at the earliest possible stage of the emergency. • The person or role responsible for making or verifying the notification. • The '000' number in the procedure. • Communicating with site personnel and supporting their physical relocation. • Ensuring all buildings and plant are adequately secured. • Initiating any bushfire protection measures such as sprinkler or deluge systems, or pre-emptive shut-down, prior to the arrival of the fire front.	

BUSHFIRE HAZARD THREAT REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
			• Liaising with the emergency services where possible. Consider the following criteria for inclusion within the Emergency Management Plan. All criteria are for consideration only, being non-bushfire measures identified within The Design Guidelines and Model Requirements – Renewable Energy Facilities (CFA August 2023). • Emergency procedures based on identified risks and hazards of the battery energy storage system and related infrastructure, including but not limited to: i. Electrical infrastructure faults and fire. ii. Battery energy storage system damage or faults, including battery monitoring faults, temperature increases above normal operating parameters, electrical faults, chemical spills or reactions, off-gassing, thermal events/runaway, smoke and fire. iii. The management of fire water runoff. • A plan for partial and full decommissioning of the battery energy storage system in the event of an emergency incident that renders the facility inoperable or unsafe, prior to its anticipated end-of-life. • The shut down and/or isolation procedures if the batteries are involved in fire, and appropriate personnel contact details for verifying that the battery enclosure/container system has been isolated/shut-down and de-energised during emergencies.	

[1] The full description of each bushfire protection measure and the detail of the assessment is presented in Section 5.1.4.

[2] Refer to Appendix A1.3.5 for implementation priority rating explanation.

4.2.1.2 EXPOSURE REDUCING MEASURES - PERSONS

PERSONS EXPOSURE REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
Establish sufficient separation from relevant bushfire hazard threats	Persons Located Onsite and Temporarily Offsite			
	2.5	Relocate to safer onsite open area	Emergency muster points should be reasonably adjacent to large solar panel banks (>200m wide), as the central portion of the larger banks are subject to <2kW/m2 radiant heat flux. These areas are suitable for emergency onsite shelter during a bushfire event, where evacuation is no longer safe.	Lowest

[1] The full description of each bushfire protection measure and the detail of the assessment is presented in Section 5.3.1 and Section 5.3.2.

[2] Refer to Appendix A1.2.5 for implementation priority rating explanation.

4.2.1.3 EXPOSURE REDUCING MEASURES – ALL STRUCTURES

ALL STRUCTURES EXPOSURE REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
Establish sufficient separation from relevant bushfire hazard threats	4.3 6.3 7.3 8.3	Landscaping - asset protection zone (APZ)	<u>Class 1-10 Buildings</u> If the building type/design is not required to or cannot construct to AS 3959, they should be sited to ensure radiant heat flux exposure does not exceed 10kW/m2 radiant heat flux. Any future Class 1-10 buildings should be sited within previously cleared, managed areas to reduce the requirement for ongoing management. <u>BESS</u> The APZ for BESS cabinets and associated infrastructure will ensure exposure to the bushfire hazard threat of radiant heat will be limited to a maximum radiant heat flux of 10 kW/m2 (calculated with an assumed flame temperature of 1090K) by providing the required separation distances from the bushfire hazard. The 10m portion of the APZ immediately around the BESS cabinets must be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc). BESS cabinets are recommended to be sited on concrete slabs or other sealed, non-combustible surface. <u>Solar Panels</u> A 10kW/m2 APZ should be applied where possible to ensure cabling is not exposed to its critical threshold. BAL-19 has been adopted as site constraints limit the installation of a 10kW/m2 APZ. It must be therefore recognised that exposed cabling (not shielded or buried underground) positioned within 10kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement, and PV panels will not ignite but may suffer damage. <u>Substation</u> A BAL-19 APZ is required for the HV substation. Exposed cabling (not shielded or buried underground) positioned within 12kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement. The substation footprint should be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc).	Highest
	6.4 7.4	Landscaping - tree location	Any future Landscape Management Plan should be reviewed by the Bushfire Consultant to provide additional advice on vegetation location, demographics, and structure.	Medium

ALL STRUCTURES EXPOSURE REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
	4.7 6.7 7.7	Separation from stored and constructed combustible items (consequential fire fuels)	All non-structural combustible materials are to be removed within 10m of assets. This includes but is not limited to; waste, leaf litter, machinery, grasses, vehicles, fuel, furniture, and timber. When storage of flammable items or materials are stored on site temporarily (for maintenance etc), separation distances must be complied with. This requirement is to be included in the Site Operating Procedures document. The Intensium Shift datasheet provides minimum clearances between BESS cabinets and other features. A >1hour intervention period should be assumed for determining the appropriate setbacks, as the proposed site is within a regional area. Where the manufacturer specification does not specify a distance between BESS cabinets and other structures, Class 1-10 buildings and solar arrays should be sited a minimum of 15m from BESS cabinets.	High
Establish shielding from relevant bushfire hazard threats	4.12 6.12 7.12 8.12	Shield operation critical non-structural elements	Cabling and plumbing subject to >10kW/m2 (not within the <10kW/m2 setback), or beyond footprint of buildings or constructed assets, are recommended to be installed underground, or shielded with non-combustible material (or enclosed) where practical.	High

[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Sections 5.3.3 & 5.3.4 & 5.3.5 & 5.3.6.

[2] Refer to Appendix A1.3.5 for implementation priority rating explanation.

4.2.1.4 VULNERABILITY REDUCING MEASURES - PERSONS

PERSONS VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
Lower risk road construction (design and materials)	Persons on Access / Egress Routes in Vehicles			
	10.1	Greater road width	Internal access roads should be constructed to be 6m wide to ensure unrestricted two-way traffic.	Medium
	10.7	Interconnected road network to provide route options	At the detailed design stage, the internal access network should be reviewed by the Bushfire Consultant to provide additional advice. Access points are likely to be gated but should be openable in the same manner (the same key, keycard, access code, remote etc). Access points are to comply, at a minimum, with the specifications for Private Driveways within Table 6 of the *Guidelines for Planning in Bushfire Prone Areas v1.4.*	Medium

[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Section 5.4.1 and Section 5.4.2.

[2] Refer to Appendix A1.2.5 for implementation priority rating explanation.

4.2.1.5 VULNERABILITY REDUCING MEASURES – ALL STRUCTURES

ALL STRUCTURES VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
Construction design and materials	11.1	Construct to AS 3959:2018	Any proposed or future Class 1-9 buildings should be constructed to their assessed BAL to a minimum of BAL-12.5 under AS3959 to reduce the vulnerability to ember attack, even if subject to BAL-LOW. This does not apply to Class 10 buildings which cannot comply with AS3959.	Medium
	11.3 13.3 14.3 15.3	Construction materials for external and internal cavity building elements	Class 1-10 Buildings For any future Class 1-10 buildings, include non-combustible structural elements where practical. In particular, avoid: polycarbonate (sheeting and skylights), softwoods (<650 kg/m3 density at 12% moisture content), and fibrous materials. BESS Review compliance against NFPA 855 - Standard for the Installation of Stationary Energy Storage Systems (2023) noting that as a North American planning standard, all requirements may not be applicable. The Intensium Shift datasheet includes an ambient temperature range of -20°C to +45C, with an option for +55°C. The 55°C option should be investigated to account for high ambient temperature combining with heat generated from bushfire.	Medium
	11.4 13.4 14.4 15.4	Construction materials for consequential fire fuels	It is recommended non-combustible elements are used for structural and supporting/associated constructions wherever practical. This includes sheds, lean-tos, verandas, shade screening, lattice, garden edging, fencing etc.	Medium
	13.8 14.8 15.8	Minimise re-entrant detail to minimise debris and ember accumulation	Where electrical cabling, or gas or liquid piping, contacts the ground or any arrangement of associated structures creates a 'pocket' for accumulation of debris, this should be rectified by design or filling with non-combustible material such as mineral earth. Consideration should be given to making the arrangement self-cleaning through wind action to the greatest extent possible. These measures will reduce accumulation and/or make the management (clearing) of accumulated debris easier. E.g. cable raking to be 100mm above ground.	Lowest

ALL STRUCTURES VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
	11.11 13.11 15.11	Minimise construction cavities to minimise debris and ember accumulation	Any subfloor cavities must have exposed subfloor spaces enclosed, sealed with non-combustible material, or be ember screened. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium.	Lowest
	11.12	Minimise external openings to limit flame / radiant heat / ember / debris entry	The detailed design of any Class 1-10 Buildings should be reviewed to ensure it is possible for them to be fully enclosed.	Lowest
	11.13 13.13 15.13	Screen and seal gaps and penetrations	<u>Class 1-10 Buildings</u> Any Class 1-10 buildings (including non-habitable structures) must have ember screening/sealants installed on any gaps, penetrations, and external glazed elements. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium. <u>BESS</u> The manufacturer or appropriate engineers should be contacted to enquire if it is possible to apply ember screening to intake/exhaust/air conditioning vents and other paths of entry to the interior cavity or accessing any combustible elements of BESS cabinets. This ember screening would be applicable to the exterior of the battery cabinet, not internal components. The intention is to prevent both ember ingress and debris accumulation. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium. <u>Substation</u> Consider application of ember screening to the external vent interface of the control room, switchroom, terminal boxes etc. The intention is to prevent both ember ingress and debris accumulation. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium.	High
	13.15 15.15	Shutter external doors and windows	External doors (if present) should be self-closing. Doors should be tightly fitting against the frame.	Lowest
	13.16	Construction materials for critical non-structural elements	Review *FM Global Property Loss Prevention Data Sheet 5-33 (2020) Electrical Energy Storage Systems* for additional measures applicable to the development.	Lowest

ALL STRUCTURES VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
Availability of a firefighting response capability	11.16 13.17 14.17 15.17	Firefighting water supply	The following requirements apply to the firefighting water supply, via Measure 13.17 in the associated Bushfire Risk Report. The specifications will be confirmed at the detailed design stage. <u>Access</u> • Firefighting water access points (hydrants, hard suction, or drafting) must be clearly identifiable, visible from internal roads, and unobstructed. • An all-weather hardstand turnaround area meeting the requirements of the *Guidelines for Planning in Bushfire Prone Areas v1.4* (Explanatory Note E3.3) must be provided within 4 metres static water storage tank(s) and any independent hard suction points (hydrants). • Site Operating Procedures must include that access routes must be unobstructed at all times. <u>Siting and Capacity</u> • The Solar Farm development will require 4 tanks installed throughout the site, each with a minimum capacity of 50,000L. The specific location of water tanks will be determined once the internal access network is known at the detailed design phase. The following requirements will apply to the 4 tanks: o Tanks must be installed adjacent to access points into solar farm areas, either from public road reserves or from other parts of the development area. o Tanks *may* be installed within public road reserves in consultation with the Shire of Narrogin. o All areas of the solar farm footprint must be within 5km travel of a water tank. • The static firefighting water supply associated with the BESS development must be calculated per AS 2419. Based on the approximately 12,800m2 footprint, the required supply will be 432,000L. • Water tanks must be positioned >15m from BESS cabinets, solar panels, PCUs, inverters, etc. • The water tank(s) should apply a BAL-29 APZ at a minimum. <u>Construction</u> • The static water storage tank(s) must be an above-ground water tank constructed of concrete or steel. • An external water level indicator must be installed on static water storage tank(s) and be visible from internal roads and the adjoining turnaround area.	Highest

ALL STRUCTURES VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
			• Signage indicating 'FIRE WATER' and the tank capacity must be fixed to each tank. • The hard-suction point must be protected from mechanical damage (eg. bollards) where vehicle contact is possible. • Couplings at hard suction points are required to be 125mm Storz fittings (*Guidelines v1.4* s2.2.2.1). DFES Built Environment and the local emergency services should be contacted for input on appropriate couplings and adaptors. • During the detailed design stage, the entity designing the firefighting water supply should provide information on compliance with AS2419.1-2021 (Open Yard Protection) and what variations are applied (if any).	
	13.18	Firefighting equipment actively operated	Two suitable fire extinguishers should be provided within 20m of each PCU.	Lowest
	13.19 14.19 15.19	Firefighting equipment passively operated	Automatic fire detection and suppression systems should be installed and maintained, as appropriate to the BESS details and recommended by the manufacturer. Consider the potential for arc flash due to smoke from a bushfire.	High
	11.19 13.20 14.20	Firefighting equipment operability maintained	Any firefighting water pump will be either self-powered (diesel tank) or connected to a backup generator (if connected to mains power). Ensure the diesel tank capacity and pump itself is capable of operating for a period not less than the determined minimum water supply period (e.g. if a 4-hour water supply has been determined, the diesel tank must hold a 4-hour supply). All firefighting water tanks, pumps, connections, couplings, and pipes are to be metal or else non-combustible. As soon as practical before the arrival of the fire front, preparation systems/procedures should be engaged. Such systems/procedures should be determined in consultation with the manufacturer, but may include: • Orienting PV panels to the maximum vertical plane (estimated 50 degrees from the horizontal).	High

ALL STRUCTURES VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
			• Orienting PV panels away from the sun (to reduce residual energy generation post-shutdown). • Disconnecting solar arrays from the electrical grid. • Engaging any appropriate automatic fire suppression systems.	
Manage and maintain effectiveness of applied protection measures	11.21 13.22 14.22 15.22	Formal documents created to guide and enforce management	The decision maker should note that multiple international standards and guidelines exist, and full compliance with all may not be achievable. Australia lacks a guiding standard, as discussed in the *Battery Energy Storage Systems Guidance Report* (GHD March 2023, prepared for the Australian Energy Council). The decision maker may choose to review this report for an overview of context, concerns, and outcomes, for the construction and installation of BESS proposals. Ongoing requirements established in this Risk Assessment and Section 5.7 of the associated Bushfire Management Plan, must be included in operational documents. Site Operating Procedures must include the following information: <u>Maintenance</u> • Maintenance intervals. Scheduling can be detailed within a supporting document. • Assigned responsibilities of staff. • Maintenance procedures and servicing to manufacturer's specifications. • Testing procedures of the firefighting water supply and equipment. <u>Inspections</u> • Inspection intervals. Frequency of inspections are recommended to be increased during the bushfire season (see the Local Government Prohibited Burning Period) where practical. • Inspection triggers, including extreme weather events or seismic activity. • Established inspection criteria, including: o Accumulation of debris and vegetative material within 10m of battery modules. o Mechanical damage to exterior elements. o Vegetation regrowth within the Asset Protection Zone, particularly immediately prior to and during bushfire season (see the Local Government Prohibited Burning Period).	Highest

ALL STRUCTURES VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES				
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details	Implementation Priority Rating [2]
			o Obstruction of access routes including firebreaks. o Volume of the firefighting water supply.	
[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Sections 5.4.3 & 5.4.4 & 5.4.5 & 5.4.6. [2] Refer to Appendix A1.2.5 for implementation priority rating explanation.				

4.2.2 ADDITIONAL ISSUES AND ADVICE FOR CONSIDERATION

This section presents items the bushfire consultant has identified as being:

- Issues that are additional to or not specifically addressed within the assessment of bushfire risk management conducted in Section 6; and
- Advice for dealing with these issues or other issues that require emphasising, for consideration by management.

The *Guidelines and Model Requirements – Renewable Energy Facilities v4* (Victorian Country Fire Authority August 2023) considered in the construction of this Bushfire Risk Report, includes numerous considerations beyond the experience/qualification of a bushfire consultant.

Within the *Guidelines*, s4.2.6.4 Management of Fire Water Runoff states:

CFA recommends that infrastructure is provided for the containment and management of contaminated fire water runoff from battery energy storage systems.

Infrastructure may include bunding, sumps and/or purpose-built, impervious retention facilities. A fire water management plan may consist of the containment and disposal of contaminated fire water.

CFA recommends a containment and management capacity equivalent to the on-site fire protection system. Containment is to be provided as per AS 4681- 2000: The storage and handling of class 9 dangerous goods, Section 7.3.9: Control of run-off.

The impact of fire water runoff and any applicable containment/mitigation measures should be considered. This may include measures such as earthen bunding or impermeable membranes below the soil level.

4.3 MAPS TO INFORM MANAGEMENT

The data required to derive bushfire attack levels has been collected and the BAL separation distances calculated in assessing the establishment, both currently and potentially, of the exposure reducing bushfire protection mechanism of increasing separation from the bushfire hazard.

From this information, BAL contour maps can be produced. These maps can visually illustrate both the current situation and what might be achieved, regarding the potential impact of the flame contact, radiant heat transfer, and to a lesser extent, the ember/firebrand bushfire direct attack mechanisms.

These maps are an effective way to quickly convey important information to management, hence their inclusion in this summary risk management section of the report.

Other maps may be included in this section when it is considered they are useful and effective at providing relevant risk management information to property owners/operators.

4.3.1 BUSHFIRE ATTACK LEVEL (BAL) CONTOUR MAP

INFORMATION TO ASSIST INTERPRETATION OF THE BAL CONTOUR MAP

The Modelling Methodology (Calculations) Applied: AS 3959:2018 establishes the Bushfire Attack Level (BAL) determination methodology that will be applied to the relevant vegetation. When applicable, other bushfire behaviour models may be applied, and their application would be identified and justified in this report.

The Relevant Vegetation: This will be bushfire prone vegetation existing on the 'Subject Land + 150m Extent' that is classified according to the AS 3959:2018 BAL determination methodology. The classified vegetation maps and supporting vegetation photos and calculation data is presented in Appendix 6;

BAL Contour Map: The levels of potential flame contact and radiant heat transfer are assessed as bushfire attack levels and presented as a 'BAL Contour Map'. The levels to which any element at risk (e.g., a building), whose location on the map is identified, can be derived from this map.

The map(s) illustrate the site-specific separation distances from classified vegetation that will correspond to each Bushfire Attack Level (BAL) as coloured contours.

The BAL Contours: The contours, each of varying widths, extend out from each area of classified vegetation. Each different contour represents a set range of potential radiant heat transfer (in kW/m^2) to an element at risk located within the contour and is stated as a BAL rating.

The Vegetation Separation Distances: The horizontal distances from the edge of the classified vegetation to the start and the end of each different BAL contour, represent the separation distances (between the classified vegetation and the element at risk), that will correspond to that BAL rating for that site. The calculated distances have accounted for site specific vegetation types, ground slopes and other relevant input variables. These separation distances can also be presented in a table.

In addition to BAL rating separation distances, a distance that corresponds to singular levels of radiant heat transfer such as 2 kW/m^2 and 10 kW/m^2, may also be presented for specific purposes including proposed vulnerable land uses; and

The Applicable BAL Rating: Any element at risk (as the receiver of the radiant heat), that exists wholly or partly within a given contour, will be subject to that BAL rating. The rating establishes the applicable bushfire construction standard requirements. These ratings can also be applied to the derivation of flame contact and radiant heat transfer levels when required as a component of bushfire risk assessment.

Figure 4.1.1

BAL Contour Map North

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

NARRAKINE RD SOUTH
COMINI RD
WANERIE RD
MELLONS RD
NOTTLE RD
SIMMONS RD
GREAT SOUTHERN HWY
NARRAKINE RD SOUTH

------ LEGEND ------

- Subject Site
- Cadastral
- 150m Assessment Area
- BESS Layout
- Solar Layout
- Substation
- 10kW APZ

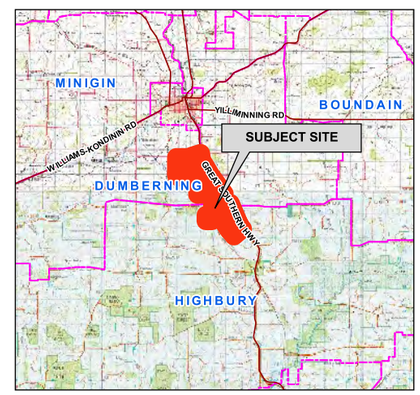
Bushfire Attack Levels

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

0 200 400 600 800

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 28-08-2024
SCALE (A3): 1 : 15000

BUSHFIRE PRONE PLANNING

Disclaimer and Limitation: This map has been prepared for bushfire management planning purposes only. All depicted areas, contours and any dimensions shown are subject to survey. Bushfire Prone Planning does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

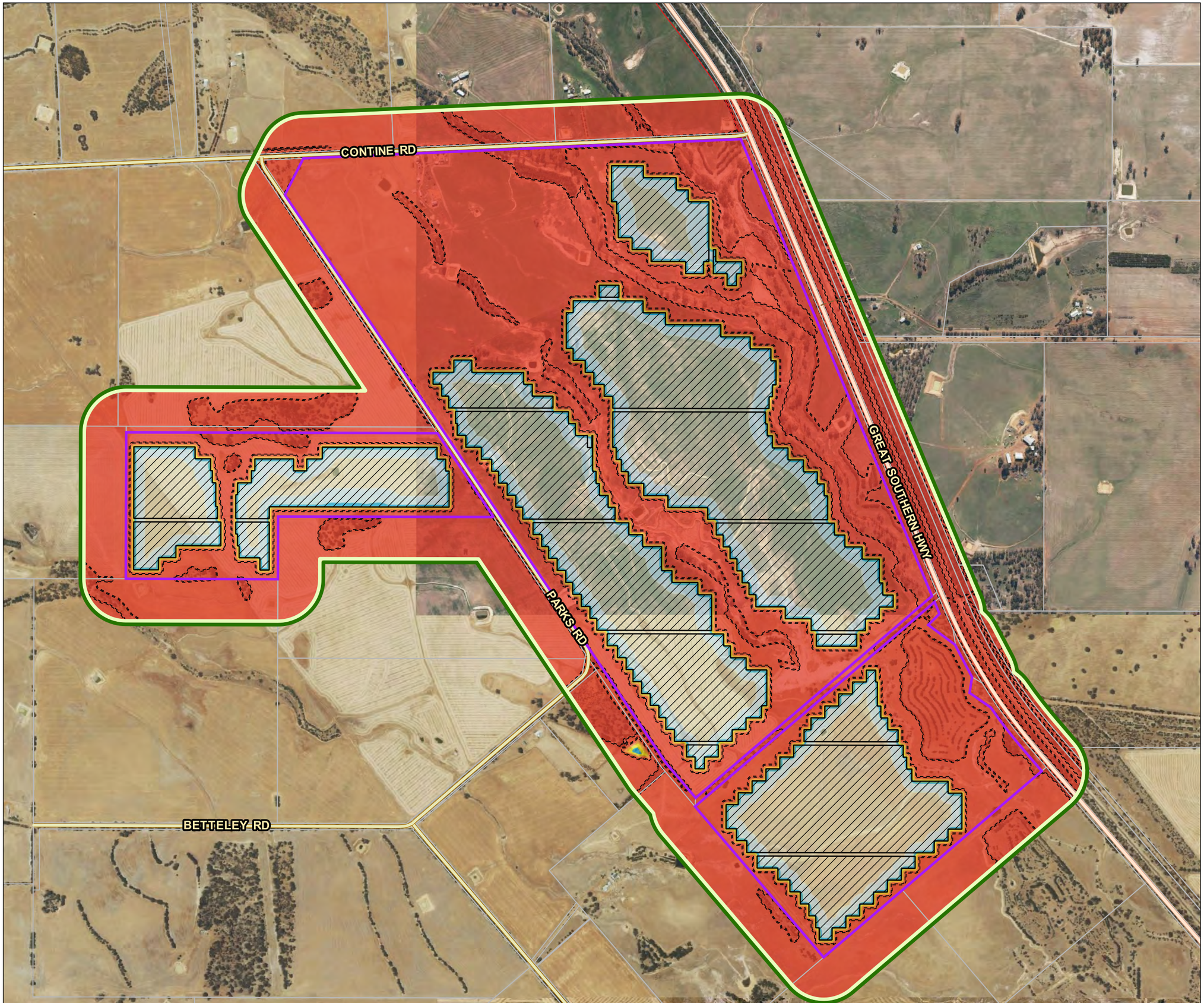


Figure 4.1.2

BAL Contour Map South

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

------ LEGEND ------

- Subject Site
- Cadastral
- 150m Assessment Area
- BESS Layout
- Solar Layout
- Substation

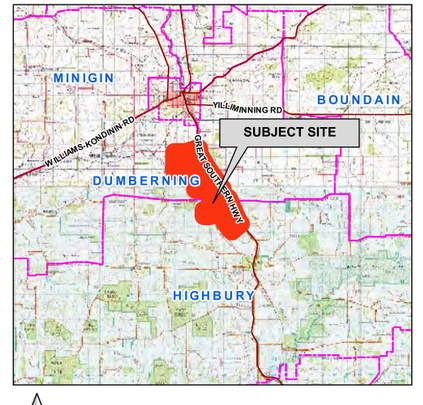
Bushfire Attack Levels

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

0 200 400 600

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 28-08-2024
SCALE (A3): 1 : 12000

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5 BUSHFIRE RISK ASSESSMENT

5.1 BUSHFIRE HAZARD THREAT LEVEL ASSESSMENT (THE SURROUNDING LANDSCAPE)

INFORMATION TO ASSIST INTERPRETATION

AREA OF LAND TO BE ASSESSED AS THE SURROUNDING LANDSCAPE

The assessment for this report considers the surrounding landscape to be comprised of two parts:

1. The subject site and all land surrounding the subject land extending out to 150 metres as the 'Subject Land + 150m Extent'; and
2. The land surrounding the 'Subject Land + 150m Extent' extending out to the maximum distance that will be established by one or more of the following factors:
    - The distance away from the subject land that will result in an area of land that, when supporting bushfire prone vegetation, is of sufficient size such that a large-scale bushfire can develop (landscape scale fire);
    - The distance away from the subject land from which the bushfire direct attack mechanism of embers/ burning debris may reasonably be expected impact the subject land. This is highly dependent on the 'category' of vegetation present regarding its potential ember/burning debris threat (refer to Appendix 2 for explanatory information); and/or
    - The distance away from the subject land that contains the road network that persons in vehicles (including emergency services) would traverse in evacuating or accessing the subject land in the event of a bushfire.

To achieve the required assessment outcomes a maximum distance of 5 km from the subject land is likely to be considered sufficient, with this distance being reduced when the vegetation categories presenting the higher ember/burning debris threat level do not exist.

ASSESSMENT PURPOSE - EXISTENCE OF RELEVANT PHYSICAL FACTORS

To identify whether the land surrounding the existing or proposed development and its use contains the physical factors necessary for any of the following scenarios to exist:

1. The potential exists for the bushfire hazard threat of embers/burning debris to impact elements at risk on the subject land. It is particularly important this threat is identified when any vegetation planned to be retained and/or established on the subject land and within 100 metres (the 'Subject Land + 150m Extent') may not present this threat - or at least not to the same level. Refer to Appendices A1.3 and A1.6 for additional information.

    Note: Scientific research indicates that at least 80% of building losses from past Australian bushfires can be attributed to ember/firebrand attack (mostly in isolation but also in combination with radiant heat), and the resultant consequential fires. It is a very important threat to be identified; and/or

2. The potential exists for development of a large-scale bushfire event(s) that can impact the subject land because the necessary extent of bushfire prone vegetation exists. Such events may increase the severity of bushfire behaviour within the 'Subject Land + 150m Extent' vegetation, consequently increasing the levels of all bushfire hazard threats impacting elements at risk; and/or
3. The potential exists for development of dynamic fire behaviours and deep flaming that are associated with extreme bushfire events (including pyroconvective events). Dynamic fire propagation arises from complex interactions between the terrain, the atmosphere, and the fire (refer to Appendix 3 for additional information).

    Extreme bushfire events have the potential to impact subject land through generating fire driven strong winds, increasing erratic fire behaviour and increasing the levels of all bushfire hazard threats impacting elements at risk.; and/or
4. The potential exists for increased levels of bushfire hazard threats, to persons in vehicles who need to move through this area of land (i.e., persons evacuating from the subject land and emergency services), thereby increasing level of risks associated with bushfire.

5.1.1 DETERMINATION OF THE ASSESSMENT EXTENT TO BE APPLIED

THE SURROUNDING LANDSCAPE ASSESSMENT EXTENT	
BASIS FOR DETERMINATION	
The vegetation categories identified surrounding the subject land include significant extents and continuity of those that contain trees with bark hazards. These present the potential for developing significant ember/burning debris threat levels. These threats are either medium (up to 5km) and/or long distance (greater than 5km) spotting. [1]	
The vegetation categories identified surrounding the subject land only include those that have the potential for shorter distance spotting (ember/burning debris attack) of up to 500-750m. [1]	✓
The distance away from the subject land that contains the road network that persons in vehicles would traverse in evacuating or accessing the subject land in the event of a bushfire, has determined the assessment extent.	
Assessment Comments: The local area is dominated by pasture and revegetation or remnant vegetation with variable assemblages. Pasture produces little moderate or longer range embers. The regional vegetation complexes include wandoo, casuarina, flooded gum, mallee, and various smooth bark eucalypts. The vegetation is unlikely to generate significant long-distance embers, as ribbon/candle bark types are infrequent. The fibrous barks associated with casuarina are finer with shorter burnout times.	
The extent of land surrounding the subject land that is to be considered as being the surrounding landscape for assessment purposes:	Approximately 2 km
Note 1: Refer to Appendix 2 and Appendix 3 for additional information.	

5.1.2 IDENTIFICATION OF VEGETATION CATEGORIES PRESENT AND RANGE OF POTENTIAL THREAT LEVELS

Vegetation categories are established to enable a comprehensive assessment of the type and severity of the bushfire attack mechanisms (i.e., the bushfire threats), potentially generated by bushfire prone vegetation on surrounding land. This enables variations in vegetation composition and structure to be more appropriately accounted for in the determination of the levels of risk associated with a local bushfire event.

The variations in potential threat level ranges corresponding to each vegetation category in the table below are the result of these differences.

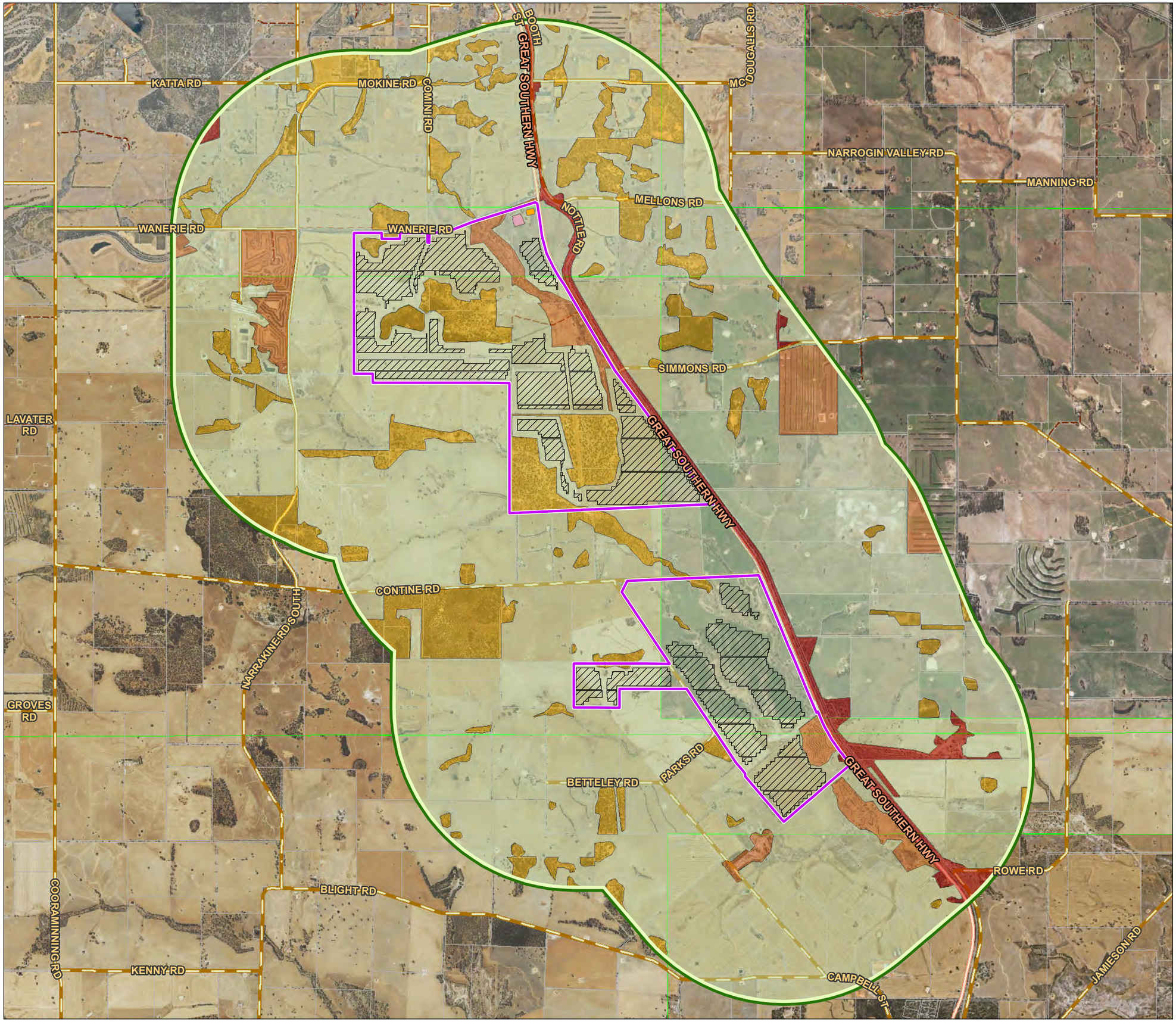
The 'Categories' are necessarily different to the vegetation 'Classifications' applied in the BAL determination methodology of AS 3959:2018. The Standard is applied to determination of construction requirements and primarily considers the flame contact and radiant heat attack mechanisms and does not fully address ember/firebrand attack or other threats levels.

VEGETATION CATEGORIES IDENTIFIED IN THE SURROUNDING LANDSCAPE (AND CORRESPONDING POTENTIAL THREAT LEVEL RANGES)		
Vegetation Category [1 & 2]	Assessment Comments	Potential Threat Level Range [2]
Tree-1	Tree-1 areas are most associated with road reserves and intentional plantings of applicable species, or high density of Red Morrel, Jarrah, or Marri.	Moderate to Extreme
Tree-2	Brown Mallet, Gimlet, and some Mallees occasionally display ribbon barks. Tree species and assemblages include those with longer distance spotting potential.	Moderate to Extreme
Tree/Shrub	Within the assessment area the category is applied to some mallees, scrub, or Wandoo, Powderbark, or Salmon Gum woodlands. This is the most common structure in the assessment area.	Moderate to Very High
Shrub	Not present.	Low to Moderate
Grass	These areas support a range of broadleaf and grass pasture species. Some are managed more intensively and are stocked more regularly, and therefore eaten down – or are part of usage rotations involving horticultural cropping. Others have various levels of management but will generally have some form of material reduction during the year or have inherently low fuel loads due to regular disturbance and/or lower quality soils.	Low to Moderate
No/Low Threat	Not present.	None to Low
Note 1: Refer to Figure 5.1: Surrounding landscape – the identified vegetation categories. Note 2: Refer to Appendix 5 for a description of the criteria that establish the vegetation categories, the base bushfire hazard scenario and the potential threat levels and the application of these levels.		

Figure 5.1

Surrounding Landscape Vegetation Categories Map

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN



------ LEGEND ------

- Subject Site
- BESS Layout
- Solar Layout
- Substation
- Other Lots
- 2km from Subject Site

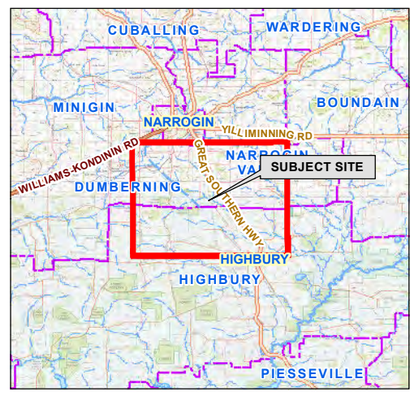
Vegetation Categories

- Tree-1
- Tree-2
- Tree/Shrub
- Grass

0 500 1,000 1,500 2,000 2,500

Metres

------ LOCALITY ------



Aerial Imagery : Landgate/SLIP
Image Date : Dec 2016

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
Map compiled by: Neil Stoney 16/09/2024
Map updated by: Neil Stoney 16/09/2024
A3 Scale 1:40,000

BUSHFIRE PRONE PLANNING

Disclaimer and Limitation: This map has been prepared for bushfire management planning purposes only. All depicted areas, contours and any dimensions shown are subject to survey. Bushfire Prone Planning does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence arising from relying on any information depicted.
Map Document Path / Name: K:\Projects\Jobs 2023\231010 - Narrogin Solar Farm (BMP BRMP)\Mapping_copied to JG 2024-08-27\MXD\231010_BRR_Fig5-1_Veg-Cat_Narrogin.mxd

5.1.3 MODIFYING INDICATIVE THREAT LEVELS - ASSESS EXISTENCE OF RELEVANT PHYSICAL FACTORS

5.1.3.1 VEGETATION EXTENT AND CONTINUITY FACTORS

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL (VEGETATION EXTENT AND CONTINUITY OF IDENTIFIED VEGETATION CATEGORIES)						
Relevant Physical Factors [1,4 & 6]	Vegetation Location Within the Surrounding Landscape [2]	Vegetation Classification AS 3959:2018 [3]	Vegetation Category [4]	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Threat Level [4 & 5]
The extent of vegetation is sufficient to support a fully developed bushfire but insufficient to result in an extreme bushfire event. [4] Note: Vegetation within the 'Subject Land + 150m Extent' is only assessed independently of the surrounding vegetation when it is sufficiently isolated. If the relevant area of vegetation is not isolated or can support an extreme bushfire event (see next physical factor) the assessment response will be N/A.	N/A Vegetation within the 150 metre assessment area is not isolated from other external vegetation areas.					

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL (VEGETATION EXTENT AND CONTINUITY OF IDENTIFIED VEGETATION CATEGORIES)						
Relevant Physical Factors [1,4 & 6]	Vegetation Location Within the Surrounding Landscape [2]	Vegetation Classification AS 3959:2018 [3]	Vegetation Category [4]	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Threat Level [4 & 5]
The extent of vegetation is sufficient to support large active flaming zones (landscape scale fire). This presents one of the physical factors required for the development of an extreme bushfire event. [6]	The 'Subject Land + 150m Extent'.	A. FOREST	Tree-1	Limited	This vegetation bounds road verges only.	Major Decrease
		A. FOREST	Tree-2	Partially Exists	Areas are substantial but of insufficient extent to support landscape scale fire.	Minor Decrease
		B. WOODLAND				
		E. MALLEE/MULGA				
		A. FOREST	Tree/Shrub	Substantially Exists	Pockets are sufficiently large to allow bushfire to fully establish.	Neutral
		B. WOODLAND				
		D. SCRUB				
		G. GRASSLAND	Grass	Substantially Exists	Onsite grassland is of substantial extent.	Neutral
	The Land Surrounding the 'Subject Land + 150m Extent'		Tree-1	Limited	This vegetation is narrow or limited at the regional scale.	Significant Decrease
			Tree-2	Limited	Areas are 50<100 ha.	Neutral
			Tree/Shrub	Substantially Exists	Many substantial pockets exist regionally.	Minor Increase
			Grass	Predominantly Exists	Cleared pasture areas are common locally.	Minor Increase
The bushfire fuels are continuous. Fire can spread uninterrupted and not be slowed by the intermittent absence of fuels.	The 'Subject Land + 150m Extent'.	A. FOREST	Tree-1	Limited	Vegetated areas are separated by external roads as they follow road verges. Fragmentation of the vegetation exists where driveways or cleared areas are present.	Significant Decrease
		A. FOREST	Tree-2	Predominantly Exists	The vegetation is internally continuous.	Neutral
		B. WOODLAND				
		E. MALLEE/MULGA				

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL (VEGETATION EXTENT AND CONTINUITY OF IDENTIFIED VEGETATION CATEGORIES)						
Relevant Physical Factors [1,4 & 6]	Vegetation Location Within the Surrounding Landscape [2]	Vegetation Classification AS 3959:2018 [3]	Vegetation Category [4]	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Threat Level [4 & 5]
This presents one of the physical factors required for the development of an extreme bushfire event. [6]		A. FOREST	Tree/Shrub	Substantially Exists	Occasional fragmentation due to access tracks or rock formations.	Neutral
		B. WOODLAND				
		D. SCRUB				
		G. GRASSLAND	Grass	Partially Exists	Access tracks and external roads fragments the vegetation to a limited extent.	Minor Decrease
	The Land Surrounding the 'Subject Land + 150m Extent'		Tree-1	Limited	Vegetated areas are separated by external roads as they follow road verges. Fragmentation of the vegetation exists where driveways or cleared areas are present.	Significant Decrease
			Tree-2	Limited	Tree-2 areas are frequently plantations with significant breaks between rows.	Significant Decrease
			Tree/Shrub	Partially Exists	These areas are generally continuous.	Neutral
			Grass	Predominantly Exists	Access tracks and external roads fragments the vegetation to a limited extent.	Minor Decrease

Note 1: Refer to Appendix 2 for additional information.

Note 2: Refer to Figure 5.1 Surrounding landscape – the identified vegetation categories.

Note 3: Refer to Appendix A6.4.2 for the map of classified (AS 3959:2018) bushfire prone vegetation and topography within the 'Subject Land + 150m Extent'. The identified classified vegetation that best corresponds to the categorised vegetation will be specific to the subject land and its surrounds and is identified in this column.

Note 4: Refer to Appendix 5 for a description of the criteria that establish the vegetation categories and their potential threat level range.

Note 5: The modification rating is derived for the identified area of vegetation/land after conducting a qualitative assessment of the existence of the relevant physical factor. It is applied to deriving a 'Potential Threat Level' from the 'Potential Threat Level Range' associated with each vegetation category.

Note there is a base bushfire fuels, terrain and fire weather assumption that has been applied in establishing the 'Potential Threat Level' ranges. It is a scenario of a sufficiently large area of bushfire prone vegetation, with continuous fuels, on flat to undulating terrain with no slopes greater than ten degrees, that can support a fully developed bushfire. It is also assumed to be possible for the most adverse (catastrophic) fire weather to occur. This scenario establishes the midpoint of the 'Potential Threat Level Range'. Refer to Appendix 5 for additional explanatory and supporting information.

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL (VEGETATION EXTENT AND CONTINUITY OF IDENTIFIED VEGETATION CATEGORIES)						
Relevant Physical Factors [1,4 & 6]	Vegetation Location Within the Surrounding Landscape [2]	Vegetation Classification AS 3959:2018 [3]	Vegetation Category [4]	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Threat Level [4 & 5]
Note 6: A physical factor with identified links (from bushfire research) to dynamic bushfire propagation and subsequent development of extreme bushfire events, including the development of pyroconvective, coupled atmosphere events. Refer to Appendix 3 for additional information.						

5.1.3.2 VEGETATION FUEL LOAD/ARRANGEMENT/BARK HAZARD FACTORS

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL (FUEL LOAD/ARRANGEMENT/BARK HAZARD OF IDENTIFIED VEGETATION CATEGORIES)						
Relevant Physical Factors [1 & 6]	Vegetation Location Within the Surrounding landscape [2]	Vegetation Classification AS 3959:2018 [3]	Vegetation Category [4]	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Potential Threat Level [4 & 5]
Managed Fuel Loads Evidence that management of fuel loads is planned, conducted regularly and enforced. Includes prescribed burning programs.	The 'Subject Land + 150m Extent'.	A. FOREST	Tree-1	Does Not Exist	-	Neutral
		A. FOREST	Tree-2	Does Not Exist	-	Neutral
		B. WOODLAND				
		E. MALLEE/MULGA				
		A. FOREST	Tree/Shrub	Does Not Exist	-	Neutral
		B. WOODLAND				
		D. SCRUB				
		G. GRASSLAND	Grass	Partially Exists	Grassed areas are often grazed or cropped short. This is not a planned or conducted measure.	Significant Decrease
	The Land Surrounding the 'Subject Land + 150m Extent'		Tree-1	Does Not Exist	-	Neutral
			Tree-2	Partially Exists	Some fuel load reduction works appears to occur in plantation areas.	Minor Decrease
			Tree/Shrub	Does Not Exist	-	Neutral
			Grass	Partially Exists	Grassed areas are often grazed or cropped short. This is not a planned or conducted measure.	Significant Decrease
Adverse Fuel Loads and Arrangement [6] Fuel loads heavier than a normal range for the category or are uncharacteristic	The 'Subject Land + 150m Extent'.	A. FOREST	Tree-1	Partially Exists	Tree-1 areas often have a heavy surface fuels or dense understory, approximately within the average range.	Neutral
		A. FOREST	Tree-2	Partially Exists	The vegetation is highly variable in fuel loads.	Minor Decrease
		B. WOODLAND				
		E. MALLEE/MULGA				
		A. FOREST	Tree/Shrub	Does Not Exist		

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL (FUEL LOAD/ARRANGEMENT/BARK HAZARD OF IDENTIFIED VEGETATION CATEGORIES)						
Relevant Physical Factors [1 & 6]	Vegetation Location Within the Surrounding landscape [2]	Vegetation Classification AS 3959:2018 [3]	Vegetation Category [4]	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Potential Threat Level [4 & 5]
for the category; and/or Worst case fuel arrangement exists. [Where heavy forest fuel types with loads more than 15-20 t/ha exist, the potential for vorticity-driven lateral spread exists (as a dynamic fire behaviour) if the required terrain characteristics are present].		B. WOODLAND			Wandoo suppresses understory growth. There is functionally no understory in most areas.	Significant Decrease
		D. SCRUB				
		G. GRASSLAND	Grass	Does Not Exist	Grassed areas are often grazed or cropped short.	Significant Decrease
	The Land Surrounding the 'Subject Land + 150m Extent'		Tree-1	Partially Exists	Tree-1 areas often have a heavy surface fuels or dense understory, approximately within the average range.	Neutral
			Tree-2	Partially Exists	The vegetation is highly variable in fuel loads. Plantation areas have lower understory and surface fuels than expected.	Minor Decrease
			Tree/Shrub	Does Not Exist	Wandoo suppresses understory growth. There is functionally no understory in most areas.	Significant Decrease
			Grass	Does Not Exist	Grassed areas are often grazed or cropped short.	Significant Decrease
Bark Hazard The presence of high threat level bark hazards with potential for high levels of ember/burning debris production (spotting density) and long burnout	The 'Subject Land + 150m Extent'.	A. FOREST	Tree-1	Predominantly Exists	The bark hazard was a primary factor in identifying Tree-1 areas.	Significant Increase
		A. FOREST	Tree-2	Limited	The plants displaying Tree-2 bark structures are in lower density (gimlet) or in an arrangement which is less likely to become airborne (mallee).	Significant Decrease
		B. WOODLAND				
		E. MALLEE/MULGA				
		A. FOREST	Tree/Shrub	Limited	Wandoo, Powderbark, or Salmon Gum have smooth or low density flaky barks.	Significant Decrease
		B. WOODLAND				
		D. SCRUB				

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL (FUEL LOAD/ARRANGEMENT/BARK HAZARD OF IDENTIFIED VEGETATION CATEGORIES)						
Relevant Physical Factors [1 & 6]	Vegetation Location Within the Surrounding landscape [2]	Vegetation Classification AS 3959:2018 [3]	Vegetation Category [4]	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Potential Threat Level [4 & 5]
times (travel distance). Refer to photo evidence in Appendix A6.3.		G. GRASSLAND	Grass	Does Not Exist	-	Neutral
	The Land Surrounding the 'Subject Land + 150m Extent'		Tree-1	Predominantly Exists	The bark hazard was a primary factor in identifying Tree-1 areas.	Significant Increase
			Tree-2	Limited	The plants displaying Tree-2 bark structures are in lower density (gimlet) or in an arrangement which is less likely to become airborne (mallee).	Significant Decrease
			Tree/Shrub	Limited	The trees present within scrub vegetation (with <10% coverage) are usually banksia or melaleuca, and stunted forms of local trees are also present.	Significant Decrease
			Grass	Does Not Exist	-	Neutral

Note 1: Refer to Appendix 2 for additional information.

Note 2: Refer to Figure 5.1 Surrounding landscape – the identified vegetation categories.

Note 3: Refer to Appendix A6.4.2 for the map of classified (AS 3959:2018) bushfire prone vegetation and topography within the 'Subject Land + 150m Extent'. The identified classified vegetation that best corresponds to the categorised vegetation will be specific to the subject land and its surrounds and is identified in this column.

Note 4: Refer to Appendix 5 for a description of the criteria that establish the vegetation categories and their potential threat level range.

Note 5: The modification rating is derived for the identified area of vegetation/land after conducting a qualitative assessment of the existence of the relevant physical factor. It is applied to deriving an 'Potential Threat Level' from the 'Potential Threat Level Range' associated with each vegetation category.

Note there is a base bushfire fuels, terrain and fire weather assumption that has been applied in establishing the 'Potential Threat Level' ranges. It is a scenario of a sufficiently large area of bushfire prone vegetation, with continuous fuels, on flat to undulating terrain with no slopes greater than ten degrees, that can support a fully developed bushfire. It is also assumed to be possible for the most adverse (catastrophic) fire weather to occur. This scenario establishes the midpoint of the 'Potential Threat Level Range'. Refer to Appendix 5 for additional explanatory and supporting information.

Note 6: A physical factor with identified links (from bushfire research) to dynamic bushfire propagation and subsequent development of extreme bushfire events, including the development of pyroconvective, coupled atmosphere events. Refer to Appendix 3 for additional information.

5.1.3.3 TERRAIN FACTORS

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL (GROUND SLOPE AND SLOPE LENGTH UNDER IDENTIFIED VEGETATION CATEGORIES)						
Relevant Physical Factors [1 & 6]	Vegetation Location Within the Surrounding landscape [2]	Vegetation Classification AS 3959:2018 [3]	Vegetation Category [4]	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Potential Threat Level [4 & 5]
Effective Slopes ≥ 10 Degrees Vegetation exists, at least partially, on terrain of 10 degrees or greater ground slope and of sufficient length (see slope length factor), that will increase fire rates of spread and consequent fire intensity.	The 'Subject Land + 150m Extent'.	A. FOREST	Tree-1	Limited	Locally and regionally, slopes are generally <5 degrees. Slopes rarely exceed 10 degrees within 2km. The >10 degree slopes which do exist are local outcroppings surrounded by pasture, where the effective slope is upslope relative to the development site. See Figure 5.3.	Neutral
		A. FOREST	Tree-2			
		B. WOODLAND				
		E. MALLEE/MULGA				
		A. FOREST	Tree/Shrub			
		B. WOODLAND				
		D. SCRUB				
		G. GRASSLAND	Grass			
	The Land Surrounding the 'Subject Land + 150m Extent'		Tree-1			
			Tree-2			
			Tree/Shrub			
			Grass			
Effective **Slopes ≥ 2**0 Degrees [6] Vegetation exists, at least partially, on steep terrain of 20 degrees or greater ground slope and of	The 'Subject Land + 150m Extent'.	A. FOREST	Tree-1	Does Not Exist		Neutral
		A. FOREST	Tree-2			
		B. WOODLAND				
		E. MALLEE/MULGA				
		A. FOREST	Tree/Shrub			
		B. WOODLAND				

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL (GROUND SLOPE AND SLOPE LENGTH UNDER IDENTIFIED VEGETATION CATEGORIES)						
Relevant Physical Factors [1 & 6]	Vegetation Location Within the Surrounding landscape [2]	Vegetation Classification AS 3959:2018 [3]	Vegetation Category [4]	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Potential Threat Level [4 & 5]
sufficient length (see slope length factor). The presence of ridges able to present steep leeward slopes to exposed elements is an additional component of this factor.		D. SCRUB				
		G. GRASSLAND	Grass			
	The Land Surrounding the 'Subject Land + 150m Extent'		Tree-1			
			Tree-2			
			Tree/Shrub			
			Grass			
Sufficient Length of Steep Slopes The identified 20 degree and greater slopes can support the entire flame depth of a fully developed fire.	The 'Subject Land + 150m Extent'.	A. FOREST	Tree-1	Does Not Exist		Neutral
		A. FOREST	Tree-2			
		B. WOODLAND				
		E. MALLEE/MULGA				
		A. FOREST	Tree/Shrub			
		B. WOODLAND				
		D. SCRUB				
		G. GRASSLAND	Grass			
	The Land Surrounding the 'Subject Land + 150m Extent'		Tree-1			
			Tree-2			
			Tree/Shrub			
			Grass			
Note 1: Refer to Appendix 2 for additional information.						

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL (GROUND SLOPE AND SLOPE LENGTH UNDER IDENTIFIED VEGETATION CATEGORIES)						
Relevant Physical Factors [1 & 6]	Vegetation Location Within the Surrounding landscape [2]	Vegetation Classification AS 3959:2018 [3]	Vegetation Category [4]	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Potential Threat Level [4 & 5]
Note 2: Refer to Figure 5.1 Surrounding landscape – the identified vegetation categories. Note 3: Refer to Appendix A6.4.2 for the map of classified (AS 3959:2018) bushfire prone vegetation and topography within the 'Subject Land + 150m Extent'. The identified classified vegetation that best corresponds to the categorised vegetation will be specific to the subject land and its surrounds and is identified in this column. Note 4: Refer to Appendix 5 for a description of the criteria that establish the vegetation category and its potential threat level range. Note 5: The modification rating is derived for the identified area of vegetation/land after conducting a qualitative assessment of the existence of the relevant physical factor. It is applied to deriving an 'Potential Threat Level' from the 'Potential Threat Level Range' associated with each vegetation category. Note there is a base bushfire fuels, terrain and fire weather assumption that has been applied in establishing the 'Potential Threat Level' ranges. It is a scenario of a sufficiently large area of bushfire prone vegetation, with continuous fuels, on flat to undulating terrain with no slopes greater than ten degrees, that can support a fully developed bushfire. It is also assumed to be possible for the most adverse (catastrophic) fire weather to occur. This scenario establishes the midpoint of the 'Potential Threat Level Range'. Refer to Appendix 5 for additional explanatory and supporting information. Note 6: A physical factor with identified links (from bushfire research) to dynamic bushfire propagation and subsequent development of extreme bushfire events, including the development of pyroconvective, coupled atmosphere events. Refer to Appendix 3 for additional information. Note 7: Refer to Figure 5.3: Surrounding landscape - terrain slope map.						

Figure 5.2

Surrounding Landscape Terrain Elevation Map

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

KATTA RD
MOKINE RD
COMINI RD
MCDOUGALLS RD
MELLONS RD
MANNING RD
WANERIE RD
WANERIE RD
NARROGIN VALLEY RD
Narrogin Brook
NARRAKINE RD SOUTH
NOTTLE RD
SIMMONS RD
COORAMINNING RD
CONTINE RD
GREAT SOUTHERN HWY
PARKS RD
BETTELEY RD
ROWE RD
Narrakine Gully
BLIGHT RD
KENNY RD

------ LEGEND ------

- Other Lots
- Subject Site
- 2 km Assessment Area

KEY

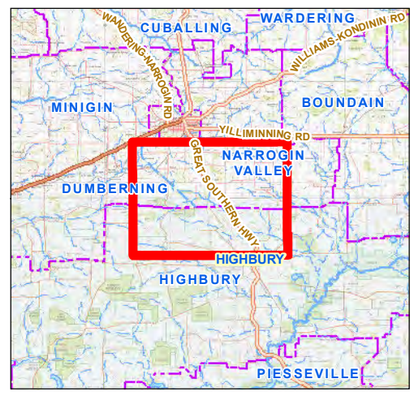
Elevation (m)

- < 290
- 291 - 300
- 301 - 310
- 311 - 320
- 321 - 330
- 331 - 340
- 341 - 350
- 351 - 360
- 361 - 370
- 371 - 380
- 381 - 390
- 391 - 400
- 401 - 410
- 410 <

0 500 1,000 1,500 2,000 2,500

Metres

------ LOCALITY ------



N

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
Map compiled by: Ian Ross 20/09/2024
Map updated by: Neil 20/09/2024
A3 Scale 1:40,000

Disclaimer and Limitation: This map has been prepared for bushfire management planning purposes only. All depicted areas, contours and any dimensions shown are subject to survey. Bushfire Prone Planning does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence arising from relying on any information depicted.
Map Document Path / Name: K:\Projects\Jobs 2023\231010 - Narrogin Solar Farm (BMP BRMP)\Mapping\MXD\231010_BRR_Fig5-2_DEM_Narrogin.mxd

Figure 5.3

Surrounding Landscape Terrain Slope Map

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

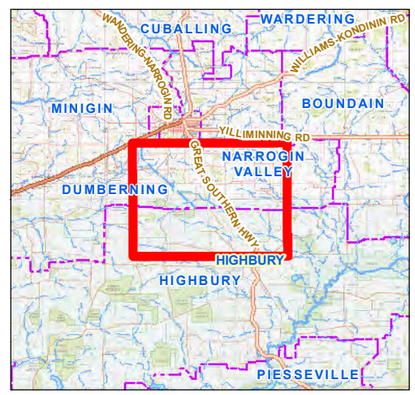
KATTA RD
MOKINE RD
COMINI RD
MCDOUGALL'S RD
MELLONS RD
WANERIE RD
WANERIE RD
NARROGIN VALLEY RD
Narrogin Brook
MANNING RD
NARRAKINE RD SOUTH
NORTH EAST RD
SIMMONS RD
MINNING RD
COORAMINNING
CONTINE RD
BETTELEY RD
PARKS RD
GREAT SOUTHERN HWY
ROWE RD
Narrakine Gully
BLIGHT RD
KENNY RD

KEY
Slope Degrees
0
0 - 5
5 - 10
10 - 15
15- 20

------ LEGEND ------
Other Lots
Subject Site
2 km Assessment Area

0 500 1,000 1,500 2,000 2,500
Metres

------ LOCALITY ------



N

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
Map compiled by: Ian Ross 20/09/2024
Map updated by: Neil 20/09/2024
A3 Scale 1:40,000

Disclaimer and Limitation: This map has been prepared for bushfire management planning purposes only. All depicted areas, contours and any dimensions shown are subject to survey. Bushfire Prone Planning does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence arising from relying on any information depicted.
Map Document Path / Name: K:\Projects\Jobs 2023\231010 - Narrogin Solar Farm (BMP BRMP)\Mapping\MXD\231010_BRR_Fig5-3_Slope_Narrogin.mxd

5.1.3.4 FIRE WEATHER FACTORS

The purpose of including consideration of fire weather factors in the surrounding landscape assessment is to be able to account for those scenarios in which the most adverse (catastrophic) fire weather conditions are either (a) cannot occur; or (b) highly unlikely to occur and this can be fully justified. Otherwise, such conditions are accounted for in the 'Potential Threat Level' ranges stated for each category of vegetation in Appendix 5.

THE EXISTENCE OF RELEVANT PHYSICAL FACTORS AND THEIR LIKELY IMPACT ON THE BASE POTENTIAL THREAT LEVEL - FIRE WEATHER CONSIDERATIONS			
Relevant Physical Factor	Existence of Physical Factor	Assessment Comments (As Needed)	Resultant Modification of the Potential Threat Level [1]
Associated with intensification of fire behaviour			
Location has persistent strong synoptic winds (i.e., not fire driven)	Possible to Occur	The nearest station with wind data is Wandering. The prevailing wind direction during the bushfire season is south-easterly (66% frequency). Wind speeds are <20km/hr with approximately 80% frequency.	Minor Decrease
Very low relative humidity and very high ambient air temperature	Possible to Occur	Common during the bushfire season.	Neutral
Associated with development of dynamic fire propagation behaviours, intensification of fire behaviour, and development of extreme bushfire events. [2]			
Wind speeds in excess of approximately 20 km/hr and wind direction within 30-40 degrees of ridge/scarp features – increasing the potential for vorticity-driven lateral spread.	N/A	Ridges/scarps are not present within the region.	N/A
Due to weather factors, fuel moisture contents can dry to around 5% or less.	Possible to Occur	Due to the drying climate and increasing temperatures, these factors may be possible.	Neutral
Atmospheric instability creating opportunity for atmospheric coupling and violent pyroconvection. [3]	Possible to Occur	Atmospheric instability occurs where air higher in the atmosphere is cool relative to the surface (>9.8°C per vertical kilometre differential). This weather condition is always possible to occur.	Neutral
Note 1: The modification rating is derived for the identified area of vegetation/land after conducting a qualitative assessment of the existence of the relevant physical factor. It is applied to deriving an 'Potential Level' from the 'Potential Threat Level Range' associated with each vegetation category. Note there is a base bushfire fuels, terrain and fire weather assumption that has been applied in establishing the 'Potential Threat Level' ranges. It is a scenario of a sufficiently large area of bushfire prone vegetation, with continuous fuels, on flat to undulating terrain with no slopes greater than ten degrees, that can support a fully developed bushfire. It is also assumed to be possible for the most adverse (catastrophic) fire weather to occur. This scenario establishes the midpoint of the 'Potential Threat Level Range'. Refer to Appendix 5 for additional explanatory and supporting information. Note 2: Refer to Appendix 3 for additional information.			

Note 3: Regarding the potential for a pyroconvective fire event to occur, the default assumption is that most locations will have the potential for vertical movement of air without any resistance to that movement (e.g. temperature inversion), as one of the typical requirements for such an event to occur.

It is not sufficiently risk averse to assume that atmospheric instability is unlikely to exist. Different temperature air masses can always interact as a consequence of the passage of different weather systems at any location. Justifying a variation to this is outside the scope of this assessment.

5.1.3.5 OUTCOME OF RELEVANT PHYSICAL FACTOR ASSESSMENT – THE BASE POTENTIAL THREAT LEVEL

THE BUSHFIRE HAZARD OF THE SURROUNDING LANDSCAPE – SUMMARY OF HOW THE POTENTIAL THREAT LEVEL IS DERIVED							
Vegetation Location Within the Surrounding Landscape	Identified Vegetation Categories	Potential Threat Level Range	Assessed Potential for the Modification of the Threat Level by Each Stated Physical Factor				The Derived Potential Threat Level of Each Vegetation Category
			Vegetation Extent and Continuity	Fuel Load / Arrangement and Bark Hazard	Terrain - Ground Slope and Slope Length	Fire Weather	
(Section 5.1)	(Figure 5.1 & Appendix 5)	(Appendix 5)	(Section 5.1.3.1)	(Section 5.1.3.2)	(Section 5.1.3.3)	(Section 5.1.3.4)	
The 'Subject Land + 150m Extent'	Tree-1	Moderate to Extreme	Major Decrease	Minor Increase	Neutral	Neutral	High
	Tree-2	Moderate to Extreme	Neutral	Minor Decrease	Neutral	Neutral	High
	Tree/Shrub	Moderate to High	Neutral	Significant Decrease	Neutral	Neutral	Moderate
	Grass	Low to Moderate	Neutral	Significant Decrease	Neutral	Neutral	Low
The Land Surrounding the 'Subject Land + 150m Extent'	Tree-1	Moderate to Extreme	Significant Decrease	Minor Increase	Neutral	Neutral	High
	Tree-2	Moderate to Extreme	Minor Decrease	Minor Decrease	Neutral	Neutral	Moderate
	Tree/Shrub	Moderate to High	Minor Increase	Significant Decrease	Neutral	Neutral	Moderate
	Grass	Low to Moderate	Neutral	Minor Decrease	Neutral	Neutral	Low
THE BASE BUSHFIRE HAZARD POTENTIAL THREAT LEVEL TO APPLY TO THE SITE [1]			Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐
Note 1: Derived qualitatively by considering the assessed potential threat level for each identified category of vegetation and the relative extents of each category. The highest level will be applied unless it is associated with a less significant extent of vegetation.							

ASSESSMENT SUMMARY COMMENTS

The dominant vegetation locally is Grass and Tree/Shrub. A threat of Moderate is adopted.

5.1.4 THREAT LEVEL ASSESSMENT – BUSHFIRE PROTECTION MEASURE ANALYSIS

For each identified bushfire hazard, an assessment is conducted that considers the effectiveness and application status of all available threat reducing bushfire protection measures that are listed under their applicable bushfire protection mechanism. This information is subsequently applied to deriving threat levels applied to deriving risk levels.

5.1.4.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE THREAT LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
THE PROTECTION MECHANISM – PREVENT BUSHFIRE IGNITION AND/OR SEVERITY BY MANAGING THE FUELS: Eliminate or reduce vegetation fuel loads, modify their properties (vegetation types and fuel arrangement). Maintain the measures over time to eliminate bushfire or lower the severity of fire behaviours and the consequent threat levels. Desired and mandatory environmental conservation will likely always be the most significant limitation to applying the mechanism.						
1.1	Remove Offsite Bushfire Fuel: Remove fuel permanently by clearing bushfire prone vegetation - only when permission and relevant agreements for removal have been established with the landowner and relevant authorities.	Very High	N/A	N/A	N/A	N/A
Assessment Comments: Not environmentally acceptable and beyond the control of the developer. *Recommendation Details:* Not Applicable						
1.2	Reduce Offsite Bushfire Fuel - Prescribed Burning: Planned hazard reduction when permission and relevant agreements to conduct and maintain have been established with the landowner and relevant authorities.	High	N/A	N/A	N/A	N/A
Assessment Comments: Neighbouring lots are private land. Prescribed offsite burning is managed by the landowners of those lots. *Recommendation Details:* Not Applicable						
1.3	Reduce Offsite Bushfire Fuel - Mechanical: Modify composition of vegetation types and/or the arrangement of fuels and maintain the modification over time e.g. reduce canopy, limit higher threat bark types (e.g. stringy, ribbon), minimise 'ladder' fuels'. Will likely require permission and relevant agreements to conduct and maintain from the landowner and relevant authorities.	High	N/A	N/A	N/A	N/A
Assessment Comments: Not environmentally acceptable and beyond the control of the developer. *Recommendation Details:* Not Applicable						

PROTECTION MEASURES AVAILABLE TO REDUCE THREAT LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
1.4	Remove Onsite Bushfire Fuel: Remove fuel permanently by clearing bushfire prone vegetation – only after the necessary approvals from relevant authorities have been obtained.	Very High	Yes	No	Partly	Yes
Assessment Comments: Permanent removal of onsite vegetation will be required in limited areas to establish the internal road network, firebreaks, pads for BESS etc. Permanent removal of onsite vegetation (other than grassland) will be required to establish an appropriate APZ. Vegetation beyond this APZ will not be removed. The BAL-29 Planning APZ is considered 'Planned' and the increased APZs applicable to different assets is 'Additionally Recommended.' The 10m portion of the APZ immediately around the BESS must be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc). *Recommendation Details:* See Measure 6.3.						
1.5	Reduce Onsite Bushfire Fuel - Prescribed Burning: Planned hazard reduction only after the necessary approvals from relevant authorities have been obtained.	High	Yes	No	Unknown	No
Assessment Comments: Coarse fuels (>6mm diameter) are present but are not consumed in prescribed (cool) burns. The primary fine surface and near-surface fuels are grasses, which rapidly regrow after prescribed burning. Prescribed burning is likely to have no impact or increase the available fine fuels within a year of the burn. *Recommendation Details:* Not Applicable						
1.6	Reduce Onsite Bushfire Fuel - Mechanical: Modify composition of vegetation types and/or the arrangement of fuels and maintain the modification over time e.g. reduce canopy, limit higher threat bark types (e.g. stringy, ribbon), minimise 'ladder' fuels'. Approvals from relevant authorities regarding environmental considerations may be required.	High	Yes	Yes	Unknown	Yes
Assessment Comments: Mechanical fuel reduction will not be applied due to the scale and frequency of maintenance required. Vegetation classifications applied are already conservative, with Class B Woodland vegetation assemblages being classified as Class A Forest. Livestock grazing can be considered to reduce fuel loads. *Recommendation Details:* See Measure 1.9.						
1.7	Reduce Road Verge Fuel: Road verges of designated evacuation routes are subject to fuel load reduction, tree management and ongoing maintenance when an authority exists to conduct and maintain.	Medium	No	No	No	No
Assessment Comments: Verge fuel reduction following the local road network would require support from the Shire of Narrogin. As the vegetation provides visual screening it is unlikely to be supported. *Recommendation Details:* Not Applicable						

PROTECTION MEASURES AVAILABLE TO REDUCE THREAT LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
1.8	Enforce Compliance with Local Government Property Management Directives: Inform landowners of the high level of enforcement that will be applied by the relevant authority.	High	Yes	Yes	No	No
Assessment Comments: The Firebreak Notice is enforceable by law, at the discretion of the Shire of Narrogin. Surrounding landowners are broadly compliant with the Notice, with APZs and firebreaks installed. *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM – PREVENT BUSHFIRE IGNITION BY MANAGING HEAT ENERGY SOURCES: The use of measures that control the existence of potential ignition sources. This includes human actions and/or faulty or poorly designed equipment. Natural causes of ignition (lightning) cannot be controlled and will remain an unmanageable limitation.						
1.9	Robust and Effective Site Operational Procedures: Apply fire safe principles to site operation procedures including: • Eliminating or reducing the potential for open air creation of fire, embers or sparks; and • Closing identified high risk operations when a bushfire event exists. • Ensure safe practices are carried out via appropriate guidelines, protocols, signage and education.	Very High	Yes	No	Partly	Yes
Assessment Comments: Compliance with any Dangerous Goods Licences is a regulatory requirement, and will include operational procedures. Operating procedures document has not yet been prepared. The site is unstaffed so ongoing procedures may not be comprehensive. *Recommendation Details:* Contact Narrogin VFRS and Narrogin and Minigin BFB prior to commissioning and offer a familiarisation visit and explanation of emergency procedures, access, hazards, and fire detection and suppression systems. Contact DFES Built Environment Branch to determine if an Emergency Response Guide (FES-ERG) is required. A comprehensive Emergency Management Plan is to be prepared for the facility. This is to outline Prevention, Preparedness, Response, and Recovery (PPRR) procedures for potential emergencies, of which bushfire is one component. The following details have been identified for inclusion within the Emergency Management Plan (and/or the Site Operating Procedures, as appropriate to the document structure): **Details and Information** • A summary of fire hazards and risks to and from the site, specific to its location, infrastructure, activities and occupancy. • A facility description, including infrastructure details, operations, number of personnel, and operating hours. • A site plan depicting structures/built assets, operational areas, site access points and internal roads, firefighting infrastructure, drainage (as applicable), and neighbouring properties.					

PROTECTION MEASURES AVAILABLE TO REDUCE THREAT LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend

- Up-to-date contact details for facility personnel, including for at least two persons who may be able to provide information or support during emergencies (24 hours a day). Update contact information when necessary.
- Details of emergency resources, including fire detection and suppression systems and equipment; gas detection; emergency eye-wash and shower facilities; spill containment systems and equipment; emergency warning systems; communication systems; personal protective equipment; first aid.
- Contact information for 24/7/365 specialist technical support for the battery energy storage system.
- Specifications for safe operating conditions for temperature.
- Schematics and technical data for battery energy storage system containers/enclosures, the number of containers/enclosures on-site, and the number of battery racks or modules within each container/enclosure.
- Details of the hazards for the battery energy storage system, including thermal events/runaway, electrical safety hazards, explosion hazards, dangerous goods hazards (including off-gassing), and the effects of fire on the battery energy storage system (e.g., explosion, release of toxic gases).
- Details of all provided battery failure/safety and protective systems, including a description, the activation process/automatic trigger, and any hazards associated with these systems.

Procedures

Prevention

- Smoking restrictions or designated smoking locations.
- Procedures regarding vegetation management and accidental ignition prevention.
- The specifications of Schedule 1 of the Guidelines for Planning in Bushfire Prone Areas and the Shire of Narrogin Firebreak Notice can be achieved via livestock grazing. The vegetation must continue to be monitored for compliance with Schedule 1, and additional vegetation management works undertaken as required.
- Heavy equipment is not to be operated where long grass (>100mm) or heavy leaf litter is present, particularly during the bushfire season (see the Local Government Prohibited Burning Period).
- Servicing of battery energy storage systems should not take place on days of High, Extreme or Catastrophic Fire Danger Rating, except where the system is experiencing malfunction or abnormal behaviour.

The following procedures should be completed prior to the bushfire season (see the Local Government Prohibited Burning Period):

- Scheduled maintenance to assets, emergency equipment, or fire detection/prevention systems.
- The ongoing requirements outlined in the Bushfire Management Plan.
- Scheduled housekeeping inspections including:
    - Hazard identification - ensuring that infrastructure, plant, equipment, vehicles and safety/warning signs show no signs of damage or dilapidation.

PROTECTION MEASURES AVAILABLE TO REDUCE THREAT LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend

- Facility access - ensuring all vehicle site access points, including emergency access points, are clear and accessible.
- Fire protection systems and equipment – ensuring that all equipment is unobstructed, clearly identifiable, in-service and performing optimally.
- Vegetation management - ensuring that any accumulation of combustible materials is cleared from infrastructure, buildings and fire breaks, and removed from the site.
- Security measures - ensuring that fences, gates, and security cameras are inspected for damage, and that any damage is immediately actioned (eg., repaired or replaced).

Preparedness

- Evacuation and shelter-in-place triggers and procedures, unless included within a Bushfire Emergency Plan.
- Procedures for review of the Emergency Management Plan, including the ongoing effectiveness of control measures.
- An ongoing schedule of site familiarisation for Narrogin VFRS and Narrogin and Minigin BFB to account for changing personnel, facility infrastructure and hazards.
- The Emergency Management Plan and any Emergency Response Guide (FES-ERG) should contain procedures for isolation, shut-down, fail safe or management of critical/high-risk plant, equipment, and utilities, and their advised triggers.
- Visitors must provide mobile phone numbers to site management. Within the Emergency Management Plan, a key response will be to contact and advise all persons onsite. Both Telstra and Optus networks have coverage over the entirety of the site.
- A bushfire monitoring procedure for the Restricted/Prohibited Burning Period (see Shire of Narrogin Firebreak Notice), including:
  - Nominating a person/role in your Emergency Control Organisation to be responsible for identifying, responding to, and communicating Fire Danger Ratings in advance.
  - Identifying bushfire activity within 20km of the facility.
  - Communicating this information to everyone likely to be present on-site, and relevant off-site personnel.
  - An outline of site activities to be modified or cease as a response (if any).

Response

DFES Comcen should immediately be notified of:

- Any shorts, faults, temperature increases above normal parameters (eg. precursor to thermal events/runaway).
- Equipment failures with the potential to ignite or propagate fire.
- Off-gassing, smoke or fire.

PROTECTION MEASURES AVAILABLE TO REDUCE THREAT LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
• The monitoring personnel can determine if Emergency Services response is necessary. The notification is for awareness. Bushfire emergency response procedures must include: • A specific action to notify (or verify notification) the emergency services, at the earliest possible stage of the emergency. • The person or role responsible for making or verifying the notification. • The '000' number in the procedure. • Communicating with site personnel and supporting their physical relocation. • Ensuring all buildings and plant are adequately secured. • Initiating any bushfire protection measures such as sprinkler or deluge systems, or pre-emptive shut-down, prior to the arrival of the fire front. • Liaising with the emergency services where possible. Consider the following criteria for inclusion within the Emergency Management Plan. All criteria are for consideration only, being non-bushfire measures identified within The Design Guidelines and Model Requirements – Renewable Energy Facilities (CFA August 2023). • Emergency procedures based on identified risks and hazards of the battery energy storage system and related infrastructure, including but not limited to: iv. Electrical infrastructure faults and fire. v. Battery energy storage system damage or faults, including battery monitoring faults, temperature increases above normal operating parameters, electrical faults, chemical spills or reactions, off-gassing, thermal events/runaway, smoke and fire. vi. The management of fire water runoff. • A plan for partial and full decommissioning of the battery energy storage system in the event of an emergency incident that renders the facility inoperable or unsafe, prior to its anticipated end-of-life. • The shut down and/or isolation procedures if the batteries are involved in fire, and appropriate personnel contact details for verifying that the battery enclosure/container system has been isolated/shut-down and de-energised during emergencies.						
1.10	Develop Planning and Management Procedures for Prescribed Burning: Ensure proper management of hazard reduction burning to prevent ignition of unintended fuels.	Medium	No	No	No	No
Assessment Comments: Local burns by the volunteer Bushfire Brigades will not be undertaken near hazardous or flammable materials (non-vegetation). Burns will not be conducted by development staff. *Recommendation Details:* Not Applicable						

PROTECTION MEASURES AVAILABLE TO REDUCE THREAT LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
1.11	Design and Construct Equipment to Prevent Airborne Ignition: Apply fire safe design principles to equipment, vehicles, and energy transmission etc. Design to control rate of energy release and eliminate/reduce potential for open air creation of fire, embers or sparks.	Medium	Yes	No	Yes	No
Assessment Comments: All equipment must meet minimum national and state standards and guidelines. Due to the nature of the site, control of ignition sources will be stringent. A bushfire consultant cannot provide additional design measures to prevent accidental ignition (due to faults/failure of the asset or equipment), so this scenario is assumed. Accidental ignition is instead managed through operating procedures (Measure 1.9). *Recommendation Details:* Not Applicable						
1.12	Actively Enforce Activity Restrictions: Impose restrictions on source of ignition operations by enforcing total fire bans.	Medium	Yes	Yes	No	No
Assessment Comments: Total fire bans will be complied with. Total fire ban exemptions will be applied for, if necessary for site functionality. *Recommendation Details:* Not Applicable						
1.13	Monitor and Penalise Illegal Activity: Reduce arson events as sources of ignition by monitoring and publicising enforcement of penalties.	Medium	N/A	N/A	N/A	N/A
Assessment Comments: Unlikely to have any impact given the scale of relevant vegetation and the population density of the region. *Recommendation Details:* Not Applicable						
1.14	**Bushfire Awareness and 'Good Practices'** Education: Educate persons to reduce the occurrence of accidental ignitions in vegetation by persons and/or vehicles, including in road reserves.	Medium	Yes	No	Yes	No
Assessment Comments: Activities which may result in fire are prohibited onsite. Contractors and staff are required to complete inductions and/or be escorted, and follow the operating procedures per Measure 1.9. *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM - PREVENT BUSHFIRE IGNITION BY MANAGING INTERACTIONS OF HEAT ENERGY SOURCES AND FUELS: The use of measures that control the interaction of heat sources and fuels.						
1.15	Barriers (Shielding) between Ignition Sources and Fuels: Utilise physical barriers (shielding) between bushfire fuels and heat energy sources such as electricity generation / transmission, fuel supplies, stored flammable products etc.	Medium	Yes	No	No	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE THREAT LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
	Examples include appropriate walls, enclosures, and underground transmission of electricity or liquid/gas fuels.					
Assessment Comments: Batteries and Solar Arrays are part of the site layout and will be required to have a sufficient APZ installed that flame contact and excessive radiant heat will not occur. This has been addressed in Measures 6.3 and 7.3. Any ignition of offsite vegetation would likely be due to embers or flaming debris/firebrands, which shielding is not effective against, except internal to the battery cabinets themselves. Ember screening of battery cabinets is required through Measure 13.13 which will reduce the capacity for such embers to escape a compromised battery cabinet. *Recommendation Details:* See Measures 13.13.						
1.16	Equipment Design and Construction to Reduce Heat Transfer: Through design (e.g., insulation) and materials, control heat energy transfer via conduction, convection and radiation.	Medium	Yes	No	Yes	Yes
Assessment Comments: All equipment must meet minimum national and state standards and guidelines. Due to the nature of the site, control of ignition sources will be stringent. *Recommendation Details:* See Measure 13.16 and 14.16.						
1.17	Separation Distance Between Ignition Sources and Fuels: Establish sufficient separation distance between bushfire fuels and heat energy sources such as electricity generation / transmission, fuel supplies, stored flammable products etc.	Medium	Yes	No	Yes	Yes
Assessment Comments: <u>Solar</u> The separation of solar arrays is to be a minimum of 6m. Product designers determine the setback between arrays to minimise the risk of fire transmission between arrays. The Asset Protection Zone applied exceeds the setback between arrays. Grasses require approximately 250 degree temperature to ignite with no ignition source- thus the setback required to minimise the capacity for flame contact it the relevant concern as compared to heat flux. Embers can travel beyond any applicable APZ. This has been addressed in Measure 7.3. Possible fire suppression systems for the solar farm likely considers asset-to-asset fire as the primary concern, however consideration should be given for the capacity for surface fire (within stubble and other surface fuels) escaping beyond the solar bank footprint. A surface fire may pose minimal threat to solar panels but could establish a bushfire offsite. This is applied in Measure 14.19. <u>BESS</u> Radiant heat flux in battery fires is relatively low, the Victorian Big Battery Fire (July 2021) required only a 20m exclusion zone for personnel (such an exclusion zone would generally be <4kW/m2 radiant heat flux). Note the <10kW/m2 APZ proposed is also >20m. Therefore in the reasonable worst case scenario, flame contact and radiant heat flux will be insufficient to ignite a bushfire in the surrounding vegetation. Grasses require approximately 250 degree temperature to ignite with no ignition source- thus the setback required to minimise the capacity for flame contact it the relevant concern as compared to heat flux. Embers can travel beyond any applicable APZ.						

PROTECTION MEASURES AVAILABLE TO REDUCE THREAT LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Onsite fine and heavy fuel sources are required to be eliminated in project design and strictly controlled in ongoing operation to prevent the capacity for embers to be generated. This has been addressed in Measure 6.3. *Recommendation Details:* See Measures 6.3, 7.3, and 14.19.					

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining.

Note 2: Protection Measure Application Status:

- Possible: Protection measures that can potentially be applied to the proposed development/use.
- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

  These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.1.4.2 PROTECTION MEASURE ANALYSIS - EFFECTIVENESS AND NUMBER APPLIED

For the identified bushfire hazard, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing threat levels is stated. This information is subsequently applied to assess the ability of applied protection measures to reduce threat levels. Refer to Appendix 1 for explanatory and supporting information.

THREAT REDUCING PROTECTION MEASURE ANALYSIS							
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommend
Prevent Bushfire Ignition and/or Severity by Managing the Fuels	Very High	2	1				1
	High	5	3	2			1
	Medium	1					
	Not Relevant						
Prevent Bushfire Ignition by Managing Heat Energy Sources	Very High	1	1			1	1
	High						
	Medium	5	3	1		2	
	Not Relevant						
Prevent Bushfire Ignition by Managing Interactions of Heat Energy Sources and Fuels	Very High						
	High						
	Medium	3	3			2	3
	Not Relevant						
Number Analysis	Very High	3	2			1	2
	High	5	3	2			1
	Medium	9	6	1		4	3
	Not Relevant						
	Totals	17	11	3		5	6

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.1.4.3 PROTECTION MEASURE ANALYSIS - POTENTIAL TO REDUCE THREAT LEVELS

For the identified bushfire hazard, the potential for applied bushfire protection measures to reduce threat levels is assessed as a function of:

- The number of bushfire protection measures that can be applied compared to the number available; and
- The weighting applied to each protection measure that indicates how effective it can be at reducing hazard threat levels.

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE BUSHFIRE HAZARD THREAT LEVELS [1]			
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]			
Bushfire Direct Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind
Moderate	Moderate	Minimal	Significant
Moderate			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]			
Bushfire Direct Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind
Very Significant	Significant	Moderate	Significant
Significant			

Note 1: Refer to Appendix A1.2 for explanatory and supporting information.

Note 2: This threat reducing potential will be applied to deriving the inherent threat level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This threat reducing potential will be applied to deriving the residual threat level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

5.1.5 OUTCOME OF THE BUSHFIRE HAZARD POTENTIAL THREAT LEVEL ASSESSMENT

Inherent and residual threat levels (each referring to a different stage of bushfire protection measure application), are derived from preceding bushfire hazard assessments of:

1. The bushfire hazard potential threat level that has accounted for the identified vegetation categories in the surrounding landscape and the existence (or otherwise) of relevant physical factors that can intensify bushfire behaviour resulting in increased threat levels; and
2. The assessed potential impact of applied bushfire protection measures in reducing potential threat levels.

The resulting inherent and residual potential threat levels are derived through a qualitative assessment process (refer to Appendices A1.3.1 and A1.3.2 for explanatory and supporting information).

These threat levels, in combination with the corresponding assessed exposure and vulnerability levels for each of the assessed elements at risk, are later applied to deriving the inherent and residual bushfire risk levels (on an 'indicative' basis).

BUSHFIRE HAZARD POTENTIAL THREAT LEVEL ASSESSMENT OUTCOMES [1]					
THE IDENTIFIED BUSHFIRE HAZARD - VEGETATION CATEGORIES AND POTENTIAL THREAT LEVEL RANGES [2]					
Tree-1	Tree-2	Tree/Shrub	Shrub	Grass	No/Low Threat
Moderate to Extreme	Moderate to Extreme	Moderate to Very High	Low to Moderate	Low to Moderate	None to Low
THE BASE BUSHFIRE HAZARD POTENTIAL THREAT LEVEL TO APPLY TO THE SITE [3]					
Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
THE POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE BUSHFIRE HAZARD POTENTIAL THREAT LEVELS [4]					
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED			WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED		
Moderate			Significant		
RESULTANT INHERENT THREAT LEVEL [5] (Current State)			RESULTANT RESIDUAL THREAT LEVEL [5] (Potential Future State)		
High			Moderate		

Note 1: Refer to Appendix 1 for explanatory information.

Note 2: Assessment detail is in Section 5.1.2.

Note 3: After the consideration of the surrounding landscape and existence of relevant physical factors. Assessment detail is in Section 5.1.3.

Note 4: Assessment detail is in Section 5.1.4.

Note 5: Refer to A1.3.3 for explanatory information.

Assessment Comments: The existing and planned protection measures are partly considered in the base bushfire hazard threat level (e.g. local grazing intensity). The measures are insufficient to reduce the inherent threat level.

The additional planned measures (primarily increased APZs and operating procedures) result in a reduced residual threat.

5.2 THE IDENTIFIED ELEMENTS AT RISK

THE IDENTIFIED ELEMENTS AT RISK AND SUBJECT TO ASSESSMENT			
Possible Types	Exists on Subject Site and is Exposed to Bushfire Hazard Threats	Bushfire Risk Report Objectives Establish Requirement to Assess	Description
Persons located onsite and temporarily offsite as part of site operations - includes occupants, staff, visitors and persons on day trips offsite (e.g. tourism)		✓	The site is proposed to be unstaffed. However, persons onsite have been assessed as an element at risk as: • The scale of the site necessitates regular visitation for maintenance, inspections etc, and; • The external road access is restrictive. The contingency for emergency services or staff temporarily onsite being unable to safely evacuate must be accounted for.
Persons on access/egress routes (roads, driveways, access ways) in vehicles:		✓	The site is proposed to be unstaffed. Persons on access/egress routes has been assessed for Emergency Services and any staff temporarily onsite for maintenance etc.
Buildings or Structures – NCC Class 10 - non-habitable – shed, carport, garage, fence, retaining wall etc.		✓	No Class 1-10 buildings have been included within the provided site plan. The assessment considers maintenance and storage sheds which may be present onsite.
Built Infrastructure Assets – structures associated with telecommunications / power generation / transport / water supply etc.	✓	✓	BESS Cabinets and Associated Infrastructure.
			Solar Arrays and Associated Infrastructure.
			HV Substation and Transmission Lines.

5.3 EXPOSURE LEVEL ASSESSMENT – BUSHFIRE PROTECTION MEASURE ANALYSIS

For each stated element at risk and each relevant bushfire hazard, an assessment is conducted that considers the effectiveness and application status of all available exposure reducing bushfire protection measures that are listed under their applicable bushfire protection mechanism. This information is subsequently applied to deriving exposure levels.

5.3.1 PERSONS ONSITE AND TEMPORARILY OFFSITE

5.3.1.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons Onsite and Temporarily Offsite					
THE PROTECTION MECHANISM – ESTABLISH SUFFICIENT SEPARATION FROM RELEVANT BUSHFIRE HAZARD THREATS: To ensure that the persons are located or re-located at a sufficient distance from the bushfire hazard to ensure the level of exposure to the threats, and the associated risk of persons death or injury, is contained within acceptable parameters.						
2.1	Stay Away from the Subject Site: Prevent access to, occupancy or operation of the subject site (i.e. closure of use) in response to a pre-determined fire danger rating (FDR) or fire behaviour index (FBI) and/or activity restriction (e.g., total fire ban) or a defined period of the year (highest risk). The relevant conditions and the requirement to stay away will be established through relevant site operational documents such as a Bushfire Emergency Plan or Site Emergency Plan/Guide.	Very High	Yes	No	Yes	No
Assessment Comments: The measure differs as the site is unstaffed- there will usually be no persons to notify. Site works are restricted by Total Fire Bans/Vehicle Movement Bans, and scheduled maintenance is restricted through Measure 1.9. Therefore, staff/contractors/visitors attending the site during these periods will do so for important tasks (attending to faults, security issues etc) or for inspection only, in which case evacuation could be engaged immediately. Visitors must provide mobile phone numbers to site management. Within the Emergency Management Plan, a key response will be to contact and advise all persons onsite. *Recommendation Details:* Not Applicable						
2.2	Remote Tourism Sites - Stay Within the Subject Site: Relevant when tourism operations are moving persons offsite as part of operations e.g., tourism day trips. All associated persons (staff, guests, visitors), in response to a pre-determined fire danger rating (FDR) or fire behaviour index (FBI) and/or activity restriction (e.g., total fire ban), will remain on-site as better communication and sheltering options exist on-site compared to travelling in a remote area – if possible. The relevant conditions and the requirement to stay will be established through relevant site operational documents such as a Bushfire Emergency Plan or Site Emergency Guide.	High	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons Onsite and Temporarily Offsite					
Assessment Comments: Not a tourism site and there are no external visits. *Recommendation Details:* Not Applicable						
2.3	Remote Tourism Sites - Relocate to Designated Safer Offsite Location: Relevant when tourism operations are moving persons offsite as part of operations e.g., tourism day trips. A suitable offsite alternative safer location(s) is identified as a destination should the subject site and/or the route back to the subject site, be impacted by a bushfire event during the time away from the site.	High	N/A	N/A	N/A	N/A
Assessment Comments: Not a tourism site and there are no external visits. *Recommendation Details:* Not Applicable						
2.4	Relocate (Evacuate) to Designated Safer Offsite Location(s): A building, area or general location is identified and accessible from the subject site as an evacuation destination. The offsite location exists at a sufficient distance away ensuring that the destination and the subject site are not likely to be simultaneously impacted by a bushfire event.	High	Yes	Yes	No	No
Assessment Comments: The visitation will be low, being either a small number of staff/visitors/contractors, or Emergency Services personnel. Any persons evacuating from the site will be familiar with the local area and will self-evacuate to a preferred location. The Narrogin townsite exists as an appropriate destination. *Recommendation Details:* Not Applicable						
2.5	Relocate to Safer Onsite Open Area: Provide an accessible area located in the open (i.e. not in an enclosed building), within the subject site and on which persons can assemble and that will not be subject to radiant heat flux in excess of 2 kW/m^2 (determined using a flame temperature of 1200 K). Consideration must also be given to potential exposure to embers, adverse weather, availability of water / facilities and the relative importance of these to the specific use proposal.	High	Yes	Partly	No	Yes
Assessment Comments: The solar farm footprints are sufficiently large that they contain areas subject to <2kW/m2 radiant heat flux.						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons Onsite and Temporarily Offsite					

FLAMESOL FPA AUSTRALIA

Calculated September 12, 2024, 9:46 pm (BALc v.4.9)

Bushfire Attack Level calculator - AS3959-2018 (Method 2)

Inputs		Outputs	
Grassland Fire Danger Index	110	Rate of spread	20.19 km/h
Vegetation classification	Grassland	Flame length	8.16 m
Understorey fuel load	4.5 t/ha	Flame angle	81 °
Total fuel load	4.5 t/ha	Panel height	8.06 m
Vegetation height	n/a	Elevation of receiver	12.34 m
Effective slope	5 °	Fire intensity	46,945 kW/m
Site slope	-5 °	Transmissivity	0.737
Distance to vegetation	95 m	Viewfactor	0.0248
Flame width	100 m	Radiant heat flux	2.04 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-12.5
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,200 K		

Rate of Spread - Noble et al. 1980
Flame length - Purton, 1982
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

FLAMESOL FPA AUSTRALIA

Calculated September 12, 2024, 9:51 pm (BALc v.4.9)

Bushfire Attack Level calculator - AS3959-2018 (Method 2)

Inputs		Outputs	
Fire Danger Index	80	Rate of spread	3.38 km/h
Vegetation classification	Forest	Flame length	26.22 m
Understorey fuel load	25 t/ha	Flame angle	77 °
Total fuel load	35 t/ha	Panel height	25.55 m
Vegetation height	n/a	Elevation of receiver	28.08 m
Effective slope	5 °	Fire intensity	61,280 kW/m
Site slope	-5 °	Transmissivity	0.6889999999999999
Distance to vegetation	175 m	Viewfactor	0.0264
Flame width	100 m	Radiant heat flux	2.03 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-12.5
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,200 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980
Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

FLAMESOL FPA AUSTRALIA

Calculated September 12, 2024, 9:52 pm (BALc v.4.9)

Bushfire Attack Level calculator - AS3959-2018 (Method 2)

Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.03 km/h
Vegetation classification	Woodland	Flame length	16.21 m
Understorey fuel load	15 t/ha	Flame angle	79 °
Total fuel load	25 t/ha	Panel height	15.91 m
Vegetation height	n/a	Elevation of receiver	19.94 m
Effective slope	5 °	Fire intensity	26,263 kW/m
Site slope	-5 °	Transmissivity	0.712
Distance to vegetation	137 m	Viewfactor	0.0257
Flame width	100 m	Radiant heat flux	2.04 kW/m²
Windspeed	n/a	Bushfire Attack Level	BAL-12.5
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,200 K		

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980
Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Recommendation Details: Emergency muster points should be reasonably adjacent to large solar panel banks (>200m wide), as the central portion of the larger banks are subject to <2kW/m2 radiant heat flux. These areas are suitable for emergency onsite shelter during a bushfire event, where evacuation is no longer safe.

2.6	Safer Pathways for Onsite Movement: To ensure lower risk movement (walking) of persons and firefighters on the site, heavy fuels are excluded from areas adjacent to pathways used to access designated safer locations onsite. The required minimum separation distances are [13] [31]: • At least 4m from stored heavy fuels (refer to Appendix 2). • At least 6m from stored and constructed large heavy fuels (refer to Appendix 2).	Medium	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons Onsite and Temporarily Offsite					
	• At least 12m from constructed large heavy fuels that are buildings/structures. Additionally: • The pathway/route is constructed of non-combustible materials; • No gas bottles are venting towards the pathway/route; and • Shrubs are separated from the pathway/route corresponding to a distance to minimise the threats to persons on foot with consideration of their flammability and height.					
Assessment Comments: The site is large-scale and any persons onsite will travel in vehicles. *Recommendation Details:* Not Applicable						
2.7	Pre-Emptively Relocate to Designated Safer Offsite Location(s): In response to a pre-determined fire danger rating (FDR) or fire behaviour index (FBI) and/or activity restriction (e.g., total fire ban) or other established condition, all persons onsite will pre-emptively relocate offsite for the duration of the existence of the conditions. The relevant conditions and the requirement to pre-emptively relocate will be established through relevant site operational documents such as a Bushfire Emergency Plan or Site Emergency Guide.	High	Yes	No	Yes	No
Assessment Comments: Persons onsite will be notified in advance via Measure 2.1. Pre-emptive relocation will not be applied as it is unnecessarily restrictive to inspection/maintenance/repair operations. Staff/contractors/visitors attending the site during high Fire Danger Ratings/Total Fire Ban periods will do so for important tasks (attending to faults, security issues etc) or for inspection only, in which case evacuation could be engaged immediately. *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM – ESTABLISH SHIELDING FROM RELEVANT BUSHFIRE HAZARD THREATS: To utilise constructed or natural shielding to reduce the exposure of persons to the flame, radiant heat, and ember attack from bushfire and consequential fire.						
2.8	On-site Shelter Building – Community Bushfire Refuge Standard [20]: Applicable to use by 'vulnerable' persons (refer to Glossary). Provide a building which is constructed in accordance with the NCC and the ABCB Design and Construction of Community Bushfire Refuges – Information Handbook [20]. Note: The minimum requirement for floor area per person of 0.75 m^2 may be increased by relevant authorities in specific jurisdictions (e.g., to 1.0 m^2 in WA, Guidelines v1.4 [22]).	High	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons Onsite and Temporarily Offsite					
2.9	On-site Shelter Building – Limit Radiant Heat Exposure Only: Applicable to use by 'vulnerable' persons (refer to Glossary) where accommodation is not part of the site use. Provide a building that will not be subject to radiant heat flux in excess of 10 kW/m^2 (determined using AS 3959 BAL determination methodology [4] and applying a flame temperature of 1200 K) and constructed to the bushfire standard corresponding to the BAL-29 rating (to provide greater resistance to consequential fire threats).	High	N/A	N/A	N/A	N/A
2.10	On-site Shelter Building – Resilient to Potential Bushfire Impacts to the Degree Necessary: Provide a building that incorporates design and construction protection measures to reduce the building's vulnerability to bushfire and consequential fire threats to the degree necessary. Refer to the section of this report that identifies bushfire protection measures to reduce the vulnerability of buildings/structures). Alternatively, provide a building that will not be subject to radiant heat flux in excess of 10 kW/m^2 (determined using AS 3959 BAL determination methodology [4] and applying a flame temperature of 1200 K) and constructed to the bushfire standard corresponding to the BAL-29 rating (to provide greater resistance to consequential fire threats).	High	Yes	No	No	No
2.11	On-site Shelter Structure – Class 10c: Provide a private bushfire shelter (Class 10c building) constructed in accordance with the NCC and the *Performance Standard – The design and construction of private bushfire shelter (ABCB 2014).* This is not a standalone measure but an additional measure as a last resort.	High	Yes	No	No	No
Assessment Comments: The site is not proposed to have permanent staffing or suitable buildings for shelter (e.g. site office). A shelter building for this purpose is not practical, and <2kW/m2 areas are available in Measure 2.5. *Recommendation Details:* Not Applicable						
2.12	Constructed Barrier – Shield Persons in the Open: Construct walls / fences / landforms as shielding structures that are not buildings, applying appropriate fire resistant / non-combustible construction materials (e.g. masonry, steel, earthworks). These are to withstand the impact of direct bushfire attack mechanisms for the required period of time and provide the required reduction in threat levels to persons in the open. Construction requirements will correspond, as a minimum, to the BAL-FZ requirements for walls as established by AS 3959:2018 [4] and/or the NASH Standard [33] and additionally informed by the research report 'Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires' [29].	Medium	Yes	No	No	No
Assessment Comments: Heat barriers are not required to achieve the required <2kW/m2 radiant heat flux exposure.						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons Onsite and Temporarily Offsite					
Recommendation Details: Not Applicable						
2.13	Natural Barrier – Shield Persons in the Open: Utilise natural landforms that have the potential to shield persons from the bushfire and consequential fire threats.	Medium	No	No	No	No
Assessment Comments: No such landforms are present. *Recommendation Details:* Not Applicable						
2.14	Constructed/Natural Barrier – Shielding for Persons on Pathways to Safer Onsite Area/Building: Where possible, alongside pathways to an on-site shelter building/area, utilise walls / fences / landforms as shielding structures constructed using fire resistant / non-combustible construction materials (e.g. masonry, steel, earthworks). These are to withstand the impact of direct bushfire attack mechanisms for the required period of time and provide the required reduction in threat levels to persons (including firefighters) traversing the pathway. Construction can be informed by the BAL-FZ requirements for walls as established by AS 3959:2018 [4] and/or the NASH Standard [33] and additionally informed by the research report 'Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires' [29].	Medium	N/A	N/A	N/A	N/A
Assessment Comments: The site is large-scale and any persons onsite will travel in vehicles. *Recommendation Details:* Not Applicable						

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining.

Note 2: Protection Measure Application Status:

- Possible: Protection measures that can potentially be applied to the proposed development/use.
- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons Onsite and Temporarily Offsite					

- Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).

- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.3.1.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing exposure levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the exposure of the relevant element at risk to bushfire hazard threats.

EXPOSURE REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Persons Onsite and Temporarily Offsite						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Availabl e	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommen
Establish Sufficient Separation from Relevant Bushfire Hazard Threats	Very High	1	1			1	
	High	5	3	1	1	1	1
	Medium	1					
	Not Relevant						
Establish Shielding from Relevant Bushfire Hazard Threats	Very High						
	High	4	2				
	Medium	3	1				
	Not Relevant						
Number Analysis	Very High	1	1			1	
	High	9	5	1	1	1	1
	Medium	4	1				
	Not Relevant						
	Totals	14	7	1	1	2	1

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.3.1.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE EXPOSURE

From the information presented in the previous section, the exposure reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce exposure (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE EXPOSURE TO BUSHFIRE HAZARD THREATS [1]							
Element at Risk	Persons Onsite and Temporarily Offsite						
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Very Significant	Moderate	Moderate	Moderate	Significant	Moderate	Significant	Minimal
Significant				Moderate			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Very Significant	Significant	Moderate	Significant	Significant	Significant	Significant	Moderate
Significant				Significant			

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This exposure reducing potential will be applied to deriving the inherent exposure level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This exposure reducing potential will be applied to deriving the residual exposure level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

Assessment Comments: Designation of appropriate onsite open shelter locations subject to <2kW/m2 radiant heat flux is the only applicable measure to reduce exposure. The area would be available with a 'Planning BAL-29' APZ, and persons onsite would naturally move away from excessive heat to these areas. The measure is only to locate muster points in appropriate locations and thus the inherent and residual exposures are both Low.

5.3.1.4 DERIVED EXPOSURE LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual exposure levels.

In combination with the corresponding assessed threat and vulnerability levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL EXPOSURE LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]							
ELEMENT AT RISK		Persons Onsite and Temporarily Offsite					
BUSHFIRE ATTACK MECHANISMS [2]		INHERENT EXPOSURE LEVEL (CURRENT STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	Low
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
BUSHFIRE ATTACK MECHANISMS [2]		RESIDUAL EXPOSURE LEVEL (POTENTIAL FUTURE STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	Low
DIRECT	Radiant Heat [4]	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix 2 for explanatory and supporting information.

Note 3: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

Note 4: The level of exposure to flames and radiant heat is derived from the assessed BAL ratings (refer to the BAL contour map). The exposure levels applied are BAL-LOW/Very Low Exposure, BAL-12.5/Low Exposure, BAL-19/Moderate Exposure, BAL-29/High Exposure, BAL-40 and BAL-FZ/Extreme Exposure.

5.3.2 PERSONS ON ACCESS/EGRESS ROUTES IN VEHICLES

5.3.2.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS				Effectiveness Rating [1]	Application Status [2]			
					Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons on Access / Egress Routes in Vehicles	Access Route Description	Local road network including internal roads- applicable to Emergency Services.					
THE PROTECTION MECHANISM - ESTABLISH SUFFICIENT SEPARATION FROM RELEVANT BUSHFIRE HAZARD THREATS: To utilise distance away from relevant bushfire hazard threats (primarily flames, radiant heat and tree strike/obstruction) while traversing an access/egress route in a vehicle to lower the exposure of persons for the expected time on the route.								
3.1	Locate Access/Egress Routes Away from Adjacent Hazards: Existing or to be installed vehicular access/egress route components (roads, access ways, and driveways) are positioned to maximise the distance away from any adjacent bushfire prone vegetation where possible.			High	No	Partly	No	No
Assessment Comments: The measure is not under the control of site management. External access routes are existing and cannot be changed. The external routes (along multiple roads) travel through grassland vegetation with patches of forest and woodland. Once Great Southern Highway is reached, no large forested sections are present along the route to Narrogin. Internal access routes (other than perimeter access) are within the development area will generally be bounded by pasture. *Recommendation Details:* Not Applicable								
3.2	Egress Routes Located to Ensure Driving Away from Hazard: Existing or to be installed vehicular access/egress route components (roads, access ways, and driveways) are positioned so that the direction of egress is away from the hazard into lower threat areas.			Very High	No	Partly	No	No
Assessment Comments: Once Great Southern Highway is reached, no large forested sections are present along the route to Narrogin. The measure cannot be addressed, except by selecting the safer route to travel. *Recommendation Details:* Not Applicable								
3.3	Greater Road Width: Wider roads will allow for a greater separation distance between traversing vehicles and the bushfire hazard. The incorporation of non-vegetated and trafficable road verges/shoulders and adjacent footpaths can also safely increase effective separation for slower moving vehicles.			High	Yes	Partly	No	No

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS				Effectiveness Rating [1]	Application Status [2]			
					Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons on Access / Egress Routes in Vehicles	Access Route Description	Local road network including internal roads- applicable to Emergency Services.					
Assessment Comments: Great Southern Highway is a major state route and Wanerie Road is a major local road, both with >18m clearance. Other local roads accessing the site have lesser clearances. Shoulders are largely grasses 10-20cm long with trees or scrub alongside the road for much of the route, however this is generally connected to pasture areas only. Primary internal access routes (other than perimeter access) will be constructed to a minimum 6m trafficable width and will be bounded by grassland, low threat, or non-vegetated areas (the development area and APZ). *Recommendation Details:* Not Applicable								
3.4	Reduce and Maintain Road Verge Fuel to a Low Threat State: Road verges, or part off, support low threat vegetation or vegetation is removed or reduced and maintained to a minimal fuel condition to increase the separation distance from the bushfire hazard. This is practical when an authority exists to conduct the management and will have greater threat reducing impact as a protection measure, if there is certainty it will be carried out.			Medium	No	No	No	No
Assessment Comments: Verges offsite are not maintained in a low-threat condition. Internal routes will be bounded by grassland, low threat, or non-vegetated areas (the development area and APZ). *Recommendation Details:* Not Applicable								
THE PROTECTION MECHANISM – ESTABLISH SHIELDING FROM RELEVANT BUSHFIRE HAZARD THREATS: To utilise constructed or natural shielding to reduce the exposure of persons, traversing the access/egress routes, to relevant bushfire threats (primarily flames, radiant heat and embers). To assist with ensuring the level of exposure to the threats is survivable for the expected time on the route while travelling in a vehicle.								
3.5	Ensure Evacuation Vehicle Types Provide a Degree of Protection: People can only tolerate low levels of radiant heat without some protection. Vehicles provide some protection from low intensity fires (if they stay on cleared area and remain in the vehicle) but they will not protect people in moderate to intense grass fires or in any location where scrub or forest adjoin the road. Protection provided by vehicles with predominantly metal bodies (including roof) and able to be enclosed (glass window), while limited is also still significant. It is particularly significant when compared to other potentially available modes of transport on roads (e.g. open top/backed vehicles, motorbikes, bicycles and being on foot). The availability such vehicles of required capacity can contribute to reduced exposure to the bushfire threats for persons on access/egress routes.			Medium	Partly	Yes	No	No
Assessment Comments: The site is intended to be unstaffed but visitation is possible. These contractors will have enclosed vehicles for traversing the site. Vehicles accessing the site in a bushfire event will be Emergency Services, with vehicles which provide a measure of protection.								

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS				Effectiveness Rating [1]	Application Status [2]			
					Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons on Access / Egress Routes in Vehicles	Access Route Description	Local road network including internal roads- applicable to Emergency Services.					
Recommendation Details: Not Applicable								

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining.

Note 2: Protection Measure Application Status:

- Possible: Protection measures that can potentially be applied to the proposed development/use.
- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

  These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.3.2.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing exposure levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the exposure of the relevant element at risk to bushfire hazard threats.

EXPOSURE REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Persons on Access / Egress Routes in Vehicles						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommend
Establish Sufficient Separation from Relevant Bushfire Hazard Threats	Very High	1			1		
	High	2	1		2		
	Medium	1					
	Not Relevant						
Establish Shielding from Relevant Bushfire Hazard Threats	Very High						
	High						
	Medium	1	1	1			
	Not Relevant						
Number Analysis	Very High	1			1		
	High	2	1		2		
	Medium	2	1	1			
	Not Relevant						
	Totals	5	2	1	3		

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.3.2.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE EXPOSURE

From the information presented in the previous section, the exposure reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce exposure (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE EXPOSURE TO BUSHFIRE HAZARD THREATS [1]							
Element at Risk	Persons On Access/Egress Routes in Vehicles						
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Moderate	Minimal	Minimal	Minimal	N/A	Moderate	Minimal	Moderate
Minimal				Moderate			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Moderate	Minimal	Minimal	Minimal	N/A	Moderate	Minimal	Moderate
Minimal				Moderate			

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This exposure reducing potential will be applied to deriving the inherent exposure level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This exposure reducing potential will be applied to deriving the residual exposure level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

Assessment Comments: No recommendations are applicable. The inherent and residual risk are the same. As the site is intended to be unstaffed, the relevant persons on access routes are Emergency Services.

5.3.2.4 DERIVED EXPOSURE LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual exposure levels.

In combination with the corresponding assessed threat and vulnerability levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL EXPOSURE LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]							
ELEMENT AT RISK		Persons on Access/Egress Routes in Vehicles					
BUSHFIRE ATTACK MECHANISMS [2]		INHERENT EXPOSURE LEVEL (CURRENT STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	High
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☒	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
BUSHFIRE ATTACK MECHANISMS [2]		RESIDUAL EXPOSURE LEVEL (POTENTIAL FUTURE STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	High
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☒	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix 2 for explanatory and supporting information.

Note 3: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

Note 4: The level of exposure to flames and radiant heat is derived from the assessed BAL ratings (refer to the BAL contour map). The exposure levels applied are BAL-LOW/Very Low Exposure, BAL-12.5/Low Exposure, BAL-19/Moderate Exposure, BAL-29/High Exposure, BAL-40 and BAL-FZ/Extreme Exposure.

5.3.3 BUILDINGS AND STRUCTURES - NCC CLASSES 1-10

5.3.3.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Buildings/Structures - NCC Classes 1-10					
THE PROTECTION MECHANISM – ESTABLISH SUFFICIENT SEPARATION FROM RELEVANT BUSHFIRE HAZARD THREATS: To reduce exposure to the relevant direct and indirect attack mechanisms of bushfire by locating buildings and attached/adjacent structures at sufficient distances away from the bushfire hazard and consequential fire fuels. The required distances will be dependent on the assessed threat levels and the degree of bushfire resilience that exists or is planned to be incorporated into the exposed elements through design and construction.						
4.1	Siting of Buildings/Structures Considering Potential High Wind Exposure: Site buildings and attached/adjacent structures in locations that have less exposure to terrain influenced prevailing synoptic winds, and particularly those locations with potential for significant terrain/bushfire threat intensification interactions (refer to Appendix 3). Avoid the top and sides of ridges. Strong winds can directly or indirectly (airborne materials/debris) cause damage to the external building envelope, potentially allowing flame, radiant heat and ember entry.	High	Yes	No	No	Yes
Assessment Comments: The site is approximately 1002 hectares and the location of potential Class 1-10 structures is not known. The BAL-29 APZ required will have a minor impact on exposure to fire-driven wind. The local topography (within 150m) is flat to gently undulating so the location will not experience significant terrain/bushfire threat intensification. Siting possible future buildings away from vegetation capable of generating fire-driven wind is the available option for reducing exposure and is applied in Measure 4.3. *Recommendation Details:* See Measure 4.3.						
4.2	Designed Location of Non-Vegetated Areas and/or Managed Open Space: Non-vegetated land uses include footpaths, paved areas, roads, parking, open drainage channels, and major services delivery (power, water, gas) installed in common corridors. Managed open space is land for public or private use on which the vegetation is either low threat due to type or situation or is continually managed in a minimal fuel condition. This can include public open space providing recreation facilities. Use these design elements to create or increase separation from any bushfire prone vegetation by positioning them adjacent to the bushfire hazard.	Very High	Yes	No	Partly	No

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Buildings/Structures - NCC Classes 1-10					
Assessment Comments: There are no such areas existing. Proposed internal access roads and hardstand will be located throughout the site and any future building will require trafficable access. Slashed/grazed grasses will likely be present within the solar farm area. The 10m portion of the APZ immediately around the BESS must be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc), applied in Measure 6.3. BESS and the substation must be sited on suitably sealed surfaces. Any future buildings will be positioned with trafficable access but the location of other non-vegetated areas relative to the building will be dependent on its siting. *Recommendation Details:* Not Applicable						
4.3	Landscaping - Asset Protection Zone (APZ): Ensure an APZ is established surrounding the relevant element(s) at risk to create the required separation distance from the bushfire hazard to protect against the direct attack mechanisms of flame contact and radiant heat and reduce exposure to embers. *In addition to providing separation from the direct bushfire attack mechanisms, the nature of the APZ design and management requirements is intended to minimise the potential impact of the indirect bushfire attack mechanisms of surface fire attack, debris production and accumulation, tree strike and consequential fire (refer to Appendix 2).* This is achieved by ensuring the APZ contains low threat vegetation; and/or has potential fire fuels managed in a minimal fuel condition; and/or contains non-vegetated areas (e.g. footpaths, paved areas, driveways, parking, swimming pools etc) and/or limits the presence/location of constructed/stored combustible items. For different States and local government areas, APZ establishment and maintenance guides ideally need to be local environment specific. Some authorities establish general requirements while specific requirements may also be established through site specific management documents (e.g. bushfire management plan). The required dimensions of the APZ will correspond to the maximum level of radiant heat the exposed element is to be exposed to – or a greater distance if it is stipulated by a relevant authority. As a minimum avoid dimensions (separation distances) that correspond to BAL-FZ and BAL-40 ratings for any given site/vegetation combination of relevant parameters. This will also apply to BAL-29 separation distances if flame length modelling indicates potential contact due to specific site and effective slope configurations. The location of an APZ should be entirely within the boundaries of each lot so that landowners can have control and responsibility for its implementation and maintenance. Exceptions exist for instances where adjoining land is not vegetated or it can be justified that the fire fuels will be managed in a minimal fuel, low threat state on an ongoing basis, in perpetuity.	Very High	Yes	No	Yes	Yes
Assessment Comments: Any future class 1-10 buildings will apply a minimum BAL-29 dimensioned APZ as required by the Guidelines for Planning in Bushfire Prone Areas.						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Buildings/Structures - NCC Classes 1-10					
The buildings are not for habitable purposes and this APZ is intended to prevent flame contact and excessive radiant heat, and provide shielding to stored material from these impacts and ember attack. There is no planned landscaping on-site that will include vegetation of any kind. Visual screens may be planted, but these will be classifiable vegetation and thus will not form part of the APZ. *Recommendation Details:* A BAL Assessment should be completed for any future Class 1-10 buildings. Class 1-9 buildings must be constructed to their assessed BAL. If the building type/design is not required to or cannot construct to AS 3959, they should be sited to ensure radiant heat flux exposure does not exceed 10kW/m2 radiant heat flux. Any future Class 1-10 buildings should be sited within previously cleared, managed areas to reduce the requirement for ongoing management.						
4.4	Landscaping - Tree Location: Use separation to minimise the potential for debris accumulation and tree strike damage to the building/structures that will allow flame, radiant heat and ember entry to internal spaces. Principles to apply are: • The buildings/structures are separated from trees (or trees from buildings) by a distance of at least 1.5 times the height of the tallest tree; and • Trees that produce significant quantities of debris (fine fuels) during the bushfire season should be located a sufficient distance away from vulnerable exposed elements to ensure debris cannot drop and accumulate within at least 4m of buildings/structures or be likely to be relocated by wind to closer than 4m to buildings / structures. Avoid planting trees with ribbon or stringy bark (ember/firebrand production). • If the minimum distance cannot be achieved with an existing tree either remove the tree or at least ensure tree branches are sufficiently separated from buildings and attached/adjacent structures (at a minimum to not overhang) to ensure branches cannot fall onto or be blown onto the buildings/structures.	Medium	Yes	No	Yes	No
Assessment Comments: Future class 1-10 buildings will likely be sited within the APZ established for BESS, Solar, or Substation developments and thus no further clearing or setbacks will be required. These APZs are unlikely to contain trees. *Recommendation Details:* Not Applicable						
4.5	Separation from Stored Flammable Products - Gas in Cylinders: To reduce the potential for gas flaring or explosion (consequential fire), installation of LPG cylinders is to apply as a minimum, the principles and requirements established in AS 1596 'The Storage and Handling of LP Gas'. Readily available guidance is provided by CSIRO Best Practice Bushfire Guide (https://research.csiro.au/bushfire/new-builds/water-electricity-gas/) and WA Dept. Mines, Industry, Regulation and Safety 'LP Gas cylinder safety in bushfire prone areas' (https://www.commerce.wa.gov.au/publications/lp-gas-cylinder-safety-bushfire-prone-areas). Otherwise, the required separation distance is 6m from any combustible materials.	Medium	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Buildings/Structures - NCC Classes 1-10					
	Heat from bushfire or consequential fire can be sufficient to cause cylinder pressure to reach critical levels and the pressure relief valve release large quantities of gas (flare). If the cylinder falls over the pressure relief valve may not function correctly, and the cylinder may rupture (explosion).					
Assessment Comments: Gas storage is not proposed on site. Any LPG will be stored in compliance with AS 1596. *Recommendation Details:* Not Applicable						
4.6	Separation from Stored Flammable Products – Fuels / Other Hazardous Materials (Consequential Fire Fuels): Establish sufficient separation distance between these consequential fire fuels and buildings/structures. The required separation distance will be dependent on the fuel and storage type.	High	Yes	No	Yes	Yes
Assessment Comments: Fuel and other hazardous material will not be stored on site. Both flammable and combustible materials are required to be positioned and maintained >10m from assets by Measure 6.7. *Recommendation Details:* See Measure 6.7.						
4.7	Separation from Stored and Constructed Combustible Items (Consequential Fire Fuels): These consequential fire fuels include: • Stored Combustible Items - Heavy Fuels (>6mm diameter) e.g. building materials, packaging materials, firewood, branches, sporting/playground equipment, outdoor furniture, rubbish bins etc; • Stored Combustible Items – Large Heavy Fuels e.g. vehicles, caravans, boats and large quantities of dead vegetation materials stored as part of site use; • Constructed Combustible Items – Heavy Fuels e.g. landscaping structures including fences, screens, walls, plastic water tanks; and • Constructed Combustible Items – Large Heavy Fuels e.g. adjacent buildings/structures including houses, sheds, garages, carports. (Note: If the adjacent structure is constructed to BAL-29 requirements or greater and can implement a significant number of additional bushfire protection measures associated with reducing exposure and vulnerability, these minimum separation distances could be reduced by 30%) [31]. *Apply the rule of thumb [13] "assume flames produced from a consequential fire source will be twice as high as the object itself … where the consequential fire source is a structure, then the maximum eave height is a reasonable measure of maximum height".*	High	Yes	No	No	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Buildings/Structures - NCC Classes 1-10					
	Apply the following separation distances from the subject building/structure as a multiple of the height of the consequential fire source and dependent on the bushfire construction standard applied to the building/structure [13 and 31]: • At least six times the height when the building/structure construction incorporates design and materials that is only intended to resist low levels of radiant heat up to 12.5 kW/m^2) and no flame contact; • Between 4 and 6 six times the height when the building/structure construction incorporates design and materials intended to resist radiant heat up to 29 kW/m^2 and no flame contact. • Between 2 and 4 times the height when the building/structure construction incorporates design and materials intended to resist up to 40kW/m^2 and potential flame contact. • Less than 2 times the height when the building/structure construction incorporates design and materials intended to resist extreme levels of radiant heat and flame contact. • Zero separation distance is required if the building/structure is separated by a non-combustible FRL 60/60/60 rated wall, or the potential consequential fire source is fully enclosed by the building/structure.					
Assessment Comments: Future buildings may not be able to be constructed to AS 3959, and thus <12.5kW/m2 radiant heat level construction is considered. Buildings can be positioned >6x the height of BESS cabinets and solar panels. A BESS cabinet is approximately 2.6m tall (15.6m separation) and a solar panel aligned to the vertical extent is approximately 2.5m (15m separation). *Recommendation Details:* See Measure 6.7.						
THE PROTECTION MECHANISM – ESTABLISH SHIELDING FROM RELEVANT BUSHFIRE HAZARD THREATS: Reduce exposure the direct bushfire attack mechanisms of flame, radiant heat, surface migration of embers and to a potentially limited extent, fire driven wind - by shielding buildings and attached/adjacent structures or other consequential fire fuels. To also reduce exposure to the indirect attack mechanism of debris accumulation against buildings/structures and other consequential fire fuels.						
4.8	Constructed Barrier – Shielding from Bushfire: Walls, fences and/or landforms to shield the subject building/structure from direct and indirect bushfire attack mechanisms and reduce the potential impact. Must be constructed using appropriate fire resistant / non-combustible construction materials (e.g. masonry, steel, earthworks). These are to withstand the impact of direct bushfire attack mechanisms for the required period of time. Apply the bushfire construction standards for external walls subject to the assessed level of radiant heat or flame contact to which the barrier will be exposed (or otherwise to BAL-FZ requirements). These are established by AS 3959:2018 [4] and/or the NASH Standard [33] and additionally informed by the research report 'Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires.' [29]	High	Yes	No	No	No

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Buildings/Structures - NCC Classes 1-10					
Assessment Comments: The measure is not cost-effective as an appropriate APZ can be established, and any such buildings will likely be sited within the APZ established for BESS, Solar, or Substation developments. *Recommendation Details:* Not Applicable						
4.9	Constructed Barrier - Shielding from Consequential Fire: Applicable to all consequential fire fuel sources. Install a non-combustible barrier (including complete enclosure when appropriate), of required robustness, that can perform the following as relevant: • Reduce the exposure of the subject building/structure to the threats of consequential fire; and/or • Reduce the exposure of the consequential fire fuels to the bushfire hazard.	High	Yes	No	No	No
Assessment Comments: Consequential fire sources are addressed in Measure 6.7. *Recommendation Details:* Not Applicable						
4.10	Natural Landforms Barrier: Use existing natural landforms to reduce buildings/structures exposure to radiant heat, and lower wind speeds (prevailing synoptic and/or fire driven).	High	No	No	No	No
Assessment Comments: No appropriate landforms exist. *Recommendation Details:* Not Applicable						
4.11	Planted Vegetation Barrier: Use appropriate species (lower flammability) of hedges and trees strategically to reduce (to varying extents) buildings/structures exposure to radiant heat, to filter/trap embers and firebrands, and to lower wind speeds (prevailing synoptic and/or fire driven).	Medium	Yes	No	No	No
Assessment Comments: Landscaped vegetation is not recommended within the APZ to remove the capacity for surface fire and production of debris (leaf litter etc). *Recommendation Details:* Not Applicable						
4.12	Shield Operation Critical Non-Structural Elements: These are vulnerable elements essential to the continued operation of the building/structure which are potentially exposed to the attack mechanisms of both bushfire and consequential fire. These elements include cabling and plumbing associated with power delivery, data transmission, fuel and water transport.	Medium	Yes	No	No	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Buildings/Structures - NCC Classes 1-10					
	When the use of fire rated materials to the degree necessary is not possible or practical, the application of non-combustible shielding can be applied to reduce exposure to the threats. Shielding includes underground installation.					

Assessment Comments: Any Class 1-10 buildings are not expected to contain such components. High-risk components are addressed through the appropriate asset type (BESS, Solar, Substation).

Recommendation Details: See Measure 7.12.

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining.

Note 2: Protection Measure Application Status:

- Possible: Protection measures that can potentially be applied to the proposed development/use.
- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

  These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.3.3.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing exposure levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the exposure of the relevant element at risk to bushfire hazard threats.

EXPOSURE REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Buildings / Structures - NCC Classes 1-10						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommen
Establish Sufficient Separation from Relevant Bushfire Hazard Threats	Very High	2	2			2	1
	High	3	3			1	3
	Medium	2	1			1	
	Not Relevant						
Establish Shielding from Relevant Bushfire Hazard Threats	Very High						
	High	3	2				
	Medium	2	2				1
	Not Relevant						
Number Analysis	Very High	2	2			2	1
	High	6	5			1	3
	Medium	4	3			1	1
	Not Relevant						
	Totals	12	10			4	5

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding Section.

5.3.3.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE EXPOSURE

From the information presented in the previous section, the exposure reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce exposure (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE EXPOSURE TO BUSHFIRE HAZARD THREATS [1]							
Element at Risk	Buildings/Structures - NCC Classes 1-10						
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Significant	Moderate	Minimal	Significant	Significant	Minimal	Moderate	Minimal
Moderate				Moderate			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Very Significant	Significant	Moderate	Significant	Very Significant	Moderate	Significant	Significant
Significant				Significant			

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This exposure reducing potential will be applied to deriving the inherent exposure level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This exposure reducing potential will be applied to deriving the residual exposure level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

Assessment Comments: Most measures relate to the increased size and standard of maintenance of the APZ, and separations from and between hazards.

5.3.3.4 DERIVED EXPOSURE LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual exposure levels.

In combination with the corresponding assessed threat and vulnerability levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL EXPOSURE LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]							
ELEMENT AT RISK		Buildings and Structures – NCC Classes 1-10					
BUSHFIRE ATTACK MECHANISMS [2]		INHERENT EXPOSURE LEVEL (CURRENT STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	Moderate
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☒	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
BUSHFIRE ATTACK MECHANISMS [2]		RESIDUAL EXPOSURE LEVEL (POTENTIAL FUTURE STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	Low
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix 2 for explanatory and supporting information.

Note 3: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

Note 4: The level of exposure to flames and radiant heat is derived from the assessed BAL ratings (refer to the BAL contour map). The exposure levels applied are BAL-LOW/Very Low Exposure, BAL-12.5/Low Exposure, BAL-19/Moderate Exposure, BAL-29/High Exposure, BAL-40 and BAL-FZ/Extreme Exposure.

5.3.4 BUILT INFRASTRUCTURE ASSETS – BESS CABINETS

5.3.4.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
THE PROTECTION MECHANISM – ESTABLISH SUFFICIENT SEPARATION FROM RELEVANT BUSHFIRE HAZARD THREATS: To reduce exposure to the relevant direct and indirect attack mechanisms of bushfire by locating buildings and attached/adjacent structures at sufficient distances away from the bushfire hazard and consequential fire fuels. The required distances will be dependent on the assessed threat levels and the degree of bushfire resilience that exists or is planned to be incorporated into the exposed elements through design and construction.						
6.1	Siting of Buildings/Structures Considering Potential High Wind Exposure: Site buildings and attached/adjacent structures in locations that have less exposure to terrain influenced prevailing synoptic winds, and in particular, those locations with potential for significant terrain/bushfire threat intensification interactions (refer to Appendix 3). Avoid the top and sides of ridges. Strong winds can directly or indirectly (airborne materials/debris) cause damage to the external building envelope, potentially allowing flame, radiant heat and ember entry.	High	No	Yes	No	No
Assessment Comments: The BESS development is required to have a <10kW/m2 APZ installed, which will greatly reduce the exposure to fire-driven wind. The local topography (within 150m) is flat to gently undulating so the location will not experience significant terrain/bushfire threat intensification. *Recommendation Details:* Not Applicable						
6.2	Designed Location of Non-Vegetated Areas and/or Managed Open Space: Non-vegetated land uses include footpaths, paved areas, roads, parking, open drainage channels, and major services delivery (power, water, gas) installed in common corridors. Managed open space is land for public or private use on which the vegetation is either low threat due to type or situation or is continually managed in a minimal fuel condition. This can include public open space providing recreation facilities. Use these design elements to create or increase separation from any bushfire prone vegetation by positioning them adjacent to the bushfire hazard.	Very High	Yes	No	Yes	Yes
Assessment Comments: There are no such areas existing. The non-vegetated areas will be the internal access roads, 10m non-vegetated area around the BESS development (applied in Measure 6.3), and surfaced hardstand of the BESS and Substation footprint. *Recommendation Details:* See Measure 6.3.						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
6.3	Landscaping - Asset Protection Zone (APZ): Ensure an APZ is established surrounding the relevant element(s) at risk to create the required separation distance from the bushfire hazard to protect against the direct attack mechanisms of flame contact and radiant heat and reduce exposure to embers. *In addition to providing separation from the direct bushfire attack mechanisms, the nature of the APZ design and management requirements is intended to minimise the potential impact of the indirect bushfire attack mechanisms of surface fire attack, debris production and accumulation, tree strike and consequential fire (refer to Appendix 2).* This is achieved by ensuring the APZ contains low threat vegetation; and/or has potential fire fuels managed in a minimal fuel condition; and/or contains non-vegetated areas (e.g. footpaths, paved areas, driveways, parking, swimming pools etc) and/or limits the presence/location of constructed/stored combustible items. For different States and local government areas, APZ establishment and maintenance guides ideally need to be local environment specific. Some authorities establish general requirements while specific requirements may also be established through site specific management documents (e.g. bushfire management plan). The required dimensions of the APZ will correspond to the maximum level of radiant heat the exposed element is to be exposed to – or a greater distance if it is stipulated by a relevant authority. As a minimum avoid dimensions (separation distances) that correspond to BAL-FZ and BAL-40 ratings for any given site/vegetation combination of relevant parameters. This will also apply to BAL-29 separation distances if flame length modelling indicates potential contact due to specific site and effective slope configurations. The location of an APZ should be entirely within the boundaries of each lot so that landowners can have control and responsibility for its implementation and maintenance. Exceptions exist for instances where adjoining land is not vegetated or it can be justified that the fire fuels will be managed in a minimal fuel, low threat state on an ongoing basis, in perpetuity.	Very High	Yes	No	Yes	Yes

Assessment Comments:

The Asset Protection Zone applicable to a development should be commensurate to the vulnerabilities and maximum thresholds of that asset. The *Guidelines for Planning in Bushfire Prone Areas* v1.4 requires a BAL-29 dimensioned APZ for proposed developments regardless of asset type, use, construction, and any critical (or possibly sacrificial) nature.

The exterior and structural components of battery cabinets are non-combustible, generally being metal, fibrous cement, mineral wool etc. The Intensium Shift an approximately sea container sized cabinet with a series of battery racks installed. A single battery rack consists of battery cells (each cell connected into a module), and a control box with chiller. Power and computer cabling is associated within and between racks. These are the relevant components regarding potential for fire.

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					

- Individual batteries have been found to be highly resistant to conductive heat. Applied temperatures exceeding 400 degrees Celsius destroyed, but did not ignite, running battery cells. See UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Cell Energy Storage Systems, Third Edition (UL LLC; 8 July 2020). Other trigger/failure conditions must be met for battery cells to ignite (mechanical rupture, flame contact, product failure etc).
- Control boxes are computers which will apply thermal throttling and thermal shutdown if internal temperatures exceed a determined threshold. Once a computer system is shut down in this scenario, the threshold is expected to be that of the cabling (below).
- Associated cabling (both power transmission and computer). Common electrical cabling reaches its critical point at >12kWm2 (Kaczorek-Chrobak et al. 2007). Electrical cabling and components are expected to exceed this standard, being industrial and high capacity, however the 12kW threshold is adopted for the highest potential vulnerability.

Heat Flux Thresholds

BESS technologies are continuing to develop and the critical heat flux thresholds of assets may vary slightly between engineering designs.

Heat flux thresholds are not available for any BESS product. Thresholds can occasionally be found for components of various assets other than Class 1-10 buildings. However, these specifications understate the tolerance to high heat fluxes as they test major asset fire, which have far longer residence periods as compared to bushfire.

The following document was found to be relevant in the assessment of proposed substations: *NS187 Passive Fire Mitigation Design of Major Substations - Internal Document No. NW000-S0007* (Ausgrid 2020). Ausgrid Pty Ltd is Australia's largest electricity distributor (in terms of customers and energy load), and the document referenced is an internal network standard. The below table is sourced from Section 12 of the network standard.

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.				

Table 3 – Radiant Heat Exposure Limits for Bushfires

Item	Maximum allowable radiant heat flux (kW/m^2)	Comment
Cable	12.5 20	PVC Cables begin to distort and may ignite. Ignition of XLPE cables between 85 and 550 seconds.
Steel support structure	35	To 60% of yield strength after a maximum duration of 5 minutes. Applies where elastic deflections due to elevated temperatures are not critical.
Porcelain bushing/Insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Polymeric bushing/insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Aluminium busbar	20	Based on 250°C after a maximum duration of 5 minutes. Comparable to withstand temperature under fault conditions.
Copper busbar	25	Busbars may undergo significant distortion and impose significant stresses on rigid insulators.
Transformer tank	>35 (see Note 1)	Refer to above regarding bushings and cables.
Combustibles	12.5	Piloted ignition may occur on timber.

Note 1. Transformers always have some more vulnerable components such as bushings and cables etc. Refer to Clause 7.2.

'Combustibles' in this description are consequential fire hazards for the purposes of the bushfire assessment: packing materials, pallets, waste, and other assorted debris. These should not be present within the immediate siting and where necessary should be positioned away from infrastructure components, applied in Measure 7.7.

This leaves cables as the relevant consideration, with a maximum allowable heat flux comparable to the findings of (Kaczorek-Chrobak et al. 2007) [49], which found common electrical cabling reaches its critical point at >12kWm2. Electrical cabling and components may exceed this standard, being industrial and high capacity, however the 12kW threshold is adopted for the highest potential vulnerability.

Associated cabling (both power transmission and computer) will be present both internally and externally connecting to SWIS network.

Control boxes are computers which will apply thermal throttling and thermal shutdown if internal temperatures exceed a determined threshold. Once a computer system is shut down in this scenario, the threshold is expected to be that of the cabling (above).

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					

Exposed cabling (not shielded or buried underground) positioned beyond the <12kW zone may be damaged/destroyed in a bushfire event and require replacement. The manufacturer/developer should identify where any such exposed cabling can be sacrificed and replaced, and if de-powering/disconnection from the grid etc is required for this to be appropriate. Critical cabling should be installed within structures, underground, or shielded with appropriate sheaths.

Temperature Thresholds

The thermal insulation of the battery cabinet is not readily available, and may be specified within the standards with which the cabinet is compliant (being purchase-only). The construction, cladding, and insulation may meet or exceed the requirements for BAL-29, NASH, or the ABCB Handbook.

Radiant heat from a bushfire or other source against the battery cabinet can heat the interior, however direct calculations between radiant heat and ambient temperature within an enclosure are not available. Testing has been conducted, but only directional heat exposure (nearby asset fire or heating elements).

A critical consideration is that the full duration for the passage of a fire front is brief relative to structural fires. AS 3959 assumes a peak heat flux phase of 2 minutes. With pre-heating, flaming phase, and residual heat, the full period is generally <10 minutes. For grassland vegetation and other fine fuels, the entire exposure duration is <30 seconds.

The individual batteries have been found to be highly resistant to conductive heat. Applied temperatures exceeding 400 degrees Celsius destroyed, but not ignite, running battery cells. See *UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Cell Energy Storage Systems, Third Edition* (UL LLC; 8 July 2020). Other trigger/failure conditions must be met for battery cells to ignite (mechanical rupture, flame contact, product failure etc).

The maximum storage and design temperatures vary on the manufacturer specifications of the specific product. The lowest maximums found are:

- Switchgear: 105°C
- Transformer: 130°C
- Cables: 130°C
- Liquid cooling rack: 60°C
- Battery cell: 55°C for 12 months / 60°C 24 hours.

The product is required to comply with UN 38.3 under s2.9.4 of the *Australian Code for the Transport of Dangerous Goods by Road & Rail* v7.9 (Australian National Transport Commission 2024). UN 38.3.4.2 *Test T.2: Thermal test* which requires cells and batteries to be tested to 72C ± 2°C for 6 hours, with 10 repeats of the same set of cells or batteries. As shown above, it must be considered that battery cells and associated infrastructure/equipment are tested to be able to withstand an environment of sustained high temperatures beyond human endurance.

- The ABCB Handbook requires refuge structures for a tenable human environment be subject to <10kw/m2 radiant heat flux, and a maximum mean internal temperature <39°C for 1 hour (and peak of 45°C).

This 'tenable environment' for battery infrastructure within the BESS cabinet should be adopted as 60°C for a period of 6 hours.

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					

Emergency Response

The *Guidelines for Planning in Bushfire Prone Areas* v1.4 allows for on-site shelter options for Vulnerable Tourism Land Uses. This can be via the ABCB Handbook (above) or construction to BAL-29 and radiant heat exposure <10kW/m2.

The stated intention of the <10kW APZ applied within the *ABCB Handbook* and the *Guidelines* is that emergency responders with suitable PPE are able to operate within areas subject to <10kW/m2 radiant heat flux for limited periods. The BESS Infrastructure and the substation will be subject to <10kW/m2 radiant heat flux.

A <10kW/m2 APZ would align to these guidance documents. Note that as the development does not include persons sheltering, the applied flame temperature would be 1090K rather than 1200K.

View Factor Adjustment – Application of a Radiant Heat Barrier

The following is *not* a Method 2 calculation of a View Factor Adjustment.

All assumptions within the View Factor Adjustment are met as the battery cabinet is a full enclosure (e.g. barrier height against the emitting radiant heat panel), or not relevant (e.g. flame deflection, as the minimum 50 APZ applied exceeds the modelled solid flame length of 22.1m).

A constructed barrier must consist of solid non-combustible materials. The quality of materials and construction (including quantity and quality of fixings) must be able to withstand the expected amount of radiation and its duration (as associated with the type of vegetation present), and any other reasonably expected potential impacts.

Effective barrier materials and construction include barriers that can comply with the requirements established by AS 3959:2018 clause 9.4.1 for walls subject to BAL-FZ (FRL -/60/60 or 60/60/60 if load-bearing).

The insulation period is the critical measure (e.g. FRL 60/60/60), as this accounts for the radiant heat on the external element transferring through conduction to the internal panel and thus heating the internal environment- and thus impacting the 'tenability' above.

The barrier (battery enclosure) will not assume flame contact at <10kW/m2 radiant heat flux exposure, and the duration of pre-heating, flaming phase, and residual heat is generally <10 minutes. Therefore, the duration applied for BAL-FZ construction can justifiably be reduced.

As a reference of materials and effectiveness, findings from the project '*Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires*' (2006) conducted by BlueScope Steel Limited, CSIRO Bushfire Research and the Bushfire CRC, established the following as a key output:

"COLORBOND steel had the best performance as it is a non-combustible material, it maintained structural integrity as a heat barrier under all experimental exposure conditions, and it did not spread flame laterally or contribute to the fire intensity during exposure. The fencing reduced radiation levels within the fencing boundary to below 5 kW/m² immediately behind the fencing system during all radiation exposures and reduced the radiant heat exposure on a structure 9 m from the fencing by at least a factor of two".

This is to provide evidence that effective radiant heat shielding exists and can be applied, however direct calculations do not exist.

The technical report 21-*0010 IHE Safety Distance* (SAFT Engineering Department 14/1/2021) tested a forced fire propagation via thermal runaway of a battery module within a container on an adjoining container. This report is based on older battery chemistry. Flame ignited after 3 hours of abuse, with a duration of approximately 2 hours, and peak flame temperature of approximately 800 degrees (note- bushfire modellings applies a standard flame temperature of 1090 degrees). The impact on the neighbouring cabinet within 3m

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
was to increase the external panel to 55 degrees, with the internal environment increasing by 20 degrees only. The inputs cannot be compared to a bushfire. However, the shielding effect of the cabinet is substantial. The impact of shielding is not applied, as calculations are not available. However, the APZs applied are based on assets being entirely exposed, when in reality a significant measure of shielding will exist and reduce the exposure to the asset. *Recommendation Details:* The APZ for BESS cabinets and associated infrastructure will ensure exposure to the bushfire hazard threat of radiant heat will be limited to a maximum radiant heat flux of 10 kW/m2 (calculated with an assumed flame temperature of 1090K) by providing the required separation distances from the bushfire hazard. The 10m portion of the APZ immediately around the BESS cabinets must be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc). BESS cabinets are recommended to be sited on concrete slabs or other sealed, non-combustible surface.						
6.4	Landscaping - Tree Location: Use separation to minimise the potential for debris accumulation and tree strike damage to the building envelop potentially allowing flame, radiant heat and ember entry to internal spaces. • The buildings/structures are separated from trees (or trees from buildings) by a distance of at least 1.5 times the height of the tallest tree. • Trees that produce significant quantities of debris (fine fuels) during the bushfire season should be located a sufficient distance away from vulnerable exposed elements to ensure debris cannot drop and accumulate within at least 4m of buildings/structures or be likely to be relocated by wind to closer than 4m to buildings / structures. • If the minimum distances cannot be achieved with an existing tree either remove the tree or at least ensure tree branches are sufficiently separated from buildings and attached/adjacent structures (at a minimum to not overhang) to ensure branches cannot fall onto or be blown onto the buildings/structures.	Medium	Yes	Yes	Yes	Yes
Assessment Comments: Trees are not proposed within the 10kW/m2 APZ applied to BESS infrastructure. Landscape screening along public roads may be considered. Where applied, this would likely be a condition of approval from the decision maker. The only trees within 150m of the BESS development are associated with Class A Forest and will require a 49m setback. This APZ setback will also result in a setback from tree strike/obstruction as the trees have an approximate maximum 25m height (25 x 1.5 = 37.5m separation). *Recommendation Details:* Any future Landscape Management Plan should be reviewed by the Bushfire Consultant to provide additional advice on vegetation location, demographics, and structure.						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
6.5	Separation from Stored Flammable Products - Gas in Cylinders: To reduce the potential for gas flaring or explosion (consequential fire), installation of LPG cylinders is to apply as a minimum, the principles and requirements established in AS 1596 'The Storage and Handling of LP Gas'. Readily available guidance is provided by CSIRO Best Practice Bushfire Guide (https://research.csiro.au/bushfire/new-builds/water-electricity-gas/) and WA Dept. Mines, Industry, Regulation and Safety 'LP Gas cylinder safety in bushfire prone areas' (https://www.commerce.wa.gov.au/publications/lp-gas-cylinder-safety-bushfire-prone-areas). Otherwise, the required separation distance is 6m from any combustible materials. Heat from bushfire or consequential fire can be sufficient to cause cylinder pressure to reach critical levels and the pressure relief valve release large quantities of gas (flare). If the cylinder falls over the pressure relief valve may not function correctly, and the cylinder may rupture (explosion).	Medium	N/A	N/A	N/A	N/A
Assessment Comments: Gas storage is not proposed on site. Any LPG will be stored in compliance with AS 1596. *Recommendation Details:* Not Applicable						
6.6	Separation from Stored Flammable Products – Fuels / Other Hazardous Materials (Consequential Fire Fuels): Establish sufficient separation distance between these consequential fire fuels and buildings/structures. The required separation distance will be dependent on the fuel and storage type.	High	Yes	No	Yes	Yes
Assessment Comments: All infrastructure will be installed to manufacturers specification, including separation distances. Fuel and other hazardous material will not be stored on site. Both flammable and combustible materials are required to be positioned and maintained >10m from assets by Measure 6.7. *Recommendation Details:* See Measure 6.7.						
6.7	Separation from Stored and Constructed Combustible Items (Consequential Fire Fuels): These consequential fire fuels include: • Stored Combustible Items - Heavy Fuels e.g. building materials, packaging materials, rubbish bins etc; • Stored Combustible Items – Large Heavy Fuels e.g. vehicles, caravans and large quantities of dead vegetation materials stored as part of site use; • Constructed Combustible Items – Heavy Fuels e.g. landscaping structures including fences, screens, walls, plastic water tanks; and • Constructed Combustible Items – Large Heavy Fuels e.g. adjacent buildings/structures including houses, sheds, garages, carports. (Note: If the adjacent structure is constructed to BAL-29 requirements or greater and can	High	Yes	No	Yes	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Element at Risk: Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
implement a significant number of additional bushfire protection measures associated with reducing exposure and vulnerability, these minimum separation distances could be reduced by 30%) [31]. *Apply the rule of thumb [13] "assume flames produced from a consequential fire source will be twice as high as the object itself … where the consequential fire source is a structure, then the maximum eave height is a reasonable measure of maximum height".* Apply the following separation distances from the subject building/structure as a multiple of the height of the consequential fire source and dependent on the construction standard applied to the building/structure [13 and 31]: • At least six times the height when the building/structure construction incorporates design and materials that is only intended to resist low levels of radiant heat up to 12.5 kW/m²) and no flame contact; • Between 4 and 6 six times the height when the building/structure construction incorporates design and materials intended to resist radiant heat up to 29 kW/m² and no flame contact. • Between 2 and 4 times the height when the building/structure construction incorporates design and materials intended to resist up to 40kW/m² and potential flame contact. • Less than 2 times the height when the building/structure construction incorporates design and materials intended to resist extreme levels of radiant heat and flame contact. • Zero separation distance is required if the building/structure is separated by a non-combustible FRL 60/60/60 rated wall, or the potential consequential fire source is fully enclosed by the building/structure.					
Assessment Comments: The design and layout of the facility has been determined by the relevant designer/engineer and are assumed to be appropriate in reducing the risk of structure-to-structure (or asset) fire. BESS cabinets will be positioned >6x the height of solar panels. A solar panel aligned to the vertical extent is approximately 2.5m tall (15m separation). The separation between i-Shift containers is >1m on the shorter and >3m on the longer side. The separation between other assets is based on intervention with 1 hour, which should not be expected for the subject site, and thus greater separation distances should be applied. The below excerpt is from the *Intensium Shift technical description* revA1 s3 (Saft 2022).					

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.				

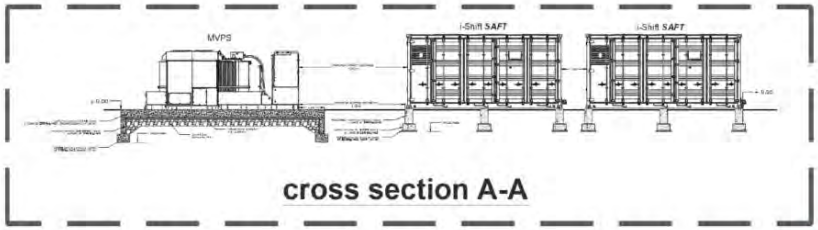
Intensium Shift – Clearance (safety or maintenance)

(Typical layout in next slide)

Clearance for the i-Shift:

1. Distance between i-Shift and another i-Shift (from the longer side): ≥ 3 m.
2. Distance between i-Shift and another i-Shift (from the shorter side): ≥ 1 m.
3. Distance between i-Shift and other industrial equipment (i.e PCS): ≥ 3 m *.
4. Distance between an i-Shift and a professional building or a non-permanent public domain (field, road): ≥ 3,50 m *
5. Distance between i-Shift and a professional building or a permanent public area permanent: ≥ 4 m *.
6. Safety End distances of thermal radiation (=plastic water tank) :
   10m with i-Shift if intervention within 1 hour,
   15 m if intervention in more than 1 hour.

* : if intervention of first responder within 1h



cross section A-A

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Recommendation Details: All non-structural combustible materials are to be removed within 10m of assets. This includes but is not limited to; waste, leaf litter, machinery, grasses, vehicles, fuel, furniture, and timber. When storage of flammable items or materials are stored on site temporarily (for maintenance etc), separation distances must be complied with. This requirement is to be included in the Site Operating Procedures document.

The Intensium Shift datasheet provides minimum clearances between BESS cabinets and other features. A >1hour intervention period should be assumed for determining the appropriate setbacks, as the proposed site is within a regional area.

Where the manufacturer specification does not specify a distance between BESS cabinets and other structures, Class 1-10 buildings and solar arrays should be sited a minimum of 15m from BESS cabinets.

THE PROTECTION MECHANISM – ESTABLISH SHIELDING FROM RELEVANT BUSHFIRE HAZARD THREATS: To shield buildings and attached/adjacent structures (or other consequential fire fuels) from the direct bushfire attack mechanisms of flame, radiant heat, surface fire and surface migration of embers. To also reduce exposure to the indirect attack mechanism of debris accumulation against buildings/structures and other consequential fire fuels and wind attack.

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
6.8	Constructed Barrier – Shielding from Bushfire: Walls, fences and/or landforms to shield the subject building/structure from direct and indirect bushfire attack mechanisms and reduce the potential impact of these. Must be constructed using appropriate fire resistant / non-combustible construction materials (e.g. masonry, steel, earthworks). These are to withstand the impact of direct bushfire attack mechanisms for the required period of time. Apply the bushfire construction standards for external walls subject to the assessed level of radiant heat or flame contact to which the barrier will be exposed (or otherwise to BAL-FZ requirements). These are established by AS 3959:2018 [4] and/or the NASH Standard [33] and additionally informed by the research report 'Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires.' [29]	High	Yes	No	No	No
Assessment Comments: The measure is not cost-effective for the scale which would be required to be effective (functional height and perimeter), and the radiant heat flux exposure of the assets (maximum 10kW/m2 radiant heat flux). *Recommendation Details:* Not Applicable						
6.9	Constructed Barrier - Shielding from Consequential Fire: Applicable to all consequential fire fuel sources. Install a non-combustible barrier (including complete enclosure when appropriate), of required robustness, that can perform the following as relevant: • Reduce the exposure of the subject building/structure to the threats of consequential fire; and/or • Reduce the exposure of the consequential fire fuels to the bushfire hazard.	High	Yes	No	No	No
Assessment Comments: Consequential fire sources are addressed in Measure 6.7. *Recommendation Details:* Not Applicable						
6.10	Natural Landforms Barrier: Use existing natural landforms to reduce buildings/structures exposure to radiant heat, and lower wind speeds (prevailing synoptic and/or fire driven).	High	No	No	No	No
Assessment Comments: No appropriate landforms exist. *Recommendation Details:* Not Applicable						
6.11	Planted Vegetation Barrier: Use appropriate hedges and trees strategically to reduce (to varying extents) buildings/structures exposure to radiant heat, to filter/trap embers and firebrands, and to lower wind speeds (prevailing synoptic and/or fire driven).	Medium	Yes	No	No	No

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
Assessment Comments: Vegetation is not recommended within the APZ to remove the capacity for surface fire and production of debris (leaf litter etc). *Recommendation Details:* Not Applicable						
6.12	Shield Operation Critical Non-Structural Elements: These are vulnerable elements essential to the continued operation of the building/structure which are potentially exposed to the attack mechanisms of both bushfire and consequential fire. These elements include cabling and plumbing associated with power delivery, data transmission, fuel and water transport. When the use of fire rated materials to the degree necessary is not possible or practical, the application of non-combustible shielding can be applied to reduce exposure to the threats. Shielding includes underground installation.	Medium	Yes	Unknown	No	Yes
Assessment Comments: All high-risk components will be positioned such that they are subject to a maximum 10kW/m2 radiant heat flux. *Recommendation Details:* Cabling and plumbing subject to >10kW/m2 (not within the <10kW/m2 setback), or beyond footprint of buildings or constructed assets, are recommended to be installed underground, or shielded with non-combustible material (or enclosed) where practical.						

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining.

Note 2: Protection Measure Application Status:

- Possible: Protection measures that can potentially be applied to the proposed development/use.
- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Additionally Recommend: Protection measures that:

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					

- Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
- Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.3.4.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing exposure levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the exposure of the relevant element at risk to bushfire hazard threats.

EXPOSURE REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommen
Establish Sufficient Separation from Relevant Bushfire Hazard Threats	Very High	2	2			2	2
	High	3	2	1		2	2
	Medium	2	1	1		1	1
	Not Relevant						
Establish Shielding from Relevant Bushfire Hazard Threats	Very High						
	High	3	2				
	Medium	2	2				1
	Not Relevant						
Number Analysis	Very High	2	2			2	2
	High	6	4	1		2	2
	Medium	4	3	1		1	2
	Not Relevant						
	Totals	12	9	2		5	6

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.3.4.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE EXPOSURE

From the information presented in the previous section, the exposure reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce exposure (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE EXPOSURE TO BUSHFIRE HAZARD THREATS [1]							
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.						
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Significant	Moderate	Minimal	Significant	Significant	Minimal	Significant	Moderate
Moderate				Moderate			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Very Significant	Very Significant	Moderate	Very Significant	Very Significant	Significant	Significant	Significant
Very Significant				Significant			

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This exposure reducing potential will be applied to deriving the inherent exposure level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This exposure reducing potential will be applied to deriving the residual exposure level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

Assessment Comments: Most measures relate to the increased size and standard of maintenance of the APZ, separations from and between hazards, and between assets.

5.3.4.4 DERIVED EXPOSURE LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual exposure levels.

In combination with the corresponding assessed threat and vulnerability levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL EXPOSURE LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]							
ELEMENT AT RISK		Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
BUSHFIRE ATTACK MECHANISMS [2]		INHERENT EXPOSURE LEVEL (CURRENT STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	Moderate
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☒	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
BUSHFIRE ATTACK MECHANISMS [2]		RESIDUAL EXPOSURE LEVEL (POTENTIAL FUTURE STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	Very Low
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix 2 for explanatory and supporting information.

Note 3: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

Note 4: The level of exposure to flames and radiant heat is derived from the assessed BAL ratings (refer to the BAL contour map). The exposure levels applied are BAL-LOW/Very Low Exposure, BAL-12.5/Low Exposure, BAL-19/Moderate Exposure, BAL-29/High Exposure, BAL-40 and BAL-FZ/Extreme Exposure.

5.3.5 BUILT INFRASTRUCTURE ASSETS – SOLAR ARRAYS

5.3.5.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
THE PROTECTION MECHANISM – ESTABLISH SUFFICIENT SEPARATION FROM RELEVANT BUSHFIRE HAZARD THREATS: To reduce exposure to the relevant direct and indirect attack mechanisms of bushfire by locating buildings and attached/adjacent structures at sufficient distances away from the bushfire hazard and consequential fire fuels. The required distances will be dependent on the assessed threat levels and the degree of bushfire resilience that exists or is planned to be incorporated into the exposed elements through design and construction.						
7.1	Siting of Buildings/Structures Considering Potential High Wind Exposure: Site buildings and attached/adjacent structures in locations that have less exposure to terrain influenced prevailing synoptic winds, and in particular, those locations with potential for significant terrain/bushfire threat intensification interactions (refer to Appendix 3). Avoid the top and sides of ridges. Strong winds can directly or indirectly (airborne materials/debris) cause damage to the external building envelope, potentially allowing flame, radiant heat and ember entry.	High	No	Partly	No	No
Assessment Comments: The site is approximately 1002 hectares and the solar farm is proposed across most of the cleared lot area. The BAL-19 APZ applied will have a minor impact on exposure to fire-driven wind. The local topography (within 150m) is flat to gently undulating so the location will not experience significant terrain/bushfire threat intensification. *Recommendation Details:* Not Applicable						
7.2	Designed Location of Non-Vegetated Areas and/or Managed Open Space: Non-vegetated land uses include footpaths, paved areas, roads, parking, open drainage channels, and major services delivery (power, water, gas) installed in common corridors. Managed open space is land for public or private use on which the vegetation is either low threat due to type or situation or is continually managed in a minimal fuel condition. This can include public open space providing recreation facilities. Use these design elements to create or increase separation from any bushfire prone vegetation by positioning them adjacent to the bushfire hazard.	Very High	Yes	No	Partly	No
Assessment Comments: There are no such areas existing. Slashed/grazed grasses will likely be present within the solar farm area, however perimeter roads around each solar bank will be required for access and will create a non-vegetated buffer between banks and between surrounding vegetation within and beyond the APZ. *Recommendation Details:* Not Applicable						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
7.3	Landscaping - Asset Protection Zone (APZ): Ensure an APZ is established surrounding the relevant element(s) at risk to create the required separation distance from the bushfire hazard to protect against the direct attack mechanisms of flame contact and radiant heat and reduce exposure to embers. *In addition to providing separation from the direct bushfire attack mechanisms, the nature of the APZ design and management requirements is intended to minimise the potential impact of the indirect bushfire attack mechanisms of surface fire attack, debris production and accumulation, tree strike and consequential fire (refer to Appendix 2).* This is achieved by ensuring the APZ contains low threat vegetation; and/or has potential fire fuels managed in a minimal fuel condition; and/or contains non-vegetated areas (e.g. footpaths, paved areas, driveways, parking, swimming pools etc) and/or limits the presence/location of constructed/stored combustible items. For different States and local government areas, APZ establishment and maintenance guides ideally need to be local environment specific. Some authorities establish general requirements while specific requirements may also be established through site specific management documents (e.g. bushfire management plan). The required dimensions of the APZ will correspond to the maximum level of radiant heat the exposed element is to be exposed to – or a greater distance if it is stipulated by a relevant authority. As a minimum avoid dimensions (separation distances) that correspond to BAL-FZ and BAL-40 ratings for any given site/vegetation combination of relevant parameters. This will also apply to BAL-29 separation distances if flame length modelling indicates potential contact due to specific site and effective slope configurations. The location of an APZ should be entirely within the boundaries of each lot so that landowners can have control and responsibility for its implementation and maintenance. Exceptions exist for instances where adjoining land is not vegetated or it can be justified that the fire fuels will be managed in a minimal fuel, low threat state on an ongoing basis, in perpetuity.	Very High	Yes	No	Yes	Yes
Assessment Comments: Associated cabling (both power transmission and computer) will run between panels and be wired to individual panels. Common electrical cabling reaches its critical point at >12kWm2 (Kaczorek-Chrobak et al. 2007) [49]. This aligns with *NS187 Passive Fire Mitigation Design of Major Substations* - Internal Document No. NW000-S0007 (Ausgrid 2020) referenced in Section 5.4.6 of this report (>12.5kW/m2 for PVC cabling). Electrical cabling and components are expected to exceed this standard, being industrial and high capacity, however the 12kW/m2 threshold is adopted for the highest potential vulnerability. 10kW/m2 has been adopted to ensure the heat flux considered is *below* the 12kW/m2 threshold rather than meeting it.						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
The research paper *Experimental Studies on the Flammability and Fire Hazards of Photovoltaic Modules* (Materials (Basel): July 2015) was found to apply a critical heat flux threshold of 26kW/m2. Technology in terms of safety and reliability of solar panels has advanced since publication in 2015, but similar more recent test articles have not been found. A BAL-19 (<19kW/m2 radiant heat flux) APZ is applied to PV modules themselves, to ensure the heat flux considered is *below* the 26kW/m2 threshold rather than meeting it. Flame contact is unlikely with the required BAL-19 APZ. The setbacks APZ exceed the modelled solid flame lengths within the associated vegetation type (per AS 3959(: • Forest (5°): 31m setback / 26.2m flame length • Woodland (5°): 20m setback / 16.2m flame length • Scrub (5°): 19m setback / 13.6m flame length • Shrubland (5°): 15m setback / 9.1m flame length • Mallee (5°): 14m setback / 8.1m flame length • Grassland (5°): 14m setback / 8.2m flame length *Recommendation Details:* A 10kW/m2 APZ should be applied where possible to ensure cabling is not exposed to its critical threshold. BAL-19 has been adopted as site constraints limit the installation of a 10kW/m2 APZ. It must be therefore recognised that exposed cabling (not shielded or buried underground) positioned within 10kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement, and PV panels will not ignite but may suffer damage.						
7.4	Landscaping - Tree Location: Use separation to minimise the potential for debris accumulation and tree strike damage to the building envelope potentially allowing flame, radiant heat and ember entry to internal spaces. • The buildings/structures are separated from trees (or trees from buildings) by a distance of at least 1.5 times the height of the tallest tree. • Trees that produce significant quantities of debris (fine fuels) during the bushfire season should be located a sufficient distance away from vulnerable exposed elements to ensure debris cannot drop and accumulate within at least 4m of buildings/structures or be likely to be relocated by wind to closer than 4m to buildings / structures. • If the minimum distances cannot be achieved with an existing tree either remove the tree or at least ensure tree branches are sufficiently separated from buildings and attached/adjacent structures (at a minimum to not overhang) to ensure branches cannot fall onto or be blown onto the buildings/structures.	Medium	Yes	Partly	Partly	Yes
Assessment Comments: Landscape screening along public roads may be considered. Where applied, this would likely be a condition of approval from the decision maker.						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
Existing trees within 150m of the solar farm area are associated with Class A Forest (37m setback) and Class B Woodland (20m setback). There is the limited potential for tree strike to occur from Class B Woodland vegetation. However, siting of solar panels considers potential shading of nearby trees. It is likely that at the detailed design phase, panels will not be sited where significant shading will occur, and thus away from significantly tall trees. *Recommendation Details:* See Measure 6.4.						
7.5	Separation from Stored Flammable Products - Gas in Cylinders: To reduce the potential for gas flaring or explosion (consequential fire), installation of LPG cylinders is to apply as a minimum, the principles and requirements established in AS 1596 'The Storage and Handling of LP Gas'. Readily available guidance is provided by CSIRO Best Practice Bushfire Guide (https://research.csiro.au/bushfire/new-builds/water-electricity-gas/) and WA Dept. Mines, Industry, Regulation and Safety 'LP Gas cylinder safety in bushfire prone areas' (https://www.commerce.wa.gov.au/publications/lp-gas-cylinder-safety-bushfire-prone-areas). Otherwise, the required separation distance is 6m from any combustible materials. Heat from bushfire or consequential fire can be sufficient to cause cylinder pressure to reach critical levels and the pressure relief valve release large quantities of gas (flare). If the cylinder falls over the pressure relief valve may not function correctly, and the cylinder may rupture (explosion).	Medium	N/A	N/A	N/A	N/A
Assessment Comments: Gas storage is not proposed on site. Any LPG will be stored in compliance with AS 1596. *Recommendation Details:* Not Applicable						
7.6	Separation from Stored Flammable Products – Fuels / Other Hazardous Materials (Consequential Fire Fuels): Establish sufficient separation distance between these consequential fire fuels and buildings/structures. The required separation distance will be dependent on the fuel and storage type.	High	Yes	No	Yes	Yes
Assessment Comments: All infrastructure will be installed to manufacturers specification, including separation distances. Fuel and other hazardous material will not be stored on site. Both flammable and combustible materials are required to be positioned and maintained >10m from assets by Measure 6.7. *Recommendation Details:* See Measure 6.7.						
7.7	Separation from Stored and Constructed Combustible Items (Consequential Fire Fuels): These consequential fire fuels include: • Stored Combustible Items - Heavy Fuels e.g. building materials, packaging materials, rubbish bins etc;	High	Yes	No	Yes	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Element at Risk: Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
• Stored Combustible Items – Large Heavy Fuels e.g. vehicles, caravans and large quantities of dead vegetation materials stored as part of site use; • Constructed Combustible Items – Heavy Fuels e.g. landscaping structures including fences, screens, walls, plastic water tanks; and • Constructed Combustible Items – Large Heavy Fuels e.g. adjacent buildings/structures including houses, sheds, garages, carports. (Note: If the adjacent structure is constructed to BAL-29 requirements or greater and can implement a significant number of additional bushfire protection measures associated with reducing exposure and vulnerability, these minimum separation distances could be reduced by 30%) [31]. *Apply the rule of thumb [13] "assume flames produced from a consequential fire source will be twice as high as the object itself … where the consequential fire source is a structure, then the maximum eave height is a reasonable measure of maximum height".* Apply the following separation distances from the subject building/structure as a multiple of the height of the consequential fire source and dependent on the construction standard applied to the building/structure [13 and 31]: • At least six times the height when the building/structure construction incorporates design and materials that is only intended to resist low levels of radiant heat up to 12.5 kW/m^2) and no flame contact; • Between 4 and 6 six times the height when the building/structure construction incorporates design and materials intended to resist radiant heat up to 29 kW/m^2 and no flame contact. • Between 2 and 4 times the height when the building/structure construction incorporates design and materials intended to resist up to 40kW/m^2 and potential flame contact. • Less than 2 times the height when the building/structure construction incorporates design and materials intended to resist extreme levels of radiant heat and flame contact. • Zero separation distance is required if the building/structure is separated by a non-combustible FRL 60/60/60 rated wall, or the potential consequential fire source is fully enclosed by the building/structure.					
Assessment Comments: Setback between solar panels and rows is determined by the manufacturer to limit fire spread. Setback between assets and vegetation is considered within the Bushfire Risk Report. Solar arrays will be positioned >6x the height of BESS cabinets. A BESS cabinet is approximately 2.6m tall (15.6m separation). Product designers determine the setback between arrays to minimise the risk of fire transmission between PV panels. The minimum separation between solar panel banks is prescribed within AS 5033-2021. The tracking line centre distance for the solar farm design is >6m. When panels are aligned to the maximum vertical extent, the trafficable					

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
carriageway would be >4m (usually >5m) between rows. Each solar panel bank (a series of solar arrays connected to a single PCU) will have a permanent 6m trafficable access road around the perimeter. Locking the PV panels in the maximum vertical plane (estimated 50 degrees from the horizontal) as a site response will increase the distance between PV panels. This is applied in Measure 14.20. *Recommendation Details:* See Measures 6.7 and 14.20.						
THE PROTECTION MECHANISM – ESTABLISH SHIELDING FROM RELEVANT BUSHFIRE HAZARD THREATS: To shield buildings and attached/adjacent structures (or other consequential fire fuels) from the direct bushfire attack mechanisms of flame, radiant heat, surface fire and surface migration of embers. To also reduce exposure to the indirect attack mechanism of debris accumulation against buildings/structures and other consequential fire fuels and wind attack.						
7.8	Constructed Barrier – Shielding from Bushfire: Walls, fences and/or landforms to shield the subject building/structure from direct and indirect bushfire attack mechanisms and reduce the potential impact of these. Must be constructed using appropriate fire resistant / non-combustible construction materials (e.g. masonry, steel, earthworks). These are to withstand the impact of direct bushfire attack mechanisms for the required period of time. Apply the bushfire construction standards for external walls subject to the assessed level of radiant heat or flame contact to which the barrier will be exposed (or otherwise to BAL-FZ requirements). These are established by AS 3959:2018 [4] and/or the NASH Standard [33] and additionally informed by the research report 'Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires.' [29]	High	Yes	No	No	No
Assessment Comments: The measure is not cost-effective for the scale which would be required to be effective (functional height and perimeter). *Recommendation Details:* Not Applicable						
7.9	Constructed Barrier - Shielding from Consequential Fire: Applicable to all consequential fire fuel sources. Install a non-combustible barrier (including complete enclosure when appropriate), of required robustness, that can perform the following as relevant: • Reduce the exposure of the subject building/structure to the threats of consequential fire; and/or • Reduce the exposure of the consequential fire fuels to the bushfire hazard.	High	Yes	No	No	No
Assessment Comments: Consequential fire sources are addressed in Measure 6.7. *Recommendation Details:* Not Applicable						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
7.10	Natural Landforms Barrier: Use existing natural landforms to reduce buildings/structures exposure to radiant heat, and lower wind speeds (prevailing synoptic and/or fire driven).	High	No	No	No	No
Assessment Comments: No appropriate landforms exist. *Recommendation Details:* Not Applicable						
7.11	Planted Vegetation Barrier: Use appropriate hedges and trees strategically to reduce (to varying extents) buildings/structures exposure to radiant heat, to filter/trap embers and firebrands, and to lower wind speeds (prevailing synoptic and/or fire driven).	Medium	Yes	No	No	No
Assessment Comments: Landscaped vegetation is not recommended within the APZ to remove the capacity for surface fire and production of debris (leaf litter etc). *Recommendation Details:* Not Applicable						
7.12	Shield Operation Critical Non-Structural Elements: These are vulnerable elements essential to the continued operation of the building/structure which are potentially exposed to the attack mechanisms of both bushfire and consequential fire. These elements include cabling and plumbing associated with power delivery, data transmission, fuel and water transport. When the use of fire rated materials to the degree necessary is not possible or practical, the application of non-combustible shielding can be applied to reduce exposure to the threats. Shielding includes underground installation.	Medium	Yes	No	No	Yes
Assessment Comments: Exposed cabling (not shielded or buried underground) positioned within 10kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement, and PV panels will not ignite but may suffer damage. *Recommendation Details:* See Measure 6.12.						

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining.

Note 2: Protection Measure Application Status:

- Possible: Protection measures that can potentially be applied to the proposed development/use.
- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
    - Are incorporated into the site plans;

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					

- Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
- Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).

- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.3.5.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing exposure levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the exposure of the relevant element at risk to bushfire hazard threats.

EXPOSURE REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommend
Establish Sufficient Separation from Relevant Bushfire Hazard Threats	Very High	2	2		1	1	1
	High	3	2		1	2	2
	Medium	2	1		1	1	1
	Not Relevant						
Establish Shielding from Relevant Bushfire Hazard Threats	Very High						
	High	3	2				
	Medium	2	2				1
	Not Relevant						
Number Analysis	Very High	2	2		1	1	1
	High	6	4		1	2	2
	Medium	4	3		1	1	2
	Not Relevant						
	Totals	12	9		3	4	5

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.3.5.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE EXPOSURE

From the information presented in the previous section, the exposure reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce exposure (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE EXPOSURE TO BUSHFIRE HAZARD THREATS [1]							
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.						
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Significant	Moderate	Minimal	Significant	Significant	Minimal	Significant	Minimal
Moderate				Moderate			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Very Significant	Significant	Minimal	Significant	Very Significant	Moderate	Significant	Significant
Significant				Significant			

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This exposure reducing potential will be applied to deriving the inherent exposure level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This exposure reducing potential will be applied to deriving the residual exposure level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

Assessment Comments: A BAL-19 dimensioned APZ will be applied rather than BAL-29 as required for planning approval. Other measures consider separations from and between hazards, and between assets.

5.3.5.4 DERIVED EXPOSURE LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual exposure levels.

In combination with the corresponding assessed threat and vulnerability levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL EXPOSURE LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]							
ELEMENT AT RISK		Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
BUSHFIRE ATTACK MECHANISMS [2]		INHERENT EXPOSURE LEVEL (CURRENT STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	Moderate
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☒	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
BUSHFIRE ATTACK MECHANISMS [2]		RESIDUAL EXPOSURE LEVEL (POTENTIAL FUTURE STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	Low
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix 2 for explanatory and supporting information.

Note 3: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

Note 4: The level of exposure to flames and radiant heat is derived from the assessed BAL ratings (refer to the BAL contour map). The exposure levels applied are BAL-LOW/Very Low Exposure, BAL-12.5/Low Exposure, BAL-19/Moderate Exposure, BAL-29/High Exposure, BAL-40 and BAL-FZ/Extreme Exposure.

5.3.6 BUILT INFRASTRUCTURE ASSETS - HV SUBSTATION AND TRANSMISSION LINES.

5.3.6.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
THE PROTECTION MECHANISM – ESTABLISH SUFFICIENT SEPARATION FROM RELEVANT BUSHFIRE HAZARD THREATS: To reduce exposure to the relevant direct and indirect attack mechanisms of bushfire by locating buildings and attached/adjacent structures at sufficient distances away from the bushfire hazard and consequential fire fuels. The required distances will be dependent on the assessed threat levels and the degree of bushfire resilience that exists or is planned to be incorporated into the exposed elements through design and construction.						
8.1	Siting of Buildings/Structures Considering Potential High Wind Exposure: Site buildings and attached/adjacent structures in locations that have less exposure to terrain influenced prevailing synoptic winds, and in particular, those locations with potential for significant terrain/bushfire threat intensification interactions (refer to Appendix 3). Avoid the top and sides of ridges. Strong winds can directly or indirectly (airborne materials/debris) cause damage to the external building envelope, potentially allowing flame, radiant heat and ember entry.	High	No	Partly	No	No
Assessment Comments: A transmission line will run from the north-eastern corner of the development site, along Great Southern Highway, and north to connect to the Narrogin Terminal. The substation must be positioned as close as practical to the north-eastern extent of the site. The BAL-19 APZ applied will have a minor impact on exposure to fire-driven wind. The local topography (within 150m) is flat to gently undulating so the location will not experience significant terrain/bushfire threat intensification. *Recommendation Details:* Not Applicable						
8.2	Designed Location of Non-Vegetated Areas and/or Managed Open Space: Non-vegetated land uses include footpaths, paved areas, roads, parking, open drainage channels, and major services delivery (power, water, gas) installed in common corridors. Managed open space is land for public or private use on which the vegetation is either low threat due to type or situation or is continually managed in a minimal fuel condition. This can include public open space providing recreation facilities. Use these design elements to create or increase separation from any bushfire prone vegetation by positioning them adjacent to the bushfire hazard.	Very High	Yes	Partly	Yes	Yes
Assessment Comments: There are no such areas existing. The non-vegetated areas will be the internal access roads, 10m non-vegetated area around the BESS development (applied in Measure 6.3), and surfaced hardstand of the BESS and Substation footprint.						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
Recommendation Details: See Measure 8.3.						
8.3	Landscaping - Asset Protection Zone (APZ): Ensure an APZ is established surrounding the relevant element(s) at risk to create the required separation distance from the bushfire hazard to protect against the direct attack mechanisms of flame contact and radiant heat and reduce exposure to embers. *In addition to providing separation from the direct bushfire attack mechanisms, the nature of the APZ design and management requirements is intended to minimise the potential impact of the indirect bushfire attack mechanisms of surface fire attack, debris production and accumulation, tree strike and consequential fire (refer to Appendix 2).* This is achieved by ensuring the APZ contains low threat vegetation; and/or has potential fire fuels managed in a minimal fuel condition; and/or contains non-vegetated areas (e.g. footpaths, paved areas, driveways, parking, swimming pools etc) and/or limits the presence/location of constructed/stored combustible items. For different States and local government areas, APZ establishment and maintenance guides ideally need to be local environment specific. Some authorities establish general requirements while specific requirements may also be established through site specific management documents (e.g. bushfire management plan). The required dimensions of the APZ will correspond to the maximum level of radiant heat the exposed element is to be exposed to – or a greater distance if it is stipulated by a relevant authority. As a minimum avoid dimensions (separation distances) that correspond to BAL-FZ and BAL-40 ratings for any given site/vegetation combination of relevant parameters. This will also apply to BAL-29 separation distances if flame length modelling indicates potential contact due to specific site and effective slope configurations. The location of an APZ should be entirely within the boundaries of each lot so that landowners can have control and responsibility for its implementation and maintenance. Exceptions exist for instances where adjoining land is not vegetated or it can be justified that the fire fuels will be managed in a minimal fuel, low threat state on an ongoing basis, in perpetuity.	Very High	Yes	No	Yes	Yes
Assessment Comments: AS 2067-2016 *Substations and high voltage installations exceeding 1 kV a.c.* and AS/NZS 7000:2016 *Overhead Line Design* are not available to the bushfire consultant. The development is assumed to comply with Australian Standards, but it is not known if external fire sources (specifically bushfire) are addressed and to what extent. The applied BAL-19 APZ exceeds the Western Power vegetation clearances per Western Australian Distribution Connections Manual 2015.						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.				

The following document was found to be relevant in the assessment of proposed substations: *NS187 Passive Fire Mitigation Design of Major Substations* - Internal Document No. NW000-S0007 (Ausgrid 2020). Ausgrid Pty Ltd is Australia's largest electricity distributor (in terms of customers and energy load), and the document referenced is an internal network standard. The below table is sourced from Section 12 of the network standard.

Table 3 – Radiant Heat Exposure Limits for Bushfires

Item	Maximum allowable radiant heat flux (kW/m^2)	Comment
Cable	12.5	PVC Cables begin to distort and may ignite.
	20	Ignition of XLPE cables between 85 and 550 seconds.
Steel support structure	35	To 60% of yield strength after a maximum duration of 5 minutes. Applies where elastic deflections due to elevated temperatures are not critical.
Porcelain bushing/Insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Polymeric bushing/insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Aluminium busbar	20	Based on 250°C after a maximum duration of 5 minutes. Comparable to withstand temperature under fault conditions.
Copper busbar	25	Busbars may undergo significant distortion and impose significant stresses on rigid insulators.
Transformer tank	>35 (see Note 1)	Refer to above regarding bushings and cables.
Combustibles	12.5	Piloted ignition may occur on timber.

Note 1. Transformers always have some more vulnerable components such as bushings and cables etc. Refer to Clause 7.2.

'Combustibles' in this description are consequential fire hazards for the purposes of the bushfire assessment: packing materials, pallets, waste, and other assorted debris. These should not be present within the substation footprint and where necessary should be positioned away from infrastructure components, applied in Measure 6.7.

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
The internal network standard and the *Asset Management System* Distribution Substation Plant Manual 2019*:* Chapter 5 – Substation Fire Risk (Western Power March 2021) align in identifying Transformer Oil as being a consequential fire source (within the context of bushfire assessments). This is a flammable material with a low flash point of 135°C, and a radiant heat flux threshold dependent on the period of exposure: 3-4 hours at 4.5kW/m2, however the pre-heating, flaming phase, and residual heat of a bushfire is generally <10 minutes. The network standard considers radiant heat impact from asset fires on transformer oil but not bushfires, which appears to be due to the greatly reduced residence period and the transformer oil being contained within the transformer tank, which provides shielding/insulation to the contents to prevent the flash point being reached. The Transformer Tank has a maximum heat flux threshold of >35kW/m2 As an appropriate heat flux for the short residence period of a bushfire is not available, the capacity for this risk to be managed is dependent on the developer recognising the issue and ensuring that the design/procedures that are applied to manage transformer oil fires, also consider the possibility of external bushfire impact igniting the oil (either through piloted ignition from embers or radiant heat only). PVC cables should be either enclosed within structures or installed underground where practical. Exposed cabling (not shielded or buried underground) positioned within 12kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement. Automated isolation and shut-down of affected systems are applied in substation design, to prevent any such fire spread. The manufacturer/developer should identify where any such exposed cabling can be sacrificed and replaced. Critical cabling should be installed within structures, underground, or shielded with appropriate sheaths. Flame contact is unlikely with the required BAL-19 APZ. The setbacks APZ exceed the modelled solid flame lengths within the associated vegetation type (per AS 3959(: • Forest (5°): 31m setback / 26.2m flame length • Woodland (5°): 20m setback / 16.2m flame length • Scrub (5°): 19m setback / 13.6m flame length • Shrubland (5°): 15m setback / 9.1m flame length • Mallee (5°): 14m setback / 8.1m flame length • Grassland (5°): 14m setback / 8.2m flame length *Recommendation Details:* A BAL-19 APZ is required for the HV substation. Exposed cabling (not shielded or buried underground) positioned within 12kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement. The substation footprint should be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc).						
8.4	Landscaping - Tree Location: Use separation to minimise the potential for debris accumulation and tree strike damage to the building envelope potentially allowing flame, radiant heat and ember entry to internal spaces.	Medium	Yes	Yes	No	No

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
	• The buildings/structures are separated from trees (or trees from buildings) by a distance of at least 1.5 times the height of the tallest tree. • Trees that produce significant quantities of debris (fine fuels) during the bushfire season should be located a sufficient distance away from vulnerable exposed elements to ensure debris cannot drop and accumulate within at least 4m of buildings/structures or be likely to be relocated by wind to closer than 4m to buildings / structures. • If the minimum distances cannot be achieved with an existing tree either remove the tree or at least ensure tree branches are sufficiently separated from buildings and attached/adjacent structures (at a minimum to not overhang) to ensure branches cannot fall onto or be blown onto the buildings/structures.					
Assessment Comments: Electric line easements are under the management of Western Power. Vegetation clearances will follow *Vegetation Clearances for the Construction of Overhead Powerlines* (Western Power Standard - Internal Document - DM#9288088). The only trees within 150m of the substation are associated with Class A Forest and will require a 37m setback. This APZ setback will also result in a setback from tree strike/obstruction as the trees have an approximate maximum 25m height (25 x 1.5 = 37.5m separation). *Recommendation Details:* Not Applicable						
8.5	Separation from Stored Flammable Products - Gas in Cylinders: To reduce the potential for gas flaring or explosion (consequential fire), installation of LPG cylinders is to apply as a minimum, the principles and requirements established in AS 1596 'The Storage and Handling of LP Gas'. Readily available guidance is provided by CSIRO Best Practice Bushfire Guide (https://research.csiro.au/bushfire/new-builds/water-electricity-gas/) and WA Dept. Mines, Industry, Regulation and Safety 'LP Gas cylinder safety in bushfire prone areas' (https://www.commerce.wa.gov.au/publications/lp-gas-cylinder-safety-bushfire-prone-areas). Otherwise, the required separation distance is 6m from any combustible materials. Heat from bushfire or consequential fire can be sufficient to cause cylinder pressure to reach critical levels and the pressure relief valve release large quantities of gas (flare). If the cylinder falls over the pressure relief valve may not function correctly, and the cylinder may rupture (explosion).	Medium	N/A	N/A	N/A	N/A
Assessment Comments: Gas storage is not proposed on site. Any LPG will be stored in compliance with AS 1596. *Recommendation Details:* Not Applicable						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
8.6	Separation from Stored Flammable Products – Fuels / Other Hazardous Materials (Consequential Fire Fuels): Establish sufficient separation distance between these consequential fire fuels and buildings/structures. The required separation distance will be dependent on the fuel and storage type.	High	Yes	No	Yes	Yes
Assessment Comments: All infrastructure will be installed to manufacturers specification, including separation distances. Fuel and other hazardous material will not be stored on site. Both flammable and combustible materials are required to be positioned and maintained >10m from assets by Measure 6.7. *Recommendation Details:* See Measure 6.7.						
8.7	Separation from Stored and Constructed Combustible Items (Consequential Fire Fuels): These consequential fire fuels include: • Stored Combustible Items - Heavy Fuels e.g. building materials, packaging materials, rubbish bins etc; • Stored Combustible Items – Large Heavy Fuels e.g. vehicles, caravans and large quantities of dead vegetation materials stored as part of site use; • Constructed Combustible Items – Heavy Fuels e.g. landscaping structures including fences, screens, walls, plastic water tanks; and • Constructed Combustible Items – Large Heavy Fuels e.g. adjacent buildings/structures including houses, sheds, garages, carports. (Note: If the adjacent structure is constructed to BAL-29 requirements or greater and can implement a significant number of additional bushfire protection measures associated with reducing exposure and vulnerability, these minimum separation distances could be reduced by 30%) [31]. *Apply the rule of thumb [13] "assume flames produced from a consequential fire source will be twice as high as the object itself … where the consequential fire source is a structure, then the maximum eave height is a reasonable measure of maximum height".* Apply the following separation distances from the subject building/structure as a multiple of the height of the consequential fire source and dependent on the construction standard applied to the building/structure [13 and 31]: • At least six times the height when the building/structure construction incorporates design and materials that is only intended to resist low levels of radiant heat up to 12.5 kW/m^2) and no flame contact; • Between 4 and 6 six times the height when the building/structure construction incorporates design and materials intended to resist radiant heat up to 29 kW/m^2 and no flame contact.	High	Yes	No	Yes	No

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
	• Between 2 and 4 times the height when the building/structure construction incorporates design and materials intended to resist up to 40kW/m^2 and potential flame contact. • Less than 2 times the height when the building/structure construction incorporates design and materials intended to resist extreme levels of radiant heat and flame contact. • Zero separation distance is required if the building/structure is separated by a non-combustible FRL 60/60/60 rated wall, or the potential consequential fire source is fully enclosed by the building/structure.					
Assessment Comments: The substation will be positioned >6x the height of BESS cabinets and solar panels. A BESS cabinet is approximately 2.6m tall (15.6m separation) and a solar panel aligned to the vertical extent is approximately 2.5m (15m separation). *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM – ESTABLISH SHIELDING FROM RELEVANT BUSHFIRE HAZARD THREATS: To shield buildings and attached/adjacent structures (or other consequential fire fuels) from the direct bushfire attack mechanisms of flame, radiant heat, surface fire and surface migration of embers. To also reduce exposure to the indirect attack mechanism of debris accumulation against buildings/structures and other consequential fire fuels and wind attack.						
8.8	Constructed Barrier – Shielding from Bushfire: Walls, fences and/or landforms to shield the subject building/structure from direct and indirect bushfire attack mechanisms and reduce the potential impact of these. Must be constructed using appropriate fire resistant / non-combustible construction materials (e.g. masonry, steel, earthworks). These are to withstand the impact of direct bushfire attack mechanisms for the required period of time. Apply the bushfire construction standards for external walls subject to the assessed level of radiant heat or flame contact to which the barrier will be exposed (or otherwise to BAL-FZ requirements). These are established by AS 3959:2018 [4] and/or the NASH Standard [33] and additionally informed by the research report 'Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires.' [29]	High	No	No	No	No
Assessment Comments: Shielding cannot be applied to vegetation types which exceed the height of the barrier (Class A Forest up to 20m tall). *Recommendation Details:* Not Applicable						
8.9	Constructed Barrier - Shielding from Consequential Fire: Applicable to all consequential fire fuel sources. Install a non-combustible barrier (including complete enclosure when appropriate), of required robustness, that can perform the following as relevant: • Reduce the exposure of the subject building/structure to the threats of consequential fire; and/or • Reduce the exposure of the consequential fire fuels to the bushfire hazard.	High	Yes	No	No	No

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
Assessment Comments: Consequential fire sources are addressed in Measure 6.7. *Recommendation Details:* Not Applicable						
8.10	Natural Landforms Barrier: Use existing natural landforms to reduce buildings/structures exposure to radiant heat, and lower wind speeds (prevailing synoptic and/or fire driven).	High	No	No	No	No
Assessment Comments: No appropriate landforms exist. *Recommendation Details:* Not Applicable						
8.11	Planted Vegetation Barrier: Use appropriate hedges and trees strategically to reduce (to varying extents) buildings/structures exposure to radiant heat, to filter/trap embers and firebrands, and to lower wind speeds (prevailing synoptic and/or fire driven).	Medium	Yes	No	No	No
Assessment Comments: Landscaped vegetation is not recommended within the APZ to remove the capacity for surface fire and production of debris (leaf litter etc). *Recommendation Details:* Not Applicable						
8.12	Shield Operation Critical Non-Structural Elements: These are vulnerable elements essential to the continued operation of the building/structure which are potentially exposed to the attack mechanisms of both bushfire and consequential fire. These elements include cabling and plumbing associated with power delivery, data transmission, fuel and water transport. When the use of fire rated materials to the degree necessary is not possible or practical, the application of non-combustible shielding can be applied to reduce exposure to the threats. Shielding includes underground installation.	Medium	Yes	No	No	Yes
Assessment Comments: Exposed cabling (not shielded or buried underground) positioned within 12kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement. *Recommendation Details:* See Measure 6.12.						
Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining. Note 2: Protection Measure Application Status: • Possible: Protection measures that can potentially be applied to the proposed development/use.						

PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					

- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

  These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.3.6.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing exposure levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the exposure of the relevant element at risk to bushfire hazard threats.

EXPOSURE REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommend
Establish Sufficient Separation from Relevant Bushfire Hazard Threats	Very High	2	2		1	2	2
	High	3	2		1	2	1
	Medium	2	1	1			
	Not Relevant						
Establish Shielding from Relevant Bushfire Hazard Threats	Very High						
	High	3	1				
	Medium	2	2				1
	Not Relevant						
Number Analysis	Very High	2	2		1	2	2
	High	6	3		1	2	1
	Medium	4	3	1			1
	Not Relevant						
	Totals	12	8	1	2	4	4

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.3.6.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE EXPOSURE

From the information presented in the previous section, the exposure reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce exposure (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE EXPOSURE TO BUSHFIRE HAZARD THREATS [1]							
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.						
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Significant	Moderate	Minimal	Significant	Minimal	Minimal	Moderate	Moderate
Moderate				Minimal			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Very Significant	Significant	Minimal	Significant	Moderate	Significant	Very Significant	Significant
Significant				Significant			

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This exposure reducing potential will be applied to deriving the inherent exposure level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This exposure reducing potential will be applied to deriving the residual exposure level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

Assessment Comments: A BAL-19 dimensioned APZ will be applied rather than BAL-29 as required for planning approval. Other measures consider separations from and between hazards, and between assets.

The BAL-19 APZ additionally increases the setback from forest structure vegetation, which is effective against debris (leaf litter) accumulation and tree strike.

5.3.6.4 DERIVED EXPOSURE LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual exposure levels.

In combination with the corresponding assessed threat and vulnerability levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL EXPOSURE LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]							
ELEMENT AT RISK		Built Infrastructure Assets - HV Substation and Transmission Lines.					
BUSHFIRE ATTACK MECHANISMS [2]		INHERENT EXPOSURE LEVEL (CURRENT STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	High
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☒	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
BUSHFIRE ATTACK MECHANISMS [2]		RESIDUAL EXPOSURE LEVEL (POTENTIAL FUTURE STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	Low
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix 2 for explanatory and supporting information.

Note 3: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

Note 4: The level of exposure to flames and radiant heat is derived from the assessed BAL ratings (refer to the BAL contour map). The exposure levels applied are BAL-LOW/Very Low Exposure, BAL-12.5/Low Exposure, BAL-19/Moderate Exposure, BAL-29/High Exposure, BAL-40 and BAL-FZ/Extreme Exposure.

5.4 VULNERABILITY LEVEL ASSESSMENT – BUSHFIRE PROTECTION MEASURE ANALYSIS

For each stated element at risk an assessment is conducted that considers the effectiveness and application status of all available vulnerability reducing bushfire protection measures that are listed under their applicable bushfire protection mechanism. This information is subsequently applied to deriving vulnerability levels.

5.4.1 PERSONS ONSITE AND TEMPORARILY OFFSITE

5.4.1.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Persons Onsite and Temporarily Offsite					
THE PROTECTION MECHANISM – TRANSPORT AND MULTIPLE EVACUATION DESTINATIONS AND ROUTES AVAILABLE						
9.1	Sufficient Evacuation Transport Available: Ensure that all persons likely to be on site have access to transport. This can be through own vehicles, facility vehicles, a formal arrangement with an external provider or a combination of these.	Very High	Yes	Yes	No	No
Assessment Comments: The location is within 4km of travel from the built-out area of the Narrogin townsite. It has no public transport and is not a reasonable walking commute. The site is intended to be unstaffed but visitation is possible. All staff/visitors/contractors must necessarily have a vehicle to reach and traverse the site. *Recommendation Details:* Not Applicable						
9.2	Multiple Safer Offsite Locations Available: Increasing the route and destination options decreases vulnerability of persons as the exposed element. Multiple buildings/areas are accessible from the subject site as evacuation destinations. The offsite locations exist at a sufficient distance from the subject site ensuring that the destination and the subject site are very unlikely to be simultaneously impacted by a bushfire event. For the most robust scenario: • Multiple access/egress route are available to the safer locations from the subject site; • The entirety of at least two routes is unlikely to be simultaneously impacted by a bushfire event; and • The availability of water and amenities corresponding to person numbers increases the effectiveness of the measure.	Very High	No	Yes	No	No

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Persons Onsite and Temporarily Offsite					
Assessment Comments: Two-way access compliant with the *Guidelines for Planning in Bushfire Prone Areas* v1.4 is available at the property access of all lots within the proposed development. From an intersection with Great Southern Highway, persons can proceed north to Narrogin or south to Wagin. *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM – PROVISION OF BUSHFIRE EMERGENCY INFORMATION AND EDUCATION						
9.3	Develop a Bushfire Emergency Plan: This will provide operational guidance for the implementation of prevention, preparation, response and recovery procedures and their associated actions. The format and content of the plan documents will be aligned with the specific needs of the site and its use. Development of the Plan considers site specific information that includes: • The site's use and the numbers and types of persons who will be on the site at any time; • The physical characteristics of the site and its structures; and • The surrounding topography and bushfire prone vegetation; and • The surrounding human settlement and road networks. It is produced for use by the site owners, managers, operators and occupants (as relevant).	High	Yes	No	Yes	Yes
Assessment Comments: The site is proposed to be unstaffed, but an Emergency Management Plan will be required for the development. The requirements of a Bushfire Emergency Plan should be contained within the Emergency Management Plan, noting that as the site is intended to be unstaffed, some of the contents may not be relevant. *Recommendation Details:* See Measure 1.9						
9.4	Operational Documents are to Contain the Bushfire Protection Measures to be Implemented: The documents include the 'planning' or 'operational' Bushfire Management Plan (BMP), the Bushfire Emergency Plan (BEP), the Site Emergency Plan and any relevant documents associated with a projects design phase. The purpose of this measure is to ensure the application of applicable protection measures identified in this Report, will be acted upon through responsibilities created within the operational documents.	High	Yes	No	Yes	Yes
Assessment Comments: Requirements for the Site Operational Procedures are outlined in Measure 1.9. *Recommendation Details:* See Measure 1.9						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Persons Onsite and Temporarily Offsite					
9.5	Prominent Display of Bushfire Emergency Information: The relevant format and content of the site specific bushfire emergency response information, taken from the planning developed for a bushfire emergency, is made readily available to all persons on site.	Medium	Yes	No	Yes	Yes
Assessment Comments: The site is unstaffed and there is no site office or similar structure which would be 'prominent' for this purpose. A DFES Emergency Response Guide (FES-ERG) is required for some sites which store or handle dangerous goods. This manifest is required to be located within a signed weatherproof container at site entry. *Recommendation Details:* See Measure 1.9						
9.6	Direct to Persons Emergency Messaging System: Have a process and system (e.g. SMS) for site managers to provide persons onsite and temporarily offsite with emergency information as necessary. Consideration will need to be given to availability and reliability of the infrastructure that is to facilitate this system.	Medium	Yes	No	No	Yes
Assessment Comments: Bushfire alerts within a 10km radius should be communicated to persons onsite. This is due to the primarily grassland vegetation types within the region, and the lower ember generation capacity of the vegetation within the region (See Section 5.1). Visitors must provide mobile phone numbers to site management. Within the Emergency Management Plan, a key response will be to contact and advise all persons onsite. Both Telstra and Optus networks have coverage over the entirety of the site. *Recommendation Details:* See Measure 1.9						
9.7	An Alternative Internet and Mobile Phone System is Available: Establish and maintain an appropriate alternative system to ensure the required capabilities for emergency communication and access to emergency information will be retained if there is an outage of the primary communication system. This includes direct to satellite connections for voice and data.	Medium	Yes	No	No	No
Assessment Comments: Satellite communications etc are applicable to remote staffed sites. The site is likely to have effective mobile phone coverage as there was no loss of service during the site visit. *Recommendation Details:* Not Applicable						
9.8	Egress Pathway Signage: Where pathways exist onsite for occupants to relocate to an identified safer onsite location, appropriate signage to guide unfamiliar persons can reduce their vulnerability.	Medium	Yes	No	No	No

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Persons Onsite and Temporarily Offsite					
Assessment Comments: Any persons onsite will have immediate vehicle access and are likely to be familiar with the site. Persons will proceed to site access point to evacuate. *Recommendation Details:* Not Applicable						
9.9	Personnel are Trained to Implement the Bushfire Emergency Plan: Operational persons (staff) are provided with appropriate training, aligned with the subject site's prepared Bushfire Emergency Plan (BEP). The process will also identify specific roles and persons to fill those roles.	High	Yes	No	Yes	No
Assessment Comments: Staff instruction and training in site firefighting equipment will be required under the site Emergency Management Plan. The level of instruction may vary due to the frequency/duration of visitation, and is thus not established here. *Recommendation Details:* Not Applicable						
9.10	Build Community Resilience Through Education: When relevant to the type and scale of proposed development/use, the delivery of effective community education programs, to ensure information is acted upon and packages of protection measures are put in place, will result in lowering the vulnerability of the community to a bushfire event, once the. Local government develops an ongoing program of innovative and leading edge community and landowner education that builds on the information presented within this Report. Implementation of recommended/required protection measures can be encouraged through legislation, education, audits, enforcement, and penalties as appropriate. Examples of such community education programs exist in various jurisdictions. The CSIRO (2020) Climate and Disaster Resilience Overview Report in 'Recommendation No. 5' [18] encourages collaboration with research agencies on the issue of building community resilience.	High	N/A	N/A	N/A	N/A
9.11	**Encourage 'Property Bushfire Resilience Assessments'**: Local government to promote (and potentially incentivise) the conducting of these assessments and the implementation of any recommendations. These assessments address bushfire hazard threat levels and the level of exposure and vulnerability of specific buildings and persons. It identifies appropriate protection measures that can be implemented to increase bushfire resilience.	High	N/A	N/A	N/A	N/A
Assessment Comments: The site is an unstaffed commercial operation. *Recommendation Details:* Not Applicable						
9.12	Locations of Vulnerable Persons are Registered: Relevant department of local government and their emergency services maintains a register of the location of land uses that are likely to result in a number of 'vulnerable' persons (see Glossary)	Medium	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Persons Onsite and Temporarily Offsite					
	residing onsite, so that their needs can be addressed as a priority in a bushfire emergency. The subject development/use would exist on that register.					
Assessment Comments: No vulnerable persons will be onsite. *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM – ONSITE PERSONS CAPABLE OF MANAGING A BUSHFIRE EMERGENCY ARE AVAILABLE						
9.13	Onsite Persons Available to Manage Bushfire Emergency Procedures: Different categories of persons can perform this role in different scenarios, with potentially varying levels of expertise and effectiveness. These include: • Appropriately trained person(s) will be onsite at all times, or able to be onsite at short notice. They are trained in bushfire emergency procedures in general and have specific knowledge of the site's Bushfire Emergency Plan, and the environment in which the development/use exists. This person(s) may have the official title of fire warden. • An untrained person familiar with the local area will be onsite at all times. They have knowledge and instruction gained from the site's Bushfire Emergency Plan and can implement the required procedures. They can guide and assist persons onsite.	High	N/A	N/A	N/A	N/A
Assessment Comments: The site is intended to be unstaffed. *Recommendation Details:* Not Applicable						
9.14	Onsite Persons Can Operate Firefighting Equipment: Such person(s) is suitably capable of maintaining and operating any installed firefighting water supply and associated pumps, hoses/nozzles and sprinklers.	Medium	No	No	Partly	No
Assessment Comments: The site is intended to be unstaffed and personal firefighting equipment will not be necessary. Where any permanent buildings or site vehicles are used, fire extinguishers will be made available at these assets. Staff are not intended to operate major firefighting equipment. *Recommendation Details:* Not Applicable						
9.15	External Emergency Response Services Available: An emergency service with a bushfire response capability is located within a realistic operational distance of the subject development/use. This includes services provided by government (e.g., career fire and rescue services or other agencies) and volunteer services.	Medium	Yes	Yes	No	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Element at Risk: Persons Onsite and Temporarily Offsite					
Note: The services of these limited resources should not be relied upon, as their availability for a given event can be compromised by other obligations at the crucial time. *Bushfire Verification Method – Handbook s6.6 [14] states "During significant bushfires, there will be conflicting demands on fire brigade resources and reliance should not be placed on fire brigade intervention to protect a specific property.* *Prior to the 2009 Black Saturday fires, an early evacuation or stay and defend policy was in place and data from major fires indicated that the presence of occupants significantly increased the probability of house survival (refer Table 7.1). However, in response to the subsequent Royal Commission findings there is now a greater emphasis on early evacuation. Whilst this is expected to reduce fatalities by reducing the numbers of people at risk, a negative consequence will be an increase in property losses for buildings constructed to similar standards. It should therefore be assumed that there will be no fire brigade or occupant intervention with respect to protecting a specific property."*					
Assessment Comments: Contact Narrogin VFRS and Narrogin and Minigin BFB prior to commissioning and offer a familiarisation visit and explanation of emergency procedures, access, hazards, and fire detection and suppression systems. Contact DFES Built Environment Branch to determine if an Emergency Response Guide (FES-ERG) is required. These are established in Measure 1.9. *Recommendation Details:* See Measure 1.9.					

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining.

Note 2: Protection Measure Application Status:

- Possible: Protection measures that can potentially be applied to the proposed development/use.
- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk:	Persons Onsite and Temporarily Offsite					

These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).

- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.4.1.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing vulnerability levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the vulnerability of the relevant element at risk to bushfire hazard threats.

VULNERABILITY REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Persons Onsite and Temporarily Offsite						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommen
Transport and multiple evacuation destinations and routes available	Very High	2	1	2			
	High						
	Medium						
	Not Relevant						
Provision of bushfire emergency information and education	Very High						
	High	5	3			3	2
	Medium	4	4			1	2
	Not Relevant						
Onsite Persons Capable of Managing a Bushfire Emergency Are Available	Very High						
	High	1					
	Medium	2	1	1		1	1
	Not Relevant						
Number Analysis	Very High	2	1	2			
	High	6	3			3	2
	Medium	6	5	1		2	3
	Not Relevant						
	Totals	14	9	3		5	5

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.4.1.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE VULNERABILITY

From the information presented in the previous section, the vulnerability reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce vulnerability (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE VULNERABILITY TO BUSHFIRE HAZARD THREATS [1]	
Element at Risk	Persons Onsite and Temporarily Offsite
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]	WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]
Minimal	Significant

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This vulnerability reducing potential will be applied to deriving the inherent vulnerability level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This vulnerability reducing potential will be applied to deriving the residual vulnerability level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Assessment Comments: Persons are vulnerable to radiant heat, flame contact, and smoke exposure only.

The existing and planned measures assume the site is unstaffed, thus they have minimal impact. The recommended measures include monitoring, communication, and procedures and training for bushfire response.

5.4.1.4 DERIVED VULNERABILITY LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual vulnerability levels.

In combination with the corresponding assessed threat and exposure levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL VULNERABILITY LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]				
ELEMENT AT RISK	Persons Onsite and Temporarily Offsite			
INHERENT VULNERABILITY LEVEL (CURRENT STATE) [2]				
Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐
THE RESIDUAL VULNERABILITY LEVEL (POTENTIAL FUTURE STATE) [2]				
Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

5.4.2 PERSONS ON ACCESS/EGRESS ROUTES IN VEHICLES

5.4.2.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS				Effectiveness Rating [1]	Application Status [2]			
					Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons on Access/Egress Routes in Vehicles	Access/Egress Route ID	Local road network including internal roads- applicable to Emergency Services.					
THE PROTECTION MECHANISM – LOWER RISK ROAD CONSTRUCTION (DESIGN AND MATERIALS): The application of as many of the following protection measures as possible ensures a greater level of safety for users and lowers the associated risk when roads need to be used to evacuate to a safer offsite location in potentially high stress situations within a threatening environment. Safety for persons using the route is increased through reducing the likelihood of vehicle/terrain or vehicle/vehicle accidents and the ability to maintain travelling speed.								
10.1	Greater Road Width: Ensure appropriate width roads are installed. Wider roads allow safer passing of the anticipated traffic that can be travelling in both directions (e.g. emergency services travelling towards the emergency event). The effectiveness of road width to reduce vulnerability is also a function of the required carriage capacity - which may be increased by the proposed development/use when it will increase traffic intensity. The incorporation of non-vegetated and trafficable road verges/shoulders and adjacent footpaths can also be considered to increase effective width for slower moving vehicles (providing additional separation from the hazard and passing opportunities).			High	Partly	Partly	No	Yes
Assessment Comments: Great Southern Highway, Wanerie Road, Narrakine Road South, and Condine Road have a >8m carriageway. Primary internal access routes (other than perimeter access) will be constructed to a minimum 6m trafficable width and will be bounded by low threat or non-vegetated areas (the development area and APZ). *Recommendation Details:* Internal access roads should be constructed to be 6m wide to ensure unrestricted two-way traffic.								
10.2	Lower Road Gradient: Ensure appropriate road gradients are available. Lower gradients help ensure traction and speed can be maintained. Steep gradients can also be associated with driver visibility. Appropriate gradients will depend on the constructed surface materials and the weights and tractive capability of expected vehicle types.			Medium	No	Yes	No	No
Assessment Comments: External public roads and the subject site (with internal roads to be constructed) have slopes not exceeding 5 degrees. See Figure 5.3. *Recommendation Details:* Not Applicable								
10.3	Greater Road Clearance: Ensure appropriate clearance can exist and is established. Sufficient horizontal and vertical clearances from obstructions ensure unhindered movement of all possible vehicle types;			Medium	Partly	Partly	No	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS				Effectiveness Rating [1]	Application Status [2]			
					Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons on Access/Egress Routes in Vehicles	Access/Egress Route ID	Local road network including internal roads- applicable to Emergency Services.					
Assessment Comments: Trees bound the external access routes in many areas. Site Operating Procedures should include that no items (plant or equipment) can be stored on access roads or on the 10m non-vegetated buffer around BESS cabinets. *Recommendation Details:* See Measure 13.17.								
10.4	Stable Road Surfaces: Ensure that roads are constructed of materials that will provide the necessary traction (also a function of gradient), can support the weight of all expected vehicle types and remain operational in all weather. The required supportive capacity also applies to associated structures such as bridges.			Medium	Yes	Partly	Yes	No
Assessment Comments: 15 tonne weight capacity is required for internal access per the *Guidelines for Planning in Bushfire Prone Areas* v1.4. External roads cannot be upgraded, though they will necessarily have a high weight capacity to transport infrastructure to the site (a pre-assembled BESS cabinet is >30 tonnes). *Recommendation Details:* Not Applicable								
10.5	Driver Visibility and Road Ahead Signage: Ensure that road design provides high levels of visibility ahead (in the absence of smoke and embers) and informative signage indicating relevant 'up ahead' route information (includes information stating distance to turnaround area for narrow roads in more remote locations). Good visibility is associated with the avoidance of 'blind' corners and crests to the greatest extent possible.			Medium	No	Yes	No	No
Assessment Comments: Great Southern Highway, Wanerie Road and Condine Road have long straight sections (>1km) and gentle curves (<30 degrees) with good visibility. Narrakine Road South has a snaking design, though it is less likely to be used for access/egress for the site. *Recommendation Details:* Not Applicable								
10.6	Shorter Road Length: Shorter distances to safer locations reduce the length of time persons remain vulnerable to bushfire threats.			High	No	Yes	No	No
Assessment Comments: The location is within 4km of travel from the built-out area of the Narrogin townsite (4 mins). *Recommendation Details:* Not Applicable								
10.7	Interconnected Road Network to Provide Route Options: Ensuring that the design of the road network provides through roads and avoids dead-end roads, provides the choice of alternative routes to for minimising close contact with a bushfire event. Otherwise, vehicles and persons can be trapped.			Very High	No	Partly	No	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS				Effectiveness Rating [1]	Application Status [2]			
					Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons on Access/Egress Routes in Vehicles	Access/Egress Route ID	Local road network including internal roads- applicable to Emergency Services.					
Assessment Comments: The *CFA Guidelines* Section 4.2 recommends provision of 2 access points into each part of the facility. Not all parts of the facility have crossovers available to public roads, and Great Southern Highway is under the control of Main Roads WA which is unlikely to support multiple crossovers. The site is large-scale and is accessed via multiple lots and from multiple public roads. There are many potential access points, including potentially informal crossovers, and some lots with no public road access (accessed internally). The specific design of the internal access network has not yet been determined. *Recommendation Details:* At the detailed design stage, the internal access network should be reviewed by the Bushfire Consultant to provide additional advice. Access points are likely to be gated but should be openable in the same manner (the same key, keycard, access code, remote etc). Access points are to comply, at a minimum, with the specifications for Private Driveways within Table 6 of the *Guidelines for Planning in Bushfire Prone Areas v1.4.*								
THE PROTECTION MECHANISM – EVACUEES ARE SELF-SUFFICIENT AND HAVE LOCAL AWARENESS AND OWN TRANSPORT: The 'type' of persons that will be present on the site of the proposed development/use influences their degree of vulnerability to both bushfire threats and to risk associated with vehicular accidents in a stressful environment. Persons that have local knowledge, are self-supportive, have their own transport and are physically and mentally capable present the lowest degree of vulnerability for this factor. This contrasts with persons who can be considered 'vulnerable' and are likely to be less capable or effective at making the required decisions and carrying out the required actions in the timeframe required. They are likely to be dependent on others for both information and transport and will not have any local knowledge.								
10.8	Self Sufficient Persons with Local Awareness: The site use and location increase the likelihood these are the type of persons that will be present on the site.			High	No	Yes	No	Yes
Assessment Comments: The site is intended to be unstaffed. Persons onsite during a bushfire emergency will be Emergency Services, who will be aware of the local area. Any other persons onsite (staff/contractors) will likely be maintenance personnel who will be familiar with the local area. *Recommendation Details:* See Measure 1.9.								
10.9	Onsite Persons Have Own Transport: There is no need to have arrangements in place for external provision of evacuation vehicles. Transport will always be available.			High	No	Yes	No	No
Assessment Comments: The site is intended to be unstaffed. Persons onsite during a bushfire emergency will be Emergency Services, who will have their vehicles immediately available. Any other persons onsite (staff/contractors) will have attended in their vehicles. *Recommendation Details:* Not Applicable								
Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining.								

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS				Effectiveness Rating [1]	Application Status [2]			
					Possible	Exists	Planned	Additionally Recommend
Element at Risk	Persons on Access/Egress Routes in Vehicles	Access/Egress Route ID	Local road network including internal roads- applicable to Emergency Services.					

Note 2: Protection Measure Application Status:

- Possible: Protection measures that can potentially be applied to the proposed development/use.
- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
    - Are incorporated into the site plans;
    - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
    - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Additionally Recommend: Protection measures that:
    - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
    - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

  These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.4.2.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing vulnerability levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the vulnerability of the relevant element at risk to bushfire hazard threats.

VULNERABILITY REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Persons on Access/Egress Routes in Vehicles						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommen
Lower Risk Road Construction (Design and Materials)	Very High	1			1		1
	High	2	1	2			1
	Medium	4	2	2	2	1	1
	Not Relevant						
Evacuees are Self-Sufficient and Have Local Awareness and Own Transport	Very High						
	High	2		2			1
	Medium						
	Not Relevant						
Number Analysis	Very High	1			1		1
	High	4	1	4			2
	Medium	4	2	2	2	1	1
	Not Relevant						
	Totals	9	3	6	3	1	4

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.4.2.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE VULNERABILITY

From the information presented in the previous section, the vulnerability reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce vulnerability (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE VULNERABILITY TO BUSHFIRE HAZARD THREATS [1]	
Element at Risk	Persons on Access/Egress Routes in Vehicles
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]	WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]
Moderate	Significant

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This vulnerability reducing potential will be applied to deriving the inherent vulnerability level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This vulnerability reducing potential will be applied to deriving the residual vulnerability level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

5.4.2.4 DERIVED VULNERABILITY LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual vulnerability levels.

In combination with the corresponding assessed threat and exposure levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

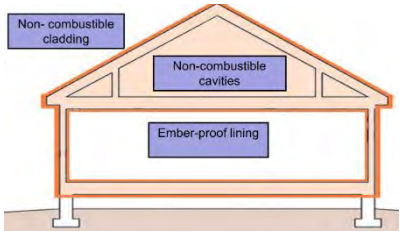
DERIVED POTENTIAL VULNERABILITY LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]				
ELEMENT AT RISK	Persons on Access/Egress Routes in Vehicles			
INHERENT VULNERABILITY LEVEL (CURRENT STATE) [2]				
Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐
THE RESIDUAL VULNERABILITY LEVEL (POTENTIAL FUTURE STATE) [2]				
Very Low ☐	Low ☒	Moderate ☒	High ☐	Extreme ☐
Note 1: Refer to Appendix 1 for explanatory and supporting information. Note 2: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.				

Assessment Comments: The site is intended to be unstaffed. Persons onsite during a bushfire emergency will be Emergency Services, who will be aware of the local area and have their vehicles immediately available. Any staff/contractors onsite will have similar awareness/vehicles.

5.4.3 BUILDINGS AND STRUCTURES (NCC CLASSES 1-10)

5.4.3.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Buildings/Structures - NCC Classes 1-10					
THE PROTECTION MECHANISM – CONSTRUCTION DESIGN AND MATERIALS: Increase bushfire resilience through the application of beneficial design and construction, including using non-combustible materials and minimising the use of vulnerable materials, to the greatest extent possible. Practicality and cost will be key considerations in determining the viability of applying protection measures in differing scenarios, but this should be determined with due consideration of threat levels and the importance of the elements at risk. The constructed systems should utilise the following properties to the greatest extent possible: reliability (which requires their durability over time, low maintenance and being unlikely to change over time), robustness (which limits damage spread from minor sources, continues to protect when thermally loaded and protects vulnerable elements), resilience (which enables their return to a functional state following an overload) and redundancy (which ensures the fate of the subject building/structure is not reliant on the effective performance of a single element). Refer to the glossary for additional explanation. The mechanism is also applicable to constructed consequential fire fuels.						
11.1	Construct to AS 3959:2018 [4]: Apply the specified requirements to construction. These are intended to reduce the risk of building ignition from bushfire direct attack mechanisms. Note that the indirect attack mechanisms and the threats presented by consequential fire fuels are not specifically considered. *"The standard is primarily concerned with improving the ability of buildings … to better withstand attack from bushfire thus giving a measure of protection to the building occupants (until the fire front passes), as well as to the building itself".* The AS 3959 approach adopts a strategy that relies on the integrity of the building's exterior envelope (i.e., the cladding of roof/wall/eaves, floor supporting structures/flooring and all penetrations) to resist all bushfire exposure conditions and environmental actions thereby protecting all structural construction elements behind it, including allowable combustible materials. It provides protection by: • Using specified materials that provide ignition resistance (tolerance of radiant heat and flames). Higher BAL ratings impose increased construction requirements for these exterior envelope materials; • Specifying precise gap control (applicable to all bushfire attack levels) for the exterior envelope of the building to prevent ember entry); and • Attached and adjacent structures (within 6m) must also comply with the Standard.	High	No	No	No	Yes
Assessment Comments: Structures (storage sheds and switchrooms etc) do not have a general structure which can comply with AS 3959 or NASH.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Buildings/Structures - NCC Classes 1-10					
Recommendation Details: Any proposed or future Class 1-9 buildings should be constructed to their assessed BAL to a minimum of BAL-12.5 under AS3959 to reduce the vulnerability to ember attack, even if subject to BAL-LOW. This does not apply to Class 10 buildings which cannot comply with AS3959.						
11.2	Construct to NASH Standard [33]: Apply the specified requirements to construction. The Standard: *"Sets out acceptable construction requirements for residential and low-rise buildings in bushfire prone areas to reduce the risk of ignition from bushfire attack involving embers, radiant heat and direct flame impingement using non-combustible materials. Buildings constructed in accordance with this Standard are intended to provide a sheltering envelope during the passage of a bushfire flame front. They do not constitute 'last resort' private bushfire shelters as defined in the NCC. The Standard is based on achieving ignition resistance through non-combustible construction using conventional building materials and a level of redundancy to provide a high level of performance in extreme bushfire events and an increased probability that unattended buildings will survive such events."* Key attributes of the Standard include: • Materials used anywhere on the building envelope (see shaded part of diagram below), must be non-combustible except for a small amount allowed externally that includes flooring, window frames, doors and external decorative trim. The building envelope is comprised of a framed roof/ceiling system, an external wall system and a floor system;  • The same construction requirements apply for all BAL ratings up to BAL-40 (except for external doors and windows which apply AS 3959 requirements). An additional benefit of this is the built in resistance to the direct attack mechanisms of consequential fire when lower BAL ratings apply. • It does not rely on eliminating ember entry to the roof space, wall cavities and floor system as these are non-combustible construction. Embers only need to be kept from entering the internal living/operating spaces. • It is ember tolerant without unrealistic workmanship, supervision and maintenance requirements;	Very High	No	No	No	No

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Buildings/Structures - NCC Classes 1-10					
	• The combination of a non-combustible cladding and cavities is a robust solution that enables the building to be configured so that failure or damage to one element does not lead to the inevitable failure of the building or a breach of the habitable envelope; and • Attached and adjacent structures (within 6m) must also comply with the Standard.					
Assessment Comments: NASH may be considered as an alternative standard for steel-framed construction rather than AS 3959. *Recommendation Details:* Not Applicable						
11.3	Construction Materials for External and Internal Cavity Building Elements: Except for internal living or operation spaces, to the degree necessary, utilise materials resistant to fire attack mechanisms of flame and radiant heat (preferably non-combustible) for all relevant building elements, including wall, roof, floor, supporting structures and framing systems.	Very High	Yes	No	Unknown	Yes
Assessment Comments: Any future Class 1-10 buildings will likely be primarily masonry, steel, aluminium and cement sheeting. *Recommendation Details:* For any future Class 1-10 buildings, include non-combustible structural elements where practical. In particular, avoid: polycarbonate (sheeting and skylights), softwoods (<650 kg/m3 density at 12% moisture content), and fibrous materials.						
11.4	Construction Materials for Consequential Fire Fuels: For constructed large consequential fire fuels, use non-combustible materials to the fullest extent possible. Potential fuels include: • Landscaping items – fences, screens, retaining walls, gazebos, plastic water tanks etc; • Attached structures - decks, verandahs, stairs, carports, garages, pergolas, patios, etc; • Adjacent structures – other houses, sheds, garages, carports, etc. Post bushfire event assessments identify structure to structure fire as a common cause of overall building loss [9].	High	Yes	No	No	Yes
Assessment Comments: The presence and design of potential large fuels is not known (other than assets assessed in Report). *Recommendation Details:* See Measure 13.4.						
11.5	Construction Design / Materials Resistant To High Wind Damage: Apply construction measures to prevent the type of building damage from wind that will open or create gaps (from the wind itself or carried projectiles) and allow the entry of embers, radiant heat and flames. This type of damage is typically superficial damage. Building codes relating to wind (e.g., cyclones) do not necessarily address this superficial type of impact.	Medium	Yes	No	No	No

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Buildings/Structures - NCC Classes 1-10					
	Additional fixings for building envelope claddings and protection of the most vulnerable elements, such as glazing, from debris impact, are key considerations. Consider applying the principles of the NASH Standard [33] design solution to construction. "Potential wind effects directly associated with bushfire events have been considered in this Standard. Wind actions may affect buildings subject to a bushfire attack in various ways including: • The intensity of flame front activity may produce locally high wind pressures on parts of the building; • In the post fire phase, some weakened components on the building envelope may be vulnerable to normal design pressures; and • Wind can drive embers into the building envelope." Most applicable when the physical requirements exist for the development of an extreme bushfire event within the surrounding surrounding landscape.					
Assessment Comments: Wind is unlikely to cause sufficient damage to create a vulnerability to embers given the setback from vegetation. Increased structural requirements to account for high wind have not been applied, as Class 1-9 buildings are required to comply with the NCC and Class 10 buildings do not have practical measures available to reduce this vulnerability. *Recommendation Details:* Not Applicable						
11.6	Construction of Gas Supply: All gas cylinders are installed and maintained in accordance with AS 1596 (for domestic house supply) as a guide. The requirement of the standard includes: • Safety release valve shall be directed away from the building and persons access/egress routes; • Metal piping and fittings shall be used on all piping inside the building's cavities and enclosable occupied spaces and the high pressure side of any gas regulators; and • Tethers securing cylinders are to be non-combustible. The objective is to reduce the risk of consequential (secondary) fire against a building and reduce the risk of death or injury, from gas flaring or explosion. The rationale is gas cylinders which have either flared or ruptured are commonly found in post bushfire surveys [9]. The heat from the bushfire or consequential (secondary) fire has been sufficient to cause their pressure to reach critical levels beyond which their pressure release valve releases large quantities of LP gas. If these gas cylinders fall over, this pressure release valve may no longer function correctly, meaning that the gas	Medium	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Buildings/Structures - NCC Classes 1-10					
	cylinder may continue to increase in pressure with continued heating until the cylinder ruptures. The resulting explosion includes a pressure wave and large ball of flame which can threaten nearby life and buildings. Readily available guidance is provided by CSIRO Best Practice Bushfire Guide (https://research.csiro.au/bushfire/new-builds/water-electricity-gas/) and WA Dept. Mines, Industry, Regulation and Safety 'LP Gas cylinder safety in bushfire prone areas' (https://www.commerce.wa.gov.au/publications/lp-gas-cylinder-safety-bushfire-prone-areas).					
Assessment Comments: Gas storage is not proposed on site. Any LPG will be stored in compliance with AS 1596. *Recommendation Details:* Not Applicable						
11.7	Construction of Electricity Supply: Cabling to be shielded (includes installing underground within subject property boundary) from applicable bushfire attack mechanisms. The objective is to assist with continuity of supply for essential site operations and/or electrically driven firefighting pumps. It also reduces the risk of electrocution to any persons onsite and reduces potentially additional sources of fire ignition. It is common in bushfires for power infrastructure to burn and collapse or be impacted by falling trees or branches while power lines are still live. Removing this risk may be appropriate for some sites.	Medium	Yes	No	No	No
Assessment Comments: Future Class 1-10 buildings may have an electricity supply. The electricity supply to buildings is not vital for emergency operations. *Recommendation Details:* Not Applicable						
11.8	Minimise Re-entrant Detail to Minimise Debris and Ember Accumulation: Avoid or limit the accumulation of unburnt debris and embers by minimising re-entrant details and/or adopting aerodynamic forms that will self-shed windblown debris and embers. For example: • Simple building/structure footprints that avoid re-entrant corners in access ways, at wall/floor, wall/ground, roof/wall junctions and around doors, vents, windows; and • Simple roof layouts that avoid valleys and minimise the number of ridges that need protection details (e.g. skillion roofs).	Medium	Yes	No	Unknown	No
Assessment Comments: The design of any Class 1-10 buildings are likely to be simple rectangular structures without complex features. *Recommendation Details:* Not Applicable						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Buildings/Structures - NCC Classes 1-10					
11.9	Minimise Debris and Ember Trapping Surfaces: Avoid or minimise the use of exposed combustible surfaces that can trap and accumulate debris and embers. These include: • Horizontal, or shallow angle surfaces e.g. exposed wall/roof framework, roofs, decking, verandahs, steps, windowsills; and • Vertical surfaces with rough textured cladding (e.g. sawn timber).	Medium	Yes	No	Unknown	No
Assessment Comments: The design of any Class 1-10 buildings are likely to be simple rectangular structures without complex features. *Recommendation Details:* Not Applicable						
11.10	Protect Roof Plumbing to Minimise Debris and Ember Accumulation: All roof plumbing (gutters, valleys) is protected from the accumulation of debris and embers that can result in direct fire attack mechanisms immediately adjacent to any combustible elements within the roof cavity.	Medium	Yes	No	No	No
Assessment Comments: There will be few to no trees within the APZ to allow for debris to accumulate. *Recommendation Details:* Not Applicable						
11.11	Minimise Construction Cavities to Minimise Debris and Ember Accumulation: Apply designs that lower the potential for accumulation of embers and debris within cavity spaces of buildings/structures. Examples include concrete floor slab on the ground and solid masonry walls.	Medium	Yes	No	Unknown	Yes
Assessment Comments: The design of any Class 1-10 buildings are likely to be simple rectangular structures without complex features. *Recommendation Details:* See Measure 13.11.						
11.12	Minimise External Openings to Limit Flame/Radiant Heat/Ember/Debris Entry: Limit potential sites for threat entry to through the external building envelope to internal spaces containing combustible materials (consequential fire fuels). Examples include reducing windows/doors on elevations facing the bushfire hazard and apply design to limit gaps and penetrations that will require screening.	Medium	Yes	No	No	Yes
Assessment Comments: None Required. *Recommendation Details:* The detailed design of any Class 1-10 Buildings should be reviewed to ensure it is possible for them to be fully enclosed.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Buildings/Structures - NCC Classes 1-10					
11.13	Screen and Seal Gaps and Penetrations: Apply fire rated sealants and/or install metal screening (corrosion resistant steel, bronze, aluminium <2mm aperture). All external construction and penetration gaps with apertures greater than 2mm will allow ember entry (and potentially debris) to internal cavities and combustible materials within (as consequential fire fuels). This includes gaps in roofs, walls, doors, windows and their surrounding trims – including those associated with penetrations, vents, weepholes, poor workmanship and material deterioration and movement over time (maintenance). Internal fire is difficult to see and extinguish.	Medium	Yes	No	Unknown	Yes
Assessment Comments: The measure is applied through construction to AS 3959 in measure 11.1. *Recommendation Details:* Any Class 1-10 buildings (including non-habitable structures) must have ember screening/sealants installed on any gaps, penetrations, and external glazed elements. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium.						
11.14	Screen External Doors and Windows: Metal screens (corrosion resistant steel, bronze, aluminium <2mm aperture) installed over non-openable and/or openable parts of windows and doors to prevent ember entry to internal spaces containing combustible materials (consequential fire fuels) and reduce radiant heat load on vulnerable surfaces.	Medium	Yes	No	Unknown	Yes
Assessment Comments: Any doors will likely be a solid panel, or composed of the same material as walls. The site will be unstaffed and thus doors will be closed at all times. Windows are unlikely to be installed. *Recommendation Details:* See Measure 13.11.						
11.15	Shutter External Doors and Windows: Fire rated shutters are installed to significantly increase bushfire resistance of the vulnerable building elements.	Medium	Yes	No	Unknown	No
Assessment Comments: Screening has been applied rather than shutters. *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM – AVAILABILITY OF A FIREFIGHTING RESPONSE CAPABILITY: Provide sufficient and reliable dedicated firefighting water supply and delivery capability as necessary for installed active and/or passive systems.						
11.16	Firefighting Water Supply: Have a dedicated static supply of firefighting water for the protection of buildings/structures before and after the passage of a bushfire front. Adequate water supply is critical for any firefighting operation, particularly where property protection is the intent. This is necessary when:	High	Yes	No	Partly	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Buildings/Structures - NCC Classes 1-10					
	• A water supply additional to a reticulated water supply is required to counter the loss of firefighting water as a protection measure, should the reticulated supply be interrupted; and • It is the only source of firefighting water. All tanks shall be non-combustible. Aside from losing water, failure of combustible tank can provide an additional heat or load to a vulnerable building element. Metal piping and fittings shall be used for any above ground components. The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.					
Assessment Comments: Not Required *Recommendation Details:* See Measure 13.17.						
11.17	Firefighting Equipment Actively Operated: In addition to a dedicated water supply, appropriate mobile firefighting appliances are available quickly and/or fixed firefighting equipment is installed (pumps, hoses, sprinklers etc). Where equipment is installed, this will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard). The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.	High	No	No	No	No
Assessment Comments: The site is unstaffed. Actively operated firefighting equipment would not be effective. *Recommendation Details:* Not Applicable						
11.18	Fire Fighting Equipment Passively Operated: In addition to a dedicated water supply, appropriate water dispensing apparatus are installed (e.g. pumps, plumbing and sprinklers) that are automatically activated. These will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard).	High	Yes	No	No	No
Assessment Comments: Prevention of ignition and spread is effective. Passive firefighting for Class 1-10 buildings is not proposed, as they will be unoccupied and items stored may be damaged by sprinkler systems (and thus loss to fire is less relevant). *Recommendation Details:* Not Applicable						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Buildings/Structures - NCC Classes 1-10					
11.19	Fire Fighting Equipment Operability Maintained: Where water pumps, shutters or other active/passive protection measures rely on the continued supply of electricity, establish barriers (shielding) or separation from potential damaging factors (e.g. falling trees/branches, fire, or other impact sources). For example, bury transmission systems to the greatest extent possible.	High	Yes	No	Yes	Yes
Assessment Comments: Not Required *Recommendation Details:* See Measure 1.9.						
11.20	Access via Firebreaks Provided: Installation and maintenance of firebreaks to facilitate firefighting access / backburning (and also limiting surface fire progression).	Medium	Yes	Yes	Yes	No
Assessment Comments: Firebreaks are currently installed throughout the project area. Some firebreaks will be upgraded to function as part of the internal road network. *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM – MANAGE AND MAINTAIN EFFECTIVENESS OF APPLIED PROTECTION MEASURES: To ensure the retention of the level of bushfire resilience that has been established through the implementation of appropriate bushfire protection measures, formal and enforceable responsibilities are created.						
11.21	Formal Documents Created to Guide and Enforce Management: Through relevant site operations document(s) and/or an enforceable agreement, regulation or standard, a mechanism is put in place to ensure that: • The required management and maintenance of applied bushfire protection measures is conducted on a regular basis – with the interval dependent on the necessary frequency that will maintain full effectiveness; • The relevant protection measures are known and understood; and • Responsibilities are created.	High	Yes	No	Yes	Yes
Assessment Comments: Not Required *Recommendation Details:* See Measure 13.22.						
Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining. Note 2: Protection Measure Application Status: • Possible: Protection measures that can potentially be applied to the proposed development/use.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Buildings/Structures - NCC Classes 1-10					

- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

  These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.4.3.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing vulnerability levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the vulnerability of the relevant element at risk to bushfire hazard threats.

VULNERABILITY REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Buildings / Structures - NCC Classes 1-10						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommen
Construction Design and Materials	Very High	2	1				1
	High	2	1				2
	Medium	11	10				5
	Not Relevant						
Availability of a Firefighting Response Capability	Very High						
	High	4	3		1	1	3
	Medium	1	1	1		1	
	Not Relevant						
Manage and Maintain Effectiveness of Applied Protection Measures	Very High						
	High	1	1		1		1
	Medium						
	Not Relevant						
Number Analysis	Very High	2	1				1
	High	7	5		2	1	6
	Medium	12	11	1		1	5
	Not Relevant						
	Totals	21	17	1	2	2	12
Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining. Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.							

5.4.3.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE VULNERABILITY

From the information presented in the previous section, the vulnerability reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce vulnerability (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE VULNERABILITY TO BUSHFIRE HAZARD THREATS [1]							
Element at Risk	Buildings and Structures – NCC Classes 1-10						
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Minimal	Moderate	Minimal	Minimal	Moderate	Moderate	Minimal	Minimal
Minimal				Minimal			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Moderate	Significant	Moderate	Minimal	Significant	Moderate	Minimal	Moderate
Moderate				Moderate			

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This vulnerability reducing potential will be applied to deriving the inherent vulnerability level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This vulnerability reducing potential will be applied to deriving the residual vulnerability level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

Assessment Comments: The protection measures concentrate on reducing the vulnerability of building(s) to ember attack, including ember screening, construction materials, enclosing subfloor cavities, and preventing leaf litter/debris accumulation.

Availability of firefighting water improves the Vulnerability Level against consequential fires, radiant heat, and flame contact.

5.4.3.4 DERIVED VULNERABILITY LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual vulnerability levels.

In combination with the corresponding assessed threat and exposure levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL VULNERABILITY LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]							
ELEMENT AT RISK		Buildings/Structures - NCC Classes 1-10					
BUSHFIRE ATTACK MECHANISMS [2]		INHERENT VULNERABILITY LEVEL (CURRENT STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☒	High
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☒	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☐	High ☐	Extreme ☒	
BUSHFIRE ATTACK MECHANISMS [2]		RESIDUAL VULNERABILITY LEVEL (POTENTIAL FUTURE STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	Moderate
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix 2 for explanatory and supporting information.

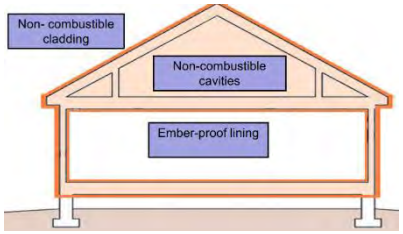
Note 3: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

Note 4: The level of exposure to flames and radiant heat is derived from the assessed BAL ratings (refer to the BAL contour map). The exposure levels applied are BAL-LOW/Very Low Exposure, BAL-12.5/Low Exposure, BAL-19/Moderate Exposure, BAL-29/High Exposure, BAL-40 and BAL-FZ/Extreme Exposure.

5.4.4 BUILT INFRASTRUCTURE ASSETS – BESS CABINETS

5.4.4.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
THE PROTECTION MECHANISM – CONSTRUCTION DESIGN AND MATERIALS: Increase bushfire resilience through the application of beneficial design and construction, including using non-combustible materials and minimising the use of vulnerable materials, to the greatest extent possible. Practicality and cost will be key considerations in determining the viability of applying protection measures in differing scenarios, but this should be determined with due consideration of threat levels and the importance of the elements at risk. The constructed systems should utilise the following properties to the greatest extent possible: reliability (which requires their durability over time, low maintenance and being unlikely to change over time), robustness (which limits damage spread from minor sources, continue to protect when thermally loaded and protects vulnerable elements), resilience (which enables their return to a functional state following an overload) and redundancy (which ensures the fate of the subject building/structure is not reliant on the effective performance of a single element). Refer to the glossary for additional explanation. The principle is also applicable to constructed consequential fire fuels.						
13.1	Construct to AS 3959:2018 [4]: Use the principles and requirements established in the Standard, for buildings in general, and apply to the infrastructure assets where they have merit. These are intended to reduce the risk of building ignition from bushfire direct attack mechanisms. Note that the indirect attack mechanisms and the threats presented by consequential fire fuels are not specifically considered. Key attributes of the Standard that may have relevance to other built assets include: • The AS 3959 strategy that relies on the integrity of the building's exterior envelope (i.e., the cladding of roof/wall/eaves, floor supporting structures/flooring and all penetrations) to resist all bushfire exposure conditions and environmental actions thereby protecting all structural construction elements behind it, including allowable combustible materials. • Using specified materials that provide ignition resistance (tolerance of radiant heat and flames). Higher BAL ratings impose increased construction requirements for these exterior envelope materials; • Specifying precise gap control (applicable to all bushfire attack levels) for the exterior envelope of the building to prevent ember entry); and • Attached and adjacent structures (within 6m) must also comply with the Standard.	High	N/A	N/A	N/A	N/A
13.2	Construct to NASH Standard [33]: Use the principles and requirements established in the Standard, for residential and low-rise buildings, and apply to the infrastructure assets where they have merit. Key attributes of the Standard that may have relevance to other built assets include:	Very High	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
	• Materials used anywhere on the building envelope (see shaded part of diagram below), must be non-combustible (except for a small number of smaller building elements). The building envelope is comprised of a framed roof/ceiling system, an external wall system and a floor system;  • The same construction requirements apply for all BAL ratings up to BAL-40 (except for external doors and windows which apply AS 3959 requirements). An additional benefit of this is the built in resistance to the direct attack mechanisms of consequential fire when lower BAL ratings apply. • It does not rely on eliminating ember entry to the roof space, wall cavities and floor system as these are non-combustible construction. Embers only need to be kept from entering the internal living/operating spaces. • It is ember tolerant without unrealistic workmanship, supervision and maintenance requirements; • The combination of a non-combustible cladding and cavities is a robust solution that enables the building to be configured so that failure or damage to one element does not lead to the inevitable failure of the building or a breach of the habitable envelope; and • Attached and adjacent structures (within 6m) must also comply with the Standard.					
Assessment Comments: Assets do not have a design which can comply with AS3959 or NASH. *Recommendation Details:* Not Applicable.						
13.3	Construction Materials for External and Internal Cavity Building Elements: Except for internal living or operation spaces, to the degree necessary, utilise materials resistant to fire attack mechanisms of flame and radiant heat (preferably non-combustible) for all relevant building elements, including wall, roof, floor, supporting structures and framing systems.	Very High	Yes	Yes	No	Yes
Assessment Comments: Assessment Comments: Battery modules will be self-contained through highly insulated steel casing used to encapsulate modules. Installation of thermally insulated steel vents within the thermal roof protecting the units from flame impingements and hot gas intrusion.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
As a developing technology, there are multiple standards and guidelines internationally which may be applicable but potentially conflict. Additionally, the guiding documents themselves are under ongoing development and may contain oversights/errors which preclude full compliance and certification. The Intensium Shift is compliant/tested in accordance with: • UL 9540A v4 - Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems. • UN38.3 (Lithium metal and lithium ion batteries) within Recommendations on the Transport of Dangerous Goods. • IEC 62619:2022 - Secondary cells and batteries containing alkaline or other non-acid electrolytes which has been adopted by Standards Australia as AS IEC 62619:2023. • UL 1973 3rd ed: Batteries for Use in Light Electric Rail (LER) Applications and Stationary Application *Recommendation Details:* Review compliance against NFPA 855 - Standard for the Installation of Stationary Energy Storage Systems (2023) noting that as a North American planning standard, all requirements may not be applicable. The Intensium Shift datasheet includes an ambient temperature range of -20°C to +45C, with an option for +55°C. The 55°C option should be investigated to account for high ambient temperature combining with heat generated from bushfire.						
13.4	Construction Materials for Consequential Fire Fuels: For constructed large consequential fire fuels, use non-combustible materials to the fullest extent possible. Potential fuels include attached structures, adjacent structures and surrounding landscaping items (fences, screens, retaining walls etc.).	High	Yes	No	Unknown	Yes
Assessment Comments: No combustible structural elements have been identified. They will likely be primarily masonry, steel, aluminium and cement sheeting. *Recommendation Details:* It is recommended non-combustible elements are used for structural and supporting/associated constructions wherever practical. This includes sheds, lean-tos, verandas, shade screening, lattice, garden edging, fencing etc.						
13.5	Construction Design / Materials Resistant To High Wind Damage: Apply construction measures to prevent the type of building damage from wind that will open or create gaps (from the wind itself or carried projectiles) and allow the entry of embers, radiant heat and flames. This type of damage is typically superficial damage. Building codes relating to wind (e.g., cyclones) do not necessarily address this superficial type of impact. Additional fixings for building envelope claddings and protection of the most vulnerable elements, such as glazing, from debris impact, are key considerations. Consider applying the principles of the NASH Standard [33] design solution to construction. "Potential wind effects directly associated with bushfire events have been considered in this Standard. Wind actions may affect buildings subject to a bushfire attack in various ways including:	Medium	Yes	Yes	No	No

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
	• The intensity of flame front activity may produce locally high wind pressures on parts of the building; • In the post fire phase, some weakened components on the building envelope may be vulnerable to normal design pressures; and • Wind can drive embers into the building envelope." Most applicable when the physical requirements exist for the development of an extreme bushfire event within the surrounding surrounding landscape.					
Assessment Comments: Assets will be installed underground, fixed to the ground (concrete or buried support pillars), and else will be metal and heavily weighted. Wind is unlikely to cause sufficient damage to create a vulnerability to embers. *Recommendation Details:* Not Applicable						
13.6	Construction of Gas Supply: All gas cylinders are installed and maintained in accordance with AS 1596 (for domestic house supply) as a guide. The requirement of the standard includes: • Safety release valve shall be directed away from the building and persons access/egress routes; • Metal piping and fittings shall be used on all piping inside the building's cavities and enclosable occupied spaces and the high pressure side of any gas regulators; and • Tethers securing cylinders are to be non-combustible. The objective is to reduce the risk of consequential (secondary) fire against a building and reduce the risk of death or injury, from gas flaring or explosion. The rationale is gas cylinders which have either flared or ruptured are commonly found in post bushfire surveys [9]. The heat from the bushfire or consequential (secondary) fire has been sufficient to cause their pressure to reach critical levels beyond which their pressure release valve releases large quantities of LP gas. If these gas cylinders fall over, this pressure release valve may no longer function correctly, meaning that the gas cylinder may continue to increase in pressure with continued heating until the cylinder ruptures. The resulting explosion includes a pressure wave and large ball of flame which can threaten nearby life and buildings. Readily available guidance is provided by CSIRO Best Practice Bushfire Guide (https://research.csiro.au/bushfire/new-builds/water-electricity-gas/) and WA Dept. Mines, Industry, Regulation and Safety 'LP Gas cylinder safety in bushfire prone areas' (https://www.commerce.wa.gov.au/publications/lp-gas-cylinder-safety-bushfire-prone-areas).	Medium	N/A	N/A	N/A	N/A
Assessment Comments: Gas storage is not proposed on site. Any LPG will be stored in compliance with AS 1596.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
Recommendation Details: Not Applicable						
13.7	Construction of Electricity Supply: Cabling to be shielded (includes installing underground within subject property boundary) from applicable bushfire attack mechanisms. The objective is to assist with continuity of supply for essential site operations and/or electrically driven firefighting pumps. It also reduces the risk of electrocution to any persons onsite and reduces potentially additional sources of fire ignition. It is common in bushfires for power infrastructure to burn and collapse or be impacted by falling trees or branches while power lines are still live. Removing this risk may be appropriate for some sites.	Medium	Yes	No	Yes	Yes
Assessment Comments: Cabling associated with BESS will be enclosed within the cabinet, with some lines potentially running between systems or to solar farm area or substation. The critical threshold for electrical cabling applied in Measure 6.3 is 12kW/m2, with the APZ being 10kW/2 to ensure this threshold is not exceeded. *Recommendation Details:* See Measure 6.12.						
13.8	Minimise Re-entrant Detail to Minimise Debris and Ember Accumulation: Avoid or limit the accumulation of unburnt debris and embers by minimising re-entrant details and/or adopting aerodynamic forms that will self-shed windblown debris and embers. For example: • Simple building/structure footprints that avoid re-entrant corners in access ways, at wall/floor, wall/ground, roof/wall junctions and around doors, vents, windows; and • Simple roof layouts that avoid valleys and minimise the number of ridges that need protection details (e.g. skillion roofs).	Medium	Yes	Yes	Unknown	Yes
Assessment Comments: The structure design and construction allow for little debris accumulation. No trees are proposed to be planted or retained within the 10kW/m2 APZ and thus accumulation of debris will be unlikely and, where any occurs, will occur slowly. Recommendation Details: Where electrical cabling, or gas or liquid piping, contacts the ground or any arrangement of associated structures creates a 'pocket' for accumulation of debris, this should be rectified by design or filling with non-combustible material such as mineral earth. Consideration should be given to making the arrangement self-cleaning through wind action to the greatest extent possible. These measures will reduce accumulation and/or make the management (clearing) of accumulated debris easier. E.g. cable raking to be 100mm above ground.						
13.9	Minimise Debris/Ember Trapping Surfaces: Avoid or minimise the use of exposed combustible surfaces that can trap and accumulate debris and embers. These include:	Medium	Yes	Yes	Unknown	No

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
	• Horizontal, or shallow angle surfaces e.g. exposed wall/roof framework, roofs, decking, verandahs, steps, windowsills; and • Vertical surfaces with rough textured cladding (e.g. sawn timber).					
Assets are not expected to include the above features. Horizontal surfaces may exist but will be open-air and will be self-clearing through wind. No rough textured vertical surfaces will exist as assets will be metal, concrete, or tilt-up panels. No trees are proposed to be planted or retained within the 10kW/m2 APZ and thus accumulation of debris will be unlikely and, where any occurs, will occur slowly. *Recommendation Details:* Not Applicable						
13.10	Protect Roof Plumbing to Minimise Debris and Ember Accumulation: All roof plumbing (gutters, valleys) is protected from the accumulation of debris and embers that can result in direct fire attack mechanisms immediately adjacent to any combustible elements within the roof cavity.	Medium	N/A	N/A	N/A	N/A
Assessment Comments: BESS cabinets will not have roof plumbing. *Recommendation Details:* Not Applicable						
13.11	Minimise Construction Cavities to Minimise Debris and Ember Accumulation: Apply designs that lower the potential for accumulation of embers and debris within cavity spaces of buildings/structures. Examples include concrete floor slab on the ground and solid masonry walls.	Medium	Yes	Yes	No	Yes
Assessment Comments: The internal spaces of assets will be entirely enclosed. BESS cabinets may have exposed subfloors (as containers placed on the ground). BESS cabinets are recommended to be sited on concrete slabs or other sealed, non-combustible surface in Measure 6.3. *Recommendation Details:* Any subfloor cavities must have exposed subfloor spaces enclosed, sealed with non-combustible material, or be ember screened. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium.						
13.12	Minimise External Openings to Limit Flame/Radiant Heat/Ember/Debris Entry: Limit potential sites for threat entry to through the external building envelope to internal spaces containing combustible materials (consequential fire fuels). Examples include reducing windows/doors on elevations facing the bushfire hazard and apply design to limit gaps and penetrations that will require screening.	Medium	Yes	Yes	No	Yes
Assessment Comments: BESS cabinets include intake/extraction/air conditioning vents. Assets will otherwise be sealed against weather impacts. *Recommendation Details:* See Measures 13.11 and 13.13.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
13.13	Screen and Seal Gaps and Penetrations: Apply fire rated sealants and/or install metal screening (corrosion resistant steel, bronze, aluminium <2mm aperture). All external construction and penetration gaps with apertures greater than 2mm will allow ember entry (and potentially debris) to internal cavities and combustible materials within (as consequential fire fuels). This includes gaps in roofs, walls, doors, windows and their surrounding trims – including those associated with penetrations, vents, weepholes, poor workmanship and material deterioration and movement over time (maintenance). Internal fire is difficult to see and extinguish.	Medium	Yes	Unknown	No	Yes
Assessment Comments: Not Required *Recommendation Details:* The manufacturer or appropriate engineers should be contacted to enquire if it is possible to apply ember screening to intake/exhaust/air conditioning vents and other paths of entry to the interior cavity or accessing any combustible elements of BESS cabinets. This ember screening would be applicable to the exterior of the battery cabinet, not internal components. The intention is to prevent both ember ingress and debris accumulation. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium.						
13.14	Screen External Doors and Windows: Metal screens (corrosion resistant steel, bronze, aluminium <2mm aperture) installed over non-openable and/or openable parts of windows and doors to prevent ember entry to internal spaces containing combustible materials (consequential fire fuels) and reduce radiant heat load on vulnerable surfaces.	Medium	N/A	N/A	N/A	N/A
Assessment Comments: Assets will not have windows. Doors will be a solid metal panel. *Recommendation Details:* Not Applicable.						
13.15	Shutter External Doors and Windows: Fire rated shutters are installed to significantly increase bushfire resistance of the vulnerable building elements.	Medium	Yes	Unknown	No	Yes
Assessment Comments: Assets will not have windows. *Recommendation Details:* External doors (if present) should be self-closing.						
13.16	Construction Materials for Critical Non-Structural Elements: Utilise fire/radiant heat rated products (rated to the level determined necessary), for the construction of non-structural elements that are essential to the continued operation of the built asset, and which are potentially exposed to the attack mechanisms of both bushfire and consequential fire.	High	Yes	Yes	Yes	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
	These vulnerable elements include cabling and plumbing associated with power (delivery) inputs and outputs, data transmission, liquid/gas transport (fuel/water) etc.					
The materials identified as critical are discussed in Measure 6.3 in determining the appropriate Asset Protection Zone. These components are integral to the design and cannot be replaced with materials more resistant to fire attack mechanisms. Asset fire is the major concern for the risks associated with BESS technologies and the engineer/manufacturer is assumed to have applied fire risk reduction in material selection to the maximum practical extent. No constructed assets or infrastructure are expected to include flammable or otherwise vulnerable materials. *Recommendation Details:* Review *FM Global Property Loss Prevention Data Sheet 5-33 (2020) Electrical Energy Storage Systems* for additional measures applicable to the development.						
THE PROTECTION MECHANISM – AVAILABILITY OF A FIREFIGHTING RESPONSE CAPABILITY: Provide sufficient and reliable dedicated firefighting water supply and delivery capability as necessary for installed active and/or passive systems.						
13.17	Firefighting Water Supply: Have a dedicated static supply of firefighting water for the protection of buildings/structures before and after the passage of a bushfire front. Adequate water supply is critical for any firefighting operation, particularly where property protection is the intent. This is necessary when: • A water supply additional to a reticulated water supply is required to counter the loss of firefighting water as a protection measure, should the reticulated supply be interrupted; and • It is the only source of firefighting water. All tanks shall be non-combustible. Aside from losing water, failure of combustible tank can provide an additional heat load to a vulnerable building element. Metal piping and fittings shall be used for any above ground components. The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.	High	Yes	No	Yes	Yes
Assessment Comments: The *Guidelines for Planning in Bushfire Prone Areas* does not establish a firefighting water supply for non-habitable structures, including high-risk uses. Battery Energy Storage Systems and Solar Farms do not have an applicable firefighting water supply under state or national requirements. A supply of 50,000L would meet intent of planning requirements under SPP 3.7 and the *Guidelines for Planning in Bushfire Prone Areas* v1.4. The State of Victoria Country Fire Authority has produced an applicable document, which is being used as a source to determine the appropriate firefighting water requirements. The Design Guidelines and Model Requirements – Renewable Energy Facilities (CFA August 2023) does not lay out these specifications in a single format and some criteria are applicable to the Victorian planning system.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					

A summary of applicable measures to align with the Design Guidelines, as well as modifications for bushfire risk outcomes, and to meet the Western Australian planning requirements, are provided below.

Recommendation Details: The following requirements apply to the firefighting water supply, via Measure 13.17 in the associated Bushfire Risk Report. The specifications will be confirmed at the detailed design stage.

Access

- Firefighting water access points (hydrants, hard suction, or drafting) must be clearly identifiable, visible from internal roads, and unobstructed.
- An all-weather hardstand turnaround area meeting the requirements of the *Guidelines for Planning in Bushfire Prone Areas v1.4* (Explanatory Note E3.3) must be provided within 4 metres static water storage tank(s) and any independent hard suction points (hydrants).
- Site Operating Procedures must include that access routes must be unobstructed at all times.

Siting and Capacity

- The Solar Farm development will require 4 tanks installed throughout the site, each with a minimum capacity of 50,000L. The specific location of water tanks will be determined once the internal access network is known at the detailed design phase. The following requirements will apply to the 4 tanks:
    - Tanks must be installed adjacent to access points into solar farm areas, either from public road reserves or from other parts of the development area.
    - Tanks *may* be installed within public road reserves in consultation with the Shire of Narrogin.
    - All areas of the solar farm footprint must be within 5km travel of a water tank.
- The static firefighting water supply associated with the BESS development must be calculated per AS 2419. Based on the approximately 12,800m2 footprint, the required supply will be 432,000L.
- Water tanks must be positioned >15m from BESS cabinets, solar panels, PCUs, inverters, etc.
- The water tank(s) should apply a BAL-29 APZ at a minimum.

Construction

- The static water storage tank(s) must be an above-ground water tank constructed of concrete or steel.
- An external water level indicator must be installed on static water storage tank(s) and be visible from internal roads and the adjoining turnaround area.
- Signage indicating 'FIRE WATER' and the tank capacity must be fixed to each tank.
- The hard-suction point must be protected from mechanical damage (eg. bollards) where vehicle contact is possible.
- Couplings at hard suction points are required to be 125mm Storz fittings (*Guidelines v1.4* s2.2.2.1). DFES Built Environment and the local emergency services should be contacted for input on appropriate couplings and adaptors.
- During the detailed design stage, the entity designing the firefighting water supply should provide information on compliance with AS2419.1-2021 (Open Yard Protection) and what variations are applied (if any).

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
13.18	Firefighting Equipment Actively Operated: In addition to a dedicated water supply, appropriate mobile firefighting appliances are available quickly and/or fixed firefighting equipment is installed (pumps, hoses, sprinklers etc). Where equipment is installed, this will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard). The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.	High	Yes	No	Unknown	Yes
Assessment Comments: The site is unstaffed. Actively operated firefighting equipment would not be effective. *Recommendation Details:* Two suitable fire extinguishers should be provided within 20m of each PCU.						
13.19	Fire Fighting Equipment Passively Operated: In addition to a dedicated water supply, appropriate water dispensing apparatus are installed (e.g. pumps, plumbing and sprinklers) that are automatically activated. These will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard).	High	Yes	No	Yes	Yes
Assessment Comments: The BESS units have active monitoring and electrical fault safety devices which ensure the units only remain operational within their intended operating environment, with an automated shut-down system. Fire detection and suppression systems depend on the asset type and its design, there is no 'one size fits all' solution. As BESS cabinets are delivered fully constructed (plug in and play) the detection/suppression systems will be functional immediately. The Intensium Shift product datasheet includes: *'I-Sight digital platform for external communication, remote monitoring and supervision, data management with a high cybersecurity level.'* *Recommendation Details:* Automatic fire detection and suppression systems should be installed and maintained, as appropriate to the BESS details and recommended by the manufacturer.						
13.20	Fire Fighting Equipment Operability Maintained: Where water pumps, shutters or other active/passive protection measures rely on the continued supply of electricity, establish barriers (shielding) or separation from potential damaging factors (e.g. falling trees/branches, fire, or other impact sources). For example, bury transmission systems to the greatest extent possible.	High	No	No	Unknown	Yes
Assessment Comments: DFES Guidance Note: Firefighting Water Supply Considerations for Special Hazard & Dangerous Goods Sites has been considered in the design of the firefighting water supply.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
Recommendation Details: Any firefighting water pump will be either self-powered (diesel tank) or connected to a backup generator (if connected to mains power). Ensure the diesel tank capacity and pump itself is capable of operating for a period not less than the determined minimum water supply period (e.g. if a 4-hour water supply has been determined, the diesel tank must hold a 4-hour supply). All firefighting water tanks, pumps, connections, couplings, and pipes are to be metal or else non-combustible.						
13.21	Access via Firebreaks Provided: Installation and maintenance of firebreaks to facilitate firefighting access / backburning (and also limiting surface fire progression).	Medium	Yes	Yes	Yes	No
Assessment Comments: Firebreaks are currently installed throughout the project area. Some firebreaks will be upgraded to function as part of the internal road network. *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM – MANAGE AND MAINTAIN EFFECTIVENESS OF APPLIED PROTECTION MEASURES: To ensure the retention of the level of bushfire resilience that has been established through the implementation of appropriate bushfire protection measures, formal and enforceable responsibilities are created.						
13.22	Formal Documents Created to Guide and Enforce Management: Through relevant site operations document(s) and/or an enforceable agreement, regulation or standard, a mechanism is put in place to ensure that: • The required management and maintenance of applied bushfire protection measures is conducted on a regular basis – with the interval dependent on the necessary frequency that will maintain full effectiveness; • The relevant protection measures are known and understood; and • Responsibilities are created.	High	Yes	No	Yes	Yes
Assessment Comments: The documents have been or will be produced. *Recommendation Details:* The decision maker should note that multiple international standards and guidelines exist, and full compliance with all may not be achievable. Australia lacks a guiding standard, as discussed in the *Battery Energy Storage Systems Guidance Report* (GHD March 2023, prepared for the Australian Energy Council). The decision maker may choose to review this report for an overview of context, concerns, and outcomes, for the construction and installation of BESS proposals. Ongoing requirements established in this Risk Assessment and Section 5.7 of the associated Bushfire Management Plan, must be included in operational documents. Site Operating Procedures must include the following information: <u>Maintenance</u>						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					

- Maintenance intervals. Scheduling can be detailed within a supporting document.
- Assigned responsibilities of staff.
- Maintenance procedures and servicing to manufacturer's specifications.
- Testing procedures of the firefighting water supply and equipment.

Inspections

- Inspection intervals. Frequency of inspections are recommended to be increased during the bushfire season (see the Local Government Prohibited Burning Period) where practical.
- Inspection triggers, including extreme weather events or seismic activity.
- Established inspection criteria, including:
    - Accumulation of debris and vegetative material within 10m of battery modules.
    - Mechanical damage to exterior elements.
    - Vegetation regrowth within the Asset Protection Zone, particularly immediately prior to and during bushfire season (see the Local Government Prohibited Burning Period).
    - Obstruction of access routes including firebreaks.
    - Volume of the firefighting water supply.

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining.

Note 2: Protection Measure Application Status:

- Possible: Protection measures that can potentially be applied to the proposed development/use.
- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
    - Are incorporated into the site plans;
    - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
    - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					

These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).

- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.4.4.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing vulnerability levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the vulnerability of the relevant element at risk to bushfire hazard threats.

VULNERABILITY REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommen
Construction Design and Materials	Very High	2	1	1			1
	High	3	2	1		1	2
	Medium	11	8	5		1	6
	Not Relevant						
Availability of a Firefighting Response Capability	Very High						
	High	4	3			2	4
	Medium	1	1	1		1	
	Not Relevant						
Manage and Maintain Effectiveness of Applied Protection Measures	Very High						
	High	1	1			1	1
	Medium						
	Not Relevant						
Number Analysis	Very High	2	1	1			1
	High	8	6	1		4	7
	Medium	12	9	6		2	6
	Not Relevant						
	Totals	22	16	8		6	14

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.4.4.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE VULNERABILITY

From the information presented in the previous section, the vulnerability reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce vulnerability (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE VULNERABILITY TO BUSHFIRE HAZARD THREATS [1]							
Element at Risk	Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.						
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Moderate	Significant	Moderate	Significant	Significant	Very Significant	Moderate	Minimal
Moderate				Moderate			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Very Significant	Very Significant	Significant	Significant	Significant	Very Significant	Significant	Very Significant
Very Significant				Very Significant			

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This vulnerability reducing potential will be applied to deriving the inherent vulnerability level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This vulnerability reducing potential will be applied to deriving the residual vulnerability level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

Assessment Comments: The vulnerability reducing protection measures are associated with:

- Ensuring that the design and construction of the assets can limit locations for accumulation of debris and facilitates self-cleaning by the wind.
- Having firefighting resources available of an appropriate design and capacity to extinguish consequential fires and cool battery cabinets.
- Having the BESS units fitted with active monitoring and electrical fault safety devices which ensure the units only remain operational within their intended operating environment, with an automated shut-down system.

5.4.4.4 DERIVED VULNERABILITY LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual vulnerability levels.

In combination with the corresponding assessed threat and exposure levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL VULNERABILITY LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]							
ELEMENT AT RISK		Built Infrastructure Assets - BESS Cabinets and Associated Infrastructure.					
BUSHFIRE ATTACK MECHANISMS [2]		INHERENT VULNERABILITY LEVEL (CURRENT STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	Moderate
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
BUSHFIRE ATTACK MECHANISMS [2]		RESIDUAL VULNERABILITY LEVEL (POTENTIAL FUTURE STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	Low
DIRECT	Radiant Heat [4]	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix 2 for explanatory and supporting information.

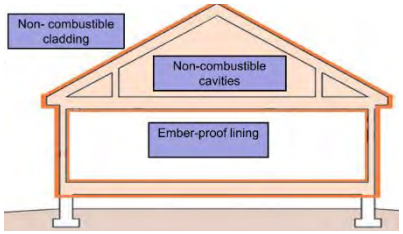
Note 3: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

Note 4: The level of exposure to flames and radiant heat is derived from the assessed BAL ratings (refer to the BAL contour map). The exposure levels applied are BAL-LOW/Very Low Exposure, BAL-12.5/Low Exposure, BAL-19/Moderate Exposure, BAL-29/High Exposure, BAL-40 and BAL-FZ/Extreme Exposure.

5.4.5 BUILT INFRASTRUCTURE ASSETS – SOLAR ARRAYS

5.4.5.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
THE PROTECTION MECHANISM – CONSTRUCTION DESIGN AND MATERIALS: Increase bushfire resilience through the application of beneficial design and construction, including using non-combustible materials and minimising the use of vulnerable materials, to the greatest extent possible. Practicality and cost will be key considerations in determining the viability of applying protection measures in differing scenarios, but this should be determined with due consideration of threat levels and the importance of the elements at risk. The constructed systems should utilise the following properties to the greatest extent possible: reliability (which requires their durability over time, low maintenance and being unlikely to change over time), robustness (which limits damage spread from minor sources, continue to protect when thermally loaded and protects vulnerable elements), resilience (which enables their return to a functional state following an overload) and redundancy (which ensures the fate of the subject building/structure is not reliant on the effective performance of a single element). Refer to the glossary for additional explanation. The principle is also applicable to constructed consequential fire fuels.						
14.1	Construct to AS 3959:2018 [4]: Use the principles and requirements established in the Standard, for buildings in general, and apply to the infrastructure assets where they have merit. These are intended to reduce the risk of building ignition from bushfire direct attack mechanisms. Note that the indirect attack mechanisms and the threats presented by consequential fire fuels are not specifically considered. Key attributes of the Standard that may have relevance to other built assets include: • The AS 3959 strategy that relies on the integrity of the building's exterior envelope (i.e., the cladding of roof/wall/eaves, floor supporting structures/flooring and all penetrations) to resist all bushfire exposure conditions and environmental actions thereby protecting all structural construction elements behind it, including allowable combustible materials. • Using specified materials that provide ignition resistance (tolerance of radiant heat and flames). Higher BAL ratings impose increased construction requirements for these exterior envelope materials; • Specifying precise gap control (applicable to all bushfire attack levels) for the exterior envelope of the building to prevent ember entry); and • Attached and adjacent structures (within 6m) must also comply with the Standard.	High	N/A	N/A	N/A	N/A
14.2	Construct to NASH Standard [33]: Use the principles and requirements established in the Standard, for residential and low-rise buildings, and apply to the infrastructure assets where they have merit. Key attributes of the Standard that may have relevance to other built assets include:	Very High	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
	• Materials used anywhere on the building envelope (see shaded part of diagram below), must be non-combustible (except for a small number of smaller building elements). The building envelope is comprised of a framed roof/ceiling system, an external wall system and a floor system;  • The same construction requirements apply for all BAL ratings up to BAL-40 (except for external doors and windows which apply AS 3959 requirements). An additional benefit of this is the built in resistance to the direct attack mechanisms of consequential fire when lower BAL ratings apply. • It does not rely on eliminating ember entry to the roof space, wall cavities and floor system as these are non-combustible construction. Embers only need to be kept from entering the internal living/operating spaces. • It is ember tolerant without unrealistic workmanship, supervision and maintenance requirements; • The combination of a non-combustible cladding and cavities is a robust solution that enables the building to be configured so that failure or damage to one element does not lead to the inevitable failure of the building or a breach of the habitable envelope; and • Attached and adjacent structures (within 6m) must also comply with the Standard.					
Assessment Comments: Assets do not have a design which can comply with AS3959 or NASH. *Recommendation Details:* Not Applicable.						
14.3	Construction Materials for External and Internal Cavity Building Elements: Except for internal living or operation spaces, to the degree necessary, utilise materials resistant to fire attack mechanisms of flame and radiant heat (preferably non-combustible) for all relevant building elements, including wall, roof, floor, supporting structures and framing systems.	Very High	No	Partly	No	No
Assessment Comments: Solar arrays do not have internal cavities. The materials used in the construction of solar panels and their mountings do not include timber, but will include various plastics and potentially small amounts of rubber, fibreglass etc. These components are integral to the design and cannot be replaced with materials more resistant to fire attack mechanisms.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
Recommendation Details: Not Applicable						
14.4	Construction Materials for Consequential Fire Fuels: For constructed large consequential fire fuels, use non-combustible materials to the fullest extent possible. Potential fuels include attached structures, adjacent structures and surrounding landscaping items (fences, screens, retaining walls etc.).	High	Yes	Yes	No	No
Assessment Comments: Supports and framework are non-combustible, being largely concrete or steel. *Recommendation Details:* Not Applicable						
14.5	Construction Design / Materials Resistant To High Wind Damage: Apply construction measures to prevent the type of building damage from wind that will open or create gaps (from the wind itself or carried projectiles) and allow the entry of embers, radiant heat and flames. This type of damage is typically superficial damage. Building codes relating to wind (e.g., cyclones) do not necessarily address this superficial type of impact. Additional fixings for building envelope claddings and protection of the most vulnerable elements, such as glazing, from debris impact, are key considerations. Consider applying the principles of the NASH Standard [33] design solution to construction. "Potential wind effects directly associated with bushfire events have been considered in this Standard. Wind actions may affect buildings subject to a bushfire attack in various ways including: • The intensity of flame front activity may produce locally high wind pressures on parts of the building; • In the post fire phase, some weakened components on the building envelope may be vulnerable to normal design pressures; and • Wind can drive embers into the building envelope." Most applicable when the physical requirements exist for the development of an extreme bushfire event within the surrounding landscape.	Medium	Yes	Yes	No	No
Assessment Comments: Extreme wind impacts are a major design consideration. Aeroelasticity is an entire field in the design and engineering of solar panels and trackers. Modern solar farms consider cyclonic winds which exceed fire-driven wind. Impact damage to PV cells does occur as solar farms are exposed to the elements. This will simply crack the surface of the panel. Management and system design (e.g. automatically disconnecting a malfunctioning panel) against physical damage prevent fire events from progressing. Serious damage to a PV cell could create a gap for ember entry into the underlying electrics, however there is no capacity to address this (highly unlikely) scenario.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
Recommendation Details: Not Applicable						
14.6	Construction of Gas Supply: All gas cylinders are installed and maintained in accordance with AS 1596 (for domestic house supply) as a guide. The requirement of the standard includes: • Safety release valve shall be directed away from the building and persons access/egress routes; • Metal piping and fittings shall be used on all piping inside the building's cavities and enclosable occupied spaces and the high pressure side of any gas regulators; and • Tethers securing cylinders are to be non-combustible. The objective is to reduce the risk of consequential (secondary) fire against a building and reduce the risk of death or injury, from gas flaring or explosion. The rationale is gas cylinders which have either flared or ruptured are commonly found in post bushfire surveys [9]. The heat from the bushfire or consequential (secondary) fire has been sufficient to cause their pressure to reach critical levels beyond which their pressure release valve releases large quantities of LP gas. If these gas cylinders fall over, this pressure release valve may no longer function correctly, meaning that the gas cylinder may continue to increase in pressure with continued heating until the cylinder ruptures. The resulting explosion includes a pressure wave and large ball of flame which can threaten nearby life and buildings. Readily available guidance is provided by CSIRO Best Practice Bushfire Guide (https://research.csiro.au/bushfire/new-builds/water-electricity-gas/) and WA Dept. Mines, Industry, Regulation and Safety 'LP Gas cylinder safety in bushfire prone areas' (https://www.commerce.wa.gov.au/publications/lp-gas-cylinder-safety-bushfire-prone-areas).	Medium	N/A	N/A	N/A	N/A
Assessment Comments: Gas storage is not proposed on site. Any LPG will be stored in compliance with AS 1596. *Recommendation Details:* Not Applicable						
14.7	Construction of Electricity Supply: Cabling to be shielded (includes installing underground within subject property boundary) from applicable bushfire attack mechanisms. The objective is to assist with continuity of supply for essential site operations and/or electrically driven firefighting pumps. It also reduces the risk of electrocution to any persons onsite and reduces potentially additional sources of fire ignition. It is common in bushfires for power infrastructure to burn and collapse or be impacted by falling trees or branches while power lines are still live. Removing this risk may be appropriate for some sites.	Medium	Yes	No	Yes	Yes
Assessment Comments: Associated cabling (both power transmission and computer) will run between panels and be wired to individual panels. Common electrical cabling reaches its critical point at >12kWm2 (Kaczorek-Chrobak et al. 2007) [49]. Electrical cabling and components are expected to exceed this standard, being industrial and high						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
capacity, however the 12kW/m2 threshold is adopted for the highest potential vulnerability. 10kW/m2 has been adopted to ensure the heat flux considered is *below* the 12kW/m2 threshold rather than meeting it. *Recommendation Details:* See Measure 7.3						
14.8	Minimise Re-entrant Detail to Minimise Debris and Ember Accumulation: Avoid or limit the accumulation of unburnt debris and embers by minimising re-entrant details and/or adopting aerodynamic forms that will self-shed windblown debris and embers. For example: • Simple building/structure footprints that avoid re-entrant corners in access ways, at wall/floor, wall/ground, roof/wall junctions and around doors, vents, windows; and • Simple roof layouts that avoid valleys and minimise the number of ridges that need protection details (e.g. skillion roofs).	Medium	Yes	Yes	No	No
14.9	Minimise Debris/Ember Trapping Surfaces: Avoid or minimise the use of exposed combustible surfaces that can trap and accumulate debris and embers. These include: • Horizontal, or shallow angle surfaces e.g. exposed wall/roof framework, roofs, decking, verandahs, steps, windowsills; and • Vertical surfaces with rough textured cladding (e.g. sawn timber).	Medium	Yes	Yes	No	No
Assessment Comments: Solar arrays are mounted to a simple vertical post, with a tracker axis and solar panels elevated from the ground with no horizontal surfaces or re-entrant details identified. *Recommendation Details:* Not Applicable						
14.10	Protect Roof Plumbing to Minimise Debris and Ember Accumulation: All roof plumbing (gutters, valleys) is protected from the accumulation of debris and embers that can result in direct fire attack mechanisms immediately adjacent to any combustible elements within the roof cavity.	Medium	N/A	N/A	N/A	N/A
14.11	Minimise Construction Cavities to Minimise Debris and Ember Accumulation: Apply designs that lower the potential for accumulation of embers and debris within cavity spaces of buildings/structures. Examples include concrete floor slab on the ground and solid masonry walls.	Medium	N/A	N/A	N/A	N/A
14.12	Minimise External Openings to Limit Flame/Radiant Heat/Ember/Debris Entry: Limit potential sites for threat entry to through the external building envelope to internal spaces containing combustible materials (consequential fire fuels).	Medium	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
	Examples include reducing windows/doors on elevations facing the bushfire hazard and apply design to limit gaps and penetrations that will require screening.					
14.13	Screen and Seal Gaps and Penetrations: Apply fire rated sealants and/or install metal screening (corrosion resistant steel, bronze, aluminium <2mm aperture). All external construction and penetration gaps with apertures greater than 2mm will allow ember entry (and potentially debris) to internal cavities and combustible materials within (as consequential fire fuels). This includes gaps in roofs, walls, doors, windows and their surrounding trims – including those associated with penetrations, vents, weepholes, poor workmanship and material deterioration and movement over time (maintenance). Internal fire is difficult to see and extinguish.	Medium	N/A	N/A	N/A	N/A
14.14	Screen External Doors and Windows: Metal screens (corrosion resistant steel, bronze, aluminium <2mm aperture) installed over non-openable and/or openable parts of windows and doors to prevent ember entry to internal spaces containing combustible materials (consequential fire fuels) and reduce radiant heat load on vulnerable surfaces.	Medium	N/A	N/A	N/A	N/A
14.15	Shutter External Doors and Windows: Fire rated shutters are installed to significantly increase bushfire resistance of the vulnerable building elements.	Medium	N/A	N/A	N/A	N/A
Assessment Comments: Solar arrays do not have the above components. *Recommendation Details:* Not Applicable						
14.16	Construction Materials for Critical Non-Structural Elements: Utilise fire/radiant heat rated products (rated to the level determined necessary), for the construction of non-structural elements that are essential to the continued operation of the built asset, and which are potentially exposed to the attack mechanisms of both bushfire and consequential fire. These vulnerable elements include cabling and plumbing associated with power (delivery) inputs and outputs, data transmission, liquid/gas transport (fuel/water) etc.	High	Yes	Yes	No	Yes
Assessment Comments: The materials identified as critical are discussed in Measure 7.3 in determining the appropriate Asset Protection Zone. These components are integral to the design and cannot be replaced with materials more resistant to fire attack mechanisms. *Recommendation Details:* See Measure 7.3						
THE PROTECTION MECHANISM – AVAILABILITY OF A FIREFIGHTING RESPONSE CAPABILITY: Provide sufficient and reliable dedicated firefighting water supply and delivery capability as necessary for installed active and/or passive systems.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
14.17	Firefighting Water Supply: Have a dedicated static supply of firefighting water for the protection of buildings/structures before and after the passage of a bushfire front. Adequate water supply is critical for any firefighting operation, particularly where property protection is the intent. This is necessary when: • A water supply additional to a reticulated water supply is required to counter the loss of firefighting water as a protection measure, should the reticulated supply be interrupted; and • It is the only source of firefighting water. All tanks shall be non-combustible. Aside from losing water, failure of combustible tank can provide an additional heat load to a vulnerable building element. Metal piping and fittings shall be used for any above ground components. The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.	High	Yes	No	Yes	Yes
Assessment Comments: See Measure 13.17. *Recommendation Details:* Not Applicable						
14.18	Firefighting Equipment Actively Operated: In addition to a dedicated water supply, appropriate mobile firefighting appliances are available quickly and/or fixed firefighting equipment is installed (pumps, hoses, sprinklers etc). Where equipment is installed, this will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard). The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.	High	Yes	No	No	No
Assessment Comments: The site is unstaffed. Actively operated firefighting equipment would not be effective. *Recommendation Details:* Not Applicable						
14.19	Fire Fighting Equipment Passively Operated: In addition to a dedicated water supply, appropriate water dispensing apparatus are installed (e.g. pumps, plumbing and sprinklers) that are automatically activated. These will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard).	High	Yes	Yes	Unknown	No

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
Assessment Comments: Possible fire suppression systems for the solar farm likely considers asset-to-asset fire as the primary concern, however consideration should be given for the capacity for surface fire (within stubble and other surface fuels) escaping beyond the solar bank footprint. A surface fire may pose minimal threat to solar panels but could establish a bushfire offsite. Solar arrays being open-air and installed over an extensive area may have limited options available for fire suppression. Automatic fire detection systems are now standard in new solar farm designs. *Recommendation Details:* Not Applicable						
14.20	Fire Fighting Equipment Operability Maintained: Where water pumps, shutters or other active/passive protection measures rely on the continued supply of electricity, establish barriers (shielding) or separation from potential damaging factors (e.g. falling trees/branches, fire, or other impact sources). For example, bury transmission systems to the greatest extent possible.	High	Yes	No	No	Yes
Assessment Comments: The solar tracker (the system controlling the orientation of the PV panel) should be 'locked' with the PV panels in the appropriate orientation, and the system shut down, significantly prior to the passage of a fire front, as pre-heating (before the arrival of the fire) can result in temperatures exceeding the safe operational temperature (generally 50-60°C). *Recommendation Details:* As soon as practical before the arrival of the fire front, preparation systems/procedures should be engaged. Such systems/procedures should be determined in consultation with the manufacturer, but may include: • Orienting PV panels to the maximum vertical plane (estimated 50 degrees from the horizontal). • Orienting PV panels away from the sun (to reduce residual energy generation post-shutdown). • Disconnecting solar arrays from the electrical grid. • Engaging any appropriate automatic fire suppression systems.					
14.21	Access via Firebreaks Provided: Installation and maintenance of firebreaks to facilitate firefighting access / backburning (and also limiting surface fire progression).	Medium	Yes	Yes	Yes	No
Assessment Comments: Firebreaks are currently installed throughout the project area. Some firebreaks will be upgraded to function as part of the internal road network. *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM – MANAGE AND MAINTAIN EFFECTIVENESS OF APPLIED PROTECTION MEASURES: To ensure the retention of the level of bushfire resilience that has been established through the implementation of appropriate bushfire protection measures, formal and enforceable responsibilities are created.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
14.22	Formal Documents Created to Guide and Enforce Management: Through relevant site operations document(s) and/or an enforceable agreement, regulation or standard, a mechanism is put in place to ensure that: • The required management and maintenance of applied bushfire protection measures is conducted on a regular basis – with the interval dependent on the necessary frequency that will maintain full effectiveness; • The relevant protection measures are known and understood; and • Responsibilities are created.	High	Yes	No	Yes	Yes
Assessment Comments: Firebreaks are currently installed throughout the project area. Some firebreaks will be upgraded to function as part of the internal road network. *Recommendation Details:* Not Applicable						

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining.

Note 2: Protection Measure Application Status:

- Possible: Protection measures that can potentially be applied to the proposed development/use.
- Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Currently Planned: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
• Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP. These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).						

5.4.5.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing vulnerability levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the vulnerability of the relevant element at risk to bushfire hazard threats.

VULNERABILITY REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommen
Construction Design and Materials	Very High	2			1		
	High	3	2	2			1
	Medium	11	4	3		1	1
	Not Relevant						
Availability of a Firefighting Response Capability	Very High						
	High	4	4	1		1	2
	Medium	1	1	1		1	
	Not Relevant						
Manage and Maintain Effectiveness of Applied Protection Measures	Very High						
	High	1	1			1	1
	Medium						
	Not Relevant						
Number Analysis	Very High	2			1		
	High	8	7	3		2	4
	Medium	12	5	4		2	1
	Not Relevant						
	Totals	22	12	7	1	4	5

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.4.5.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE VULNERABILITY

From the information presented in the previous section, the vulnerability reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce vulnerability (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE VULNERABILITY TO BUSHFIRE HAZARD THREATS [1]							
Element at Risk	Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.						
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Minimal	Moderate	Significant	Very Significant	Significant	Minimal	Moderate	Moderate
Moderate				Moderate			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Very Significant	Very Significant	Significant	Very Significant	Significant	Significant	Moderate	Very Significant
Very Significant				Significant			

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This vulnerability reducing potential will be applied to deriving the inherent vulnerability level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This vulnerability reducing potential will be applied to deriving the residual vulnerability level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

Assessment Comments: The vulnerability reducing protection measures are associated with:

- Improving firefighting resources and effectiveness.
- Establishing operational procedures and emergency responses.

5.4.5.4 DERIVED VULNERABILITY LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual vulnerability levels.

In combination with the corresponding assessed threat and exposure levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL VULNERABILITY LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]							
ELEMENT AT RISK		Built Infrastructure Assets - Solar Arrays and Associated Infrastructure.					
BUSHFIRE ATTACK MECHANISMS [2]		INHERENT VULNERABILITY LEVEL (CURRENT STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	Moderate
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
BUSHFIRE ATTACK MECHANISMS [2]		RESIDUAL VULNERABILITY LEVEL (POTENTIAL FUTURE STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	Low
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix 2 for explanatory and supporting information.

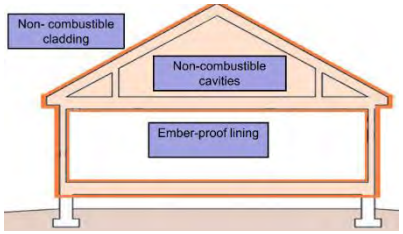
Note 3: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

Note 4: The level of exposure to flames and radiant heat is derived from the assessed BAL ratings (refer to the BAL contour map). The exposure levels applied are BAL-LOW/Very Low Exposure, BAL-12.5/Low Exposure, BAL-19/Moderate Exposure, BAL-29/High Exposure, BAL-40 and BAL-FZ/Extreme Exposure.

5.4.6 BUILT INFRASTRUCTURE ASSETS – HV SUBSTATION AND TRANSMISSION LINES

5.4.6.1 PROTECTION MEASURE ANALYSIS - IDENTIFICATION AND APPLICATION STATUS

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
THE PROTECTION MECHANISM – CONSTRUCTION DESIGN AND MATERIALS: Increase bushfire resilience through the application of beneficial design and construction, including using non-combustible materials and minimising the use of vulnerable materials, to the greatest extent possible. Practicality and cost will be key considerations in determining the viability of applying protection measures in differing scenarios, but this should be determined with due consideration of threat levels and the importance of the elements at risk. The constructed systems should utilise the following properties to the greatest extent possible: reliability (which requires their durability over time, low maintenance and being unlikely to change over time), robustness (which limits damage spread from minor sources, continue to protect when thermally loaded and protects vulnerable elements), resilience (which enables their return to a functional state following an overload) and redundancy (which ensures the fate of the subject building/structure is not reliant on the effective performance of a single element). Refer to the glossary for additional explanation. The principle is also applicable to constructed consequential fire fuels.						
15.1	Construct to AS 3959:2018 [4]: Use the principles and requirements established in the Standard, for buildings in general, and apply to the infrastructure assets where they have merit. These are intended to reduce the risk of building ignition from bushfire direct attack mechanisms. Note that the indirect attack mechanisms and the threats presented by consequential fire fuels are not specifically considered. Key attributes of the Standard that may have relevance to other built assets include: • The AS 3959 strategy that relies on the integrity of the building's exterior envelope (i.e., the cladding of roof/wall/eaves, floor supporting structures/flooring and all penetrations) to resist all bushfire exposure conditions and environmental actions thereby protecting all structural construction elements behind it, including allowable combustible materials. • Using specified materials that provide ignition resistance (tolerance of radiant heat and flames). Higher BAL ratings impose increased construction requirements for these exterior envelope materials; • Specifying precise gap control (applicable to all bushfire attack levels) for the exterior envelope of the building to prevent ember entry); and • Attached and adjacent structures (within 6m) must also comply with the Standard.	High	N/A	N/A	N/A	N/A
15.2	Construct to NASH Standard [33]: Use the principles and requirements established in the Standard, for residential and low-rise buildings, and apply to the infrastructure assets where they have merit. Key attributes of the Standard that may have relevance to other built assets include:	Very High	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
	• Materials used anywhere on the building envelope (see shaded part of diagram below), must be non-combustible (except for a small number of smaller building elements). The building envelope is comprised of a framed roof/ceiling system, an external wall system and a floor system;  • The same construction requirements apply for all BAL ratings up to BAL-40 (except for external doors and windows which apply AS 3959 requirements). An additional benefit of this is the built in resistance to the direct attack mechanisms of consequential fire when lower BAL ratings apply. • It does not rely on eliminating ember entry to the roof space, wall cavities and floor system as these are non-combustible construction. Embers only need to be kept from entering the internal living/operating spaces. • It is ember tolerant without unrealistic workmanship, supervision and maintenance requirements; • The combination of a non-combustible cladding and cavities is a robust solution that enables the building to be configured so that failure or damage to one element does not lead to the inevitable failure of the building or a breach of the habitable envelope; and • Attached and adjacent structures (within 6m) must also comply with the Standard.					
Assessment Comments: Assets do not have a design which can comply with AS3959 or NASH. *Recommendation Details:* Not Applicable.						
15.3	Construction Materials for External and Internal Cavity Building Elements: Except for internal living or operation spaces, to the degree necessary, utilise materials resistant to fire attack mechanisms of flame and radiant heat (preferably non-combustible) for all relevant building elements, including wall, roof, floor, supporting structures and framing systems.	Very High	Yes	Yes	No	No
Assessment Comments: The control room, switchroom, and terminal boxes will have internal cavities. The structural components of a substation are entirely non-combustible (generally steel). *Recommendation Details:* Not Applicable						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
15.4	Construction Materials for Consequential Fire Fuels: For constructed large consequential fire fuels, use non-combustible materials to the fullest extent possible. Potential fuels include attached structures, adjacent structures and surrounding landscaping items (fences, screens, retaining walls etc.).	High	No	Yes	Yes	No
Assessment Comments: No constructed fuels have been identified except the external electrical components (insulators, conductors etc). The substation will be designed in compliance with the relevant Australian Standards. These standards are not available to the bushfire consultant. The design and construction requirements of Australian Standards consider asset-to-asset fire, or fire spread within the asset, to be a critical issue. AS 2067-2016 *Substations and high voltage installations exceeding 1 kV a.c.* and AS/NZS 7000:2016 *Overhead Line Design* are not available to the bushfire consultant, thus additional recommendations cannot be made (as they may contradict the Australian Standards). *Recommendation Details:* Not Applicable						
15.5	Construction Design / Materials Resistant To High Wind Damage: Apply construction measures to prevent the type of building damage from wind that will open or create gaps (from the wind itself or carried projectiles) and allow the entry of embers, radiant heat and flames. This type of damage is typically superficial damage. Building codes relating to wind (e.g., cyclones) do not necessarily address this superficial type of impact. Additional fixings for building envelope claddings and protection of the most vulnerable elements, such as glazing, from debris impact, are key considerations. Consider applying the principles of the NASH Standard [33] design solution to construction. "Potential wind effects directly associated with bushfire events have been considered in this Standard. Wind actions may affect buildings subject to a bushfire attack in various ways including: • The intensity of flame front activity may produce locally high wind pressures on parts of the building; • In the post fire phase, some weakened components on the building envelope may be vulnerable to normal design pressures; and • Wind can drive embers into the building envelope." Most applicable when the physical requirements exist for the development of an extreme bushfire event within the surrounding surrounding landscape.	Medium	Yes	Yes	No	No
Assessment Comments: The reliability of substations and transmission lines against wind damage are a major design consideration internationally due to severe storm events. High wind impacts are assumed to be addressed within the relevant guidance/regulatory material.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
Recommendation Details: Not Applicable						
15.6	Construction of Gas Supply: All gas cylinders are installed and maintained in accordance with AS 1596 (for domestic house supply) as a guide. The requirement of the standard includes: • Safety release valve shall be directed away from the building and persons access/egress routes; • Metal piping and fittings shall be used on all piping inside the building's cavities and enclosable occupied spaces and the high pressure side of any gas regulators; and • Tethers securing cylinders are to be non-combustible. The objective is to reduce the risk of consequential (secondary) fire against a building and reduce the risk of death or injury, from gas flaring or explosion. The rationale is gas cylinders which have either flared or ruptured are commonly found in post bushfire surveys [9]. The heat from the bushfire or consequential (secondary) fire has been sufficient to cause their pressure to reach critical levels beyond which their pressure release valve releases large quantities of LP gas. If these gas cylinders fall over, this pressure release valve may no longer function correctly, meaning that the gas cylinder may continue to increase in pressure with continued heating until the cylinder ruptures. The resulting explosion includes a pressure wave and large ball of flame which can threaten nearby life and buildings. Readily available guidance is provided by CSIRO Best Practice Bushfire Guide (https://research.csiro.au/bushfire/new-builds/water-electricity-gas/) and WA Dept. Mines, Industry, Regulation and Safety 'LP Gas cylinder safety in bushfire prone areas' (https://www.commerce.wa.gov.au/publications/lp-gas-cylinder-safety-bushfire-prone-areas).	Medium	N/A	N/A	N/A	N/A
Assessment Comments: Gas storage is not proposed on site. Any LPG will be stored in compliance with AS 1596. *Recommendation Details:* Not Applicable						
15.7	Construction of Electricity Supply: Cabling to be shielded (includes installing underground within subject property boundary) from applicable bushfire attack mechanisms. The objective is to assist with continuity of supply for essential site operations and/or electrically driven firefighting pumps. It also reduces the risk of electrocution to any persons onsite and reduces potentially additional sources of fire ignition. It is common in bushfires for power infrastructure to burn and collapse or be impacted by falling trees or branches while power lines are still live. Removing this risk may be appropriate for some sites.	Medium	Yes	Yes	Unknown	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.				

Assessment Comments: The following document was found to be relevant in the assessment of proposed substations: *NS187 Passive Fire Mitigation Design of Major Substations* - Internal Document No. NW000-S0007 (Ausgrid 2020). Ausgrid Pty Ltd is Australia's largest electricity distributor (in terms of customers and energy load), and the document referenced is an internal network standard. The below table is sourced from Section 12 of the network standard.

Table 3 – Radiant Heat Exposure Limits for Bushfires

Item	Maximum allowable radiant heat flux (kW/m^2)	Comment
Cable	12.5 20	PVC Cables begin to distort and may ignite. Ignition of XLPE cables between 85 and 550 seconds.
Steel support structure	35	To 60% of yield strength after a maximum duration of 5 minutes. Applies where elastic deflections due to elevated temperatures are not critical.
Porcelain bushing/Insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Polymeric bushing/insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Aluminium busbar	20	Based on 250°C after a maximum duration of 5 minutes. Comparable to withstand temperature under fault conditions.
Copper busbar	25	Busbars may undergo significant distortion and impose significant stresses on rigid insulators.
Transformer tank	>35 (see Note 1)	Refer to above regarding bushings and cables.
Combustibles	12.5	Piloted ignition may occur on timber.

Note 1. Transformers always have some more vulnerable components such as bushings and cables etc. Refer to Clause 7.2.

'Combustibles' in this description are consequential fire hazards for the purposes of the bushfire assessment: packing materials, pallets, waste, and other assorted debris. These should not be present within the substation footprint and where necessary should be positioned away from infrastructure components, applied in Measure 6.7.

The materials identified as critical are discussed in Measure 8.3 in determining the appropriate Asset Protection Zone.

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
Recommendation Details: See Measure 8.3						
15.8	Minimise Re-entrant Detail to Minimise Debris and Ember Accumulation: Avoid or limit the accumulation of unburnt debris and embers by minimising re-entrant details and/or adopting aerodynamic forms that will self-shed windblown debris and embers. For example: • Simple building/structure footprints that avoid re-entrant corners in access ways, at wall/floor, wall/ground, roof/wall junctions and around doors, vents, windows; and • Simple roof layouts that avoid valleys and minimise the number of ridges that need protection details (e.g. skillion roofs).	Medium	Yes	Yes	Yes	No
Assessment Comments: At Substation components are mounted on concrete slabs and elevated from the ground, with only flat/rounded surfaces with through wind action possible. Features above ground level are more complex but are fully exposed to wind action. Fencing is the only identified feature which can trap significant quantities of debris. Fencing is set back >4m from the closest component of the substation at its nearest point (the control room), thus ignition of any accumulated debris (leaf litter) against the fenceline will not contact substation components, except through wind action which will distribute the material to be a minor hazard (individual firebrands). The fencing itself is entirely non-combustible and may be brick, weldmesh, palisade etc. *Recommendation Details:* Not Applicable						
15.9	Minimise Debris/Ember Trapping Surfaces: Avoid or minimise the use of exposed combustible surfaces that can trap and accumulate debris and embers. These include: • Horizontal, or shallow angle surfaces e.g. exposed wall/roof framework, roofs, decking, verandahs, steps, windowsills; and • Vertical surfaces with rough textured cladding (e.g. sawn timber).	Medium	No	Yes	No	No
Assessment Comments: Horizontal surfaces are present but fully exposed to wind action, so debris will not accumulate. *Recommendation Details:* Not Applicable						
15.10	Protect Roof Plumbing to Minimise Debris and Ember Accumulation: All roof plumbing (gutters, valleys) is protected from the accumulation of debris and embers that can result in direct fire attack mechanisms immediately adjacent to any combustible elements within the roof cavity.	Medium	N/A	N/A	N/A	N/A
Assessment Comments: Substations will not have roof plumbing.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
Recommendation Details: Not Applicable						
15.11	Minimise Construction Cavities to Minimise Debris and Ember Accumulation: Apply designs that lower the potential for accumulation of embers and debris within cavity spaces of buildings/structures. Examples include concrete floor slab on the ground and solid masonry walls.	Medium	No	Yes	No	No
Assessment Comments: Substations will be externally sealed and mounted on concrete slabs, so there will be no construction cavities. *Recommendation Details:* Not Applicable						
15.12	Minimise External Openings to Limit Flame/Radiant Heat/Ember/Debris Entry: Limit potential sites for threat entry to through the external building envelope to internal spaces containing combustible materials (consequential fire fuels). Examples include reducing windows/doors on elevations facing the bushfire hazard and apply design to limit gaps and penetrations that will require screening.	Medium	No	Partly	No	No
Assessment Comments: The control room, switchroom, and terminal boxes will have internal cavities. These will have a single door and no windows. Vents will be installed where required, so the design cannot be altered to reduce the capacity for ember intrusion. *Recommendation Details:* Not Applicable						
15.13	Screen and Seal Gaps and Penetrations: Apply fire rated sealants and/or install metal screening (corrosion resistant steel, bronze, aluminium <2mm aperture). All external construction and penetration gaps with apertures greater than 2mm will allow ember entry (and potentially debris) to internal cavities and combustible materials within (as consequential fire fuels). This includes gaps in roofs, walls, doors, windows and their surrounding trims – including those associated with penetrations, vents, weepholes, poor workmanship and material deterioration and movement over time (maintenance). Internal fire is difficult to see and extinguish.	Medium	Yes	No	Unknown	Yes
Assessment Comments: The control room, switchroom, and terminal boxes may have external vents. *Recommendation Details:* Consider application of ember screening to the external vent interface of the control room, switchroom, terminal boxes etc. The intention is to prevent both ember ingress and debris accumulation. Ember screening mesh is to be maximum 2mm aperture and composed of corrosion-resistant steel, bronze, or aluminium.						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
15.14	Screen External Doors and Windows: Metal screens (corrosion resistant steel, bronze, aluminium <2mm aperture) installed over non-openable and/or openable parts of windows and doors to prevent ember entry to internal spaces containing combustible materials (consequential fire fuels) and reduce radiant heat load on vulnerable surfaces.	Medium	No	No	No	No
Assessment Comments: Screening will not be applied to doors. *Recommendation Details:* Not Applicable						
15.15	Shutter External Doors and Windows: Fire rated shutters are installed to significantly increase bushfire resistance of the vulnerable building elements.	Medium	No	No	No	Yes
Assessment Comments: Assets will not have windows. Shutters are not applied to doors of the same construction as the enclosure. *Recommendation Details:* Doors should be tightly fitting against the frame.						
15.16	Construction Materials for Critical Non-Structural Elements: Utilise fire/radiant heat rated products (rated to the level determined necessary), for the construction of non-structural elements that are essential to the continued operation of the built asset, and which are potentially exposed to the attack mechanisms of both bushfire and consequential fire. These vulnerable elements include cabling and plumbing associated with power (delivery) inputs and outputs, data transmission, liquid/gas transport (fuel/water) etc.	High	Yes	Yes	No	Yes
Assessment Comments: The materials identified as critical are discussed in Measure 8.3 in determining the appropriate Asset Protection Zone. These components are integral to the design and cannot be replaced with materials more resistant to fire attack mechanisms. *Recommendation Details:* See Measure 8.3						
THE PROTECTION MECHANISM – AVAILABILITY OF A FIREFIGHTING RESPONSE CAPABILITY: Provide sufficient and reliable dedicated firefighting water supply and delivery capability as necessary for installed active and/or passive systems.						
15.17	Firefighting Water Supply: Have a dedicated static supply of firefighting water for the protection of buildings/structures before and after the passage of a bushfire front. Adequate water supply is critical for any firefighting operation, particularly where property protection is the intent. This is necessary when: • A water supply additional to a reticulated water supply is required to counter the loss of firefighting water as a protection measure, should the reticulated supply be interrupted; and • It is the only source of firefighting water.	High	Yes	No	Yes	Yes

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
	All tanks shall be non-combustible. Aside from losing water, failure of combustible tank can provide an additional heat load to a vulnerable building element. Metal piping and fittings shall be used for any above ground components. The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.					
Assessment Comments: See Measure 13.17. *Recommendation Details:* Not Applicable						
15.18	Firefighting Equipment Actively Operated: In addition to a dedicated water supply, appropriate mobile firefighting appliances are available quickly and/or fixed firefighting equipment is installed (pumps, hoses, sprinklers etc). Where equipment is installed, this will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard). The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.	High	Yes	No	No	No
Assessment Comments: The site is unstaffed. Actively operated firefighting equipment would not be effective. *Recommendation Details:* Not Applicable						
15.19	Fire Fighting Equipment Passively Operated: In addition to a dedicated water supply, appropriate water dispensing apparatus are installed (e.g. pumps, plumbing and sprinklers) that are automatically activated. These will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard).	High	Yes	No	Yes	Yes
Assessment Comments: Automatic monitoring and remote control of transmission lines allows for remote shut down in an emergency. Automatic fire protection systems can rapidly disconnect power (80 to 120 milliseconds from detection). Heavy smoke from a bushfire can increase the chance of an arc flash, thus automatic fire protection systems may be applied even where the substation is otherwise resisting the impacts of bushfire. *Recommendation Details:* Consider the potential for arc flash due to smoke from a bushfire.						
15.20	Fire Fighting Equipment Operability Maintained: Where water pumps, shutters or other active/passive protection measures rely on the continued supply of electricity, establish barriers (shielding) or separation from potential damaging	High	N/A	N/A	N/A	N/A

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					
	factors (e.g. falling trees/branches, fire, or other impact sources). For example, bury transmission systems to the greatest extent possible.					
Assessment Comments: The asset itself is the supply of electricity, so exposure/vulnerability reduction measures improve the likelihood that operability will be maintained. *Recommendation Details:* Not Applicable						
15.21	Access via Firebreaks Provided: Installation and maintenance of firebreaks to facilitate firefighting access / backburning (and also limiting surface fire progression).	Medium	Yes	Yes	Yes	No
Assessment Comments: Firebreaks are currently installed throughout the project area. Some firebreaks will be upgraded to function as part of the internal road network. *Recommendation Details:* Not Applicable						
THE PROTECTION MECHANISM – MANAGE AND MAINTAIN EFFECTIVENESS OF APPLIED PROTECTION MEASURES: To ensure the retention of the level of bushfire resilience that has been established through the implementation of appropriate bushfire protection measures, formal and enforceable responsibilities are created.						
15.22	Formal Documents Created to Guide and Enforce Management: Through relevant site operations document(s) and/or an enforceable agreement, regulation or standard, a mechanism is put in place to ensure that: • The required management and maintenance of applied bushfire protection measures is conducted on a regular basis – with the interval dependent on the necessary frequency that will maintain full effectiveness; • The relevant protection measures are known and understood; and • Responsibilities are created.	High	Yes	No	Yes	Yes
Assessment Comments: The documents have been or will be produced. Ongoing requirements are outlined in Measure 1.9. *Recommendation Details:* Not Applicable						
Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.2.4 for explanation and defining. Note 2: Protection Measure Application Status: • Possible: Protection measures that can potentially be applied to the proposed development/use. • Fully or Partly Exists: A current state assessment of protection measures already implemented by existing components of the proposed development/use. The status of current implementation can also be fully or partly. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).						

PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.					

- Currently Planned: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- Additionally Recommend: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

  These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

5.4.6.2 PROTECTION MEASURE ANALYSIS – NUMBER SUMMARY

For the stated element at risk, the numbers of both available and potentially applied bushfire protection measures are summarised and the effectiveness of each measure at reducing vulnerability levels is stated (refer to Appendix 1 for explanatory and supporting information).

This information is applied in the following section of this report to the derivation of the potential for applied bushfire protection measures to reduce the vulnerability of the relevant element at risk to bushfire hazard threats.

VULNERABILITY REDUCING PROTECTION MEASURE ANALYSIS							
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.						
The Protection Mechanism	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Fully Exists	Partly Exists	Currently Planned	Additionally Recommen
Construction Design and Materials	Very High	2	1	1			
	High	3	1	2		1	1
	Medium	11	4	5	1	1	3
	Not Relevant						
Availability of a Firefighting Response Capability	Very High						
	High	4	3			2	2
	Medium	1	1	1		1	
	Not Relevant						
Manage and Maintain Effectiveness of Applied Protection Measures	Very High						
	High	1	1			1	1
	Medium						
	Not Relevant						
Number Analysis	Very High	2	1	1			
	High	8	5	2		4	4
	Medium	12	5	6	1	2	3
	Not Relevant						
	Totals	22	11	9	1	6	7

Note 1: Protection Measure Effectiveness Rating: Refer to Appendix A1.3.4 for explanation and defining.

Note 2: Protection Measure Application Status: Refer to table footnotes in the preceding section.

5.4.6.3 PROTECTION MEASURE ANALYSIS – POTENTIAL TO REDUCE VULNERABILITY

From the information presented in the previous section, the vulnerability reducing potential of the applied bushfire protection measures is assessed as a function of:

- The number of bushfire protection measures that can be applied to the subject element at risk and the subject site/use, compared to the number available; and
- The effectiveness rating that is given to each applied protection measure that weights the relative ability of the measure to reduce vulnerability (refer to Appendix A1.3.4 for supporting and explanatory information).

ASSESSED POTENTIAL FOR APPLIED PROTECTION MEASURES TO REDUCE VULNERABILITY TO BUSHFIRE HAZARD THREATS [1]							
Element at Risk	Built Infrastructure Assets - HV Substation and Transmission Lines.						
WHEN EXISTING AND PLANNED PROTECTION MEASURES ARE APPLIED [2]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Moderate	Moderate	Moderate	Significant	Very Significant	Very Significant	Moderate	Significant
Moderate				Significant			
WHEN EXISTING, PLANNED AND RECOMMENDED PROTECTION MEASURES ARE APPLIED [3]							
Direct Attack Mechanisms [4]				Indirect Attack Mechanisms [4]			
Flame Contact	Radiant Heat	Embers / Burning Debris	High / Erratic Fire Driven Wind	Debris Production / Accumulation	Surface Fire	Tree Strike / Obstruction	Consequential (Secondary) Fire
Moderate	Significant	Very Significant	Significant	Very Significant	Very Significant	Moderate	Significant
Significant				Significant			

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: This vulnerability reducing potential will be applied to deriving the inherent vulnerability level (i.e. the current state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 3: This vulnerability reducing potential will be applied to deriving the residual vulnerability level (i.e. the potential future state). Refer to Appendix A1.3.3 for explanatory and supporting information.

Note 4: Refer to Appendix 2 for explanatory and supporting information.

Assessment Comments: Substations and transmission lines already consider fire impacts within their design and both national standards and state regulations apply. Recommendations are for shielding cabling where possible, and ensuring embers cannot enter enclosed spaces (control room, switchroom, terminal boxes etc).

5.4.6.4 DERIVED VULNERABILITY LEVEL - INHERENT AND RESIDUAL

The preceding bushfire protection measure analysis has, through a mostly qualitative assessment process, enabled the derivation of the inherent and residual vulnerability levels.

In combination with the corresponding assessed threat and exposure levels, they will subsequently be applied to deriving the inherent and residual bushfire risk levels.

DERIVED POTENTIAL VULNERABILITY LEVELS POST APPLICATION OF EXPOSURE REDUCING BUSHFIRE PROTECTION MEASURES [1]							
ELEMENT AT RISK		Built Infrastructure Assets - HV Substation and Transmission Lines.					
BUSHFIRE ATTACK MECHANISMS [2]		INHERENT VULNERABILITY LEVEL (CURRENT STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	Moderate
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
BUSHFIRE ATTACK MECHANISMS [2]		RESIDUAL VULNERABILITY LEVEL (POTENTIAL FUTURE STATE) [3]					OVERALL
DIRECT	Flame Contact [4]	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	Low
DIRECT	Radiant Heat [4]	Very Low ☐	Low ☐	Moderate ☒	High ☐	Extreme ☐	
DIRECT	Embers / Burning Debris	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
DIRECT	High/Erratic Fire Driven Wind	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Debris Production / Accumulation	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Surface Fire	Very Low ☒	Low ☐	Moderate ☐	High ☐	Extreme ☐	
INDIRECT	Tree Strike / Obstruction	Very Low ☐	Low ☐	Moderate ☐	High ☒	Extreme ☐	
INDIRECT	Consequential (Secondary) Fire	Very Low ☐	Low ☒	Moderate ☐	High ☐	Extreme ☐	

Note 1: Refer to Appendix 1 for explanatory and supporting information.

Note 2: Refer to Appendix 2 for explanatory and supporting information.

Note 3: Refer to Appendix A1.3.3 for explanatory and supporting information. 'Inherent' accounts for all currently implemented bushfire protection measures and those planned to be implemented. 'Residual' additionally accounts for bushfire protection measures recommended to be implemented by the bushfire consultant.

Note 4: The level of exposure to flames and radiant heat is derived from the assessed BAL ratings (refer to the BAL contour map). The exposure levels applied are BAL-LOW/Very Low Exposure, BAL-12.5/Low Exposure, BAL-19/Moderate Exposure, BAL-29/High Exposure, BAL-40 and BAL-FZ/Extreme Exposure.

6 BUSHFIRE RISK MANAGEMENT – PROTECTION MEASURE IMPLEMENTATION ASSESSMENTS

BUSHFIRE RISK MANAGEMENT MECHANISMS

Effective bushfire risk management mechanisms are needed to direct the implementation of required and recommended bushfire protection measures and ensure they continue to be maintained as effective measures.

To assist planners and managers to navigate this space, Bushfire Prone Planning divides the risk management mechanisms into 'mandatory' mechanisms and 'informative' mechanisms – although there will be some crossover.

Mandatory Mechanisms: Can be considered as those developed by relevant government authorities to establish required minimum protection measures and will require compliance. Some apply to both existing and future operations (use of sites), while others are primarily directed at future development. They include:

- Operating Regulations and Standards where part of the content will have direct relevance to a fire event;
- Construction Standards for buildings in bushfire prone areas; and
- Planning guidelines/overlays and any requirements for production of formal planning documents (e.g., a 'Planning' Bushfire Management Plan) for planning applications;

Informative Mechanisms: Can be considered as those documents that detail the operational responsibilities and associated actions as bushfire protection measures applicable to specific sites and their use. These protection measures can originate from various sources and include:

- Assessments, recommendations, and advice from appropriately experienced and qualified persons. This mechanism can be employed at the various life stages of a development and its use. The intent is to assist with initial planning and design, construction, extension, change of use, or just improving on existing resilience to bushfire and establishing relevant operational information to ensure bushfire resilience is retained;
- Site Operations Documents, possibly co-ordinated by an overarching 'Operational' Bushfire Management Plan (as distinct from a 'Planning' BMP), that establish detailed operations procedures. These can include (and will vary according to site use and management requirements):
    - Site Operations Procedures
    - Annual Site Works Program
    - Prescribed Burning Guide
    - Site Emergency Plan / Guide / Evacuation Plan / Bushfire Emergency Plan

SECTION SIX CONTENT OUTLINE

The following components can be included within the assessment, but the actual inclusions will be established by the objectives set for the Bushfire Risk Report in Section 2.3.

1. Compliance Assessments: For each relevant 'mandatory' risk management mechanism, a compliance assessment is conducted that establishes the site's current compliance and/or its ability to comply in the future and identifies any issues for management to consider.
2. Protection Measure Recommendations and Implementation Guidance: As an extension of the bushfire risk assessment process conducted in Section 5 of this Report:
    (a) All additionally recommended bushfire protection measures that apply to a specific site and its use are identified; and
    (b) Guidance is provided to management regarding the instruments through which these measures are best applied and those with higher priority are identified.
3. Advice: Note that where additional advice is to be provided it will be presented within the relevant summary section of this report (Section 4.5) and can consist of either:
    (c) Specific advice to inform planning for design and construction; or
    (d) General advice that identifies issues for management to consider.

6.1 INFORMATIVE MECHANISMS – ASSESSMENT AGAINST NON-MANDATORY GUIDANCE

6.1.1 APPLICABLE PLANNING GUIDELINES (PLANNING STANDARDS)

APPLICABLE PLANNING DOCUMENTS
Design Guidelines and Model Requirements for Renewable Energy Facilities v4 Victorian Country Fire Authority – Specialist Risk and Fire Safety Unit (August 2023).

6.1.1.1 COMPLIANCE ASSESSMENT

COMPLIANCE WITH THE RELEVANT ACCEPTABLE SOLUTIONS
The Planning Document/s The applicable planning documents establish packages of bushfire protection measures that are to be applied, each with different sets of specifications and requirements to be satisfied and applied to different types of development or use with appropriate variations. The aim of these is to provide for the protection of human life and minimise impacts on property from the threats of bushfire, while having due regard to development potential, site characteristics and protection of the environment. The bushfire protection measures are typically grouped under a common and specific purpose. Each purpose has: 1. A performance outcome, objective, criteria or intent to be met (satisfied); and 2. Provides for two pathways to satisfy the required performance: a) Prescriptive measures and their requirements as acceptable solutions (approved measures); or b) The ability to develop an alternative solution. The Compliance Assessment The assessment will consist of: 1. Identification of the relevant development type/use associated with the subject site. 2. Identify if the Design Advice or Model Requirement criteria is relevant within the context of the Western Australian Planning System. 3. Where a Design Advice or Model Requirement criteria is relevant: a. Determine whether the existing planning or design of the proposed development complies with the criteria or its intent; or b. Provide recommendations for the proposed development to meet the criteria or its intent; or c. Detail why the measure is not or cannot be met. 4. Potential alternative solutions may be provided, but this is applied as a 'Modification' as there is no body or process for consultation/verification that the alternative meets the intent of the criteria.

APPLICABLE DEVELOPMENT	
Type	Applicable
All Facilities *Definition (Renewable Energy Facility):* A site or installation dedicated to the generation and/or capture of renewable energy. Stand-alone battery energy storage systems are considered renewable energy facilities for the purposes of this guideline.	✓
Wind Energy Facilities *Definition:* A facility where wind turbines use the energy of the wind to spin an electric generator which produces electricity, then power conversion equipment (inverters) convert the power into alternating current (AC). The facility may include grid connection infrastructure to feed power into the electricity grid.	
Solar Energy Facilities *Definition:* A facility where solar panels convert sunlight into direct current (DC) electricity; then power conversion equipment (inverters) convert the power into alternating current (AC). The facility may include grid connection infrastructure to feed power into the electricity grid. Solar energy facilities may utilise either solar photovoltaic or solar thermal technologies. • Large-scale solar: >5MW • Micro solar: ≤5MW	✓
Battery Energy Storage Systems *Definition:* A system comprising one or more cells, modules or batteries, power conversion equipment (PCE) and isolation and protection devices. Battery energy storage systems convert energy into electrical energy and stores the energy internally. For the purposes of this guideline: • Large-scale battery systems: >1MWh • Small-scale battery systems: ≤1MWh	✓
Assessment Criteria	
The *Design Guidelines and Model Requirements for Renewable Energy Facilities v4* provides Design Advice and Model Requirements for each use type. Design Advice are factors to consider in planning of the proposal. A proposal can create modifications to Design Advice requirements whilst complying with the Guidelines. Model Requirements are '*CFA's minimum requirements for renewable energy facilities in low-risk environments, and must be reflected in the RMP.*' Alternatives can be considered as '*Modifications to Model Requirements must be in consultation with CFA.*' Applications in High-Risk Environments (analogous to Bushfire Prone Areas in Western Australia) are assessed against Section 4.1.1 of the Guidelines (within this Compliance Assessment). As consultation is not available, variations/modifications to Model Requirements are justified either to meet the intent of the Model Requirement, or to justify why the Model Requirement should not be applied. This is the 'alternative solution' pathway applicable. The measures within the *Design Guidelines and Model Requirements for Renewable Energy Facilities v4* are not applied independently of the associated Bushfire Risk Report. The criteria are instead applied in the applicable section in the body of the Bushfire Risk Report. The intent is to produce a single 'package' of protection measures recommended/required to be applied to the proposal (regardless of their source), for clarity of the proponent and decision maker(s).	

SECTION 2: CFA INVOLVEMENT WITH RENEWABLE ENERGY FACILITIES				
Subsection 2.2.1: Pre-Planning				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	a) Where located within a Bushfire Prone Area, bushfire risk is addressed according to the Victoria Planning Provisions, Clause 13.02-1S (Bushfire Planning), through bushfire hazard identification and assessment (including a bushfire hazard site and landscape assessment). This assessment must include risks to the proposed technologies from the landscape (bushfire/grassfire).	Complies with Intent	5.1.3
		b) Address risks from proposed technologies through a comprehensive risk management process, documented in a Risk Management Plan.	Complies with Intent	5.1.4
		c) Indicate where the exact specifications of elements within the renewable energy facility will be determined during the detailed design phase, such as solar panel and wind turbine model/manufacturer and battery chemistry.	Fully Complies	N/A
		d) Explicitly state that the following documentation will be prepared in accordance with this guideline, in consultation with CFA, before development starts: • Risk Management Plan • Fire Management Plan • Emergency Plan	Not Applied	N/A
	Assessment Comment: a) The development is assessed under the Western Australian Planning Provisions, being SPP 3.7 and the associated Guidelines for Planning in Bushfire Prone Areas v1.4. The WA provisions do not require landscape assessments, however this has been provided within 5.1 of the associated Bushfire Risk Report. The methodology differs from that required under Victorian Planning Provisions, as: • The planning context is not available to consider the assessment against. • Significant supplementary technical information of the purpose and methodology would be required. • No entity is available confirm the correct application of the assessment. From *Applying the Bushfire Hazard Landscape Assessment in a Bushfire Management Overlay* v4.0 (CFA March 2022): '*Where 'buildings and works' are proposed in landscape types Three or Four, it may be necessary to further enhance safety through additional bushfire protection measures.*' The applicable landscape type is unknown, as the methodology within *Planning Permit Applications Bushfire Management Overlay – Technical Guide* pp13-16 (DELWP September 2017) does not consider pasture landscapes. Additional protection measures are applied through this document regardless of the bushfire hazard type. b) Bushfire risks to design through to operation are considered within the associated Bushfire Risk Report.			

	c) The following products are proposed, with datasheets provided with the Development Application: • Battery Energy Storage System: Saft Intensium® Shift (2024 Datasheet). The Intensium Shift contains Lithium Iron Phosphate chemistry. • Solar Panels: Canadian Solar BiHiKu7 (2023 Datasheet) • Solar Tracker: NexTracker Gemini (2019 Datasheet) • Inverters: Gamesa Electric Proteus PV Inverters (2022 Datasheet) Minor components/details may be provided during the detailed design phase. Due to the timeframe of approvals/construction, the datasheet (and thus product) version may be updated from the list above. d) The documents, or WA equivalent, will be produced. However, their content will not be in accordance with the guideline.

SECTION 3: FIRE RISK MANAGEMENT				
Intent: Fire risk must be identified and measures to eliminate or reduce its occurrence and consequences must be incorporated into facility design and operations.				
Subsection 3.3: Risk Management Plan				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	A Risk Management Plan must be developed all renewable energy facilities. The Risk Management Plan must:		
		a) Describe the infrastructure (natural and built), landscape, nature of operations and occupancy of the facility.	Fully Complies	2; 5.1.3; 5.2
		b) Describe the risks and hazards at the facility to and from the renewable energy infrastructure (including battery energy storage systems).	Complies with Intent	All
		c) Specify and justify, in accordance with Section 4.2 of this guideline: • The location of the facility in the landscape, and the proposed infrastructure on-site. • Emergency vehicle access to and within the facility that: o Includes site access points of a number suitable to the size and hazard of the facility (a minimum of two). o Provides access to renewable energy infrastructure, substations and fire service infrastructure. • Firefighting water supply for the facility. • A fire break width of 10m or greater, based on radiant heat flux (output) as an ignition source: o Around the perimeter of the facility. o Between any landscape buffer/vegetation screening and infrastructure. • The separation distance, based on radiant heat flux (output) as an ignition source, between: o Adjacent renewable energy infrastructure (eg., between adjacent battery containers/enclosures). o Battery containers/enclosures and related battery infrastructure, buildings/structures, and vegetation. • All other controls for the management of on-and off-site hazards and risks at the facility (including all proposed battery energy storage system safety and protective systems).	Complies with Intent	All

		d) Provide an evidence-based determination of the effectiveness of the risk controls against the identified hazards, including justification for the omission of any battery safety and protective system/s.	Does Not Comply: Modification Applied	N/A
		e) Form the basis for the design of the facility.	Does Not Comply: Modification Applied	N/A
	Assessment Comment: a) The associated Bushfire Risk Report addresses this requirement for bushfire-related hazards. Non-bushfire hazards, including fires due to asset failure, must be addressed through product design or the appropriate regulation. b) and c) This forms the bulk of the Bushfire Risk Report. d) The associated Bushfire Risk Report comprehensively assesses bushfire risk reduction measures. Effectiveness of each measure is based on experience and logic as evidence is not available for the quantitative impact of a single measure. Fully established bushfires cannot be tested in vitro. See Appendix 1.2.4 of the Bushfire Risk Report. No battery safety systems are omitted. e) The Risk Assessment process may occur before (during initial consultation) or after (as an update/amendment) the submission of the Development Application. As the Risk Assessment is not a clearly stated requirement within Western Australia, there are many cases where it occurs after the first series of drafts and submission. In this scenario, the Risk Assessment may make modifications to the design but cannot 'form the basis of design.' Any modifications to the design of the development are applied prior to the final determination by the Decision Maker.			
Item 3.3.2: Risk Factors				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	The following factors must be considered in the risk-based design of renewable energy facilities.		
		1. Location and Siting within the Landscape Is/does the site location: • Within a Bushfire Management Overlay or Bushfire Prone Area. • At risk of grassfire from neighbouring properties. • Within the Inundation Overlay. • Contain peat. • Located near hazardous industries.	Complies with Intent	5.1.3

		2. Facility Layout Is/does the site layout: • Impact fire risk. • Allow for safe access of fire service infrastructure. • Impact safe evacuation.	Fully Complies	5.3.2
		3. Vegetation On-Site Does the vegetation prevalence, type, density or location (including screening vegetation) impact fire Risk.	Fully Complies	5.1.4
		4. Infrastructure: Electrical, Chemical, Technological Is/does the infrastructure onsite: • Contribute to fire risk, • Potentially impede firefighting operations. • Store dangerous goods.	Not Applied	N/A
		5. Site Activities and Operations • What activities undertaken on-site contribute to fire risk. • How is electricity infrastructure de-energised and isolated. • How often is critical maintenance undertaken.	Not Applied	N/A
		6. Site Occupancy • Will the facility be occupied or unoccupied. • Will there be vulnerable occupants.	Fully Complies	5.2; 5.4.1; 5.4.2
		7. Local Weather Conditions What is: • The prevailing wind speed and direction. • The annual rainfall. • The humidity and temperature during the Fire Danger Period.	Does Not Comply: Modification Applied	5.1.3
	Assessment Comment: Criterion 1: • Western Australia has a single bushfire mapping overlay- the Map of Bushfire Prone Areas. This map is more conservative than the Victorian Bushfire Management Overlay. • Grassland is not mapped within the Map of Bushfire Prone Areas. This bushfire assessment is triggered by the site being within a designated Bushfire Prone Area. Pasture/cropland dominates the local landscape, and is assessed within vegetation assessment of the BMP and the hazard threat levels within this BRR. • Flood zones are managed through the appropriate environmental assessments/approvals.			

	• The only available dataset is DBCA 042 Walpole Wild Peat Wetlands, which does not cover the subject site. The presence of peat cannot be assessed or addressed by a bushfire consultant. • The site is remote from settlements and hazardous industries. Criteria 2, 3, and 6 are applied through the associated Bushfire Risk Report. Criteria 4 and 5 are not assessable by a bushfire consultant. Criteria 7 is considered however worst-case average weather conditions are assumed.

Item 3.3.3: Hazards Specific to Facility Type				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
SOLAR ENERGY FACILITIES	Design Advice	Hazards must be considered due to their potential to ignite, spread, or intensify fire. The following is not an exhaustive list; hazards must be identified through the risk management process: • Electrical hazards, such as panel/inverter electrical faults; power surges; lightning strikes; water ingress; retained DC electricity in solar panels after shut-down/isolation. • Potential fire spread and limited emergency response due to proximity of panel banks to each other, on-site infrastructure and vegetation (including screening vegetation). • Landscape hazards, such as bushfire/grassfire ignition from fire within the facility, or external ignition of site infrastructure from embers or radiant heat.	Complies with Intent	5.1.4, 5.3.5, 5.4.5
	Assessment Comment: A bushfire consultant cannot provide measures to reduce the potential for mechanical/electrical/system failures to occur. Individual minor failures are not considered- the 'asset failure' for the purposes of the bushfire assessment is ignition of a solar panel bank in its entirety. Operational responses, containment, and/or impact can be considered. Setback between solar panels and rows is determined by the manufacturer to limit fire spread. Setback between assets and vegetation is considered within the Bushfire Risk Report. The minimum separation between solar panel banks is prescribed within AS 5033-2021. The tracking line centre distance for the solar farm design is >6m. When panels are aligned to the maximum vertical extent, the trafficable carriageway would be >4m (usually >5m) between rows. Each solar panel bank (a series of solar arrays connected to a single PCU) will have a permanent 6m trafficable access road around the perimeter. The solar tracker (the system controlling the orientation of the PV panel) should be 'locked' with the PV panels in the appropriate orientation, and the system shut down, significantly prior to the passage of a fire front, as pre-heating (before the arrival of the fire) can result in temperatures exceeding the safe operational temperature (generally 50-60°C). Assessment of 'Landscape hazards' forms the bulk of the Bushfire Risk Report.			

<table>
<tr><td></td><td colspan="4">Recommendation: Various components have a maximum operational temperature, which may be exceeded by pre-heating before the arrival of the fire front. Engaging preparation systems when a fire is within 150m is too late. As soon as practical before the arrival of the fire front, preparation systems/procedures should be engaged. Such systems/procedures should be determined in consultation with the manufacturer, but may include:
Orienting PV panels to the maximum vertical plane (NX Gemini Datasheet states 50 degrees from the horizontal).
Disconnecting solar arrays from the electrical grid.
Engaging any appropriate automatic fire suppression systems.</td></tr>
<tr><td rowspan="2">BATTERY ENERGY STORAGE SYSTEMS</td><td>Design Advice</td><td>Hazards must be considered due to their potential to ignite, spread, or intensify fire. The following is not an exhaustive list; hazards must be identified through the risk management process:
Electrical hazards, such as battery faults; overcharging; rapid discharge; loss of remote monitoring systems; internal short circuits; overheating; water ingress; lightning strike (leading to thermal events/runaway).
Chemical hazards, such as the inherent hazards of the stored dangerous goods; spills and leaks of transformer oil/diesel, refrigerant gas/coolant; chemical reactions.
Explosions, from ignition of venting gases.
Potential fire spread due to proximity of batteries (and containers/enclosures) to each other, on-site infrastructure and vegetation (including screening vegetation).
Mechanical damage to battery containers/enclosures due to vehicular impact.
Landscape hazards, such as bushfire/grassfire ignition from fire within the facility, or external ignition of site infrastructure from embers, radiant heat and flame contact.</td><td>Complies with Intent</td><td>4.2.2, 5.1.4, 5.3.4, 5.4.4</td></tr>
<tr><td colspan="3">Assessment Comment: A bushfire consultant cannot provide measures to reduce the potential for mechanical/electrical/system failures to occur. Individual minor failures are not considered- the ‘asset failure’ for the purposes of the bushfire assessment is ignition of the BESS cabinet in its entirety.
Operational responses, containment, and/or impact can be considered.

Chemical hazards relevant to the site are required to be included within a manifest. DFES Emergency Response Guide (FES-ERG) is required for some sites which store or handle dangerous goods. The production of a FES-ERG manifest is in consultation with and requires approval from DFES. The applicable requirements are provided in Dangerous Goods Safety Guidance Note - Manifest and site plan requirements for dangerous goods sites (DFES January 2019).
Setback between assets is determined by the manufacturer. Setback between assets and vegetation is considered within the Bushfire Risk Report.
Radiant heat flux in battery fires is relatively low, the Victorian Big Battery Fire (July 2021) required only a 20m exclusion zone for personnel (such an exclusion zone would generally be <4kW/m2 radiant heat flux). Note the <10kW/m2 APZ proposed is also >20m. Therefore in the reasonable worst case scenario, flame contact and radiant heat flux will be insufficient to ignite a bushfire in the surrounding vegetation. Grasses require approximately 250 degree temperature to ignite with no ignition source- thus the setback required to minimise the capacity for flame contact is the relevant concern as compared to heat flux. Embers can travel beyond any applicable APZ. Onsite fine and heavy fuel sources are required to be eliminated in project design and strictly controlled in ongoing operation to prevent the capacity for embers to be generated.</td></tr>
</table>

	Vehicular impact and spill containment are considered in Item 4.2.6 of this assessment of the CFA Guidelines. Assessment of 'Landscape hazards' forms the bulk of the Bushfire Risk Report.			
Item 3.3.5: Additional Requirements Specific to Facility Type				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
BATTERY ENERGY STORAGE SYSTEMS	Design Advice	A Fire Safety Study is conducted and provided to CFA's Specialist Risk and Fire Safety Unit for facilities with battery energy storage system(s) where the Model Requirements in this guideline are proposed to be reduced.	Not Applied	N/A
	Assessment Comment: A Fire Safety Study relates to non-bushfire hazards and is not applied within this assessment. A Fire Safety Study or a comparable assessment/information is at the discretion of the decision maker.			

SECTION 4: FACILITY LOCATION AND DESIGN				
Subsection 4.1: Facility Location				
Intent: Renewable energy facilities must be located in low-risk environments wherever possible, to reduce the risk of external fire impacting the facility and its consequences.				
	Assessment Criteria Type	Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
SOLAR ENERGY FACILITIES	Design Advice	Where practicable, solar energy facilities can be sited on grazed paddocks. Vegetation throughout the facility must be managed in line with planning permit conditions and Section 6.2 of this guideline.	Fully Complies	5.1.4
	Assessment Comment: The Asset Protection Zone must be maintained in accordance with Schedule 1 of the Guidelines for Planning in Bushfire Prone Areas, per the Bushfire Management Plan prepared to support the application. The planning permit will reference the BMP. Recommendation: The specifications of Schedule 1 of the Guidelines for Planning in Bushfire Prone Areas can be achieved via livestock grazing. The vegetation must continue to be monitored for compliance with Schedule 1, and additional vegetation management works undertaken as required.			
BATTERY ENERGY STORAGE SYSTEMS	Design Advice	Wherever possible, battery energy storage systems must be sited in low-risk location, such as where BMO and LSIO do not apply. The Risk Management Plan must inform the siting for battery energy storage systems.	Complies with Intent	5.1.2
	Assessment Comment: The subject site is largely grassy, with substantial pockets of remnant vegetation present throughout the site and locally. The Bushfire Management Overlay (Victoria) maps continuous forest vegetation as an extreme hazard. A 'low risk' location within Victoria is functionally not within 150m of continuous forest. The Map of Bushfire Prone Areas (WA) is much more conservative. The only BESS cabinets within a designated Bushfire Prone Area are due to limited verge vegetation following Great Southern Highway and Wanerie Road, which would not be mapped in the Victorian BMO. See Figure 1.4 of the associated Bushfire Management Plan. Multiple site characteristics are required/beneficial to the proposal and impact available sites to a significant extent: • A Western Power transmission line capable of supporting the load is available (connecting to the SWIS network via the Narrogin South Terminal 1.35km to the north). • The appropriate zoning under the Local Planning Scheme, allowing for the development type to be considered.			

- Is accessed via a major road (Great Southern Highway) with two-way continuous travel available.
- Remote from settlements as the facility will likely not be supported within a populated area.
- Can apply a noise and visual buffer from nearby receptors.

The Design Advice can be rarely applied.

Item 4.1.1: High-Risk Environments				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	Planning applications for all renewable energy facilities proposed in high-risk environments must address the following:		
		a) An assessment against policy at *Clause 13.02-1S (Bushfire Planning)* where the facility is located in a Bushfire Prone Area (BPA).	Not Applied	N/A
		b) The impact of any ignitions arising from the infrastructure (solar panels, wind turbines, battery energy storage systems, electrical infrastructure) on nearby communities, infrastructure and assets.	Fully Complies	5.1.4
		c) The impact of bushfire on the infrastructure (eg. ember attack, radiant heat impact, flame contact).	Fully Complies	5.3.4, 5.3.5, 5.3.6
		d) Assessment of whether the proposal will lead to an increase in risk to adjacent land and how the proposal will reduce risks at the site to an acceptable level.	Complies with Intent	5.1.4

Assessment Comment:

<u>Solar</u>

a) Not applicable to Western Australian planning system.

b) The separation of solar panel banks is specified in Item 3.3.3 to be a minimum of 6m. Product designers determine the setback between arrays to minimise the risk of fire transmission between arrays. The Asset Protection Zone applied exceeds the setback between arrays. Grasses require approximately 250 degree temperature to ignite with no ignition source- thus the setback required to minimise the capacity for flame contact it the relevant concern as compared to heat flux. Embers can travel beyond any applicable APZ.

c) The research paper Experimental Studies on the Flammability and Fire Hazards of Photovoltaic Modules (Materials (Basel): July 2015) was found to apply a critical heat flux threshold of 26kW/m2. Technology in terms of safety and reliability of solar panels has advanced since publication in 2015, but similar more recent test articles have not been found. The *Design Guidelines and Model Requirements – Renewable Energy Facilities* v4 (CFA March 2023) requires that solar arrays have a minimum 10m APZ.

Common electrical cabling reaches its critical point at >12kWm2 (Kaczorek-Chrobak et al. 2007) [49]. Electrical cabling and components are expected to exceed this standard, being industrial and high capacity, however the 12kW threshold is adopted for the highest potential vulnerability.

It must be therefore recognised that exposed cabling (not shielded or buried underground) positioned within 12kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement, and PV panels will not ignite but may suffer damage.

d) The relation to bushfire is applied in criteria b).

BESS

a) Not applicable to Western Australian planning system.

b) Radiant heat flux in battery fires is relatively low, the Victorian Big Battery Fire (July 2021) required only a 20m exclusion zone for personnel (such an exclusion zone would generally be <4kW/m2 radiant heat flux). Note the <10kW/m2 APZ proposed is also >20m. Therefore in the reasonable worst case scenario, flame contact and radiant heat flux will be insufficient to ignite a bushfire in the surrounding vegetation. Grasses require approximately 250 degree temperature to ignite with no ignition source- thus the setback required to minimise the capacity for flame contact is the relevant concern as compared to heat flux. Embers can travel beyond any applicable APZ. Onsite fine and heavy fuel sources are required to be eliminated in project design and strictly controlled in ongoing operation to prevent the capacity for embers to be generated.

c) BESS technologies are continuing to develop and the critical heat flux thresholds of assets may vary slightly between engineering designs. The exterior and structural components of battery cabinets are non-combustible, generally being metal, fibrous cement, mineral wool etc. A battery cabinet is a sea container-sized with a series of battery racks installed. A single battery rack consists of battery cells (each cell connected into a module), and a control box with chiller. Power and computer cabling is associated within and between racks. These are the relevant components regarding potential for fire.

- The individual batteries have been found to be highly resistant to conductive heat. Applied temperatures exceeding 400 degrees Celsius destroyed, but not ignite, running battery cells. See UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Cell Energy Storage Systems, Third Edition (UL LLC; 8 July 2020). Other trigger/failure conditions must be met for battery cells to ignite (mechanical rupture, flame contact, product failure etc).
- The product is tested in accordance with UN 38.3. UN 38.3.4.2 *Test T.2: Thermal test* requires cells and batteries to be tested to 72C ± 2°C for 6 hours, with 10 repeats of the same set of cells or batteries. Radiant heat from a bushfire or other source against the battery cabinet can heat the interior, however direct calculations between ambient temperature and radiant heat are not available. It must be considered that battery cells are tested to be able to withstand sustained high temperatures beyond human endurance.
    - The ABCB Handbook requires refuge structures for a tenable human environment be subject to <10kw/m2 radiant heat flux, and an maximum mean internal temperature <39°C for 1 hour (and peak of 45°C).
    - The Guidelines for Planning in Bushfire Prone Areas v1.4 allows for on-site shelter options for Vulnerable Tourism Land Uses. This can be via the ABCB Handbook (above) or construction to BAL-29 and radiant heat exposure <10kW/m2.
    - The thermal insulation of the battery cabinet is not readily available, and may be specified within the standards with which the cabinet is compliant (being purchase-only). The construction, cladding, and insulation may meet or exceed the requirements for BAL-29, NASH, or the ABCB Handbook.
- Control boxes are computers which will apply thermal throttling and thermal shutdown if internal temperatures exceed a determined threshold. Once a computer system is shut down in this scenario, the threshold is expected to be that of the cabling (below).
- Associated cabling (both power transmission and computer). Common electrical cabling reaches its critical point at >12kWm2 (Kaczorek-Chrobak et al. 2007) [49]. Electrical cabling and components are expected to exceed this standard, being industrial and high capacity, however the 12kW threshold is adopted for the highest potential vulnerability.

c) The relation to bushfire is addressed in criteria b).

d) The Intensium Shift product is designed in compliance with the relevant standards:

- UL 9540:2023 - *Standard for Energy Storage Systems and Equipment*, being one of the few standards available specific to these technologies.
- IEC 62619:2022 - *Secondary cells and batteries containing alkaline or other non-acid electrolytes* which has been adopted by Standards Australia as AS IEC 62619:2023.

As a developing technology, there are multiple standards and guidelines internationally which may be applicable but potentially conflict. Additionally, the guiding documents themselves are under ongoing development and may contain oversights/errors which preclude full compliance and certification.

HV Substation

a) Not applicable to Western Australian planning system.

b) Ignitions arising from substations are a known factor and are managed through state and national regulation, and organisational operating procedures. Substations are a well-researched and persistent technology which should not require additional assessment by a bushfire consultant for this purpose.

c) AS 2067-2016 *Substations and high voltage installations exceeding 1 kV a.c.* is not available to the bushfire consultant. The development is assumed to comply with the Australian Standard, but it is not known if external fire sources (specifically bushfire) are addressed and to what extent. The applied BAL-19 APZ exceeds the Western Power vegetation clearances per *Western Australian Distribution Connections Manual 2015*.

The following document was found to be relevant in the assessment of proposed substations: *NS187 Passive Fire Mitigation Design of Major Substations* - Internal Document No. NW000-S0007 (Ausgrid 2020). Ausgrid Pty Ltd is Australia's largest electricity distributor (in terms of customers and energy load), and the document referenced is an internal network standard. The below table is sourced from Section 12 of the network standard.

Table 3 – Radiant Heat Exposure Limits for Bushfires

Item	Maximum allowable radiant heat flux (kW/m^2)	Comment
Cable	12.5 20	PVC Cables begin to distort and may ignite. Ignition of XLPE cables between 85 and 550 seconds.
Steel support structure	35	To 60% of yield strength after a maximum duration of 5 minutes. Applies where elastic deflections due to elevated temperatures are not critical.
Porcelain bushing/Insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Polymeric bushing/insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Aluminium busbar	20	Based on 250°C after a maximum duration of 5 minutes. Comparable to withstand temperature under fault conditions.
Copper busbar	25	Busbars may undergo significant distortion and impose significant stresses on rigid insulators.
Transformer tank	>35 (see Note 1)	Refer to above regarding bushings and cables.
Combustibles	12.5	Piloted ignition may occur on timber.

Note 1. Transformers always have some more vulnerable components such as bushings and cables etc. Refer to Clause 7.2.

'Combustibles' in this description are consequential fire hazards for the purposes of the bushfire assessment: packing materials, pallets, waste, and other assorted debris. These should not be present within the substation footprint and where necessary should be positioned away from infrastructure components, applied in Measure 6.7.

The internal network standard and the *Asset Management System Distribution Substation Plant Manual 2019:* Chapter 5 – Substation Fire Risk (Western Power March 2021) align in identifying Transformer Oil as being a consequential fire source (within the context of bushfire assessments). This is a flammable material with a low flash point of 135°C, and a radiant heat flux threshold dependent on the period of exposure: 3-4 hours at 4.5kW/m2 (the residence period of a bushfire is <10 minutes). The network standard considers radiant heat impact from asset fires on transformer oil but not bushfires, which appears to be due to the greatly reduced residence period and the transformer oil being contained within the transformer tank, which provides shielding/insulation to the contents to prevent the flash point being reached. As an appropriate heat flux for the short residence period of a bushfire is not available, the capacity for this risk to be managed is dependent on the developer recognising the issue and ensuring that the design/procedures that are applied to manage transformer oil fires, also consider the possibility of external bushfire impact igniting the oil (either through piloted ignition from embers or radiant heat only).

	PVC cables should be either enclosed within structures or installed underground where practical. Exposed cabling (not shielded or buried underground) positioned within 12kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement. Automated isolation and shut-down of affected systems are applied in substation design, to prevent any such fire spread. Any such exposed cabling will can be sacrificed and replaced. d) as per criteria b). Recommendation: <u>Solar</u> A 10kW/m2 APZ should be applied where possible to ensure cabling is not exposed to its critical threshold. BAL-19 is an appropriate minimum where site constraints limit the installation of a 10kW/m2 APZ, to a minimum distance of 10m. <u>BESS</u> The Intensium Shift datasheet includes an ambient temperature range of -20°C to +45C, with an option for +55°C. The 55°C option should be implemented to account for high ambient temperature combining with heat generated from bushfire. An APZ is to be established around electrical components and infrastructure. This APZ will ensure exposure to the bushfire hazard threat of radiant heat will be limited to a maximum radiant heat flux of 10 kW/m2 (calculated with an assumed flame temperature of 1090K) by providing the required separation distances from the bushfire hazard. The 10m portion of the APZ immediately around the assets must be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc). <u>HV Substation</u> A BAL-19 APZ is required for the HV substation. Exposed cabling (not shielded or buried underground) positioned within 12kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement. The 10m portion of the APZ around the substation must be entirely non-vegetated. The substation footprint should be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc).

SECTION 4: FACILITY LOCATION AND DESIGN				
Subsection 4.2: Facility Design				
Intent: Renewable energy facilities must be designed to eliminate or reduce the risk of fire occurring and if it does occur, its consequences.				
Item 4.2.1: Emergency Vehicle (Fire Truck) Access				
Assessment Criteria Type		Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	a) Construction of a four (4) metre perimeter road within the perimeter fire break.	Fully Complies	5.4.2
		b) Roads must be of all-weather construction and capable of accommodating a vehicle of fifteen (15) tonnes (eg., no compacted earth).	Fully Complies	5.4.2
		c) Constructed roads should be a minimum of four (4) metres in trafficable width with a four (4) metre vertical clearance for the width of the formed road surface. Ensure any fencing along access routes allows for width of fire vehicles.	Fully Complies	5.4.2
		d) The average grade should be no more than 1 in 7 (14.4% or 8.1°) with a maximum of no more than 1 in 5 (20% or 11.3°) for no more than fifty (50) metres.	Fully Complies	5.4.2
		e) Dips in the road should have no more than a 1 in 8 (12.5% or 7.1°) entry and exit angle.	Fully Complies	5.4.2
		f) Roads must incorporate passing bays at least every 600 metres, which must be at least twenty (20) metres long and have a minimum trafficable width of six (6) metres. At least one passing bay must be incorporated where roads are less than 600 metres long.	Fully Complies	5.4.2
		g) Road networks must enable responding emergency services to access all areas of the facility, including fire service infrastructure, buildings, and battery energy storage systems and related infrastructure, substations and grid connection areas.	Fully Complies	5.4.2
		h) The provision of at least two (2) but preferably more access points to each part of the facility. The number of access points must be informed through a risk management process, in consultation with the CFA.	Does Not Comply: Modification Applied	5.4.2

	Assessment Comment: The 'perimeter fire break' refers to a non-vegetated portion of the APZ around assets, as 'fire break' has different definitions between Victoria and WA. The perimeter road is therefore within the APZ, following the perimeter of the assets. Criteria a) and g) are applied in the proposed facility layout. The development site is across multiple lots and crossed by multiple public roads. 'Each part of the facility' is not defined. The distinction of 'parts' should be where exit onto an external road is required to reach another part of the facility. It may be that an exit to another part of the facility may be required to meet the multiple access points. For the assessment against Criterion h), not all parts of the facility have crossovers available to public roads, and Great Southern Highway is under the control of Main Roads WA which is unlikely to support multiple crossovers. The site is large-scale and is accessed via multiple lots and from multiple public roads. There are many potential access points, including potentially informal crossovers, and some lots with no public road access (accessed internally). The specific design of the internal access network has not yet been determined. Criteria b) to f) align to or are exceeded by the specifications for Private Driveways within the *Guidelines for Planning in Bushfire Prone Areas v1.4*, with which the internal access is required to comply. Recommendation: At the detailed design stage, the internal access network should be reviewed by the Bushfire Consultant to provide additional advice. Access points are likely to be gated but should be openable in the same manner (the same key, keycard, access code, remote etc). Access points are to comply, at a minimum, with the specifications for Private Driveways within Table 6 of the *Guidelines for Planning in Bushfire Prone Areas v1.4.*			
	Design Advice	Dead-end vehicle access (driveway/access road) greater than 60m should include a turning area. No parking is permitted in the turning area and appropriate 'NO PARKING' signage is to be provided.	Complies with Intent	5.4.2
	Assessment Comment: Each solar panel bank, the substation, and the BESS development area will have a perimeter access road which will comply as a loop road turning area. 'NO PARKING' signage is unnecessary as the site is unstaffed.			
SOLAR ENERGY FACILITIES	Model Requirement	Where solar energy facilities are designed over several land parcels separated by private or public roads, overhead powerlines, and/or water courses, vehicle entrances are to be provided into each section. The number and location of vehicle access points must be determined in consultation with CFA.	Fully Complies	5.4.2

	Assessment Comment: Applied in 'All Facilities' Criterion h) above.			
	Design Advice	Micro Solar Facilities (up to and including 5MW): Construction of a four-metre perimeter road (6.2.1(a)) and the incorporation of passing bays to perimeter roads (6.2.1(f)) may be disregarded for micro solar facilities without battery energy storage systems.	Not Applicable	N/A
	Assessment Comment: The facility exceeds 5MW.			
BATTERY ENERGY STORAGE SYSTEMS	Model Requirement	At least two access points are to be provided into each section where battery energy storage systems are located. The number and location of vehicle access points must be determined in consultation with CFA.	Fully Complies	5.4.2
	Assessment Comment: Applied in 'All Facilities' Criterion h) above.			
Item 4.2.2: Firefighting Water Supply				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	a) Water access points must be clearly identifiable and unobstructed to ensure efficient access.	Fully Complies	5.4.4, 5.4.5, 5.4.6
		b) Static water storage tank installations must comply with AS 2419.1-2021: Fire hydrant installations – System design, installation and commissioning.	Fully Complies	5.4.4, 5.4.5, 5.4.6
		c) The static water storage tank(s) must be an above-ground water tank constructed of concrete or steel.	Fully Complies	5.4.4, 5.4.5, 5.4.6
		d) The static water storage tank(s) must be capable of being completely refilled automatically or manually within 24 hours.	Not Applied	N/A

		e) The static water storage tanks must be located at vehicle access points to the facility and must be positioned at least ten (10) metres from any infrastructure (solar panels, wind turbines, battery energy storage systems, etc.).	Fully Complies	5.4.4, 5.4.5, 5.4.6
		f) The hard-suction point must be provided, with a 150mm full bore isolation valve equipped with a Storz connection, sized to comply with the required suction hydraulic performance. Adapters that may be required to match the connection are: 125mm, 100mm, 90mm, 75mm, 65mm Storz tree adapters with a matching blank end cap to be provided.	Complies with Intent	5.4.4, 5.4.5, 5.4.6
		g) The hard-suction point must be positioned within four (4) metres to a hardstand area and provide a clear access for emergency services personnel.	Fully Complies	5.4.4, 5.4.5, 5.4.6
		h) An all-weather road access and hardstand must be provided to the hard-suction point. The hardstand must be maintained to a minimum of 15 tonne GVM, eight (8) metres long and six (6) metres wide or to the satisfaction of the CFA.	Complies with Intent	5.4.4, 5.4.5, 5.4.6
		i) The road access and hardstand must be kept clear at all times.	Fully Complies	5.4.4, 5.4.5, 5.4.6
		j) The hard-suction point must be protected from mechanical damage (eg. bollards) where necessary.	Fully Complies	5.4.4, 5.4.5, 5.4.6
		k) Where the access road has one entrance, an eight (8) metre radius turning circle must be provided at the tank.	Complies with Intent	5.4.4, 5.4.5, 5.4.6
		l) An external water level indicator must be provided to the tank and be visible from the hardstand area.	Fully Complies	5.4.4, 5.4.5, 5.4.6
		m) Signage indicating 'FIRE WATER' and the tank capacity must be fixed to each tank.	Fully Complies	5.4.4, 5.4.5, 5.4.6
		n) Signage must be provided at each vehicle entrance to the facility, indicating the direction to the nearest static water tank(s).	Not Applied	N/A
	Assessment Comment: Criteria d) cannot be confirmed as this depends on the availability of delivery tankers etc. Criteria f) provides specifications for Victorian firefighting operations- connections at the hard suction point will be as determined by the requirements of the *Guidelines v1.4* and in consultation with local services. Criteria n) has not been applied as the tank(s) are required to be positioned at the vehicle access point and be clearly visible via criteria a) and e). Other criteria have been established as applicable requirements, with variations to align with WA requirements as appropriate. The BESS development will require a volume of 432kL per AS 2419.1, based on the approximate footprint of 12,800m2. The Substation is sited alongside the BESS development and will be serviced with the same water supply.			

The Solar Farm development is approximately 410ha and will require 4 x 45kL water tanks. To align with the *Guidelines for Planning in Bushfire Prone Areas* v1.4, the volume applied will be 50kL. The site is large-scale and is accessed via multiple lots and from multiple public roads. There are many potential access points, including potentially informal crossovers, and some lots with no public road access (accessed internally). The specific design of the internal access network has not yet been determined, and thus the location of water tanks has not been assigned. With the capacity and number determined the location will meet the intent of *E4 Strategic water supplies* (Guidelines v1.4). Assuming a safe 30km/h travel speed, the 20-minute turnaround would require all areas of the solar farm footprint to be within 5km travel of a tank. The tank will be sited reasonably adjacent to internal or external access points and will thus align with the intent of both guiding documents. One or more water tanks *may* be provided as a strategic water tank on public land and vested in the Shire of Narrogin to improve the local firefighting water access.

Recommendation: The following requirements apply to the firefighting water supply, via Measure 13.17 in the associated Bushfire Risk Report. The specifications will be confirmed at the detailed design stage.

Access

- Firefighting water access points (hydrants, hard suction, or drafting) must be clearly identifiable, visible from internal roads, and unobstructed.
- An all-weather hardstand turnaround area meeting the requirements of the *Guidelines for Planning in Bushfire Prone Areas v1.4* (Explanatory Note E3.3) must be provided within 4 metres static water storage tank(s) and any independent hard suction points (hydrants).
- Site Operating Procedures must include that access routes must be unobstructed at all times.

Siting and Capacity

- The Solar Farm development will require 4 tanks installed throughout the site, each with a minimum capacity of 50,000L. The specific location of water tanks will be determined once the internal access network is known at the detailed design phase. The following requirements will apply to the 4 tanks:
    - Tanks must be installed adjacent to access points into solar farm areas, either from public road reserves or from other parts of the development area.
    - Tanks *may* be installed within public road reserves in consultation with the Shire of Narrogin.
    - All areas of the solar farm footprint must be within 5km travel of a water tank.
- The static firefighting water supply associated with the BESS development must be calculated per AS 2419. Based on the approximately 12,800m2 footprint, the required supply will be 432,000L.
- Water tanks must be positioned >15m from BESS cabinets, solar panels, PCUs, inverters, etc.
- The water tank(s) should apply a BAL-29 APZ at a minimum.

Construction

- The static water storage tank(s) must be an above-ground water tank constructed of concrete or steel.
- An external water level indicator must be installed on static water storage tank(s) and be visible from internal roads and the adjoining turnaround area.
- Signage indicating 'FIRE WATER' and the tank capacity must be fixed to each tank.
- The hard-suction point must be protected from mechanical damage (eg. bollards) where vehicle contact is possible.
- Couplings at hard suction points are required to be 125mm Storz fittings (*Guidelines v1.4* s2.2.2.1). DFES Built Environment and the local emergency services should be contacted for input on appropriate couplings and adaptors.

SOLAR ENERGY FACILITIES	Model Requirement	a) The fire protection system for solar energy facilities must incorporate at least one (1) x 45,000L static water tank at the primary vehicle entrance to each the part of the facility.	Complies with Intent	5.4.5
		b) Additional static fire water tanks of at least 45,000L effective capacity must also be incorporated for every 100ha.	Complies with Intent	5.4.5
	Assessment Comment: <u>The CFA Guidelines contain an error in this section. The stated requirements and the two examples do not align. The intent appears to be that 45,000L is provided for every full 100 hectares of solar farm footprint, with the initial water tank requirement accounting for the first 100ha.</u> The total Solar Farm area is approximately 410ha, thus 4 water tanks with a capacity of 45,000L would be the requirement. The requirement has been applied in the assessment for 'All Facilities' above.			
	Design Advice	<u>Micro Solar Facilities (up to and including 5MW):</u> For micro solar facilities, up to and including 5MW without battery storage, fire water of not less than 22,500 litres effective capacity may be provided. Fire water tank(s) must be located at the primary vehicle access point to the facility. Where micro solar facilities include battery energy storage systems, additional fire protection must be provided.	Not Applicable	N/A
	Assessment Comment: The facility exceeds 5MW.			
BATTERY ENERGY STORAGE SYSTEMS	Model Requirement	<u>1. Centralised or Stand-Alone Facilities</u> The fire protection system must apply requirement a) OR b) below.		
		a) Where reticulated water is available, a fire hydrant system that meets the requirements of AS 2419.1-2021: Fire hydrant installations, Section 3.9: Open Yard Protection, and Table 2.2.5(d): Number of Fire Hydrants Required to Flow Simultaneously - Open Yards. Except, that fire hydrants must be provided and located so that every part of the battery energy storage system is within reach of a 10m hose stream issuing from a nozzle at the end of a 60m length of hose connected to a fire hydrant outlet.	Not Applicable	N/A
		b) Where no reticulated water is available, a fire hydrant system that complies with AS 2419.1-2021 must be provided: i. The fire water supply must be of a quantity no less than 288,000L or as per the provisions of AS 2419.1-2021: Fire Hydrant installations, Table 2.2.5(D) for open yards flowing for a period of no less than four hours at 20L/s, whichever is the greater. ii. The quantity of static fire water storage is to be calculated from the number of hydrants required to flow from AS 2419.1-2021: Fire hydrant installations, Table 2.2.5(D).	Fully Complies	5.4.4

		iii. Fire hydrants must be provided and located so that every part of the battery energy storage system is within reach of a 10m hose stream issuing from a nozzle at the end of a 60m length of hose connected to a fire hydrant outlet. iv. The fire water supply must be located at vehicle entrances to the facility, at least 10m from any infrastructure (electrical substations, inverters, battery energy storage systems, buildings). v. The fire water supply must be reasonably adjacent to the battery energy storage system and shall be accessible without undue danger in an emergency. (Eg., Fire water tanks are to be located closer to the site entrance that the battery energy storage system). vi. The fire water supply must comply with AS 2419.1-2021: Fire hydrant installations - Section 5: Water storage tanks.		
	Assessment Comment: The detailed requirements of the hydrant system are outside the field of a Bushfire Consultant and must be confirmed by an appropriate Fire Engineer. AS 2419.1-2021 is the current version of the Australian Standard. Recommendation: During the detailed design stage, the entity designing the firefighting water supply should provide information on compliance with AS2419.1-2021 (Open Yard Protection) and what variations are applied (if any).			
	Model Requirement	2. Decentralised Facilities The fire protection system must apply requirement a) OR b) below.		
		a) Where reticulated water is available, a fire protection system as per Model Requirement (1a) under 'Centralised Battery Energy Storage Systems'.	Not Applicable	N/A
		b) Where no reticulated water is available, a fire water supply in static storage tanks, where a minimum 45,000L static water tank is provided within 120m of each battery container. The aggregate quantity of fire water supply at the facility must be no less than 288,000L to the satisfaction of CFA.	Not Applicable	N/A
	Assessment Comment: The facility is a centralised system.			

Item 4.2.3: Fire Detection and Suppression Equipment				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	Suitable fire detection and suppression equipment must be provided:		
		a) For on-site buildings and structures, according to the requirements of the National Construction Code.	Fully Complies	5.4.3
		b) For storages of dangerous goods, according to the requirements of any Australian Standards for storing and handling of dangerous goods.	Fully Complies	5.1.4
		c) For electrical installations, a minimum of two (2) suitable fire extinguishers must be provided within 3m-20m of each PCU.	Fully Complies	5.4.5
		d) In all vehicles and heavy equipment, each vehicle must carry at least a nine (9)-litre water stored-pressure fire extinguisher with a minimum rating of 3A, or other firefighting equipment as a minimum when on-site during the Fire Danger Period.	Fully Complies	N/A
Assessment Comment: a) Compliance with the NCC is a regulatory requirement. b) Compliance with a Dangerous Goods Licence is a regulatory requirement. d) Fire extinguishers are a regulatory requirement in operational vehicles. The type of fire extinguisher will be as applicable to the facility hazards (e.g. chemical, electrical fires). As the site is intended to be unstaffed, this may not be applicable. Recommendation: Two suitable fire extinguishers should be provided within 20m of each PCU.				

Item 4.2.4: Landscape Screening and On-Site Vegetation				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	Any proposed or existing vegetation must be considered in the Risk Management Plan for its potential to intensify and propagate fire within and away from the site.	Fully Complies	5.1.4
		Vegetated landscape screening must consider any potential increase in fire risk due to the type (species), density, height, location and overall width of the screening.	Fully Complies	5.3.4, 5.3.5

		Consultation with CFA is required regarding landscape screening in high-risk environments.	Not Applicable	N/A
	Assessment Comment: A substantial portion of onsite vegetation will be retained due to environmental values and has been assessed within the Bushfire Risk Report. Landscape screening may be considered. Where applied, this would likely be a condition of approval from the decision maker. Recommendation: Any future Landscape Management Plan should be reviewed by the Bushfire Consultant to provide additional advice on vegetation location, demographics, and structure.			
SOLAR ENERGY FACILITIES	Design Advice	Where practicable, low-flammability vegetation (such as root vegetables) may be planted under solar panels, provided foliage does not extend beyond the panel footprint.	Not Applicable	N/A
	Assessment Comment: Planting within the Solar Farm area is not proposed.			
SUBSTATIONS	Design Advice	The entire substation must be surfaced to eliminate all vegetation including grasses.	Fully Complies	5.3.6
		The Electricity Safety (Electric Line Clearance) Regulations 2020 prescribe the vegetation clearance requirements for electric lines based on the assigned fire hazard rating for land established under Section 80 of the Electricity Safety Act 1998.	Complies with Intent	5.3.6
	Assessment Comment: Western Power vegetation clearances will be applied per Western Australian Distribution Connections Manual 2015. Recommendation: The substation footprint should be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc). A BAL-19 APZ is required for the HV substation, exceeding the Western Power vegetation clearances per Western Australian Distribution Connections Manual 2015. The 10m portion of the APZ around the substation must be entirely non-vegetated.			

Item 4.2.5: Fire Breaks

Note: The Victorian and Western Australian definition of 'Fire Break' differ.

In Western Australia, a 'Fire Break' is a trafficable perimeter used primarily for Emergency Services access. It is not expected to impact bushfire spread.

In Victoria, a 'Fire Break' is a gap in fuel intended to restrict bushfire spread, which ***may*** also be used for Emergency Services access. A Victorian 'Fire Break' is therefore wider than in Western Australia, and need not be trafficable. A 'Fire Break' may even follow a road.

Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	The width of fire breaks must be a minimum of 10m, and at least the distance where radiant heat flux (output) from the vegetation does not create the potential for ignition of on-site infrastructure.	Complies with Intent	5.3.4, 5.3.5, 5.3.6
		a) A fire break must be established and maintained around the perimeter of the facility, commencing from the boundary of the facility or from the vegetation screening inside the property boundary.	Complies with Intent	5.4.4
		b) A fire break must be established and maintained around the perimeter of control rooms, electricity compounds, substations and all other buildings on-site.	Complies with Intent	5.3.4, 5.3.5, 5.3.6

Assessment Comment: The 'perimeter fire break' refers to a non-vegetated portion of the APZ around the assets, as 'fire break' has different definitions between Victoria and WA.

Solar

The research paper Experimental Studies on the Flammability and Fire Hazards of Photovoltaic Modules (Materials (Basel): July 2015) was found to apply a critical heat flux threshold of 26kW/m2. Technology in terms of safety and reliability of solar panels has advanced since publication in 2015, but similar more recent test articles have not been found. The *Design Guidelines and Model Requirements – Renewable Energy Facilities* (CFA March 2022) requires that solar arrays have a minimum 10m APZ. The minimum BAL-19 APZ applied exceeds 10m.

Common electrical cabling reaches its critical point at >12kWm2 (Kaczorek-Chrobak et al. 2007) [49]. Electrical cabling and components are expected to exceed this standard, being industrial and high capacity, however the 12kW threshold is adopted for the highest potential vulnerability.

Associated cabling (both power transmission and computer) will run between panels and be wired to individual panels. Common electrical cabling reaches its critical point at >12kWm2 (Kaczorek-Chrobak et al. 2007) [49]. This aligns with *NS187 Passive Fire Mitigation Design of Major Substations* - Internal Document No. NW000-S0007 (Ausgrid 2020) referenced in Section 5.4.6 of this report (>12.5kW/m2 for PVC cabling). Electrical cabling and components are expected to exceed this standard, being industrial and high capacity, however the 12kW/m2 threshold is adopted for the highest potential vulnerability. Within the band of 12<26kW/m2 radiant heat flux, it can be expected that cabling may be compromised/destroyed but the PV panels will not ignite (but may suffer damage). A BAL-19 (<19kW/m2 radiant heat flux) APZ is applied to PV modules themselves, to ensure the heat flux considered is *below* the 26kW/m2 threshold rather than meeting it.

BESS

BESS technologies are continuing to develop and the critical heat flux thresholds of assets may vary slightly between engineering designs. The exterior and structural components of battery cabinets are non-combustible, generally being metal, fibrous cement, mineral wool etc. A battery cabinet is a sea container-sized with a series of battery racks installed. A single battery rack consists of battery cells (each cell connected into a module), and a control box with chiller. Power and computer cabling is associated within and between racks. These are the relevant components regarding potential for fire.

- The individual batteries have been found to be highly resistant to conductive heat. Applied temperatures exceeding 400 degrees Celsius destroyed, but not ignite, running battery cells. See UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Cell Energy Storage Systems, Third Edition (UL LLC; 8 July 2020). Other trigger/failure conditions must be met for battery cells to ignite (mechanical rupture, flame contact, product failure etc).

- The product is required to comply with UN 38.3 under s2.9.4 of the *Australian Code for the Transport of Dangerous Goods by Road & Rail* v7.9 (Australian National Transport Commission 2024). UN 38.3.4.2 *Test T.2: Thermal test* requires cells and batteries to be tested to 72C ± 2°C for 6 hours, with 10 repeats of the same set of cells or batteries. Radiant heat from a bushfire or other source against the battery cabinet can heat the interior, however direct calculations between ambient temperature and radiant heat are not available. It must be considered that battery cells are tested to be able to withstand sustained high temperatures beyond human endurance.
    - The ABCB Handbook requires refuge structures for a tenable human environment be subject to <10kw/m2 radiant heat flux, and a maximum mean internal temperature <39°C for 1 hour (and peak of 45°C).
    - The Guidelines for Planning in Bushfire Prone Areas v1.4 allows for on-site shelter options for Vulnerable Tourism Land Uses. This can be via the ABCB Handbook (above) or construction to BAL-29 and radiant heat exposure <10kW/m2.
    - The thermal insulation of the battery cabinet is not readily available, and may be specified within the standards with which the cabinet is compliant (being purchase-only). The construction, cladding, and insulation may meet or exceed the requirements for BAL-29, NASH, or the ABCB Handbook.
- Control boxes are computers which will apply thermal throttling and thermal shutdown if internal temperatures exceed a determined threshold. Once a computer system is shut down in this scenario, the threshold is expected to be that of the cabling (below).
- Associated cabling (both power transmission and computer). Common electrical cabling reaches its critical point at >12kWm2 (Kaczorek-Chrobak et al. 2007) [49]. Electrical cabling and components are expected to exceed this standard, being industrial and high capacity, however the 12kW threshold is adopted for the highest potential vulnerability.

<u>HV Substation</u>

AS 2067-2016 *Substations and high voltage installations exceeding 1 kV a.c.* is not available to the bushfire consultant. The development is assumed to comply with the Australian Standard, but it is not known if external fire sources (specifically bushfire) are addressed and to what extent. The applied BAL-19 APZ exceeds the Western Power vegetation clearances per Western Australian Distribution Connections Manual 2015.

The following document was found to be relevant in the assessment of proposed substations: *NS187 Passive Fire Mitigation Design of Major Substations* - Internal Document No. NW000-S0007 (Ausgrid 2020). Ausgrid Pty Ltd is Australia's largest electricity distributor (in terms of customers and energy load), and the document referenced is an internal network standard. The below table is sourced from Section 12 of the network standard.

Table 3 – Radiant Heat Exposure Limits for Bushfires

Item	Maximum allowable radiant heat flux (kW/m^2)	Comment
Cable	12.5 20	PVC Cables begin to distort and may ignite. Ignition of XLPE cables between 85 and 550 seconds.
Steel support structure	35	To 60% of yield strength after a maximum duration of 5 minutes. Applies where elastic deflections due to elevated temperatures are not critical.
Porcelain bushing/Insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Polymeric bushing/insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Aluminium busbar	20	Based on 250°C after a maximum duration of 5 minutes. Comparable to withstand temperature under fault conditions.
Copper busbar	25	Busbars may undergo significant distortion and impose significant stresses on rigid insulators.
Transformer tank	>35 (see Note 1)	Refer to above regarding bushings and cables.
Combustibles	12.5	Piloted ignition may occur on timber.

Note 1. Transformers always have some more vulnerable components such as bushings and cables etc. Refer to Clause 7.2.

'Combustibles' in this description are consequential fire hazards for the purposes of the bushfire assessment: packing materials, pallets, waste, and other assorted debris. These should not be present within the substation footprint and where necessary should be positioned away from infrastructure components, applied in Measure 6.7.

The internal network standard and the *Asset Management System* Distribution Substation Plant Manual 2019*:* Chapter 5 – Substation Fire Risk (Western Power March 2021) align in identifying Transformer Oil as being a consequential fire source (within the context of bushfire assessments). This is a flammable material with a low flash point of 135°C, and a radiant heat flux threshold dependent on the period of exposure: 3-4 hours at 4.5kW/m2, however the residence period of a bushfire is <10 minute). The network standard considers radiant heat impact from asset fires on transformer oil but not bushfires, which appears to be due to the greatly reduced residence period and the transformer oil being contained within the transformer tank, which provides shielding/insulation to the contents to prevent the flash point being reached. As an appropriate heat flux for the short residence period of a bushfire is not available, the capacity for this risk to be managed is dependent on the developer recognising the issue and ensuring that the design/procedures that are applied to manage transformer oil fires, also consider the possibility of external bushfire impact igniting the oil (either through piloted ignition from embers or radiant heat only).

PVC cables should be either enclosed within structures or installed underground where practical. Exposed cabling (not shielded or buried underground) positioned within 12kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement. Automated isolation and shut-down of affected systems are applied in substation design, to prevent any such fire spread. Any such exposed cabling will can be sacrificed and replaced.

Recommendation:

Solar

A 10kW/m2 APZ should be applied where possible to ensure cabling is not exposed to its critical threshold. BAL-19 is an appropriate minimum where site constraints limit the installation of a 10kW/m2 APZ.

BESS

An APZ is to be established around electrical components and infrastructure. This APZ will ensure exposure to the bushfire hazard threat of radiant heat will be limited to a maximum radiant heat flux of 10 kW/m2 (calculated with an assumed flame temperature of 1090K) by providing the required separation distances from the bushfire hazard. The 10m portion of the APZ immediately around the assets must be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc).

HV Substation

A BAL-19 APZ is required for the HV substation. Exposed cabling (not shielded or buried underground) positioned within 12kW<19kW buffer may be damaged/destroyed in a bushfire event and require replacement.

Design Advice	Fire breaks must be: • Non-combustible, constructed of concrete, mineral earth or non-combustible mulch such as crushed rock. • Free of vegetation and obstructions at all times. No plant or equipment of any kind is to be stored in fire breaks.	Does Not Comply: Modification Applied	5.3.4, 5.4.2
	Where screening or other vegetation is a width of 20m or less (open density as per AS 3959-2018), or 15m or less (closed density as per AS 3959-2018), a fire break of 10m may be appropriate to prevent radiant heat from vegetation fully involved in fire becoming an ignition source for on-site infrastructure.	Not Applicable	N/A

Assessment Comment: No vegetation screening is proposed. Where applied, vegetation screening will be considered through Item 4.3.4. Maintaining clear access will be a component of site operational procedures.

The first 10m portion of the APZ being permanently sealed/scarified/mulched is appropriate for BESS cabinets, but not for Solar Farms or the HV Substation. These assets will have perimeter access tracks (Private Driveways) which will be non-vegetated and limit the spread of surface fire from within the area to vegetation beyond.

Recommendation: The 10m portion of the APZ immediately around BESS cabinets must be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc).

Site Operating Procedures should include that no items (plant or equipment) can be stored on access roads or on the 10m non-vegetated buffer.

BATTERY ENERGY STORAGE SYSTEMS	Model Requirement	A fire break must be established and maintained around battery energy storage systems and related infrastructure.	Fully Complies	5.3.4
	Assessment Comment: The criterion can be summarised as a permanently non-vegetated buffer around the asset (the first 10m of the APZ). Recommendation: The 10m portion of the APZ immediately around the assets must be entirely and permanently non-vegetated (sealed, compacted, or mineral earth).			
	Design Advice	In addition to radiant heat flux (output) from vegetation, the width of fire breaks between vegetation and battery energy storage systems must be at least the distance where the radiant heat flux (output) from the battery energy storage system fully involved in fire does not create the potential for ignition of vegetation.	Fully Complies	5.1.4
	Assessment Comment: Radiant heat flux in battery fires is relatively low, the Victorian Big Battery Fire (July 2021) required only a 20m exclusion zone for personnel (such an exclusion zone would generally be <4kW/m2 radiant heat flux). Note the <10kW/m2 APZ proposed is also >20m. Therefore in the reasonable worst case scenario, radiant heat flux will be insufficient to ignite a bushfire in the surrounding vegetation. Grasses require approximately 250 degree temperature to ignite with no ignition source- thus the setback required to minimise the capacity for flame contact is the relevant concern as compared to heat flux. The 10m buffer around assets is strictly required to contain no combustible materials. The assets have a total height of 2.9m (the non-combustible cabinet itself, not the battery modules). Assuming a conservative flame height of 3x the height of cabinet, the total flame peak would be approximately 12m from ground level. The APZ would prevent flame contact to nearby vegetation even assuming extreme wind creating a near-horizontal flame. Embers can travel beyond any applicable APZ. Onsite fine and heavy fuel sources are required to be eliminated in project design and strictly controlled in ongoing operation to prevent the capacity for embers to be generated. Additionally, ember screening of cabinets is established as a requirement and which will also inhibit embers generation due to minor internal fires escaping from, as well as entering the cabinet. Functionally, the APZ required to address bushfire impacts on the asset, far exceeds the setback required to address asset fires on bushfire prone vegetation.			
Item 4.2.6: Design Specific to Facility Type				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section

SOLAR ENERGY FACILITIES	Model Requirement	Solar energy facilities are to have a minimum six (6) metre separation between solar panel banks.	Fully Complies	5.1.4
	Assessment Comment: Applied in Item 3.3.3.			
	Design Advice	Separation wherever possible: • Is between each 'bank' of solar panels, where a 'bank' is that connected to a single power conversion unit/inverter, or • Is provided so that no unbroken area of solar panels is greater than 25ha, or • Is designed in consultation with CFA. This zone is to be cleared of trees and scrub (where permitted by the responsible authority) and grass must be no more than 100mm during the Fire Danger Period.	Complies with Intent	5.1.4
	Assessment Comment: Solar panel banks are separated within the submitted site layout. Additionally, each bank is <25ha. CFA cannot be consulted. <100mm grass height is a requirement of the Shire of Narrogin Firebreak Notice.			
	Design Advice	<u>Micro Solar Facilities (up to and including 5MW):</u> Separation of solar panel banks by 6m is not required for micro solar facilities.	Not Applicable	N/A
	Assessment Comment: The facility exceeds 5MW.			
BATTERY ENERGY STORAGE SYSTEMS	Model Requirement	1) The design of the facility must incorporate:		
		a) A separation distance that prevents fire spread between battery containers/enclosures and: • Other battery containers/enclosures. • On-site buildings. • Substations. • The site boundary. • Any other site buildings. • Vegetation.	Complies with Intent	5.3.4

		Separation must be at least the distance where the radiant heat flux (output) from a battery energy storage system container/enclosure fully involved in fire does not create the potential for ignition of these site elements.		
		b) A fire break around the battery energy storage system and related infrastructure, of a width of no less than 10m, or greater where determined in the Risk Management Plan. Fire breaks must be non-combustible, constructed of concrete, mineral earth or non-combustible mulch such as crushed rock. *The width must be calculated based on the ignition source being radiant heat of surrounding vegetation, including landscaping.*	Fully Complies	5.3.4
		c) A layout of site infrastructure that: i. Considers the safety of emergency responders. ii. Minimises the potential for grassfire and/or bushfire to impact the battery energy storage system. iii. Minimises the potential for fires in battery containers/enclosures to impact on-site and off- site infrastructure.	Fully Complies	5.3.4
		2) Battery energy storage systems must be:		
		a) Located so as to be reasonably adjacent to a site vehicle entrance (suitable for emergency vehicles).	Does Not Comply: Modification Applied	5.4.2
		b) Located so that the site entrance and any fire water tanks are not aligned to the prevailing wind direction (therefore least likely to be impacted by smoke in the event of fire at the battery energy storage system.)	Does Not Comply	N/A
		c) Provided with in-built detection and suppression systems. Where these systems are not provided, measures to effectively detect fires within containers must be detailed within the Risk Management Plan.	Fully Complies	5.4.4
		d) Provided with explosion prevention via sensing and venting, or explosion mitigation through deflagration panels.	Not Applied	5.4.4
		e) Provided with suitable ember protection to prevent embers from penetrating battery containers/enclosures.	Fully Complies	5.4.4

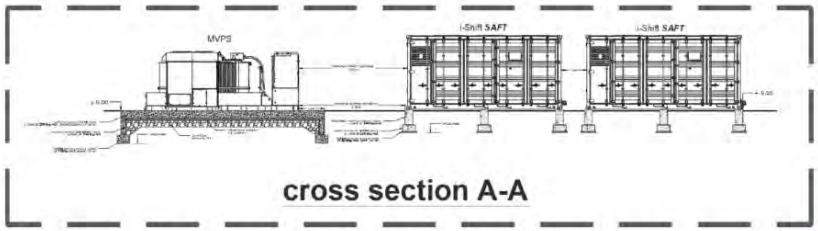
		f) Provided with suitable access roads for emergency services vehicles, to and within the site, including to battery energy storage system(s) and fire service infrastructure.	Fully Complies	5.4.2
		g) Installed on a non-combustible surface such as concrete.	Fully Complies	5.3.4
		h) Provided with suitable ventilation.	Fully Complies	N/A
		i) Provided with impact protection to at least the equivalent of a W guardrail-type barrier, to prevent mechanical damage to battery containers/enclosures.	Not Applied	N/A
		j) Provided with enclosed wiring and buried cabling, except where required to be above-ground for grid connection.	Fully Complies	5.3.4
		k) Provided with spill containment that includes provision for management of fire water runoff.	Unable to Verify: Modification Applied	4.2.2
	Assessment Comment: 1a) The design and layout of the facility has been determined by the relevant designer/engineer and are assumed to be appropriate in reducing the risk of structure-to-structure (or asset) fire. BESS cabinets will be positioned >6x the height of solar panels. A solar panel aligned to the vertical extent is approximately 2.5m tall (15m separation). The separation between i-Shift containers is >1m on the shorter and >3m on the longer side. The separation between other assets is based on intervention with 1 hour, which should not be expected for the subject site, and thus greater separation distances should be applied.			

Intensium Shift – Clearance (safety or maintenance)

Clearance for the i-Shift: (Typical layout in next slide)

1. Distance between i-Shift and another i-Shift (from the longer side): ≥ 3 m.
2. Distance between i-Shift and another i-Shift (from the shorter side): ≥ 1 m.
3. Distance between i-Shift and other industrial equipment (i.e PCS): ≥ 3 m *.
4. Distance between an i-Shift and a professional building or a non-permanent public domain (field, road): ≥ 3,50 m *
5. Distance between i-Shift and a professional building or a permanent public area permanent: ≥ 4 m *.
6. Safety End distances of thermal radiation (=plastic water tank) :
   10m with i-Shift if intervention within 1 hour,
   15 m if intervention in more than 1 hour.

* : if intervention of first responder within 1h



cross section A-A

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Criteria 1.b) and 1.c) are addressed through Item 4.2.5 of this assessment.

2a) It is unclear what is 'reasonably adjacent' when the assets require visual screening and safety setbacks from publicly accessible areas. The total route from Wanerie Road is approximately 400m, which can be traversed in <1 minute. This should not be considered an unreasonable distance from a public road.

b) The prevailing wind direction during the bushfire season is south-easterly (66% frequency). The site entry and water tanks will be upwind from the BESS location.

c) It is recommended that automatic fire detection and suppression systems are installed and maintained, as appropriate to the BESS details and recommended by the manufacturer.

d) Explosion prevention/mitigation is a design component, applied via national/international safety standards. The Intensium Shift product is designed in compliance with the relevant standards:

- UL 9540:2023 - *Standard for Energy Storage Systems and Equipment*, being one of the few standards available specific to these technologies.
- IEC 62619:2022 - *Secondary cells and batteries containing alkaline or other non-acid electrolytes* which has been adopted by Standards Australia as AS IEC 62619:2023.

	e) It is recommended that ember screens are installed to BESS units and all other cabinets over intake/exhaust vents and other gaps to the interior cavity or accessing any combustible elements. Ember screening mesh is corrosion-resistant steel, bronze, or aluminium with an aperture <2mm. f) The internal road from Wanerie Road will need to be installed with sufficient weight capacity to support installation of the BESS cabinets themselves, with a weight of 35 tons per unit. Firefighting infrastructure will have access installed compliant with Schedule 2 of the *Guidelines* v1.4. g) BESS cabinets are recommended to be sited on concrete slabs or other sealed, non-combustible surface. h) The criteria likely refers to ventilation around BESS cabinets where contained within a structure. The cabinets will be open-air. i) The criteria has not been provided as a recommendation as the site is unstaffed. The facility may comply, but will be confirmed via the manufacturer's recommendations or at the detailed design stage. j) Cabling and plumbing subject to >10kW/m2 (not within the <10kW/m2 setback), or beyond footprint of buildings or constructed assets, are recommended to be installed underground, or shielded with non-combustible material (or enclosed) where practical. k) Spill containment of fire water runoff is outside the field of a Bushfire Consultant. Recommendation: Where the manufacturer specification does not specify a distance between BESS cabinets and other structures, any Class 1-10 buildings should be sited a minimum of 10m from BESS cabinets. Automatic fire suppression systems are recommended to be installed and maintained, as appropriate to the BESS details and recommended by the manufacturer. Ember screens are recommended to be installed to BESS units and all other cabinets over intake/exhaust vents and other gaps to the interior cavity or accessing any combustible elements. Ember screening mesh is corrosion-resistant steel, bronze, or aluminium with an aperture <2mm. BESS cabinets are recommended to be sited on concrete slabs or other sealed, non-combustible surface. Cabling and plumbing subject to >10kW/m2 (not within the <10kW/m2 setback), or beyond footprint of buildings or constructed assets, are recommended to be installed underground, or shielded with non-combustible material (or enclosed) where practical. Spill containment of fire water runoff is outside the field of a Bushfire Consultant. The impact of fire water runoff and any applicable containment/mitigation measures should be considered. The Intensium Shift datasheet provides minimum clearances between BESS cabinets and other features. The <1hour intervention period should not be assumed for determining the appropriate setbacks, as the proposed site is within a regional area. Where the manufacturer specification does not specify a distance between BESS cabinets and other structures, Class 1-10 buildings and solar arrays should be sited a minimum of 15m from BESS cabinets.			
	Design Advice	Consideration should be given to the provision of non-combustible, floor-to-ceiling partition 'walls' (thermal barriers) between battery racks (stacked modules) within battery containers/enclosures. Refer to FM Global Property Loss Prevention Data Sheet 5-33 (2020) Electrical Energy Storage Systems for details.	Fully Complies	5.4.4

		Consideration should be given to the provision of non-combustible, floor-to-ceiling partition 'walls' (thermal barriers) between battery racks (stacked modules) within battery containers/enclosures. Refer to FM Global Property Loss Prevention Data Sheet 5-33 (2020) Electrical Energy Storage Systems for details. In the absence of a current Australian Standard pertaining to large scale battery energy storage system facilities, the current versions of the following should be used in the design and operation of battery energy storage systems, except where varied by this guideline. • NFPA 855: Standard for the Installation of Stationary Energy Storage Systems • UL 9540: Energy Storage System Requirements • UL 9540A: Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems FM Global Property Loss Prevention Data Sheet 5-33 Electrical Energy Storage Systems	Fully Complies	5.4.4
		Infrastructure is recommended for the containment and management of contaminated fire water runoff from battery energy storage systems. Infrastructure may include bunding, sumps and/or purpose-built, impervious retention facilities. A fire water management plan may include the containment and disposal of contaminated fire water. A containment and management capacity equivalent to the on-site fire protection system is recommended. Containment is to be provided as per AS 4681-2000: The storage and handling of class 9 dangerous goods, Section 7.3.9: Control of run-off.	Unable to Verify: Modification Applied	4.2.2
		The following safety and/or protective systems are recommended: • Battery management/monitoring systems for monitoring the state of battery systems to ensure safe operation. • Systems for detecting smoke, heat (thermal), fire and toxic off-gassing within battery containers. Detection systems for off-gassing must be single-trigger and provide for both lighter and heavier than air gases. • Systems to prevent heat/fire spread within battery containers (such as thermal barriers, shut-down separators, isolation systems, cooling systems). • Systems to prevent explosion within battery containers (such as ventilation, pressure relief and exhaust systems). • Systems to prevent water ingress to battery containers and appropriate ingress protection (IP) ratings for containers/cabinets and/or battery modules.	Complies with Intent	5.4.4

		• Warning and alarm systems within the battery containers, and/or the facility, to enable early warning for faults, operation of the battery energy storage system above 'normal'/safe parameters, smoke, off-gassing, and fire.		
	Assessment Comment: The 'thermal barriers' referenced are within FM Global Property Loss Prevention Data Sheet 5-33 (2020) Electrical Energy Storage Systems, as required above. Per the *Battery Energy Storage Systems Guidance Report* (Australian Energy Council Limited March 2023), the CFA Guidelines and NFPA 855 are standards providing differing requirements. The CFA Guidelines are likely to be more relevant as they will consider bushfire as a more pressing hazard. Recommendation: Review compliance against *NFPA 855 - Standard for the Installation of Stationary Energy Storage Systems* (2023) noting that as a North American planning standard, all requirements may not be applicable. Spill containment of fire water runoff is outside the field of a Bushfire Consultant. The impact of fire water runoff and any applicable containment/mitigation measures should be considered. Automatic fire detection, and suppression systems where practical, should be investigated and implemented in consultation with the manufacturer.			
	Design Advice	<u>Decentralised Facilities</u>		
		Where battery energy storage systems are decentralised (eg., in multiple, separate locations on-site) they must be separated from adjacent infrastructure, such as solar panel banks. Separation must be to at least the distance where the radiant heat flux (output) from the battery energy storage system enclosure/container/cabinet fully involved in fire does not create the potential for ignition of the adjacent infrastructure.	Not Applicable	N/A
	Assessment Comment: The facility is a centralised system.			

SECTION 5: FACILITY CONSTRUCTION AND COMMISSIONING				
Intent: Fire risks must be identified and effectively managed during the construction and commissioning of renewable energy facilities.				
Subsection 5.1: Recommended Risk Controls				
Item 5.1.1: Fire Detection and Suppression Systems				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	a) Install and commission fire detection and suppression systems for the facility at the earliest possible stage of construction.	Fully Complies	5.1.4, 5.4.4, 5.4.5
		b) Provide first-aid firefighting equipment, such as fire extinguishers (and where possible, portable fire hose reels), appropriate to the identified emergency scenarios, at all construction portables/buildings on-site, in the vicinity of all construction activities, and in site-based vehicles.	Fully Complies	5.4.3
		c) Provide the required fire protection equipment for any storages of dangerous goods as per the relevant Australian Standards.	Fully Complies	5.1.4
	Assessment Comment: a) Fire detection and suppression systems depend on the asset type and its design, there is no 'one size fits all' solution. As BESS cabinets are delivered fully constructed (plug in and play) the detection/suppression systems will be functional immediately. Solar arrays being open-air and installed over an extensive area may have limited options available for fire suppression. Automatic fire detection systems are now standard in new solar panel designs. b) The site is intended to be unstaffed and personal firefighting equipment will not be necessary. Where any permanent buildings or site vehicles are used, fire extinguishers will be made available at these assets. c) Compliance with a Dangerous Goods Licence (which reference Australian Standards) is a regulatory requirement. Recommendation: Automatic fire detection and suppression systems should be installed and maintained, as appropriate to the BESS details and recommended by the manufacturer. Possible fire suppression systems for the solar farm likely considers asset-to-asset fire as the primary concern, however consideration should be given for the capacity for surface fire (within stubble and other surface fuels) escaping beyond the solar bank footprint. A surface fire may pose minimal threat to solar panels but could establish a bushfire offsite.		
Item 5.1.2: Fire Risk Management				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section

ALL FACILITIES	Design Advice	a) Obtain appropriate permits for work during the Fire Danger Period, and ensure that any conditions on permits are adhered to.	Fully Complies	5.1.4
		b) Adhere to restrictions on Total Fire Ban or days of elevated fire danger according to CFA's website.	Complies with Intent	5.1.4
		c) During the Fire Danger Period, ensure vehicle operators are instructed to remain on tracks and are not permitted to drive through paddocks.	Complies with Intent	5.1.4
		d) Restrict smoking to prescribed areas and provide suitable ash and butt disposal facilities.	Fully Complies	5.1.4
		e) Provide remotely-accessible site/system security monitoring at the facility.	Complies with Intent	5.4.4
	Assessment Comment: Criteria a) to c) are enforceable through WA Total Fire Bans. Restrictions on smoking will be applied through facility Operating Procedures. e) The Intensium Shift product datasheet includes: *'I-Sight digital platform for external communication, remote monitoring and supervision, data management with a high cybersecurity level.'* The criterion is otherwise outside the field of a Bushfire Consultant. Recommendation: Include smoking restrictions or designated smoking locations within the Site Operating Procedures document.			
Item 5.1.3: Personnel Training				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	a) Provide training for personnel in the use of on-site first-aid firefighting equipment, and responsibilities during emergencies.	Complies with Intent	5.4.1
		b) Ensure that all on-site personnel complete CFA's online training module 'Bushfire Safety for Workers'.	Not Applied	N/A
	Assessment Comment: Staff instruction and training in site firefighting equipment will be required under the site Emergency Management Plan. The level of instruction may vary due to the frequency/duration of visitation. The site is proposed to be unstaffed, however visitation for inspections or maintenance will be common due to the extent of the development. Recommendation: Training should be scheduled at appropriate intervals, accounting for staff turnover and the complexity of firefighting equipment.			
Item 5.1.4: Emergency Management				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section

ALL FACILITIES	Model Requirement	An Emergency Plan must be developed for the construction and commissioning phase, before development starts.	Not Applied	N/A
	Assessment Comment: Emergency Management Planning for construction and commissioning phase is not a standard approach, as various contractors and visitors will attend at different times, and hazards and resources will change. The emergency response for the construction phase is to evacuate. The requirements for Total Fire Bans and/or Harvest and Vehicle Movement Bans would restrict operations during construction and commissioning.			
	Design Advice	a) The Emergency Plan must address the requirements of Section 7 of this guideline.	Complies with Intent	5.1.4
		b) An emergency communication system must be provided that is reliable and will operate in the event of power failure.	Complies with Intent	5.1.4
		c) CFA must be notified at least seven days prior to the commissioning of any high-risk infrastructure at the facility (eg., battery energy storage systems).	Not Applied	N/A
	Assessment Comment: a) See Section 7 below. b) The site is proposed to be unstaffed, however visitation for inspections or maintenance will be common due to the extent of the development. c) Any new development within the facility will require a separate Development Application, and the asset will be addressed at that stage. Recommendation: Visitors must provide mobile phone numbers to site management. Within the Emergency Management Plan, a key response will be to contact and advise all persons onsite. Both Telstra and Optus networks have coverage over the entirety of the site.			
Item 5.1.5: Occupational Health and Safety				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	Development of safe work procedures for the facility, encompassing but not limited to:		
		a) Electricity and chemical management.	Not Applied	N/A
		b) Vegetation management.	Fully Complies	5.1.4, 5.4.4, 5.4.5
		c) Site security.	Not Applied	N/A
		d) Ignition source control, including hot works.	Fully Complies	5.1.4

		e) Infrastructure, equipment and vehicle maintenance.	Not Applied	N/A
		f) Emergency management.	Fully Complies	5.1.4
	Assessment Comment: Criteria a), c), and e) are unrelated to bushfire and not applied. Criterion f) is addressed through the Emergency Management Plan. Recommendation: Site Operating Procedures should include vegetation management and accidental ignition prevention.			

SECTION 6: FACILITY OPERATION				
Intent: Fire risks must be effectively managed for the duration of the operational life of renewable energy facilities.				
Subsection 6.1: Fire Management Plan				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	A Fire Management Plan must be developed for the facility, in conjunction with CFA, before development starts.	Fully Complies	5.1.4
	Assessment Comment: A 'Fire Management Plan' does not have an analogue in Western Australia. The contents are generally contained within the site Emergency Management Plan (e.g. as a Fire and Emergency Management Plan). Recommendation: The site Emergency Management Plan should contain fire prevention and response, including: • A summary of fire hazards and risks to and from the site, specific to its location, infrastructure, activities and occupancy. • Description of control measures to prevent fire occurring and limit the consequences of fire at the facility. • Description of control measures to prevent and reduce the consequences of external fire impacting the facility. • Details of equipment and resources to manage fire at the facility. • Policies and procedures that ensure all control measures are appropriate and effective, and remain so. • Procedures for review of the Plan.			
	Design Advice	The Fire Management Plan should address the following: • A summary of fire hazards and risks to and from the site, specific to its location, infrastructure, activities and occupancy. • Description of control measures to prevent fire occurring and limit the consequences of fire at the facility. • Description of control measures to prevent and reduce the consequences of external fire impacting the facility. • Details of equipment and resources to manage fire at the facility. • Policies and procedures that ensure all control measures are appropriate and effective, and remain so. • Procedures for review of the Fire Management Plan.	Fully Complies	5.1.4
	Assessment Comment: See above. Recommendation: None required.			

SECTION 6: FACILITY OPERATION				
Subsection 6.2: Fire Hazards and Risk Controls				
Item 6.2.1: Bushfire and Grassfire				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	If your facility is at-risk of bushfire, prevention and preparedness activities must be detailed in the Fire Management Plan.	Fully Complies	5.1.4
	Assessment Comment: See Section 6.1.			
	Design Advice	1. Site occupiers must: a) Take steps to understand how a bushfire may affect site occupants, facility infrastructure, and the surrounding community. b) Ensure that fire risk controls commensurate to the fire risk are developed, implemented and reviewed. c) Be proactive in modelling and maintaining both a culture of bushfire awareness and safety. d) Establish and maintain a relationship with the local CFA brigade.	Complies with Intent	All
		2. Develop and implement fire risk controls to ensure: a) Fire permits are obtained and followed, and restrictions based on Fire Danger Ratings or Total Fire Ban status are implemented. b) Job hazard analysis processes are developed and implemented that consider site infrastructure, operations and landscape hazards. c) Any accumulation of combustible materials are cleared and removed from site. d) Systems to monitor faults and abnormalities are effective. e) Fire protection and detection systems, plant, vehicles and equipment are regularly maintained. f) Safe and compliant practices regarding dangerous goods storage and handling. g) Bushfire-focused inspections are conducted at least three months, and again one month, prior to the Fire Danger Period.	Fully Complies	N/A
		3. Develop a bushfire monitoring procedure for the Fire Danger Period, including: • Nominating a person/role in your Emergency Control Organisation to be responsible for identifying, responding to and communicating Fire Danger Ratings at least four days ahead.	Complies with Intent	5.1.4

		• Identifying bushfire activity within 50km of the facility, through the VicEmergency website, app, or ABC local radio. • Communicating this information to everyone likely to be present on-site, and relevant off-site personnel.		
		4. A risk management process must be undertaken to determine the modification of site activities where there is risk of bushfire and grassfire. Fire Management Plans must: a) List the modified activities for each Fire Danger Rating and during the Fire Danger Period. b) Provide details of the modification based on the requirements of Fire Danger Period or Total Fire Ban permit/s, the Fire Danger Rating, and the risk management process.	Complies with Intent	N/A
		5. Where driving on days of Severe and above Fire Danger Rating is critical and unavoidable: Procedures must be developed and in place for planning and undertaking this travel. Never travel into any high-risk bushfire area where Catastrophic fire danger has been declared. • Download the VicEmergency App and set 'watch zones' for areas of travel. • Save the number for the VicEmergency Hotline in your phone: 1800 226 226. • Safety equipment must be provided, and serviced, in all company vehicles that may be used during the Fire Danger Period. • A communications plan must be in place to verify that personnel required to travel have arrived safely at each destination.	Not Applied	N/A
	Assessment Comment: 1a) and b) are applied as the bulk of the Bushfire Risk Report. 1c) and d) are objectives, not measures which can be required via planning or design. 2. is a summary of controls applied through compliance with other sections of the CFA Guidelines (and this assessment). 3. To be a component of the Site Operating Procedures. The procedure is likely to differ as the site is unstaffed- there will usually be no persons to notify. Fire danger ratings are only released 3 days in advance and are subject to change. 50km from the subject site extends to the Shires of Wandering, Pingelly, Cuballing, Wickepin, Dumbleyung, Wagin, Woodanilling, West Arthur, and Williams. Fires occur frequently (daily or multiple events daily) within this radius during the bushfire season. The radius applied is 10km. This is due to the primarily grassland vegetation types within the region, and the lower ember generation capacity of the vegetation within the region (See Section 5.1). 4. Is a summary of controls applied through compliance with other sections of the CFA Guidelines (and this assessment). 5. Driving passenger vehicles (on sealed roads/driveways) during high fire danger weather has not been restricted. It is unclear why this extreme restriction would be imposed on this facility specifically but not any other development type, landholding, or purpose (business or personal). Driving on paddocks etc is restricted by Harvest and Vehicle Movement Bans. Recommendation: Develop a bushfire monitoring procedure for the Fire Danger Period, including: • Nominating a person/role in your Emergency Control Organisation to be responsible for identifying, responding to and communicating Fire Danger Ratings in advance. • Identifying bushfire activity within 10km of the facility.			

	• Communicating this information to everyone likely to be present on-site, and relevant off-site personnel.			
Item 6.2.2: Vegetation Management				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	Facility operators must undertake the following measures during the Fire Danger Period: a) Grass must be maintained at or below 100mm in height during the declared Fire Danger Period. b) Long grass and/or deep leaf litter must not be present in areas where heavy equipment will be working, during construction or operation. c) Restrictions and guidance must be adhered to during the Fire Danger Period, days of High (and above) fire danger and Total Fire Ban days (refer to www.cfa.vic.gov.au).	Fully Complies	5.1.4
	Assessment Comment: a) is enforced through the associated Bushfire Management Plan and Shire of Narrogin Firebreak Notice. b) will be applied through Site Operating Procedures. Total Fire Bans restrict vehicle movements in such areas. c) is enforceable through WA Total Fire Bans. Recommendation: Site Operating Procedures should include procedures to ensure heavy equipment is not operated where long grass (>100mm) or heavy leaf litter is present, particularly during the bushfire season (see the Local Government Prohibited Burning Period).			
SOLAR ENERGY FACILITIES	Design Advice	Grass must be maintained to no more than 100mm under solar panels during the Fire Danger Period.	Fully Complies	N/A
		Solar energy facilities on grazed paddocks: If additional measures to maintain grass to no more than 100mm are required, they are implemented prior to, and for the duration of the Fire Danger Period.	Fully Complies	5.1.4
	Assessment Comment: Grass maintenance is enforced through the associated Bushfire Management Plan and Shire of Narrogin Firebreak Notice. Recommendation: The specifications of Schedule 1 of the Guidelines for Planning in Bushfire Prone Areas can be achieved via livestock grazing. The vegetation must continue to be monitored for compliance with Schedule 1, and additional vegetation management works undertaken as required.			
BATTERY ENERGY	Design Advice	Containers/enclosures and infrastructure for battery energy storage systems must be maintained to be clear of vegetation, including grass, for at least ten (10) metres on all sides, or greater as informed by the Risk Management Plan.	Fully Complies	5.3.4

	Assessment Comment: Applied in Item 4.2.6. of this Assessment.			
SUBSTATIONS	Design Advice	Vegetation management within any electric line easement must ensure that falling trees would not impact the transmission lines, towers and associated infrastructure.	Complies with Intent	5.3.6
	Assessment Comment: Electric line easements are under the management of Western Power. Vegetation clearances will follow *Vegetation Clearances for the Construction of Overhead Powerlines* (Western Power Standard - Internal Document - DM#9288088).			
Item 6.2.3: Arc Flash Hazard Management				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	There must be clear demarcation of arc boundaries to at least 10m from arc flash outlet flaps (blow-out panels) on PCUs, where there is a hazard to personnel. Refer to Energy Safe Victoria's Arc Flash Hazard Management Guideline (2022) for information.	Complies with Intent	N/A
	Assessment Comment: Managed through WA government bodies (e.g. WorkSafe WA) and associated regulation/guidance.			
Item 6.2.4: Facility and System Monitoring				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	Appropriate monitoring for facility infrastructure must be provided, to ensure that any shorts, faults or equipment failures with the potential to ignite or propagate fire are rapidly identified and controlled. Any fire must be notified to 000 immediately.	Fully Complies	5.4.4
	Assessment Comment: The Intensium Shift product datasheet includes: *'I-Sight digital platform for external communication, remote monitoring and supervision, data management with a high cybersecurity level.'*			

BATTERY ENERGY STORAGE SYSTEMS	Design Advice	Appropriate monitoring and intervention measures must be provided to ensure that the following are rapidly identified and notified to 000 immediately: • Any shorts, faults, temperature increases above normal parameters (eg., precursor to thermal events/runaway). • Equipment failures with the potential to ignite or propagate fire. • Off-gassing, smoke or fire. The provision for direct alarm monitoring to the fire brigade for battery energy storage system automatic detection systems must be considered.	Complies with Intent	5.1.4
	Assessment Comment: The Intensium Shift product datasheet includes: *'I-Sight digital platform for external communication, remote monitoring and supervision, data management with a high cybersecurity level.'* Recommendation: Operating procedures for offsite monitoring should include that DFES Comcen should immediately be notified of: • Any shorts, faults, temperature increases above normal parameters (eg. precursor to thermal events/runaway). • Equipment failures with the potential to ignite or propagate fire. • Off-gassing, smoke or fire. The monitoring personnel can determine if Emergency Services response is necessary. The notification is for awareness.			
Item 6.2.5: Maintenance				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	Inspection, maintenance and any required repair activities must be conducted for all infrastructure, equipment and vehicles at the facility. Maintenance must be in line with any relevant Australian Standards and the manufacturer's requirements.	Fully Complies	N/A
	Assessment Comment: Compliance with Australian Standards is a regulatory requirement. Ongoing maintenance is not related to bushfire. Scheduled ongoing maintenance will be included in the appropriate operational/planning approval document.			

<table>
<tr><td rowspan="2"></td><td>Design Advice</td><td>A procedure, including a schedule and relevant personnel accountabilities, must be developed to inspect and maintain all infrastructure, equipment and vehicles.
Any activities that involve flame cutting, grinding, welding or soldering (hot works) must be performed under a ‘hot work permit’ system or equivalent job hazard safety or risk management process.
Any defects, faults or matters affecting the performance of fire protection systems and any equipment for emergency use must be identified through routine testing and servicing. Maintenance activities must be closed-out before the Fire Danger Period.</td><td>Complies with Intent</td><td>5.1.4</td></tr>
<tr><td colspan="4">Assessment Comment: Managed through WA government bodies (e.g. WorkSafe WA) and associated regulation/guidance. Control of hot works are enforceable through WA Total Fire Bans
Recommendation: Servicing of battery energy storage systems should not take place on days of Extreme or Catastrophic Fire Danger Rating, except where the system is experiencing malfunction or abnormal behaviour.</td></tr>
<tr><td rowspan="2">BATTERY ENERGY STORAGE SYSTEMS</td><td>Design Advice</td><td>Battery energy storage systems are to be regularly inspected for the following:
Any signs of mechanical damage to the external containers/enclosures.
Any accumulation of combustible materials (including leaf litter) in or within ten (10) metres of any battery energy storage systems and related infrastructure.
Any identified issues must be immediately rectified.</td><td>Fully Complies</td><td>5.4.4</td></tr>
<tr><td colspan="4">Assessment Comment: The measures are to be integrated into the Site Operating Procedures.
Recommendation: Site Operating Procedures must include the following information:
<u>Maintenance</u>
Maintenance intervals. Scheduling can be detailed within a supporting document.
Assigned responsibilities of staff.
Maintenance procedures and servicing to manufacturer’s specifications.
Testing procedures of the firefighting water supply and equipment.
<u>Inspections</u>
Inspection intervals. Frequency of inspections are recommended to be increased during the bushfire season (see the Local Government Prohibited Burning Period) where practical.
Inspection triggers, including extreme weather events or seismic activity.
Established inspection criteria, including:
Accumulation of debris and vegetative material within 10m of battery modules.
Mechanical damage to exterior elements.
Vegetation regrowth within the Asset Protection Zone, particularly immediately prior to and during bushfire season (see the Local Government Prohibited Burning Period).</td></tr>
</table>

	o Obstruction of access routes including firebreaks. o Volume of the firefighting water supply.

Item 6.2.6: Safe Dangerous Goods Storage and Handling				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	Signage and labelling compliant with the Dangerous Goods (Storage and Handling) Regulations 2022 and the relevant Australian Standards must be provided at the site entrance, dangerous goods storage locations, and storage tanks where applicable.	Not Applied	N/A
		Appropriate material for cleaning up dangerous goods spills and leaks (including absorbent, neutralisers, tools, disposal containers and personal protective equipment) must be provided and available on-site. Training must be provided for site personnel on the hazards, safe use and emergency response for spills, leaks and fire involving dangerous goods.	Not Applied	N/A
		All dangerous goods stored on-site must have a current Safety Data Sheet (SDS). Safety Data Sheets must be provided within the facility's Emergency Information Book(s), in the Emergency Information Container(s).	Not Applied	N/A
		The requirements of the dangerous goods legislative framework, and all relevant Australian Standards must be complied with for all facilities, including facilities with battery energy storage systems.	Not Applied	N/A
	Assessment Comment: Non-bushfire hazards, including dangerous goods, must be addressed through product design or the appropriate regulation.			

Item 6.2.7: Housekeeping				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	Site-wide bushfire preparedness housekeeping inspections must be conducted at least three months, and again one month, prior to the Fire Danger Period.	Complies with Intent	5.1.4

		Housekeeping inspections must incorporate: a) Hazard identification - ensuring that infrastructure, plant, equipment, vehicles and safety/warning signs show no signs of damage or dilapidation. b) Facility access - ensuring all vehicle site access points, including emergency access points, are clear and accessible. c) Fire protection systems and equipment – ensuring that all equipment is unobstructed, clearly identifiable, in-service and performing optimally. d) Vegetation management - ensuring that any accumulation of combustible materials is cleared from infrastructure, buildings and fire breaks, and removed from the site. e) Security measures - ensuring that fences, gates, and security cameras are inspected for damage, and that any damage is immediately actioned (eg., repaired or replaced).	Fully Complies	5.1.4
	Assessment Comment: 3 months prior to the bushfire season is August (winter), which has the second-highest rainfall and second-lowest temperature average. Recommendation: Site Operating Procedures should include the following procedures to be completed prior to the bushfire season (see the Local Government Prohibited Burning Period): • Scheduled maintenance to assets, emergency equipment, or fire detection/prevention systems. • The ongoing requirements outlined in the Bushfire Management Plan. • Scheduled housekeeping inspections should include: o Hazard identification - ensuring that infrastructure, plant, equipment, vehicles and safety/warning signs show no signs of damage or dilapidation. o Facility access - ensuring all vehicle site access points, including emergency access points, are clear and accessible. o Fire protection systems and equipment – ensuring that all equipment is unobstructed, clearly identifiable, in-service and performing optimally. o Vegetation management - ensuring that any accumulation of combustible materials is cleared from infrastructure, buildings and fire breaks, and removed from the site. o Security measures - ensuring that fences, gates, and security cameras are inspected for damage, and that any damage is immediately actioned (eg., repaired or replaced).			
Item 6.2.8: Additional Requirements Specific to Facility Type				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
BATTERY ENERGY STORAGE	Design Advice	A Fire Management Plan for a facility that incorporates a battery energy storage system must also include: a) A schedule, list of activities and accountabilities for the inspecting, testing, monitoring and servicing of the battery and its monitoring, safety and protective systems. b) Monthly inspections of battery enclosures/containers and related infrastructure for physical damage. Any damage must be immediately assessed and rectified by a suitably qualified person.	Fully Complies	5.4.4

		c) Seismic activity as a trigger for inspecting, testing and servicing of the battery energy storage system and its related infrastructure. Any damages or changes in operating parameters must be immediately assessed and rectified by a suitably qualified person. d) Regular inspection and removal of all combustible materials near the battery enclosures/containers and related infrastructure.		
	Assessment Comment: See Item 6.2.5.			

SECTION 6: FACILITY OPERATION				
Subsection 6.3: Fire Risk Review				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	Develop procedures to ensure that: a) The Fire Management Plan is reviewed and updated regularly, in line with any reviews and changes to hazards and risk management as per the Risk Management Plan, and where there is a near-miss or incident at the facility. b) The Emergency Plan is reviewed and updated to reflect any changes in the Fire Management Plan, including where fire risks emerge or change, risk controls are added or modified, or where there is a near-miss or incident at the facility. CFA's Specialist Risk and Fire Safety Unit can also visit your site by invitation to provide specific advice on fire risk management and emergency planning in line with this guideline.	Complies with Intent	5.1.4
		For substantive changes to the Fire Management Plan or Emergency Plan, CFA recommends considering peer-review by a suitably qualified, independent third party.	Not Applied	N/A
	Assessment Comment: A 'Fire Management Plan' does not have an analogue in Western Australia. The contents are generally contained within the site Emergency Management Plan (e.g. as a Fire and Emergency Management Plan). Procedures for review are applied in Item 6.1. An independent review procedure has not been applied for this or other facility documents. Independent reviews are lengthy, and require sourcing qualified parties able to complete the review which are in limited supply.			

SECTION 7: EMERGENCY PLANNING				
Intent: Emergencies at renewable energy facilities must be planned for and effectively managed.				
Subsection 7.1: Emergency Plans				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	An Emergency Management Plan must be developed specific to the facility, in conjunction with CFA, before development starts.	Complies with Intent	N/A
	Assessment Comment: The production of an Emergency Management Plan is a requirement for the application. The site is unstaffed, and thus all points may not be addressed.			
	Design Advice	The following must be included to cover construction and commissioning, and operational phases: a) Emergency prevention, preparedness, and mitigation activities. b) Activities for preparing for emergencies. c) Control and coordination arrangements for emergency response (eg. evacuation procedures, shelter-in-place arrangements, emergency assembly areas and emergency response procedures). d) The agreed roles and responsibilities of on-site personnel (eg. equipment isolation, fire brigade liaison, evacuation management, shelter-in-place management, if applicable).	Complies with Intent	5.1.4
		The following must be included to facilitate fire brigade response: a) A facility description, including infrastructure details, operations, number of personnel, and operating hours. b) A site plan depicting infrastructure (solar panels, wind turbines, inverters, battery energy storage systems, generators, substations, grid connection points, transmission lines, dangerous goods storages, buildings, bunds), site access points and internal roads; fire services (water tanks, pumps, booster systems, fire hydrants, fire hose reels); drainage; and neighbouring properties. c) An emergency response procedure for each credible emergency event and scenario, based on a comprehensive risk management process. CFA recommends including building, infrastructure and vehicle fires, and grassfire and bushfire. d) Up-to-date contact details for facility personnel, and any relevant off-site personnel that could provide technical support during an emergency. e) Evacuation procedures and where appropriate, shelter-in-place procedures for facilities at-risk of bushfire or grassfire, if it is too late to evacuate.	Complies with Intent	5.1.4

		f) Details of emergency resources, including fire detection and suppression systems and equipment; gas detection; emergency eye-wash and shower facilities; spill containment systems and equipment; emergency warning systems; communication systems; personal protective equipment; and first aid. g) A manifest of dangerous goods (if required under the Dangerous Goods (Storage and Handling) Regulations 2022).		
	Assessment Comment: The above requirements are drawn from AS 3745-2010 Section 3, with which the Emergency Management Plan is required to comply. The above details have been adopted, with wording modifications appropriate to Western Australian systems/terminology. Dangerous goods are considered in Item 8.1. Recommendation: The Emergency Management Plan *should* include (as applicable to the site): • A facility description, including infrastructure details, operations, number of personnel, and operating hours. • A site plan depicting infrastructure (solar panels, inverters, battery energy storage systems, generators, substations, grid connection points, dangerous goods storages, buildings, bunds), site access points and internal roads; fire services (water tanks, pumps, booster systems, fire hydrants, fire hose reels); drainage; and neighbouring properties. • Up-to-date contact details for facility personnel, and any relevant off-site personnel that could provide technical support during an emergency. • Details of emergency resources, including fire detection and suppression systems and equipment; gas detection; emergency eye-wash and shower facilities; spill containment systems and equipment; emergency warning systems; communication systems; personal protective equipment; first aid. • Evacuation and shelter-in-place triggers and procedures, unless included within a Bushfire Emergency Plan.			
Subsection 7.2: Emergency Response Procedures				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	Emergency response procedures must: a) Include a specific action to notify (or verify notification) the emergency services, at the earliest possible stage of the emergency. b) Specify the person or role responsible for making or verifying the notification. c) Include '000' number in the procedure.	Fully Complies	5.1.4
		Any emergency response actions for bushfire must be determined before the Fire Danger Period, and must consider the modified site activities in the Fire Management Plan. Emergency procedures for bushfire must include: a) Communicating with site personnel and supporting their physical relocation. b) Ensuring all buildings and plant are adequately secured. c) Initiating any bushfire protection measures such as sprinkler or deluge systems. d) Liaising with the emergency services where possible. e) Ensuring that evacuation/shelter in place areas are equipped with suitable resources.	Fully Complies	5.1.4

		Procedure(s) must be developed and implemented for the isolation, shut-down, fail safe or management of critical/high-risk plant, equipment, and utilities (eg., electricity/gas) at the facility, should evacuation be required.	Fully Complies	5.1.4
	Assessment Comment: Emergency response procedures will align to Western Australian guidelines. The Local Government Restricted Burning Period is applicable rather than the Fire Danger Period. Recommendation: Emergency response procedures must: a) Include a specific action to notify (or verify notification) the emergency services, at the earliest possible stage of the emergency. b) Specify the person or role responsible for making or verifying the notification. c) Include '000' number in the procedure. Any emergency response actions for bushfire must be determined before the Fire Danger Period, and must consider the modified site activities in the Emergency Management Plan. Emergency procedures for bushfire must include: a) Communicating with site personnel and supporting their physical relocation. b) Ensuring all buildings and plant are adequately secured. c) Initiating any bushfire protection measures such as sprinkler or deluge systems. d) Liaising with the emergency services where possible. e) Ensuring that evacuation/shelter in place areas are equipped with suitable resources.			
Subsection 7.3: Evacuation and Shelter-in-Place				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	Emergency procedures for sheltering-in-place are to consider: • Who makes the decision for personnel to shelter on-site. • When the decision is made. • Where personnel are to shelter on-site. • How to communicate the need to shelter, and the sheltering location, to personnel on-site. • The on-site emergency resources and equipment to be provided to this location. • The provision of appropriate signage to identify the shelter location. Signage may also provide additional information such as procedures relating to the use of the place during a fire event. • Access to incident information. • Company position and actions if someone insists on leaving the site. • All vehicle site access points, including emergency access points, must be clear and accessible.	Complies with Intent	5.3.1

	Assessment Comment: The site is proposed to be unstaffed, however visitation for inspections or maintenance will be common due to the extent of the development. Shelter-in-place procedures should be considered within the site Emergency Management Plan. Recommendation: A minimum of one emergency muster point should be located within an area subject to <2kW/m2 radiant heat flux for persons onsite during a bushfire event, where evacuation is no longer safe.		
Subsection 7.4: Personnel Training			
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	The following information and training should be provided to any personnel working at the facility, and visitors as appropriate: • Facility and operational risks and hazards. • Facility emergency management roles, responsibilities and arrangements (as per the Emergency Plan). • The on-site emergency warning systems and location of evacuation assembly areas. • The safe and effective use of any fire-fighting equipment where there is an expectation for staff to undertake first aid firefighting. • The storage, handling and emergency procedures for dangerous goods at the facility. • The location of first aid facilities and application of first aid equipment.	Fully Complies	N/A
		For facilities with bushfire or grassfire risk, CFA recommends that all site personnel: • Download the VicEmergency App and set 'watch zones' for the facility location and any related areas of travel. • Information and training on the warning levels and messages issued by CFA and Emergency Management Victoria. • Complete CFA's free 'Bushfire Safety for Workers' e-learning module before the Fire Danger Period. CFA recommends that this module is considered mandatory professional development for all personnel at the facility.	Not Applied	N/A
	Assessment Comment: Managed through WA government bodies (e.g. WorkSafe WA) and associated regulation/guidance. The Work Health and Safety Act (WA) is applied rather than the Occupational Health and Safety Act (Vic).		
Subsection 7.5: Emergency Exercises			
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section

ALL FACILITIES	Design Advice	Where personnel are present on-site, an annual emergency exercise should be conducted at the facility, with an invitation extended to the local CFA brigade to participate.	Not Applicable	N/A
		An ongoing program of site-specific emergency response exercises is recommended to be developed as per AS 3745-2010: Planning for emergencies in facilities – Section 7: Emergency response exercises.	Not Applicable	N/A
		Emergency exercises should: • Test emergency structures, prescribed activities, personnel knowledge, and any assumptions built into the Emergency Plan. • Be consistent with the emergency procedures (based on identified hazards) in the Emergency Plan. • Be conducted in various formats, from internal desktop to multi-agency practical field exercises. • Be appropriately designed, conducted and evaluated. • Incorporate 'failure', that is, things 'going wrong' or 'not to plan', such as communication system failures, the absence of the Chief Warden, delays in the arrival of the fire brigade, escalation scenarios. How well does the Emergency Plan work in those instances? How can it be modified to be adaptable? • Be prefixed with an announcement indicating it as an exercise only, and include provision for alerting participants of an actual emergency during the exercises (i.e., 'NO DUFF'). • Incorporate a 'no blame' feedback/evaluation process that includes debriefing and at least one additional feedback method that enables anonymous feedback to be provided. • On completion, be summarised in written format as a consolidated record of 'lessons identified', with measures and accountabilities to ensure those lessons are incorporated into the Emergency Plan (or elsewhere) as required. • Be a trigger for reviewing the Emergency Plan.	Not Applicable	N/A
	Assessment Comment: The site is proposed to be unstaffed, however visitation for inspections or maintenance will be common due to the extent of the development. Regular emergency response exercises are unlikely to be applied to visitors/contractors, as their response procedure will be to evacuate or shelter-in-place. Shut-down procedures etc will be activated remotely. Emergency procedures and exercises will be designed as applicable to the site and staffing.			

Subsection 7.6: Reviewing Emergency Plans				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	Emergency Plans should be reviewed: • Following any changes to the risk on-site pertaining to site infrastructure and operations (Risk Management Plan). • Following any review of the Fire Management Plan.	Fully Complies	N/A

		• After any activation of the EP or incident involving notification to the emergency services. • After emergency exercises. • At least annually.		
	Assessment Comment: A 'Fire Management Plan' does not have an analogue in Western Australia. The contents are generally contained within the site Emergency Management Plan (e.g. as a Fire and Emergency Management Plan). Ongoing review of and updates to the Emergency Management Plan are required by AS 3745-2010 s8.1 and the *Work Health and Safety (General) Regulations 2022* s38 (Western Australia).			
NOTIFICATIONS	Design Advice	The local CFA district be notified by phone or email at least seven days prior to: • The commissioning of battery energy storage systems. • Annual servicing of battery energy storage systems.	Not Applied	N/A
		ESTA (Emergency Services Telecommunications Authority- Victoria) must be notified of fire protection system outages (eg., water-off due to faults or maintenance activities) as far in advance as possible.	Complies with Intent	5.1.4
		Annual servicing of battery energy storage systems should not take place on days of High or above Fire Danger Rating, except where the system is experiencing malfunction or abnormal behaviour.	Fully Complies	5.1.4
	Assessment Comment: Any new development within the facility (including battery energy storage systems) will require a separate Development Application, and the asset will be addressed at that stage. A restriction on servicing of BESS is already applied to the Fire Danger Rating. This criterion has not been applied as the frequency of servicing is not known and may be needlessly restrictive, for example if servicing is staged between each cluster (taking a period of days) and is conducted every 6 months. Recommendation: Notify DFES ComCen of fire protection system outages (faults or maintenance). Site Operating Procedures document should contain that servicing of battery energy storage systems should not take place on days of High, Extreme or Catastrophic Fire Danger Rating, except where the system is experiencing malfunction or abnormal behaviour.			
Subsection 7.7: Emergency Planning Specific to Facility Type				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
SOLAR ENERGY FACILITIES	Design Advice	The Emergency Plan and Emergency Information Book must include: a) Emergency procedures for isolation and shut-down where solar panels and/or related infrastructure are involved in fire. b) Emergency procedures for fires within the vicinity of solar energy facilities. c) Specifications for safe operating conditions for temperature, and the hazards related to electricity generation at the facility.	Complies with Intent	5.1.4

<table>
<tr><td></td><td colspan="4">Assessment Comment: Discussed in Item 8.1 below.</td></tr>
<tr><td rowspan="2">BATTERY ENERGY STORAGE SYSTEMS</td><td>Design Advice</td><td>The Emergency Plan and Emergency Information Book must include:
a) Contact information for 24/7/365 specialist technical support for the battery energy storage system.
b) Emergency response procedures based on identified risks and hazards of the battery energy storage system and related infrastructure, including but not limited to:
i. Electrical infrastructure faults and fire.
ii. Battery energy storage system damage or faults, including battery monitoring faults, temperature increases above normal operating parameters, electrical faults, chemical spills or reactions, off-gassing, thermal events/runaway, smoke and fire.
iii. Bushfire and grassfire.
iv. The management of fire water runoff.
c) Details of the elements monitored/controlled by the Battery Management System (BMS), including internal temperature, state of charge, voltage, etc. and the locations this information is available (eg., at the BESS containers, in an on-site control room, off-site monitoring facilities).
d) A plan for partial and full decommissioning of the battery energy storage system in the event of an emergency incident that renders the facility inoperable or unsafe, before its anticipated end-of-life.
e) Any information that supports the considerations in Appendix B: Emergency Response Considerations for Large-Scale Battery Energy Storage Systems.</td><td>Complies with Intent</td><td>5.1.4</td></tr>
<tr><td colspan="3">Assessment Comment: Measure b)iii) is applied through Item 6.2.1 of this assessment. All other criteria are non-bushfire considerations. The criteria have been provided as a package for consideration only, as their applicability, effectiveness, and practicality cannot be considered by a bushfire consultant.
Recommendation: Consider the following criteria for inclusion within the Emergency Management Plan. All criteria are for consideration only, being non-bushfire measures and being Design Advice rather than Model Requirements.
b) Contact information for 24/7/365 specialist technical support for the battery energy storage system.
c) Emergency procedures based on identified risks and hazards of the battery energy storage system and related infrastructure, including but not limited to:
i. Electrical infrastructure faults and fire.
ii. Battery energy storage system damage or faults, including battery monitoring faults, temperature increases above normal operating parameters, electrical faults, chemical spills or reactions, off-gassing, thermal events/runaway, smoke and fire.
iii. The management of fire water runoff.
d) A plan for partial and full decommissioning of the battery energy storage system in the event of an emergency incident that renders the facility inoperable or unsafe, prior to its anticipated end-of-life.
e) Specifications for safe operating conditions for temperature.</td></tr>
</table>

	f) Schematics and technical data for battery energy storage system containers/enclosures, the number of containers/enclosures on-site, and the number of battery racks or modules within each container/enclosure. g) Details of the hazards for the battery energy storage system, including thermal events/runaway, electrical safety hazards, explosion hazards, dangerous goods hazards (including off-gassing), and the effects of fire on the battery energy storage system (eg., explosion, release of toxic gases). h) Details of all provided battery failure/safety and protective systems, including a description, the activation process/automatic trigger, and any hazards associated with these systems. i) The shut down and/or isolation procedures if the batteries are involved in fire, and appropriate personnel contact details for verifying that the battery enclosure/container system has been isolated/shut-down and de-energised during emergencies.

SECTION 8: PROVISION OF EMERGENCY INFORMATION				
Subsection 8.1: Developing and Emergency Information Book				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Model Requirement	An Emergency Information Book must be developed and available to emergency responders. Emergency Information Books must be located in Emergency Information Containers, provided at each vehicle entrance the facility.	Complies with Intent	5.1.4
	Assessment Comment: DFES Emergency Response Guide (FES-ERG) is required for some sites which store or handle dangerous goods. This manifest is equivalent to a CFA Emergency Information Book, including the required location within a signed weatherproof container at site entry. Recommendation: Contact DFES Built Environment Branch to determine if an Emergency Response Guide (FES-ERG) is required.			
	Design Advice	The Emergency Information Book must include: a) A description of the premises, its infrastructure and operations. b) Site plans that include the layout of the entire site, including buildings, internal roads, infrastructure, fire protection systems and equipment, dangerous goods storage areas, gas detectors, battery energy storage systems, substations/terminals, grid connections, drains and isolation valves, neighbours and the direction of north. c) A manifest of dangerous goods (if required) as per Schedule 3 of the Dangerous Goods (Storage and Handling) Regulations 2022. d) Procedures for the management of emergencies, including evacuation, shelter-in-place (for facilities at-risk of bushfire/grassfire), containment of spills and leaks, and fire procedures (including infrastructure/plant fires, vehicle fires, grassfire/bushfire). e) Details of emergency equipment, including the type and location of gas detectors. f) Up-to-date contact details for site personnel, regulatory authorities and site neighbours. g) Safety Data Sheets (SDS) for dangerous goods stored on-site.	Complies with Intent	N/A
		Emergency Information Containers must be: a) Painted red and marked 'EMERGENCY INFORMATION' in white contrasting lettering not less than 25mm high. b) Located at all vehicle access points to the facility, installed at a height of 1.2 metres – 1.5 metres. c) Accessible with a fire brigade standard '003' key. d) Kept clear of obstructions, including products, rubbish, vehicles, vegetation and any hazards (eg., pest infestation).	Complies with Intent	N/A

	Assessment Comment: The production of a FES-ERG manifest is in consultation with and requires approval from DFES. The applicable requirements are provided in *Dangerous Goods Safety Guidance Note - Manifest and site plan requirements for dangerous goods sites* (DFES January 2019).			
BATTERY ENERGY STORAGE SYSTEMS	Design Advice	The Emergency Information Book must include: a) Specifications for safe operating conditions for temperature. b) Schematics and technical data for battery energy storage system containers/enclosures, the number of containers/enclosures on-site, and the number of battery racks or modules within each container/enclosure. c) Details of the hazards for the battery energy storage system, including thermal events/runaway, electrical safety hazards, explosion hazards, dangerous goods hazards (including off-gassing and associated vapour clouds), and the effects of fire on the battery energy storage system (eg., explosion, release of toxic gases). d) Details of the elements monitored/controlled by the Battery Management System (BMS), including internal temperature, state of charge, voltage, etc. and the locations this information is available (eg., at the BESS containers, in an on-site contr ol room, off-site monitoring facilities). e) Details of all provided battery safety and protective systems, including a description, the activation process/automatic trigger, and associated hazards. f) The shut down and/or isolation procedures if the batteries are involved in fire, and appropriate personnel contact details for verifying that the battery enclosure/container system has been isolated/shut- down and de-energised during emergencies.	Complies with Intent	5.1.4
	Assessment Comment: All criteria are non-bushfire considerations. The criteria have been provided as a package for consideration only, as their applicability, effectiveness, and practicality cannot be considered by a bushfire consultant. See Subsection 7.7 of this assessment.			
Subsection 8.2: Fire Brigade Site Familiarisation				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	Before commissioning, offer a familiarisation visit and explanation of emergency procedures to CFA brigades and other emergency services.	Fully Complies	5.1.4
		Unoccupied facilities must provide contact information for at least two persons who may be able to provide information or support during emergencies (24 hours a day).	Fully Complies	5.1.4
		A schedule for ongoing site familiarisation to account for changing personnel, facility infrastructure and hazards, and emergency exercises should be developed in conjunction with the local CFA brigade.	Fully Complies	5.1.4
	Assessment Comment: None required.			

	Recommendation: Contact Narrogin VFRS and Narrogin and Minigin BFB prior to commissioning and offer a familiarisation visit and explanation of emergency procedures, access, hazards, and fire detection and suppression systems. Include in the Emergency Management Plan an ongoing schedule of site familiarisation to account for changing personnel, facility infrastructure and hazards. Provide contact information for at least two persons who may be able to provide information or support during emergencies (24 hours a day). Provide updated contact information when necessary.			
Subsection 8.3: Review of Emergency Information				
Assessment Criteria Type		Assessment Criteria Detail (summarised)	Assessment Status	Applicable BRR Section
ALL FACILITIES	Design Advice	A review of the information contained within the facility's Emergency Information Container and Book must be undertaken before the Fire Danger Period. Any corrections, removal or addition of information must be completed as a matter of urgency.	Complies with Intent	N/A
	Assessment Comment: Ongoing review of and updates to the Emergency Management Plan are required by AS 3745-2010 s8.1 and the *Work Health and Safety (General) Regulations 2022* s38 (Western Australia). Ongoing review of a FES-ERG manifest is required '*within seven days after any significant change in the information*' or '*at intervals of not more than three years*'. The applicable requirements are provided in *Dangerous Goods Safety Guidance Note - Manifest and site plan requirements for dangerous goods sites* (DFES January 2019).			

SECTION 9: BATTERY ENERGY STORAGE SYSTEMS AT COMMERCIAL AND INDUSTRIAL FACILITIES
Increasingly, small-scale battery energy storage systems (<1MW) are being installed at commercial and industrial buildings to supplement power requirements for business operations.
Assessment Comment: The proposal is >1MW and thus the section is not applicable. The Section outlines guidance to be applied *instead* of Sections 2-8.

SECTION 10: NEIGHBOURHOOD BATTERY ENERGY STORAGE SYSTEMS
Community or neighbourhood-scale battery energy storage systems range from approximately 100kW to 5MW, and where connected to a section of the electricity distribution network operating with a nominal voltage not exceeding 66,000 volts may be exempt from planning permit requirements in most planning zones.
Assessment Comment: The proposal is not a neighbourhood system. The Section outlines guidance to be applied *instead* of Sections 2-8.

6.2 INFORMATIVE MECHANISMS – GUIDANCE FOR THE APPLICATION OF ALL BUSHFIRE PROTECTION MEASURES

6.2.1 BUSHFIRE HAZARD THREAT REDUCING MEASURES

BUSHFIRE HAZARD THREAT REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection** Measures			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** (EXTRA) MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					DOCUMENTS REQUIRED FOR PLANNING FUTURE DEVELOPMENT AND/OR RETROFIT		OPERATIONAL DOCUMENTS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
Prevent bushfire ignition and/or severity by managing the fuels	1.4	Remove onsite bushfire fuel	✓	Highest								
	1.6	Reduce onsite bushfire fuel - mechanical	✓	Lowest								
	1.8	Enforce compliance with any applicable local government property management directives										
Prevent bushfire ignition by managing heat energy sources	1.9	Robust and effective site operational procedures	✓	High			✓	✓	✓	✓	✓	✓
	1.11	Design and construct equipment to prevent airborne ignition										
	1.12	Actively enforce activity restrictions										
	1.14	Bushfire awareness and 'good practices' education										

BUSHFIRE HAZARD THREAT REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection** Measures			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** (EXTRA) MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					DOCUMENTS REQUIRED FOR PLANNING FUTURE DEVELOPMENT AND/OR RETROFIT		OPERATIONAL DOCUMENTS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
Prevent bushfire ignition by managing the interactions of heat energy sources and fuels	1.15	Barriers (shielding) between ignition sources and fuels	✓	Medium								
	1.16	Equipment design and construction to reduce heat transfer	✓	Lowest								
	1.17	Separation distance between ignition sources and fuels	✓	Highest								

[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Section 5.1.4
[2] Refer to Appendix A1.2.5 for implementation priority rating explanation.

6.2.2 EXPOSURE REDUCING MEASURES – PERSONS

PERSONS EXPOSURE REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection** Measures			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					PLANNING FUTURE DEVELOPMENT		OPERATIONAL – AS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
Establish sufficient separation from relevant bushfire hazard threats	Persons Located Onsite and Temporarily Offsite											
	2.1	Stay away from the subject site										
	2.4	Relocate (evacuate) to designated safer offsite location(s)										
	2.5	Relocate to safer onsite open area	✓	Lowest						✓		
	2.7	Pre-emptively relocate to designated safer offsite location(s)										
	Persons on Access / Egress Routes in Vehicles											
	3.1	Locating route away from adjacent hazards										
	3.2	Egress routes located to ensure driving away from hazard										
	3.3	Greater road width										
	3.4	Reduce and maintain road verge fuel to low threat state										
	Persons Located Onsite and Temporarily Offsite											

PERSONS EXPOSURE REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection** Measures			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					PLANNING FUTURE DEVELOPMENT		OPERATIONAL – AS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
Establish shielding from relevant bushfire hazard threats	Persons on Access / Egress Routes in Vehicles											
	3.5	Ensure evacuation vehicle types provide a degree of protection										

[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Section 5.3.1 and Section 5.3.2.
[2] Refer to Appendix A1.2.5 for implementation priority rating explanation.

6.2.3 EXPOSURE REDUCING MEASURES – ALL STRUCTURES

ALL STRUCTURES EXPOSURE REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection Measures**			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					PLANNING FUTURE DEVELOPMENT		OPERATIONAL – AS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
Establish sufficient separation from relevant bushfire hazard threats	4.1	Siting of buildings / structures / campsites considering potential high wind exposure	✓	Lowest								
	6.2 8.2	Design - use of non-vegetated areas and/or managed public open space	✓	Medium								
	4.3 6.3 7.3 8.3	Landscaping - asset protection zone (APZ)	✓	Highest	✓	✓					✓	
	6.4 7.4	Landscaping - tree location	✓	Medium	✓							
	4.6 6.6 7.6 8.6	Separation from stored flammable products – fuels / other hazardous materials	✓	Medium								
	4.7 6.7 7.7	Separation from stored and constructed combustible items	✓	High		✓		✓				✓

ALL STRUCTURES EXPOSURE REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection Measures**			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					PLANNING FUTURE DEVELOPMENT		OPERATIONAL – AS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
	4.12 6.12 7.12 8.12	Shield operation critical non-structural elements	✓	High								

[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Sections 5.3.3 & 5.3.4 & 5.3.5 & 5.3.6.
[2] Refer to Appendix A1.2.5 for implementation priority rating explanation.

6.2.4 VULNERABILITY REDUCING MEASURES – PERSONS

PERSONS VULNERABILITY REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection Measures**			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					PLANNING FUTURE DEVELOPMENT		OPERATIONAL – AS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
Transport and multiple evacuation destinations and routes available	Persons Located Onsite and Temporarily Offsite											
	9.1	Sufficient evacuation transport available										
	9.2	Multiple safer offsite locations available										
Provision of bushfire emergency information and education	9.3	Develop a bushfire emergency plan	✓	Medium								
	9.4	Relevant operational documents to contain the bushfire protection measures to be implemented	✓	Medium								
	9.5	Prominent display of bushfire emergency information	✓	Medium								
	9.6	Direct to Persons Emergency Messaging System	✓	Medium								
	9.9	Personnel are trained to implement the bushfire emergency plan										
Onsite persons capable of	9.14	Onsite persons can operate firefighting equipment										

PERSONS VULNERABILITY REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection Measures**			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					PLANNING FUTURE DEVELOPMENT		OPERATIONAL – AS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
managing a bushfire emergency are available	9.15	External emergency response services available	✓	High								
Lower risk road construction (design and materials)	Persons on Access / Egress Routes in Vehicles											
	10.1	Greater road width	✓	Medium		✓						
	10.2	Lower road gradient										
	10.3	Greater road clearance	✓	Lowest								
	10.4	Stable road surfaces										
	10.5	Driver visibility and road ahead signage										
	10.7	Interconnected road network to provide route options	✓	High		✓						
Evacuees are self-sufficient and have local awareness and own transport	10.8	Self-sufficient persons with local awareness	✓	Lowest								
	10.9	Onsite persons have own transport										

[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Section 5.4.1 and Section 5.4.2.
[2] Refer to Appendix A1.2.5 for implementation priority rating explanation.

6.2.5 VULNERABILITY REDUCING MEASURES – ALL STRUCTURES

ALL STRUCTURES VULNERABILITY REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection Measures**			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					PLANNING FUTURE DEVELOPMENT		OPERATIONAL – AS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
Construction design and materials	11.1	Construct to AS 3959:2018	✓	Medium	✓	✓						
	11.3 13.3 14.3 15.3	Construction materials for external and internal cavity building elements	✓	Medium		✓						
	11.4 13.4 14.4 15.4	Construction materials for consequential fire fuels	✓	Medium		✓						
	13.5 14.5 15.5	Construction design/materials resistant to high wind damage										
	13.7 14.7 15.7	Construction of electricity supply	✓	High								
	13.8 14.8	Minimise re-entrant detail to minimise debris and ember accumulation	✓	Lowest		✓						

ALL STRUCTURES VULNERABILITY REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection Measures**			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					PLANNING FUTURE DEVELOPMENT		OPERATIONAL – AS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
	15.8											
	13.9 14.9 15.9	Minimise debris and ember trapping surfaces										
	11.11 13.11 15.11	Minimise construction cavities to minimise debris and ember accumulation	✓	Lowest								
	11.12 13.12	Minimise external openings to limit flame / radiant heat / ember / debris entry	✓	Lowest		✓						
	11.13 13.13 15.13	Screen and seal gaps and penetrations	✓	High		✓						
	13.15 15.15	Shutter external doors and windows	✓	Lowest		✓						
	13.16	Construction materials for critical non-structural elements	✓	Lowest		✓						
Availability of a firefighting	11.16 13.17	Firefighting water supply	✓	Highest	✓	✓		✓	✓	✓		

ALL STRUCTURES VULNERABILITY REDUCING PROTECTION MEASURES [1] **All Implemented ('Existing' & 'Planned') and 'Additionally Recommended' Protection Measures**			IDENTIFICATION OF **'ADDITIONALLY RECOMMENDED'** MEASURES AND THEIR IMPLEMENTATION PRIORITY		APPLICATION GUIDANCE Identification of the Document(s) Recommended to Contain the Applicable Protection Measures							
					PLANNING FUTURE DEVELOPMENT		OPERATIONAL – AS RELEVANT TO SITE USE					
The Protection Mechanism	Ref No	Brief Description [1]	EXTRA MEASURE	PRIORITY RATING [2]	Bushfire Manage. Plan (Planning)	Inform Design & Construct	External Agreement	Site Operations Procedures	Emergency Services Manifest	Site Emergency Plan/Guide	Site Works	Staff Inductions and Training
response capability	14.17 15.17											
	13.18	Firefighting equipment actively operated	✓	Lowest								
	13.19 14.19 15.19	Firefighting equipment passively operated	✓	High		✓		✓		✓		
	11.19 13.20 14.20	Firefighting equipment operability maintained	✓	High		✓				✓		✓
Manage and maintain effectiveness of applied protection measures	11.21 13.22 14.22 15.22	Formal documents created to guide and enforce management	✓	Highest				✓				✓

[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Sections 5.4.3 & 5.4.4 & 5.4.5 & 5.4.6.
[2] Refer to Appendix A1.2.5 for implementation priority rating explanation.

APPENDIX 1: THE APPLIED RISK ASSESSMENT PROCESS

A1.1 THE RELEVANT RISK

For this Bushfire Risk Report, the relevant risk is the potential for loss of life, injury, or destroyed or damaged assets which results in personal loss and economic loss due to disruption of services and/or repair or replacement of buildings and infrastructure. The source of the risk is a potential bushfire event as a natural hazard.

A1.2 THE RISK ASSESSMENT FRAMEWORK

To conduct the risk assessment, Bushfire Prone Planning (BPP) has adapted the concept for 'Understanding Disaster Risk' as recognised by the United Nations Office for Disaster Risk Reduction [46] and presented in Figure A1.1. This concept is also applied by CSIRO within their Bushfire Best Practice Guide [48].

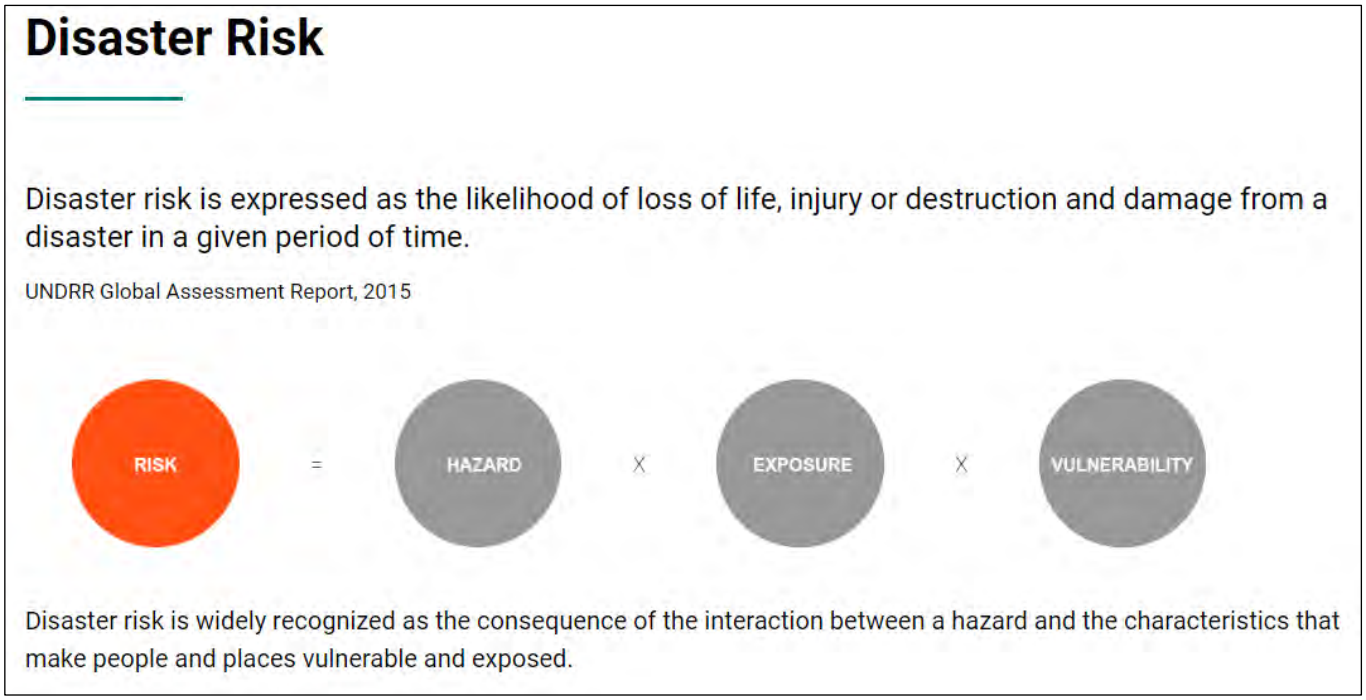


Figure A1.1: Concept for 'Understanding Disaster Risk' as recognised by the UN Office for Disaster Risk Reduction.

In applying this concept, bushfire risk can be considered a consequence of the interaction of bushfire hazard threats and the exposure and vulnerability of the elements at risk from those threats (i.e., the 'exposed elements' which can include various classes of persons and/or property).

The application of available bushfire protection measures will lower the level of risk associated with a bushfire by either:

1. Reducing the number and/or level of hazard threats; and/or
2. Reducing the level of exposure and/or vulnerability of the identified elements at risk.

Additional detail of the application of the risk assessment framework is presented in Figure A1.2 and Figure A1.3 on the following pages. Refer to the glossary for terminology information.

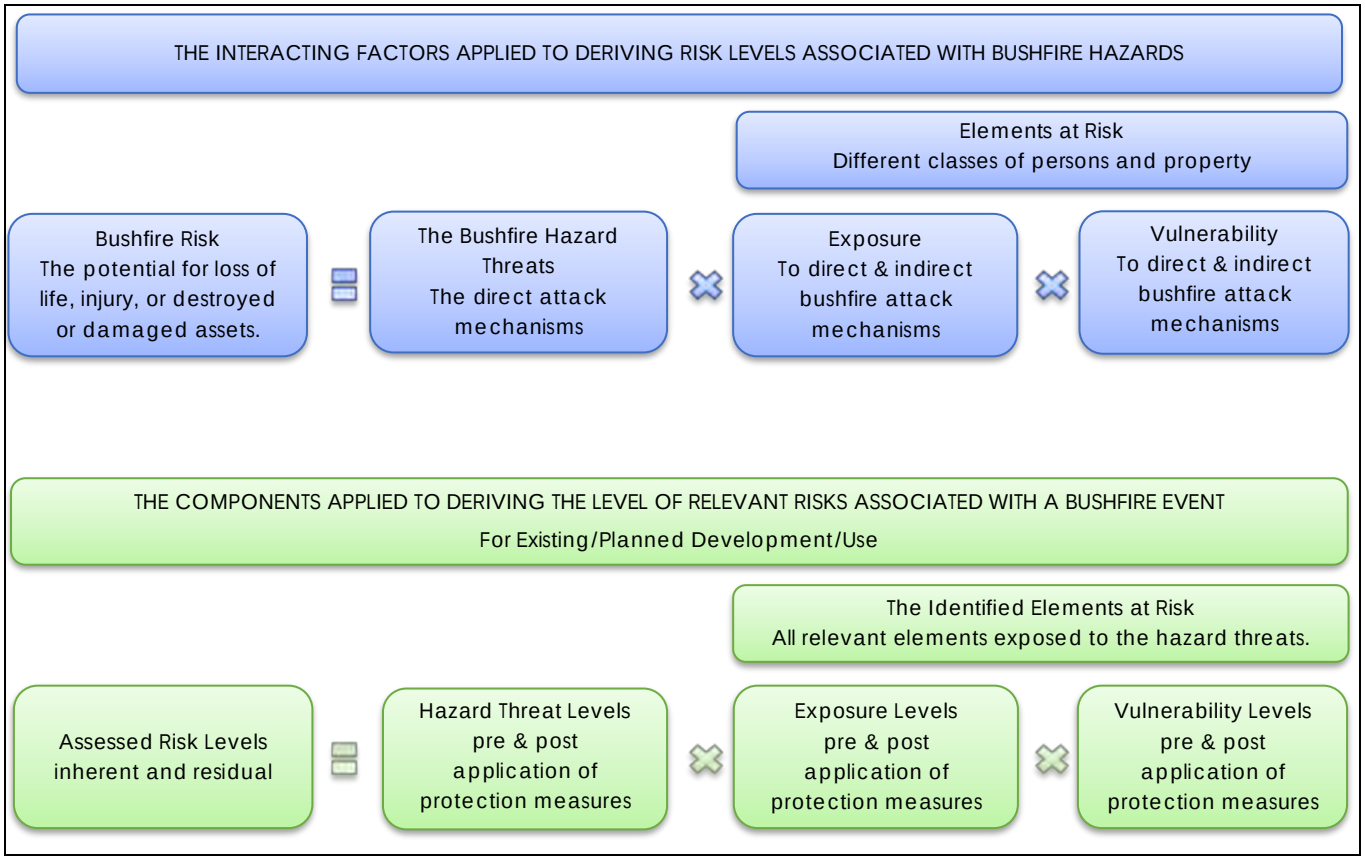


Figure A1.2: The framework of the applied bushfire risk assessment process.

Identify the Bushfire Hazard	Bushfire is a natural hazard and the common term for forest, scrub, shrub, and grass fire. It can exist in any vegetation (identified as the 'hazard') that establishes an ongoing source of readily combustible materials within and surrounding subject land, The bushfire hazard presents threats. These are the direct attack mechanisms (flame contact, radiant heat transfer, ember/burning debris attack, high/erratic fire driven wind) and indirect attack mechanisms (debris production/accumulation, surface fire, tree strike/obstruction, consequential fire). Identify and categorise surrounding vegetation based on a defined set of physical criteria. Each category has an associated 'Potential Threat Level' range.
Assess Hazard Threat Levels	Assess the existence of relevant physical factors in the surrounding landscape that can significantly change bushfire behaviour, intensity and the levels of each bushfire hazard threat and consequently the threat level for each identified category of vegetation. This assessment identifies how the threat level should be 'modified' (i.e., increased or decreased) within its potential range and derives a threat level that is to apply as the 'base' threat level, prior to application of any bushfire protection measures. Conduct a qualitative protection measure analysis that considers how many of all available bushfire protection measures - that can reduce threat levels - are and can be applied. The effectiveness of each measure at reducing threat levels is considered as part of the analysis. Apply the outcome to the derivation of 'Inherent' and 'Residual' threat levels.
Identify the Elements at Risk	Identify all relevant site specific elements 'exposed' to the bushfire hazard. These can include persons in different settings, buildings, structures, temporary accommodation, infrastructure and other physical assets.
Assess Exposure Levels	Conduct a qualitative protection measure analysis that considers how many of all bushfire protection measures available to reduce exposure levels (of an element at risk to bushfire threats), are and can be applied. Consideration of the effectiveness of each measure at reducing exposure levels is part of the analysis. Apply the outcome to the derivation of 'Inherent' and 'Residual" exposure levels.
Assess Vulnerability Levels	Conduct a qualitative protection measure analysis that considers how many of all bushfire protection measures available to reduce vulnerability levels (of an element at risk to bushfire threats), are and can be applied. Consideration of the effectiveness of each measure at reducing vulnerability levels is part of the analysis. Apply the outcome to the derivation of 'Inherent' and 'Residual' vulnerability levels.
Derive the Bushfire Risk Levels	There are potential risks associated with a bushfire hazard and a bushfire event. These include the loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Derive 'Inherent' and 'Residual' risk levels (for each element at risk) from the derived threat, exposure and vulnerability levels by reference to the risk matrix.
State the Risk Tolerability	Derive the tolerability rating by applying the risk tolerance scale. The tolerability scale is based on the 'As Low As Reasonably Practical' (ALARP) principle.

Figure A1.3: Detail of applied bushfire risk assessment process.

A1.3 RISK ANALYSIS EXPLANATORY GUIDANCE

The risk analysis will derive risk levels as the outcome of the assessment. The risk level analysis can be conducted for either each element at risk separately and/or the proposed or existing development/use overall.

Different labels are applied to reported risk levels to indicate how they have been derived and what they refer to. These labels are:

1. The labels **'Indicative** Risk Level' and **'Determined** Risk Level' are used to identify what methodology has been applied in conducting the risk analysis. (Note: This Bushfire Risk Report does not derive 'determined' risk levels (but information is included to explain why this is not possible); and
2. The labels **'Inherent Risk'** and **'Residual Risk'** are used to identify the point in time for which the risk level is being reported i.e., the existing state or a future state.

Additional detail is provided in the following sections and in the Glossary.

A1.3.1 INDICATIVE RISK – APPLICATION JUSTIFICATION AND DERIVATION

Deriving 'Indicative Risk Levels' requires conducting a qualitative assessment. This establishes a subjective understanding of the level of risk that potentially exists and is intended to inform and assist with making planning and operational decisions.

The indicative risk level is derived from a mostly qualitative assessment of the site (some components of the assessment are quantitative in nature), the existing or planned development/use, the assessment of observable physical facts and the knowledge and relevant experience of the bushfire practitioner. The outcome is the provision of an informed and justifiable opinion regarding the levels of risk associated with a bushfire event.

This is an applicable and valuable process when the quantitative information required to derive a 'determined' risk level is either not available or is not possible to generate for practical or economic reasons. Refer to Appendix A1.3.2 for explanatory information.

JUSTIFICATION OF QUALITATIVE ANALYSIS APPROACH

Justification for deriving 'indicative' risk levels is based on the following assumptions:

1. There is a limited number of 'bushfire protection mechanisms' that can be applied to reducing hazard threats and the exposure and vulnerability of at risk elements.
2. There will be a range of individual bushfire protection measures associated with each 'protection mechanism'. The number of available protection measures for each 'protection mechanism' will vary dependent on the specifics of the site and its use, including scale, but effectively these will also have a practical limit.
3. Individual bushfire protection measures will vary in their standalone effectiveness at reducing hazard threat levels and reducing the exposure and vulnerability levels of elements at risk (refer to A1.2.4).
4. The greater the number of effective bushfire protection mechanisms and associated measures that can be applied, the lower the indicative risk level will be.

DERIVATION OF THE INDICATIVE RISK LEVEL

For a given site/development/use, an indication of the level of risk associated with a bushfire event and its tolerability is derived by:

1. Assessing the 'indicative' hazard threat levels and the 'indicative' exposure and vulnerability levels of elements at risk by:
    a) Assessing the potential levels of threat presented by the direct and indirect bushfire attack mechanisms of the identified bushfire hazard;
    b) Assessing how many bushfire protection mechanisms and their associated protection measures are applicable and can be applied, compared to the total available; and
    c) Applying an effectiveness weighting to each protection measure.
2. Derive the indicative risk level by applying the risk matrix presented in Table A1.1;

3. Establish the tolerability of the risk by applying the 'As Low as Reasonably Practicable' (ALARP) principle and associated risk tolerance scale (refer to Appendix A1.2.5).

Table A1.1: Risk matrix for deriving indicative risk levels from the assessed potential hazard threats levels, and the potential exposure and vulnerability levels of elements at risk.

INDICATIVE RISK LEVEL MATRIX						
Potential Threat Level (a)	Potential Exposure Level (b)	Potential Vulnerability Level (c)				
		Very Low (1)	Low (2)	Moderate (3)	High (4)	Extreme (5)
Very Low (1)	Very Low (1)	VL1	VL2	VL3	L4	L5
	Low (2)	VL2	VL3	L4	L5	L6
	Moderate (3)	VL3	L4	L5	L6	M7
	High (4)	L4	L5	L6	M7	M8
	Extreme (5)	L5	L6	M7	M8	H9
Low (2)	Very Low (1)	VL2	VL3	L4	L5	6
	Low (2)	VL3	L4	L5	L6	M7
	Moderate (3)	L4	L5	L6	M7	M8
	High (4)	L5	L6	M7	M8	H9
	Extreme (5)	L6	M7	M8	H9	H10
Moderate (3)	Very Low (1)	VL3	L4	L5	L6	M7
	Low (2)	L4	L5	L6	M7	M8
	Moderate (3)	L5	L6	M7	M8	H9
	High (4)	L6	M7	M8	H9	H10
	Extreme (5)	M7	M8	H9	H10	H11
High (4)	Very Low (1)	L4	L5	L6	M7	M8
	Low (2)	L5	L6	M7	M8	H9
	Moderate (3)	L6	M7	M8	H9	H10
	High (4)	M7	M8	H9	H10	H11
	Extreme (5)	M8	H9	H10	H11	E12
Extreme (5)	Very Low (1)	L5	L6	M7	M8	H9
	Low (2)	L6	M7	8M	H9	H10
	Moderate (3)	M7	M8	H9	H10	H11
	High (4)	M8	H9	H10	H11	E12
	Extreme (5)	H9	H10	H11	E12	E13

Risk level key: VL = very low, L = low, M = moderate, H = high, E = extreme.
The qualitative relative levels are assigned a numerical value.
The risk value is calculated as = (a + b + c) – 2 and range from 1 (lowest) to 13 (greatest).
The risk levels are derived from an assigned a numerical range: very low = 1-3, low = 4-6, moderate = 7-8, high = 9-11, extreme = 12-13.

A1.3.2 DETERMINED RISK – APPLICATION LIMITATIONS

IMPORTANT: THIS BUSHFIRE RISK REPORT DOES NOT DERIVE DETERMINED BUSHFIRE RISK LEVELS.

Deriving 'determined' risk levels requires conducting a quantitative assessment. This establishes an objective understanding of the level of risk that potentially exists and is intended to inform and assist with making planning and operational decisions.

The key difference from an 'indicative' risk level assessment is the requirement to apply a quantitative set of risk factor criteria against which hazard threat levels and the exposure and vulnerability levels of identified elements at risk to these threats can be objectively assessed.

These risk factor criteria would be developed and supported by a relevant government authority (exercising their responsibility), accepted by persons relying on the assessment and be available for the assessor to use. In addition, the corresponding risk level matrix and the risk tolerability scale are required.

It is necessary that:

1. The risk factor criteria reflect society's and/or community's expectations and preparedness/capacity to tolerate risk;
2. The information is standardised to the greatest extent possible so that it provides an accepted basis from which the determined risk level can be derived and be relied upon in making decisions;
3. The corresponding risk level matrix and the risk tolerability scale are developed to derive a risk level and tolerance level from the derived threat, exposure, and vulnerability levels; and
4. Responsibility for development of the reference information is not left to individual assessors who have varied expertise, qualification, and no approved responsibility to provide such information. Such an approach would not result in consistent and reliable assessment outcomes.

Limitations: Where the required reference information (that is researched, effective, functional and acceptable) has not been established and provided by the responsible authorities, determined risk levels cannot be derived.

RISK FACTOR CRITERIA

The required risk factor criteria would need to establish:

- What factors are to define the different 'determined' levels of hazard threats;
- What factors are to define the different 'determined' levels of exposure of elements at risk; and
- What factors are to define the different 'determined' levels of vulnerability of elements at risk.

RISK LEVEL MATRIX

The matrix would need to establish how the 'determined' levels of threat, exposure and vulnerability are to be applied in deriving the 'determined' risk level. Different sets of matrices to account for different development types, uses and scales would likely be required.

Different development types, uses and scales are potentially capable of tolerating different levels of risk and still be considered by the relevant authority (who are reflecting the understood society/community position), to remain acceptable or at least tolerable.

RISK TOLERANCE SCALE

After the 'determined' risk level has been derived after an assessment applying the risk factor criteria and the risk level matrix, a methodology is required to classify the risk level as either unacceptable, tolerable or acceptable.

A1.3.3 INHERENT AND RESIDUAL RISK

In this Bushfire Risk Report, inherent risk is current situation risk after accounting for bushfire protection measures that are either already in place (for existing development/use) and/or are currently planned to be incorporated into the proposed development/use.

Inherent risk levels are derived before the application of any additional protection measures that have been identified and recommended by the bushfire consultant, and which subsequently determines the residual risk. If there are none, the residual risk is the same as the inherent risk. Refer to the Glossary for additional supporting information.

A1.3.4 PROTECTION MEASURE EFFECTIVENESS RATINGS

DERIVING AN EFFECTIVENESS RATING

As part of the qualitative risk assessment process, an effectiveness rating, established by the application of this table, is applied to each bushfire protection measure. The rating weights each bushfire protection measure's ability to reduce a hazard's threat levels or reduce the exposure and/or vulnerability levels of the elements at risk.

The greater the effectiveness the greater the contribution of a protection measure to the reduction in levels of risks associated with a bushfire event. It is also an important factor applied to the determination of the bushfire protection measure's implementation priority.

The effectiveness ratings incorporate the qualities of:

1. Independent/Dependent: A qualitative assessment of the extent to which a protection measure can reduce threat, exposure and vulnerability levels as a standalone measure as opposed to only providing an additive reduction by being a part of a package of protection measures; and
2. Risk Reduction Potential: A qualitative assessment of a protection measure's capacity to reduce the levels of risks associated with a bushfire event as a standalone risk measure.

The rating methodology assumes the greater the independence and risk reduction potential of a bushfire protection measure, the greater its effectiveness.

DERIVING EFFECTIVENESS RATINGS FOR BUSHFIRE PROTECTION MEASURES	
Rating	Protection Measure Characteristics and Capability
Very High	Very significant risk reduction as an independent (standalone) measure. Impact on risk reduction is immediate and persistent in all scenarios. A priority measure to be implemented wherever possible.
High	Material risk reduction as an independent (standalone) measure;
Medium	Alone the measure will have limited impact on risk reduction. It is dependent on providing additive value when combined with other protection measures to create a 'package' of bushfire protection measures.
Not Relevant	The measure is not relevant to the type of development/use. This is different to not being able to be applied – it is just not relevant to any configuration of the subject development/use.

A1.3.5 PROTECTION MEASURE IMPLEMENTATION PRIORITY RATINGS

The effectiveness of a bushfire protection measure at reducing 'relative' threat, exposure and vulnerability levels, is the primary determinant of the implementation priority rating (refer to Section A1.2.3 for effectiveness rating explanation).

However, the implementation priority rating, corresponding to each effectiveness rating, can be modified with appropriate consideration of factors that may constrain the implementation and ongoing management of the measure. A justifiable weighting for each of the factors may be incorporated into the assessment for differing scenarios, either by the consultant or applied later by the landowner/operator with their greater knowledge of specific factors.

The matrix is applied qualitatively to the determination of the implementation priority rating that will apply to a recommended bushfire protection measure in this Bushfire Risk Report.

DERIVING THE IMPLEMENTATION PRIORITY FOR BUSHFIRE PROTECTION MEASURES									
Derived Implementation Priority Rating	Primary Determinant Effectiveness Rating	Secondary Determinants - Constraints to Implementation and Management [less constraints = potentially higher implementation priority and vice versa]							
		Restrictions from Government / Regulations	Owner / Operator Acceptance	Community Acceptance	Control of Land Restrictions	Financial Cost / Affordability	Knowledge and Ability to Apply Protection Measure	Practicality and Ease of Implementation	Requirement for Ongoing Implementation and Management
Highest	Very High	No Constraints	Likely Alignment with Management Intent & Values	Likely Majority Accept	No Constraints	Likely Within Current Resource Capacity	Past / Current Application Experience	Well Within Existing Capabilities	None - Passive
High	High								
Medium	Medium	Significant Constraints	Likely Strong Conflict with Management Intent & Values	Likely Majority Do Not Accept	Significant Constraints	Unlikely to be Affordable	None – Extensive Education / Training Required	Not Practical	Necessary - Active
Lowest									

A1.3.6 DETERMINATION OF BUSHFIRE RISK LEVEL TOLERANCE

The application of a risk tolerance scale is necessary to:

1. Identify which exposed elements must be given priority for the development and application of bushfire protection measures; and
2. When planning approval is being sought, to identify if the residual risk levels can be considered as tolerable or acceptable and therefore potentially be approved for this factor.

THE APPLIED TOLERANCE SCALE

The risk tolerance scale applied in this Bushfire Risk Report is presented in Table A1.2. It incorporates the application of the 'As Low as Reasonably Practicable' (ALARP) Principle. An overview of this principle and justification for its application is presented on the following pages.

Table A1.2: The applied risk tolerance scale

<table>
<tr><th colspan="4">THE APPLIED RISK TOLERANCE SCALE - INCORPORATING THE ALARP PRINCIPLE</th></tr>
<tr><th>Risk Level</th><th colspan="2">Tolerability Description and Action Required</th><th>Risk Tolerance Level[1]</th></tr>
<tr><td>Extreme</td><td colspan="2">The risks are unacceptable and require immediate implementation of risk management measures to eliminate or reduce risk to tolerable or acceptable levels.
Proposed development giving rise to risks in this region would not be approved unless there are exceptional reasons for the development to proceed.</td><td>Unacceptable</td></tr>
<tr><td>High</td><td>The risks are the most severe that can be tolerated but not unduly high. They require monitoring in the short term as risk management measures are likely to be needed in the short term given the intent should be to drive residual risk lower down the tolerable range where possible.</td><td rowspan="3">Tolerance Regions Subject to ALARP Principle</td><td>Intolerable
- if not ALARP-</td></tr>
<tr><td></td><td></td><td>Tolerable
- if ALARP -</td></tr>
<tr><td>Moderate</td><td>The risk is approaching an acceptable level. It can be tolerated and requires monitoring in the short to medium term. Need to consider potential changes over time in the risk and/or techniques for reducing/eliminating risk.
Risk management measures may be needed to reduce risk to more acceptable levels where possible – or accept the risk.</td><td>Tolerable
- if not ALARP -
Acceptable
- if ALARP -</td></tr>
<tr><td>Low
Very Low</td><td colspan="2">The risk is accepted as it is generally regarded as insignificant or adequately controlled by existing measures. No additional risk management measures will be required in the short to medium term other than monitoring.</td><td>Acceptable</td></tr>
<tr><td colspan="4">[1] Refer to the glossary for definitions of the tolerance levels.</td></tr>
</table>

THE ADJUSTMENT OF RESIDUAL BUSHFIRE RISK LEVEL TOLERABILITY

Development/use scenarios can exist where a higher level of residual risk might be considered as tolerable or acceptable. Such a situation may exist when the exposed element is not persons and the economic cost due to the loss or damage of assets and/or disruption of services, is a risk that is retained by the owners as an informed decision.

Consideration of the knock-on risk implications to persons who might be associated with these elements, or other nearby elements at risk, will be part of the tolerability adjustment assessment.

There may also be isolated scenarios where the limits for tolerability of risk need to be established at lower residual risk levels i.e. an additional margin of safety is required. The rationale for any residual risk tolerance adjustment is presented below.

RATIONALE FOR THE ADJUSTMENT OF RISK TOLERANCE FOR PRPOSED DEVELOPMENT	
Relevant Element at Risk [Section 5.2]	Adjustment Rationale
Persons on Access/Egress Routes in Vehicles	The site is intended to be unstaffed. Persons onsite during a bushfire emergency will be Emergency Services, who will be aware of the local area and have their vehicles immediately available. Any other persons onsite (staff/contractors) will likely be maintenance personnel who will be familiar with the local area and will have attended the site in their vehicles. The tolerability for the residual risk will be adjusted due to the availability of large areas subject to <2kW/m2 radiant heat flux, and this heat flux will be due to the extremely short residence period of a grassland fire. Any persons remaining onsite can retreat from the fire front to a low threat area within the site as required.

THE ALARP PRINCIPLE

The 'As Low as Reasonably Practicable' (ALARP) Principle is based on the belief it is not possible to completely eliminate all risk involved, there will always be a certain level of risk remaining known as residual risk. The term is used to express the expected level of residual risk within a system, activity or, relevant to this document, within a proposed development/use, when good practice, judgement and duty of care are applied to decisions and operations.

The origins of the ALARP (As Low as Reasonably Practicable) principle are from United Kingdom case law and their regulatory framework. It is applied by their Health and Safety Executive (HSE) and is used by regulators and companies around the world as it provides a logical basis for managing risks.

The ALARP principle has been defined by the United Kingdom Health and Safety Executive (HSE-UK, 2001) to depict the concept that efforts to reduce risk should be continued until the incremental cost in doing so is grossly disproportionate to the value of the incremental risk reduction achieved (see figure). Incremental cost is defined in terms of time, effort, finance or other expenditure of resources – including loss of natural resources. Usually, each incremental reduction in risk will require a greater expenditure of resources.

This concept is depicted in Figure A3.1 where the triangle represents the decreasing risk and the diminishing proportional benefit as risk is reduced. There are also three regions shown in the figure into which general levels of residual risk can fall. The residual risk should fall either in the broadly acceptable region, or near the bottom of the tolerable region. This approach allows higher levels of safety to be provided where it is feasible.

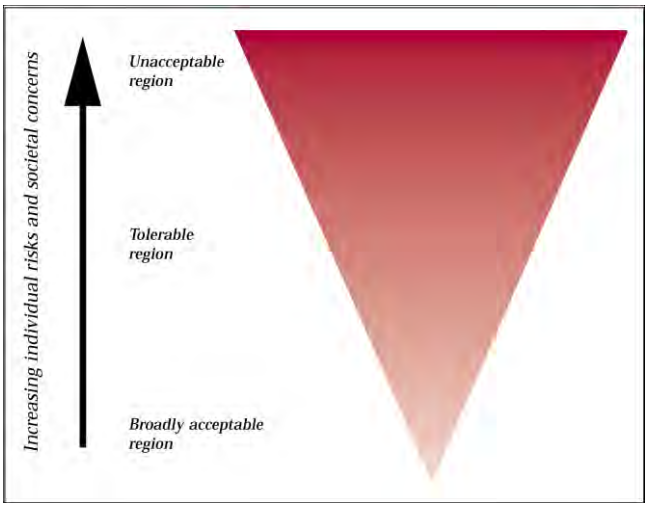


Figure A1.2: HSE framework for the tolerability of risk (source: HSE-UK, 2001)

Moving up the triangle from the region considered broadly acceptable, through a tolerable region (for which a greater range of risk can be considered), to an unacceptable region, represents increasing levels of 'risk' for a particular hazard or hazardous activity (determined through relevant risk analysis). Table A3.1 describes the risks that define each region.

Table A1.3: The risks associated with the risk tolerance regions (adapted from HSE-UK, 2001)

THE ALARP PRINCIPLE – DEFINING THE REGIONS OF RISK TOLERANCE	
Unacceptable Region	For practical purposes, a particular risk falling into this region is regarded as unacceptable whatever the level of benefits associated with the activity. Any activity, practice or use of land giving rise to risks falling in this region would, as a matter of principle, be not approved unless the activity or practice can be modified to reduce the degree of risk so that it falls in one of the regions below, or there are exceptional reasons for the activity, practice or use to be retained.
Tolerable Region	Risks in this region are typical of the risks from activities that people are prepared to tolerate in order to secure benefits, in the expectation that: • The nature and level of the risks are properly assessed, and the results used properly to determine control measures. The assessment of the risks needs to be based on the best available scientific evidence and, where evidence is lacking, on the best available scientific advice; • The residual risks are not unduly high and kept as low as reasonably practicable. This is the region to which the ALARP principle applies; and • The risks are periodically reviewed to ensure that they still meet the ALARP criteria, for example, by ascertaining whether further or new control measures need to be introduced to take into account changes over time, such as new knowledge about the risk or the availability of new techniques for reducing or eliminating risks. • In practice and where possible, the intent should be that residual risk continues to be driven down the tolerable range so that it falls either in the broadly acceptable region or is near the bottom of the tolerable region, in keeping with the duty to ensure health, safety and welfare so far as is reasonably practicable as per the ALARP principal.
Broadly Acceptable Region	Risks falling into this region are generally regarded as insignificant and adequately controlled. Regulators would not usually require further action to reduce risks unless reasonably practicable measures are available. The levels of risk characterising this region are comparable to those that people regard as insignificant or trivial in their daily lives. They are typical of the risk from activities that are inherently not very hazardous or from hazardous activities that can be, and are, readily controlled to produce very low risks.
Note: The risk tolerability framework is a conceptual model. The factors and processes that ultimately decide whether a risk is unacceptable, tolerable or broadly acceptable are dynamic in nature and are sometimes governed by the circumstances, time and environment in which the activity, practice or use occurs or is proposed. Standards change and public expectations vary between societies and change with time.	

APPLICATION OF THE ALARP PRINCIPLE IN AUSTRALIA

To contribute to justification for the use of the principle in this bushfire risk report, it is noted that the following Australian guidelines also apply adaptations of the principle:

- Australian Institute for Disaster Resilience, 2020; Land use Planning for Disaster Resilient Communities;
- WA Department of Mines, Industry Regulation and Safety, 2020; Petroleum safety and major hazard facility – guide. ALARP demonstration;
- NOPSEMA (Australia's offshore energy regulator), 2020; ALARP and risk assessment guidance notes;
- Department of Planning Lands and Heritage (DPLH), 2019; Coastal hazard risk management and adaptation planning guidelines;

- Planning Institute of Australia, 2015; National Land Use Planning Guidelines for Disaster Resilient Communities; and

- NERAG 2010, an earlier version of NERAG 2020, applied the ALARP Principle.

The following is taken from the 'National Land Use Planning Guidelines for Disaster Resilient Communities' (Planning Institute of Australia, 2015) and is also referred to in the document 'Land use Planning for Disaster Resilient Communities' (Australian Institute for Disaster Resilience, 2020).

> *Of relevance to planners in the NERAG is the ALARP principle and how it is used in evaluating risks. According to NERAG, the ALARP principle is applied to define boundaries between risks that are generally intolerable, tolerable or broadly acceptable. The ALARP principle will help to prioritise a risk hierarchy and determine which risks require action and which do not. Those that are broadly acceptable naturally require little, if any, action while risks that are at an intolerable level require attention to bring them to a tolerable level.*
>
> *According to NERAG, it is entirely appropriate and accepted practice that risks may be tolerated, provided that the risks are known and managed.*
>
> *The ALARP principle is particularly relevant to planners and other built environment professionals as it provides the means to categorise risks according to their severity, and to assign risk treatment options accordingly.*
>
> *It is important to note that the effect each hazard has on a community and its settlement is different, and therefore land use planning and building responses may not always be appropriate to treat the risk borne by a particular hazard. Equally, the effectiveness or strength of response provided by land use planning or building may not be sufficient to fully address the risk.*
>
> *In addition, it is likely that through a normal natural hazard management process a range of treatment measures will be proposed, tested and implemented to provide a comprehensive approach to risk treatment that may involve other measures working in concert with land use planning or building responses.*
>
> *The manner in which land use planning and building responses are deployed to treat specific instances of natural hazard risk will vary depending on location, information availability, community views, broader development intent for the settlement under analysis and the effect of complementary risk treatment measures.*
>
> *However, the ALARP principle provides a good reference for demonstrating the land use responses for the various ALARP risk categories. Generally speaking, in areas of intolerable risk the strongest land use planning and building responses should apply. Conversely, in areas of acceptable risk only minimal controls should apply, if at all.*
>
> *The most complex risk category for which to prescribe treatment from a land use and building perspective is those areas of tolerable risk. Such risks in existing settlements may not be sufficiently concerning to warrant severe use restrictions or relocation, however they will need treatment over time to ensure the risk does not increase. Treatment options in this instance may include limiting vulnerable uses in this area, restricting significant intensification of development, and promoting resilient urban design. Such areas of tolerable risk are also best avoided from a greenfield perspective to limit increases in future risk and costs associated with infrastructure failure in these locations that could otherwise been avoided.*

***

A1.3.7 ADDRESSING THE LIKELIHOOD OF A BUSHFIRE EVENT OCCURRING

USING THE QUALITATIVE RISK ASSESSMENT APPROACH (NOTE: APPLIED IN THIS BUSHFIRE RISK REPORT)

In using a subjective approach, the pragmatic assumption that a bushfire will occur is made. It is assumed a bushfire can occur within any timeframe and could result in loss or life or injury, or unacceptable damage to property and or unacceptable disruption to services.

This approach acknowledges that the requirements for fire of fuel, ignition source and oxygen will always exist. That is:

- The fire fuels being considered will always be there unless physically removed permanently;
- A potential ignition source will always exist through lightning and/or human activities; and
- The potential for adverse fire weather conditions to exist at some point within each year will always be present.

Additionally, the subjective assessment of the site specific potential threat levels of the direct and indirect bushfire attack mechanisms associated with the bushfire hazard, by default and indirectly, effectively incorporate a likelihood component.

Also, where the costs of implementing the required bushfire protection measures to lower indicative risk levels is not excessive, it makes sense not to try to avoid these costs by considering that risk is reduced because likelihood is lower.

USING THE QUANTITATIVE RISK ASSESSMENT APPROACH (NOTE: NOT APPLIED IN THIS BUSHFIRE RISK REPORT)

A quantitative approach will necessarily be based on the historical record of past bushfire events and determining the mathematical probability of a future event. This approach is problematic to achieving increased bushfire resilience at all stages of existing or proposed development/use for these reasons:

- Historical data may not be available or have enough data sets to be accurate;
- Historical data does not account for future changes in climate that may result in a different occurrence period. Consequently, further assumptions need to be made;
- Siting, design and construction of development to resist bushfire threats is easier, more practical (and likely economical), to incorporate at initial planning stages rather than the retro-establishment of protection measures when the considered likelihood of events increases over time for various reasons or tolerance of risk decreases;
- Time spent conducting historical research, performing statistical calculations and modifying risk levels, apart from being costly, is likely better spent assessing potential threat, exposure and vulnerability levels and developing appropriate protection measures; and
- The likelihood of occurrence cannot modify the levels of hazard threats, exposure or vulnerability. It can only be applied to reduce the overall risk level. That is, it would be applied as a modifying factor via the established risk level matrix and not the established risk factor criteria. The validity of incorporating such a factor may be indicated when, despite the existence of vegetation that can burn, there are other mitigating physical conditions that exist at the specific site that make the likelihood of ignition and severity of bushfire behaviour very low. How this is applied would need to be established by the authority establishing the relevant risk level matrix.

***

DEFINING THE BUSHFIRE HAZARD AND ITS THREATS

THE BUSHFIRE

For this assessment, a bushfire is the unplanned burning of a fire in vegetation of any type and structure. It is applied as a generic term to refer to forest fires, scrub/shrub fires and grass fires, which have differences of behaviour within and between the fire types, dependant on a range of variables. Key fire behaviours include rate of spread, flame height, intensity and spotting (i.e., ignition ahead of the fire front by embers/burning debris).

Grassfire: Note that grass fires are significantly different, and this is recognised in the assessment. Grass fire behaviour results in a much shorter duration fire, the embers produced being mostly consumed within the flame front and radiant heat flux dropping more quickly with distance from the fuel load - as indicated in the application of AS 3959:2018 methodology where 'Grassland' achieves a BAL-LOW rating at half the separation distance of all other classified vegetation. These differences are acknowledged in other jurisdictions:

> *The risk posed by grass fires is different to that of fires in other vegetation types. Grass fires burn at a higher intensity and spread more rapidly with a shorter residence time. Embers produced by grass fires are smaller and fewer in number than those produced from forest fires. In recognition of the characteristics of grassland fire behaviour, the NSW RFS has developed a simplified set of Deeming Provisions for residential infill development (Planning for Bushfire Protection, RFS NSW, 2019).*
>
> *While pastures, crops and native grasslands often experience fast moving fires, their intensity is usually insufficient to justify a land use planning response (Justin Leonard et al (2014): A new methodology for State-wide mapping of bushfire prone areas in Queensland, CSIRO, Australia)*

THE BUSHFIRE HAZARD

A bushfire hazard is the natural process/phenomenon of a bushfire event that gives rise to the associated risks of loss of life or injury or destroyed or damaged assets, which results in personal loss and economic loss.

The term bushfire hazard is necessarily applied to both the relevant vegetation as the source of the hazard and the bushfire event itself. This approach is aligned with the definition applied by the United Nations Office for Disaster Risk Reduction.

LAND USE PLANNING AND THE BUSHFIRE HAZARD THREATS TO BE ASSESSED

The bushfire hazard is a potential source of direct and indirect bushfire attack mechanisms (refer to A2.3 for additional information), that present threats to persons and property and give rise to the associated risks of loss of life or injury or destroyed or damaged assets.

Direct Attack Mechanisms: Of most relevance to land use planning are the bushfire threat levels generated by the direct attack mechanisms of:

- Flame contact;
- Radiant heat transfer; and
- Ember/burning debris attack.

Consequently, these are the bushfire hazard threats that are to be considered when assessing the potential bushfire hazard threat levels. Due consideration of winds generated by fire/terrain interactions, is applied when the physical requirements exist for development of landscape scale fire and extreme bushfire events.

Indirect Attack Mechanisms: The indirect attack mechanisms are considered within a risk assessment section of a Bushfire Risk Report when this is required, as the threat levels from these mechanisms is determined by the degree to which available bushfire protection measures are or will be implemented in mitigating risk.

FACTORS INFLUENCING BUSHFIRE BEHAVIOUR

There are three primary factors that influence the intensity, speed and spread of a bushfire. Any increase in these behaviours will result in greater threat levels, to exposed elements, from the bushfire attack mechanisms.

1. VEGETATION AND OTHER FUELS

Key characteristics that will influence fire behaviour include:

- Fuel size and shape – anything less than 6mm diameter/thickness is considered a fine fuel and will ignite and burn quickly. Larger/heavier fuels take longer to ignite but burn for longer, so the threat exists for longer;
- Fuel load – the quantity of available fuel (t/ha) will influence the size of the fire. In particular it is the fine fuel load that determines the intensity of the bushfire and the flame sizes. Vegetation type and period over which it can accumulate will determine fuel loads;
- Vegetation type – this influences the size, shape and quantity of available fuels. For bushfire purposes vegetation types include the classifications of forest, woodland, scrub, shrubland and grassland (with total fuel loads typically decreasing in that order);
- Fuel arrangement – will influence two factors of fire behaviour (1) the speed and intensity of burning and (2) how much of the total fuels are likely to be involved in the fire simultaneously. The first factor is a function of how densely packed or aerated the fuels are with the more available arrangement burning with greater intensity. The second factor is a function of the availability of 'ladder' fuels (i.e. near surface, elevated and bark fuels) to carry fire up the vegetation profile, and the continuity of fuels to carry the fuel across the land; and
- Fuel moisture content – drier fuels will ignite easily and burn quickly. The inherent moisture content of the vegetative fuels is a function of the vegetation type and arrangement and/or the positioning of the vegetation complex near readily available sources of moisture.

Greater quantities of finer, dryer, aerated and connected fuels will result in more severe behaviours and elevated bushfire threat levels. Large extents of vegetation (surrounding landscape scale) can have additional implications for the development of extreme bushfire events and the consequent increase in bushfire threat levels (refer to Appendix 3 for additional information).

2. WEATHER

Adverse fire weather that results in more severe behaviours and elevated threat levels includes strong winds, high temperatures, low relative humidity and extended periods of these factors.

Weather events at the surrounding landscape scale can have implications for the development of extreme bushfire events and consequent increase in bushfire threat levels (refer to Appendix 3 for additional information).

3. TOPOGRAPHY

The physical terrain can influence the severity of fire behaviour. At a local scale, it is the influence of ground slope on the rate a fire spreads, that is most relevant. Fire travels faster up slopes (rule of thumb is a doubling of speed for every 10 degrees increase in slope). Greater rates of spread increase fire intensity and the resultant threat levels.

At the surrounding landscape scale, the impact of topography can be significant and includes establishing the potential for development of certain dynamic fire behaviours that can lead to extreme bushfire events and elevated threat levels (refer to Appendix 3 for additional information).

BUSHFIRE THREATS - DIRECT ATTACK MECHANISMS ORIGINATING FROM THE BUSHFIRE PRONE VEGETATION

FLAME CONTACT

When flames contact buildings/structures they can flow over, under and around – impacting surfaces not directly facing the bushfire. Flames can enter small gaps and crevices resulting in a significant threat to combustible internal parts of buildings/structures.

Flames will be longer when fine fuel loads are higher and will move faster up slopes and generally, slower down slopes.

Flame temperatures are highest in the lower parts of the flame and decrease towards the tip. The flame has two distinct regions - the lower solid body flame and the upper part that is a transitory flame (intermittently present). Both flame regions can damage structures.

Note: AS 3959:2018 *Construction of buildings in bushfire prone areas*, establishes both the construction requirements corresponding to each Bushfire Attack Level (BAL) and the methodology for determining a BAL. For a bushfire modelled using this methodology, the derived flame length only provides an estimate of the solid body flame length.

RADIANT HEAT TRANSFER

This heat is produced from combustion of a fuel source, radiates in all directions from the fire and can potentially be felt from hundreds of meters away.

The amount of heat that a fire can transfer to other objects, through radiation, is influenced by its flame size and flame temperature. These are a function of the characteristics of the fuels being burnt including fuel size, dryness, structure, arrangement and quantity. The bushfire is additionally influenced by weather and topography factors that can intensify fire behaviour (described at start of this section with additional detail provided in Appendix 3).

The radiant heat:

- Can ignite combustible materials such as timber (doors, cladding, external framework), some plastics (which if not ignited will melt and distort (cladding, pipes, gutters, tanks). This breaches the building's envelope allowing flames and embers to enter, increasing the likelihood of damage or destruction;
- Can dry and heat vegetation and other fuels (combustible materials such as timber) to a temperature at which they ignite or are more easily ignited by existing flames or embers; and
- Is an extremely significant threat to persons (occupants, firefighters) when they are not physically shielded. Protective clothing can provide only limited protection.

EMBER / BURNING DEBRIS ATTACK

Note: The importance of establishing protection measures to mitigate the potential impact of consequential fire ignited by the ember attack mechanism, cannot be overstated.

An ember is a small particle of burning material that is transported in the winds that accompany a bushfire (larger particles can exist as firebrands from certain vegetation types). Typically, these consist of plant materials such as bark, leaves and twigs that exist as part of the standing vegetation or have accumulated on the ground. Experimental scientific work has shown that that embers greater than 2mm are effective at igniting combustible materials.

Ember attack is the most common way for buildings/structures to ignite in a bushfire:

Scientific research indicates that at least 80% of building losses from past Australian bushfires can be attributed to ember/firebrand attack (mostly in isolation but also in combination with radiant heat), and the resultant consequential fires. (Leonard J.E. et.al; 2004 – Blanchi R. et.al. 2005 - Blanchi R. et.al. 2006).

Embers are the primary ignition source for consequential fire:

- They accumulate around and on vulnerable parts of structures such as low angle surfaces windows and wherever re-entrant corners exist (e.g., roofs, gutters, doors, windows etc);
- They enter gaps in structure envelopes to vulnerable materials within internal cavities and spaces (e.g., roof, sub-floor, living areas); and

- They ignite surface materials such as walls and decks and any accumulated vegetative debris.

Embers can attack structures for a significant length of time before and after the passage of the fire front, as well as during. This potential length of exposure is an important factor in the consideration of the level of threat embers present.

The importance of bark as an ember source:

(Sources: CSIRO Climate and Disaster Resilience Report 2020 and Overall Fuel Hazard Assessment Guide 4th edition July 2010, Victoria DSE and Cruz, MG (2021) The Vesta Mk 2 rate of fire spread model: a user's guide. CSIRO).

Bark is the primary source of embers and spotting in Australian eucalypt forests due to the key attributes of ease of ignition, extended burnout time and the favourable size to weight ratio and aerodynamic properties. Differences in these attributes strongly influence the spotting potential from different forest types – and therefore the potential hazard rating of the bark.

The type of tree bark will determine the size, shape and number of embers/firebrands which, along with the prevailing fire behaviour and weather conditions will dictate the spotting distances and density of ignitions.

Fine fibrous barks - including stringybarks (e.g. jarrah), have loosely attached fibrous flakes and can produce massive quantities of embers (prolific spotting) for shorter (up to 0.75 km) and medium distances (up to 5 km).

Short distance spotting (including ember showers) are generally the result of embers and firebrands blown directly ahead of the fire with little or no lofting. Density tends to decrease with distance from the fire front.

Medium distance spotting results from embers and firebrands that are lofted briefly in a convection column or blown from an elevated position (e.g., from treetops on ridges). With sufficient density and coalescing spot fires, this can rapidly increase the size of a fire (deep flaming) leading to dynamic fire behaviours and extreme fire events.

Ribbon/candle type barks - have longer burnout time, extended flight paths and are more likely to be responsible for longer distance spotting > 5 km (with up to 30 km having been authenticated). This results from significant lofting of large firebrands (e.g. curled hollow tubes of bark that can burn for 40 minutes) in well-developed convection columns. These develop as separate, independent fires. Very long distance spotting requires Intense fire, maintenance of a strong convection column (to lift firebrands aloft) and strong winds aloft (to transport the firebrands).

Other bark types - that include coarsely fibrous (e.g. marri) / slab or smooth / platy and papery barks - produce lower quantities of embers and shorter distance spotting. Their highest bark hazard ratings are lower than fine fibrous or ribbon barks.

HIGH / ERRATIC FIRE DRIVEN WIND ATTACK

High winds resulting from bushfire / vegetation / terrain / fire weather interactions, can directly damage the external envelope of a building or structure by:

- Positive and negative pressure dislodging building parts; and/or;
- Causing solid materials (e.g., branches or parts of other structures) to break loose and be transported to impact and damage the building's envelope. This provides openings for other bushfire attack mechanisms to enter and ignite internal cavities.

Strong winds are common during serious bushfire events as they are a necessary requirement for bushfires to develop higher intensities and greater severity levels.

Increased wind speeds can be the result of:

1. General weather patterns that will present as strong prevailing winds; and
2. The more complex interactions of prevailing winds along with vegetation types and structures, terrain factors and fire weather factors - that can lead to the development of dynamic fire behaviours resulting in intensification of fire behaviour and generation of local and erratic high winds.

   For highest risk scenarios, the bushfire can couple with the atmosphere as a pyro-convective event resulting in extreme bushfire events and gusty, severe windspeeds (refer to Appendix 3 for more detail).

It is the potential for the interactions and outcomes of the latter that will be considered as a direct bushfire attack mechanism for the relevant bushfire hazard threat level assessment in this report.

BUSHFIRE THREATS - INDIRECT ATTACK MECHANISMS

PRIMARILY ORIGINATING FROM WITHIN AN ASSET PROTECTION ZONE (APZ)

For the following indirect bushfire attack mechanisms to impact relevant exposed elements, certain requirements need to exist within an APZ (i.e., the area immediately surrounding a subject building/structure).

Where these requirements exist, they increase the exposure of the subject building/structure to the indirect bushfire attack mechanisms.

In this Report, it is the exposure component of the risk assessment that will assess the potential impact from the bushfire threat indirect attack mechanisms.

DEBRIS PRODUCTION AND ACCUMULATION

The relevant debris are combustible fine fuels that can accumulate, by falling and/or being windblown to be close to or against buildings, surrounding structures and other heavy fuels.

This makes the ignition of these structures/heavy fuels more likely through flame contact and radiant heat generated by the accumulated debris that has been ignited by embers and/or surface fire attack (i.e. a consequential fire).

This debris can accumulate over long time periods (years) in locations such as:

- On horizontal or close to horizontal surfaces and rough timber surfaces;
- Within re-entrant corners and roof gutters/valleys;
- Against vertical surfaces; and
- Within internal spaces /cavities and under sub-floors when gaps are present.

The threat level of this attack mechanism will be determined by:

- The presence of vegetation types that produce significant quantities of combustible debris and produce this in the driest and hottest part of the year; and
- The extent of the vegetation producing this threat.

SURFACE FIRE

These are low intensity fires with short flames that burn along the ground and are not considered to be part of the 'bushfire' in identified bushfire prone vegetation. They are typically patchy and erratic in their direction, consuming low-lying vegetation, ground litter, mulch and other debris and are short lived (<40 seconds) when burning in the absence of heavier fuels.

Surface fires occur on the land immediately surrounding buildings, associated structures and other heavy consequential fire fuels. Surface fires bring the threats of direct flame contact, higher radiant heat and embers closer to the relevant elements at risk than the bushfire itself can.

To reduce the exposure of relevant elements at risk to this indirect bushfire threat, the area of land typically recognised as an APZ, should be maintained in a minimal fuel / low threat state.

TREE STRIKE/OBSTRUCTION

Branches or trees, subject to strong winds and/or tree burnout, can:

- Damage the envelope of a structure creating openings for direct attack mechanisms of bushfire (or consequential fire) to ignite internal cavities or living space; and/or
- Fall and obstruct access to or egress from, a structure or site being impacted by bushfire.

The threat level of this attack mechanism is determined by the location of relevant trees and their susceptibility to wind damage and/or burnout.

CONSEQUENTIAL (SECONDARY) FIRE

Note: The importance of establishing protection measures to mitigate the potential impact of consequential fire cannot be overstated.

Consequential fire Is the burning of vulnerable (combustible/flammable) materials, items and structures that exist within the area surrounding the subject building or structure. These vulnerable surrounding elements can also include adjacent buildings/structures.

The burning of these surrounding vulnerable elements can result in the subject building/ structure being exposed to the direct fire attack mechanisms (threats) of flame, radiant heat, embers and surface fire from a close distance.

These consequential fire threats are separate from and additional to the threats generated by the bushfire front itself - which can be and often is, a considerable distance away.

Consequential Fire Fine fuels:

- Dead plant material such as leaves grass, bark and twigs thinner than 6mm (or live material less than 3mm thick that can be consumed in a fire involving dead material); and
- Originate from the indirect bushfire attack mechanism of 'debris accumulation' and potentially from other areas of landscaped vegetation.

Consequential Fire Heavy and Large Heavy Fuels:

- Stored combustible / flammable items:
    - Building materials, packaging materials, firewood, sporting/playground equipment, outdoor furniture, matting, rubbish bins etc;
    - Large quantities of dead vegetation materials stored as part of site use;
    - Liquids and gases; and
    - Vehicles, caravans and boats, etc.
- Constructed combustible items:
    - Surrounding landscaping items - fences/screens, retaining walls, gazebos, plastic water tanks etc;
    - Attached structures - decks, verandahs, stairs, carports, garages, pergolas, patios, etc; and
    - Adjacent structures - houses, sheds, garages, carports, etc. Structure to structure fire is a common cause of overall building loss in post bushfire event assessments [9].

The threat level of this attack mechanism is determined by the existence, type and proximity of these fuels.

***

APPENDIX 3: DYNAMIC FIRE BEHAVIOURS AND EXTREME BUSHFIRE EVENTS

The content of this appendix is an overview of information that supports the assessment approach of section 5.2 of this report. It considers the risk implications arising from what is being learnt from the latest research work within the bushfire science of dynamic fire propagation and extreme fire development.

Any potential for extreme fire events to develop in the surrounding landscape surrounding the subject site, will result in increased in bushfire hazard threat levels to exposed elements and must be accounted for in the risk assessment.

The selected compilation of information is taken from various sources including peer reviewed research papers [references 1-3, 12, 15, 21, 27, 28, 41, 42].

RECENT BUSHFIRE RESEARCH

Traditionally, bushfire modelling conducted to determine rates of spread, intensity, flame lengths, radiant heat etc and provide measurements of threat levels, has been based on the quasi-steady fire state (i.e. a fire propagating under constant and uniform fuel, weather and topography – after it has finished its growth phase).

More recent research has provided important insights into the dynamic nature of fire spread in the landscape and identified local drivers of bushfire risk and highlighted the role of environmental factors that are significant for large and extreme fire development.

These environmental factors include aspects of the vertical structure of the atmosphere, meso-scale fire weather processes (e.g., sea breezes, cold fronts, squall lines, convective complexes), interactions between the fire and the atmosphere, and the modification of fire weather and fire behaviour due to the local topography.

From this work, several processes that can contribute significantly to the level of risk posed by a bushfire have been identified. These include:

- Extreme fire weather processes;
- Dynamic fire propagation; and
- Violent pyroconvection and pyrogenic winds.

Of relevance to this risk assessment are the topographic aspects of the surrounding landscape surrounding the subject site and the potential it might present for dynamic fire propagation, development of extreme fire events and therefore increased bushfire hazard threat levels and consequent risk.

DYNAMIC FIRE BEHAVIOURS

Dynamic fire behaviours (DFBs) result from interactions between the physical factors of fuel, terrain, fire weather conditions, atmosphere and different parts of the bushfire itself. They are physical phenomenon that involve rapid changes of fire behaviour and occur under specific conditions.

Certain DFBs occur at various scales and time frames (e.g. spotting), others only at large scales (e.g., conflagrations and pyroconvective events) and others at small scales and short time spans (e.g. junction fires, fire whirls). The following fire behaviours are considered DFBs:

Spotting

The production of embers/firebrands, carried by the wind/convective currents that ignite spot fires ahead of the bushfire front. Under extreme conditions, with the necessary fuels, mass spotting events can occur. Dependent on fuel types, winds and convective currents, embers can be consumed by the fire front itself or travel tens of kilometres. Spot fire occurrence can be so prevalent that spotting becomes the dominant propagation mechanism – with the fire spreading as a cascade of spot fires forming a 'pseudo' front.

Fire Whirl / Tornado

Various sized (<1m - >150m) spinning vortices of ascending hot air and gases that carry smoke, debris, and flame. The intensity of larger whirls compares to tornados. Can induce fire spread contrary to prevailing wind and ignite spot fires away from the fire front.

Junction Fire

Is associated with merging fire fronts that produces very high rates of spread and have the potential to generate fire whirls / tornadoes.

Crown Fire

Types of tree crown fires have been categorised according to their degree of dependence on the surface fire phase - passive, active, independent - with the last two being considered dynamic fire behaviour.

Active crown fire is "a fire in which a solid flame develops in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other."

Independent crown fires "advance in the tree crowns alone, not requiring any energy from the surface fire to sustain combustion or movement."

For a crown fire to start, a surface fire of sufficient intensity is first necessary. The distance between the heat source at the ground surface and the canopy-fuel layer will determine how much of the surface fire's energy is dissipated before reaching the fuels at the base of the canopy. The higher the canopy base, the lower the chance of crowning.

The existence of trees themselves, separated from surface fuels, can offer a degree of protection by absorbing radiant heat, trapping embers and shielding from winds. Necessary considerations include:

- Eliminating understorey fuels;
- Species Issue: Understanding the extent to which the trees will contribute to fuels (leaves/bark/twigs etc) that accumulate on the ground and when moved (wind) become involved in consequential fire away from the tree during the fire season. This needs to be considered against the maintenance capability (regular removal of material) of the responsible entity; and
- Species / Positioning Issue: Requirements include not being highly flammable, no loose stringy bark, less able to trap embers, not being prone to branches breaking in high winds potentially causing structural damage to buildings (allowing ember entry) and keeping crowns separated as an additional measure of safety and allow wind to permeate rather than be totally blocked.

Eruptive Fire

Behaviour where the head fire accelerates rapidly on sufficiently steep terrain with sufficiently strong wind – as a result of fire plume attachment to the surface, bathing it in flames ahead of the front (pre-heating).

Fire Channelling / VLS (vorticity-driven lateral spread)

Behaviour where rapid lateral fire spread, in generated vortices, occurs across a sufficiently steep leeward slope in a direction approximately transverse to the prevailing winds. This results in the rapid increase in width of the fire front. VLS are highly effective at producing mass spotting events.

Conflagrations

These are large, intense, destructive fires. They have a moving front as distinguished from a fire storm (blow up / pyroconvective fire). With sufficient vegetation extent, fuel loads and the development of dynamic fire behaviours, the large amounts of heat and moisture released can cause its plume to rise into the atmosphere and develop large cumulus or cumulonimbus flammagenitus cloud (pyrocumulus or pyrocumulonimbus). Where the extent of vertical development is limited (e.g. a stable atmosphere, or insufficient flaming zone), the fire is likely to remain a surface-based event.

Downbursts

These are strong wind downdrafts associated with convective columns of heated air (and associated cloud forms). The consequent falling columns of cooled air induce an outburst of strong winds on or near the ground that radially spread causing fire spread in directions contrary to the prevailing wind.

Pyroconvective Event

A pyro-convective event is an extreme manifestation of a conflagration that develops in an unstable atmosphere and can transition into a towering pyrocumulus or a pyrocumulonimbus (pyroCb's) that can extend to the upper troposphere or lower stratosphere. With the fire/atmosphere coupling, it has evolved beyond a purely surface based fire into dynamic fire propagation rather than quasi-steady propagation. In the violent pyroconvective system:

- As a fire's plume reaches higher into the atmosphere, larger scale mixing can cause drier and higher-momentum upper air to be transferred back to the surface, thereby further exacerbating the potential for more intense fire behaviour, including fire spread contrary to the prevailing wind direction;

- Pyrogenic winds can cause considerable damage to structures, directly or indirectly, increasing their vulnerability to bushfire attack mechanisms; and
- The pyroCb's carry dense ember loads, fire and other burning debris and generate lightning, all with very little rain or hail that would typically occur with an ordinary thunderstorm.

DRIVERS OF DEEP FLAMING

Deep flaming is the fire condition when the active flaming zone is unusually large and flame-front intensity is simultaneously great, resulting in large quasi-instantaneous energy release.

Deep flaming can be produced by numbers of mechanisms on varying terrain (flat, undulating of rugged) when a large enough area of sufficiently heavy fuels is present. These mechanisms include:

- Very strong winds – so the head fire advances more rapidly than the back of the flaming zone;
- Change in wind direction – so the long flank of a fire is transformed into a fast running head fire;
- Eruptive fire behaviour – where steep slopes can cause a fire to accelerate rapidly;
- Vorticity-driven lateral spread (wind channelling) – where strong winds and steep terrain interact to rapidly drive a fire laterally, accompanied by downwind mass spotting and consequent coalescing of spot fires forming large areas of flame (can include the DFB of 'junction fire').

Research has identified strong links between:

- Eruptive fire behaviour, VLS and the occurrence of deep flaming; and
- The development of deep flaming and extreme bushfire events.

EXTREME BUSHFIRE EVENTS

Extreme bushfire events create disproportionate risks to human and environmental. Their development is affected by dynamic feedback processes that result in unpredictable behaviour, and the worsening of rates of spread and intensities - even when environmental conditions are consistent.

The term 'extreme bushfire' is applied in the recent bushfire science literature in two ways:

1. Where it refers to large, intense bushfires in which one or more DFBs are simultaneously involved; and
2. Where it more specifically refers to a fire that exhibits deep or widespread flaming in an atmospheric environment conducive to the development of violent pyroconvection, often manifesting as towering pyrocumulus (pyroCu) or pyrocumulonimbus (pyroCb) storm(s) – also referred to as blow-up fire event(s).

   A distinguishing feature of these types of fires is that they involve a coupling of the fire with an unstable atmosphere to a much greater vertical extent, well above the mixed layer, which modifies or maintains the fire's propagation (e.g. through mass spotting, blustering winds and lightning);

Relevance to Risk Assessment: Given that this risk assessment is concerned with identifying the potential for the landscape surrounding the subject site to increase bushfire risk, the following common aspects of the two above descriptions are relevant:

- An extreme fire is a large intense fire, so it requires a sufficient area and sufficient fuels in which to develop; and
- An extreme fire of scale requires the formation of deep flaming to develop.

Consequently, the risk assessment is primarily focused on the extent and fuel types/loads of bushfire prone vegetation and the existence of terrain (topography) properties necessary for the relevant dynamic fire behaviours - rather than the potential for adverse fire weather / atmospheric conditions - whose likely occurrence can be assumed as possible.

Note also that the second description requires an unstable atmosphere - to enable deep/violent pyroconvection and subsequent significant cloud formation and latent heat release. This is not essential for the first. Consequently, this identifies a potential difference between the two defined extreme bushfire events to be considered when assessing risk:

- Large, intense bushfires can occur without deep convective column development. These fires remain as surface fires (essentially wind-driven fires), with a greater predictability of behaviour; and

- Large, intense bushfire that couple with an unstable atmosphere are no longer surface based. They are associated with a higher level of energy, chaos, and nonlinearity due to the enhanced (fire-induced) interaction between the boundary layer and the free troposphere, which may introduce factors that act to maintain or enhance widespread flaming. The fire behaviour is much more unpredictable.

PHYSICAL REQUIREMENTS OF TERRAIN, FUEL LOAD (AND WINDSPEED) FOR DEEP FLAMING

The dynamic fire behaviours of eruptive fire and VLS with associated mass spotting, along with potential for topographically modified winds to develop, are strongly linked with the development of deep flaming, which is a prerequisite for extreme bushfire events.

There are certain environmental thresholds that are required to be met for these dynamic fire behaviours to occur. These are described below and form part of the assessment of the bushfire hazard in Section 5.3.

Eruptive Fire Behaviour

Eruptive fires are characterised by a rapid acceleration of the head fire rate of spread (exponential increases in rate of spread have been observed). It results in a rapid deepening of the flaming zone (larger area of active flame), from which heat is released into the atmosphere.

Eruptive fire results from the interaction between the slope of the terrain and the fire's plume. In the absence of wind, plume attachment can be expected on terrain that is inclined at roughly 24° or more and the effects of wind could cause plume attachment on slopes inclined at angles of 24° or lower. Consequently, the primary topographic requirement for eruptive fire is sufficiently steep terrain and sufficiently strong wind.

"This mode of fire propagation is completely contrary to that expected under the quasi- steady fire spread paradigm … eruptive fire behaviour poses a serious threat to the successful containment of a bushfire and provides a mechanism that can substantially elevate the risk posed by a bushfire in areas that are prone to its occurrence".

Rugged terrain (areas with local topographic relief >300m), is particularly prone to eruptive fire (and dynamic fire behaviours in general).

Fire Channelling (Vorticity-Driven Lateral Spread)

Fire channelling (VLS) exists when a fire exhibits rapid spread in a direction transverse to the synoptic winds as well as in the usual downwind direction. It is characterised by intense lateral and downwind spotting and production of extensive flaming zones.

VLS is highly effective at producing mass spotting events. A link between deep flaming events caused by VLS and the formation of pyroCb has been demonstrated. Under extreme conditions, spot fire occurrence can be so prevalent that spotting becomes the dominant propagation mechanism.

VLS can only be expected to occur on parts of the landscape, and under certain fire weather conditions. VLS occurrence depends critically on the following:

- Leeward slopes greater than 20-25° are required;
- Wind direction must be within 30-40° of the topographic aspect;
- Wind speed in excess of about 20 km h-1 are required;
- Generally, VLS is only observed in heavy forest fuel types with load in excess of 15-20 t ha; and
- Fuel moisture content – dense spotting and downwind extension of the flaming zone are far more likely when fuel moisture contents are around 5% or less.

Topographically Modified Surface Winds - Downslope Winds

In WA the scarp winds are the well-known local occurrence of downslope winds. Similar meteorological phenomena (typically as foehn winds) occur in the lee of mountain ranges in many parts of the world, particularly on ranges with gentle windward and steep leeward slopes.

Scarp winds are nocturnal, strong and gusty winds that develop near the base of the scarp through summer months. The local mechanism is for a synoptic easterly flow, causing air to rise to the top of the scarp from further inland, at which point it is cooler and denser than the surrounding airmass. This produces an unstable situation and consequently the air flows down the scarp as a turbulent density current.

There are implications for enhanced fire activity for a fire located in a region of downslope winds, as they provide a clear mechanism for rapid, irregular direction of fire spread as well as turbulent transport of firebrands and plume

development. If a 'hydraulic jump' is also present, the strong vertical motion in the jump region is a mechanism for lofting and dispersal of firebrands further ahead of the bushfire front.

APPENDIX 4: EXPLAINING BUSHFIRE ATTACK LEVEL (BAL)

Bushfire attack levels are determined using the methodology established by AS 3959:2018 Construction of buildings in bushfire prone areas. The Standard defines a bushfire attack level (BAL) as a "means of measuring the severity of a building's exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kW/m^2."

Each BAL rating represents a set range of radiant heat flux (see table below). The amount of radiant heat and flame lengths generated by a bushfire is dependent on many factors that are modelled using the Standard's fire behaviour and flame length models. Key factors include vegetation type, terrain and a range of fire weather factors. The variation that can exist in these factors will result in varying separation distances, away from bushfire prone vegetation, corresponding to a given BAL rating. These distances can be presented as data in a table or illustrated by mapping – the 'BAL Contour Map'

The different BAL ratings effectively incorporate the threat levels of flame contact, radiant heat transfer and ember/firebrand attack:

- The highest ratings of BAL-FZ and BAL-40 indicate direct or likely exposure to the flame contact threat;
- Each BAL rating represents a defined range (in kW/m^2), of the radiant heat transfer threat, with the threat level increasing from BAL-LOW to BAL-FZ; and
- Each higher BAL rating assumes an increased exposure to the ember/burning debris attack threat. This is based on the practical acknowledgement that the closer the element at risk is to the source of ember production the greater the likely exposure level. In practice, this strong correlation does not exist for all bushfire event scenarios. However, AS 3959 is only intending to apply the same construction response to ember/firebrand attack for each BAL rating above BAL-LOW as consequential fire from any source other than from within the subject structure itself is not being considered by the Standard.

Bushfire Attack Level	Explanation [Source AS3959:2018]
BAL – LOW	There is insufficient risk to warrant specific construction requirements but there is still some risk. *Important Note: For AS3959:2018 purposes, BAL-LOW will exist at 100m from classified vegetation (50m for Grassland).* *However, embers/firebrands from certain vegetation types can ignite spot fires ahead of the fire front for significant distances – short range spotting up to 740m, medium range spotting up to 5km and long range spotting has been authenticated up to 30km.*
BAL – 12.5	There is a risk of ember attack. Construction elements are expected to be exposed to heat flux not greater than 12.5 kW/m^2
BAL – 19	There is a risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to radiant heat. The construction elements are expected to be exposed to a heat flux not greater than 19 kW/m^2.
BAL – 29	There is an increased risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to an increased level of radiant heat. The construction elements are expected to be exposed to a heat flux not greater than 29 kW/m^2.
BAL – 40	There is a much increased risk of ember attack and burning debris ignited by windborne embers, a likelihood of exposure to a high level of radiant heat and some likelihood of direct exposure to flames from the fire front. The construction elements are expected to be exposed to a heat flux not greater than 40kW/m^2.
BAL – FZ (Flame Zone)	There is an extremely high risk of ember attack and burning debris ignited by windborne embers, and a likelihood of exposure to an extreme level of radiant heat and direct exposure to flames from the fire front. The construction elements are expected to be exposed to a heat flux greater than 40 kW/m^2.

APPENDIX 5: THE SURROUNDING LANDSCAPE - VEGETATION CATEGORY AND HAZARD DETERMINATION CRITERIA

DETERMINATION OF VEGETATION CATEGORIES AND THE BASE BUSHFIRE HAZARD SCENARIO

The following criteria are applied to the categorisation of vegetation on the surrounding landscape and the establishment of the base bushfire hazard scenario, for the purpose of deriving potential bushfire threat levels. These threat levels are subsequently applied in the determination of risk levels associated with a bushfire event.

Vegetation Categories

These are established to enable a comprehensive assessment of the type and severity of the bushfire attack mechanisms (i.e., the bushfire threats), potentially generated by bushfire prone vegetation on surrounding land. This enables variations in vegetation composition and structure to be more appropriately accounted for in the determination of the levels of risk associated with a local bushfire event.

The variations in the potential threat level ranges assigned to each vegetation category in the table below are the result of these differences.

The 'Categories' are necessarily different to the vegetation 'Classifications' applied in the BAL determination methodology of AS 3959:2018. The building Standard primarily considers the flame contact and radiant heat attack mechanisms and does not fully address ember/firebrand attack or other threats.

The Range of Potential Threat Levels the Base Bushfire Hazard Scenario

The assumptions that make up the base bushfire hazard scenario are applied to deriving the midpoint of each potential threat level range for each category of vegetation. Variations from the base scenario will potentially modify the assessed threat level (i.e., increase or decrease it within the relevant range). The assessment of the subject site for the existence of threat modifying physical factors, is presented in Section 5.1.4 of this report.

The primary components of the Base Bushfire Hazard Scenario are:

- The extent of bushfire prone vegetation is sufficiently large such that a fully developed fire can be supported. Parameters applied to the design fire of AS 3959:2018 BAL determination methodology are applied. Specifically, a head fire width of at least 100 metres is physically possible and sufficient fire run length exists to allow a quasi-steady rate of spread (after the initial growth phase) to be attained and a head fire width of 100 metres to develop from a single point of ignition. Typically, but not in every scenario, this will equate to areas of vegetation greater than 3ha and within which fire runs directly at an element at risk will be greater than 50 -100 metres in length;
- The fire fuels are continuous, and the terrain is flat to undulating with no vegetated slopes greater than ten degrees; and
- It is assumed to be possible for the most adverse fire weather to occur at the subject locality.

SURROUNDING LANDSCAPE VEGETATION MAPPING - CATEGORY DETERMINATION CRITERIA					
Category Code	Category Description				
	Total Fuel Loads	Most Relevant Fuel [1]	Spotting Range [2]	Spotting Density [2]	Potential Threat Level Range (Property) [3]
Tree-1	Moderate to Extreme	Fine, fibrous, long strand bark	Short to Medium	Very High	Moderate to Extreme
	Trees and Bark Hazard: Tree dominated vegetation including tall species. At least 10% of the trees present have fine, longer strand fibrous barks (stringybarks). "These barks are easily dislodged from the trunk, allowing simultaneously for vertical fire propagation into the overstorey and profuse short to medium range spot fire ignitions." Spotting Threat: The fine, longer strand fibrous barks (stringybarks) have the potential to produce the highest short range (up to 500-750 metres) spotting density (quantity) and can spot out to medium ranges (up to 5 km) under conducive fuel, terrain and fire weather conditions. Potential spotting (ember / firebrand attack) threat levels range from moderate to extreme. Fuel Loads: Surface and near surface fuel loads (t/ha) range from moderate to very high (note: the worst potential fuel load for the location is applied, regardless of time since last burnt). Example Eucalyptus Species: Includes jarrah, messmate stringybark and brown/red stringybark. Marri can be included in this category due to the potential high-density spotting but will be limited to the shorter spotting range.				
Tree-2	Moderate to Very High	Ribbon, candle bark	Short to Long	Moderate	Moderate to Extreme
	Trees and Bark Hazard: Tree dominated vegetation including tall species. Less than 10% of trees present will have fine, longer strand fibrous barks (stringybarks). The predominant trees are smooth bark species where the bark sheds in long ribbons (ribbon/candle barks), and often hangs on the branches. "These bark types provide aerodynamically efficient, firebrand material that can remain alight for long periods and be transported over considerable distances." Spotting Threat: These bark types have the longest distance spotting potential (greater than 5 km) due to the long burnout time of the firebrands. However, the potential ember/firebrand density (quantity) will be lower than for fine, longer strand fibrous barks. Potential spotting (ember / firebrand attack) threat levels range from moderate to very high. Fuel Loads: Surface and near surface fuel loads (t/ha) range from moderate to very high (note: the worst potential fuel load for the location is applied, regardless of time since last burnt). Example Eucalyptus Species: Includes manna gum, blue gum, alpine ash and woollybutt, mallee species. Karri can be included in this category on the basis that while spotting distance is unlikely to be long range (as the bark is shed in short ribbons/small polygonal flakes), the potential for extreme fuel loads is relevant to the categorisation.				
Tree/Shrub	Moderate to High	Smooth, platy, papery, coarsely fibrous bark and/or Shrub fuels	Short	Low to Moderate	Moderate to High
	This category can have the most variation in vegetation types that are present. It can consist of predominantly trees with the stated bark types or be predominately shrub type vegetation or any combination. Can include areas of grass. Trees and Bark Hazard: Trees can be of any height. Bark types are more varied and have the characteristics of being tightly held onto the trunk, producing short strands, or producing chunks or				

	small flakes which fall to the ground. These bark types are described as smooth, platy, papery and coarsely fibrous. Shrub Fuels: Scrub, shrub, heath type fuels of vertically oriented, well aerated, with live and dead vegetation extending from the surface to the top of the vegetation complex and up to 6 metres high. Spotting Threat: Trees with the stated bark types can produce limited quantities of embers and shorter spotting distances (up to 500-750 metres). Shrub fuels can produce moderate to high quantities of smaller and shorter burn duration embers, resulting in mostly short distance spotting. Fuel Loads: Surface, near surface and elevated fuel loads (t/ha) range from moderate to high (note: the worst potential fuel load for the location is applied, regardless of time since last burnt).
Shrub	Low to High | Shrub fuels | Short | Low | Low to Moderate Shrub Fuels: Scrub, shrub, heath type fuels of smaller sized, vertically oriented, well aerated fuels, with continuous live and dead vegetation extending from the surface to the top of the vegetation complex and up to 2 metres high. Can include areas of grass. Spotting Threat: Shrub fuels can produce limited quantities of small and short burn duration embers resulting in low density short distance spotting (up to 500-750 metres). Fuel Loads: Surface, near surface and elevated fuel loads (t/ha) range from moderate to high (note: the worst potential fuel load for the location is applied, regardless of time since last burnt).
Grass	Low to Moderate | Fine grass fuels | Very Short | Low | Low to Moderate Fuel Types: Will be varied and includes the following groups that each have similar structural characteristics - tropical grasslands, tussock grasslands, hummock grasslands, and improved pastures / crop lands comprised of species that cure. These fuels are typically much finer than other vegetation types with a low bulk density. Where trees are present, they make up no more than 10% of canopy cover and will have no influence on fire behaviour. Fuel Loads: Are much lower than other types of vegetation complexes. For example, default total fuel loads applied in AS 3959:2018 BAL determination methodology for Grassland range from 43% to 85% less than other vegetation classifications. Fire Behaviour: Combustion rates are faster in grasslands than forest fuels due to the finer materials and more aerated structure. This gives rise to the main cause of differences in fire behaviour between grassfires and fires in other fuel types - the residence time is much shorter. This is the period during which flames remain burning over one spot on the ground. Using pastures as an example, the residence time is in the order of 5 seconds in fine light pastures and 10-15 seconds in heavy pastures. This results in grassfires spreading more quickly, reacting very quickly to changes in wind direction and speed and being a shorter duration threat to a specific exposed element. Spotting Threat: Embers produced by grass fires are smaller and fewer in number than those produced from forest fires and burn for shorter durations. Typically, spotting in grassfires occurs over very short distances and are generally not noticed as they are quickly overrun by the main fire. Potential spotting (ember / firebrand attack) threat levels are low.
No/Low Threat	No Threat to Low Areas of land will satisfy this category when the following factors apply: • Low threat vegetation characteristics including low flammability, high moisture content (including non-curing crops) and minimal fuel load. Low threat examples established in AS 3959:2018 include: managed grassland, mangroves/saline wetlands, maintained lawns, golf courses, public reserves/parklands, sporting fields, vineyards, orchards, banana plantations, market gardens, commercial nurseries, nature strips and windbreaks; and • Areas permanently cleared of vegetation, including natural features such as rocky outcrops and manmade infrastructure.

Note 1: The fuel type/s that are most relevant for the categorisation of area of vegetation are stated. This has particular relevance where certain bark types and quantity are a significant component of total fuel loads, resulting in higher threat levels for the ember/firebrand direct attack mechanism. Bark fuels are the primary source of fuel for the ember/firebrand attack threat (refer to Appendix 2 for additional information).

Note 2: Understanding and assessing the threat level generated by the ember/firebrand direct attack mechanism (spotting) is important to the management of risks associated with any bushfire hazard. With respect to categorising surrounding landscape vegetation, based on threat levels, the following points identify why the assessment of the spotting threat is important:

- At distances beyond 100 metres from a subject land the direct attack mechanisms of flame contact and radiant heat transfer cannot significantly and directly impact the building elements at risk within that site;
- However, embers/firebrands can impact subject land through the ignition of consequential fire (as an indirect attack mechanism of bushfire), in fuels and structures surrounding, upon and within the relevant elements at risk (e.g., habitable buildings). Consequential fires bring the direct attack mechanisms of flame and radiant heat much closer than the bushfire itself can. Assessments of past bushfire events indicate that ember attack and consequential fire be the cause of 80% or greater of property losses; and
- Spotting can significantly influence the increase scale of the bushfire event and its consequent intensity, both within the surrounding landscape and within the 100 metres surrounding a subject land. From *Cruz M.G. et al (2015): A Guide to Rate of Fire Spread Models for Australian Vegetation. CSIRO, AFAC*). "Spotting is an important, at times dominant, fire propagation process in high intensity fires in eucalypt forests. The type of tree bark will determine the size, shape, and number of firebrands, which the prevailing weather conditions will dictate the spotting distances and density of ignitions." Refer to Appendix 2 for additional information.

Note 3: The stated potential threat levels identify the threat level range that is associated with the stated vegetation category as it applies to constructed property, as opposed to persons in the open or travelling access routes in vehicles, which will be separately assessed.

Subsequent assessment of vegetation, terrain and fire weather factors associated with the surrounding landscape that can increase or decrease the bushfire hazard threat levels, will complete the surrounding landscape assessment for the subject land.

A6.1 LOCATION OF SUBJECT LAND RELATIVE TO DESIGNATED AREAS OF BUSHFIRE PRONE LAND

Relevant State/Territory authorities have determined what is to be considered bushfire prone vegetation and how areas of land will be identified as presenting bushfire risk, by their designation on maps.

The mapping then functions as a trigger, for development and uses within the designated areas of land, to apply one or more of the following, as applicable to the jurisdiction:

- Legislated bushfire planning provisions/controls;
- Legislated bushfire building provisions/controls; and/or
- Legislated fire controls.

The location of the subject site relative to the relevant mapping is presented in Figure A5.1.

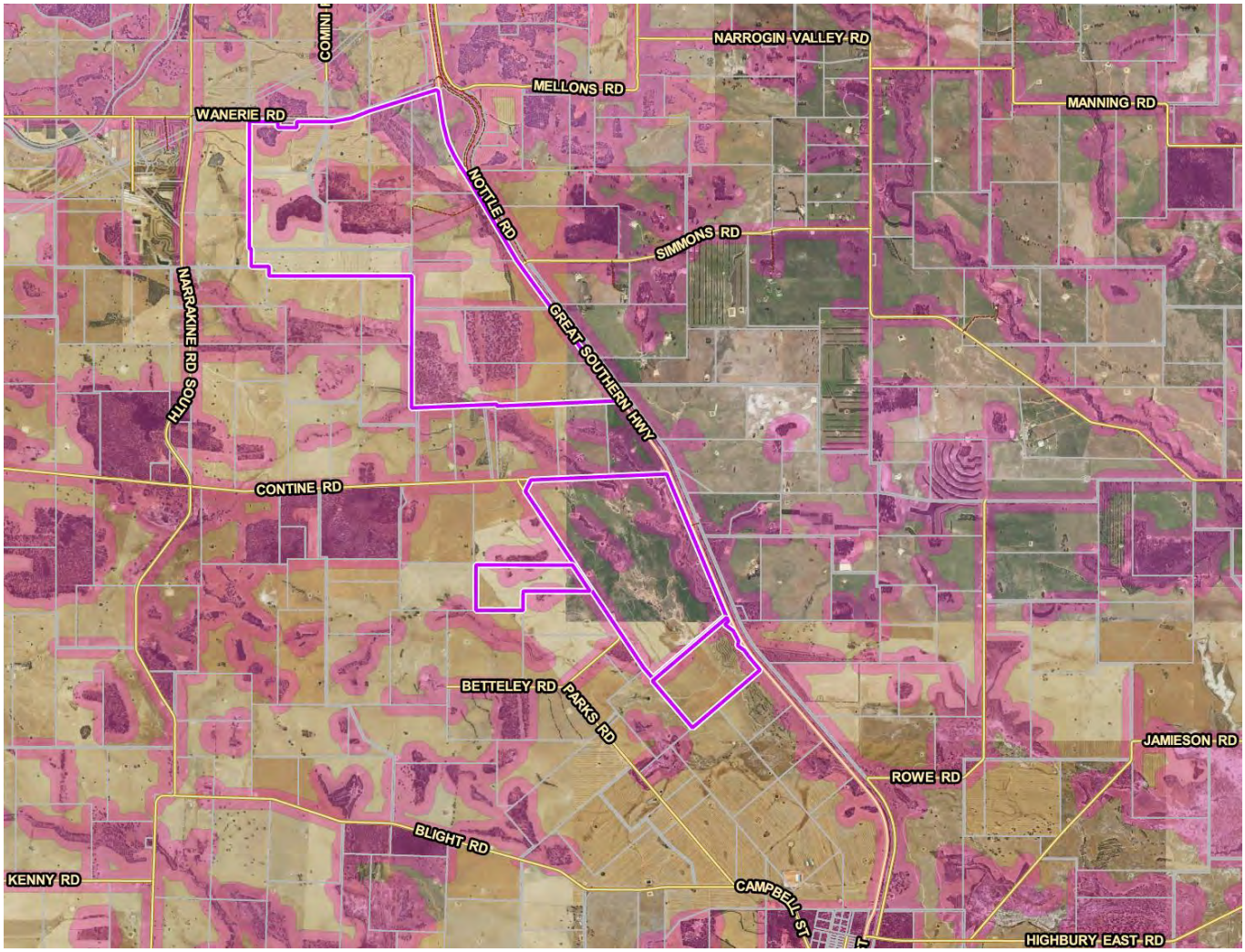


Figure A6.1: Subject site is within a Bushfire Prone Area.

A6.2 SURROUNDING LANDSCAPE - VEGETATION CATEGORISATION – PHOTO EVIDENCE

PHOTO EVIDENCE - CATEGORISED VEGETATION	
	
Category: Tree-1	Category: Tree-1
	
Category: Tree-2	Category: Tree-2
	
Category: Tree/Shrub	Category: Tree/Shrub

PHOTO EVIDENCE - CATEGORISED VEGETATION	
	
Category: Grass	Category: Grass

A6.3 SUBJECT LAND + 150M EXTENT – VEGETATION CLASSIFICATION (SUPPORTING DATA)

INFORMATION TO ASSIST INTERPRETATION

Vegetation Types and Classification

In accordance with AS 3959:2018 clauses 2.2.3 and C2.2.3.1, all vegetation types within 100 metres of the 'site' (defined as "the part of the allotment of land on which a building stands or is to be erected"), are identified and classified. Any vegetation more than 100 metres from the site that has influenced the classification of vegetation within 100 metres of the site, is identified and noted. The maximum excess distance is established by AS 3959: 2018 cl 2.2.3.2 and is an additional 100 metres.

Modified Vegetation

The vegetation types have been assessed as they will be in their natural mature states, rather than what might be observed on the day. Vegetation destroyed or damaged by a bushfire or other natural disaster has been assessed on its expected re-generated mature state. Modified areas of vegetation can be excluded from classification if they consist of low threat vegetation or vegetation managed in a minimal fuel condition, satisfying AS 3959:2018 s2.2.3.2(f), and there is sufficient justification to reasonable expect that this modified state will exist in perpetuity.

The Influence of Ground Slope

Where significant variation in effective slope exists under a consistent vegetation type, these will be delineated as separate vegetation areas to account for the difference in potential bushfire behaviour, in accordance with AS 3959:2018 clauses 2.2.5 and C2.2.5.

THE INFLUENCE OF VEGETATION GREATER THAN 100 METRES FROM THE SUBJECT SITE	
Vegetation area(s) within 100m of the site whose classification has been influenced by the existence of bushfire prone vegetation from 100m – 200m from the site:	N/A
Assessment Statement:	No vegetation types exist close enough, or to a sufficient extent, within the relevant area to influence classification of vegetation within 100 metres of the subject site.

A6.4.1 VEGETATION CLASSIFICATION PHOTOS AND JUSTIFICATION

VEGETATION AREA 1						
Classification	A. FOREST					
Types Identified	Open forest A-03 Low open forest A-04					
Exclusion Clause	N/A					
Effective Slope	Measured	d/slope 5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	30-70%	Shrub/Heath Height	1-2m	Tree Height	Up to 30m	
Justification Comments:	Native forest found throughout the site and surrounds showing highly variable species composition. The vegetation may be of forest structure, or woodland structure with >30% canopy cover.					
Post Development Assumptions:	N/A					



PHOTO ID: 1



PHOTO ID: 2



PHOTO ID: 3



PHOTO ID: 4



PHOTO ID: 5



PHOTO ID: 6



PHOTO ID: 7



PHOTO ID: 8



PHOTO ID: 9



PHOTO ID: 10



PHOTO ID: 11



PHOTO ID: 12



PHOTO ID: 13



PHOTO ID: 14



PHOTO ID: 15



PHOTO ID: 16



PHOTO ID: 17



PHOTO ID: 18



PHOTO ID: 19



PHOTO ID: 20

VEGETATION AREA 2						
Classification	B. WOODLAND					
Types Identified	Woodland B-05					
Exclusion Clause	N/A					
Effective Slope	Measured	d/slope 5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	<30%	Shrub/Heath Height	-	Tree Height	Up to 30m	
Justification Comments:	Scattered, tall trees with no understorey. Dry, grassy ground cover. Many standing, dead trees.					
Post Development Assumptions:	N/A					



PHOTO ID: 21



PHOTO ID: 22



PHOTO ID: 23



PHOTO ID: 24



PHOTO ID: 25



PHOTO ID: 26

VEGETATION AREA 3						
Classification	A. FOREST					
Types Identified	Open forest A-03		Low open forest A-04		Open scrub D-14	
Exclusion Clause	N/A					
Effective Slope	Measured	d/slope 5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	>30%	Shrub/Heath Height	Up to 6m	Tree Height	Up to 30m	
Justification Comments:	Road verge vegetation with greatly variable species assemblages and structures. The vegetation has been classified as Class A Forest as a precautionary measure.					
Post Development Assumptions:	N/A					



PHOTO ID: 27



PHOTO ID: 28



PHOTO ID: 29

VEGETATION AREA 4						
Classification	E. MALLEE/MULGA					
Types Identified	Tall shrubland E-15 Sown pasture G-26					
Exclusion Clause	N/A					
Effective Slope	Measured	d/slope 5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	<30%	Shrub/Heath Height	Up to 10m	Tree Height	-	
Justification Comments:	Mallee contained in plantations and arranged in rows with low overall canopy cover.					
Post Development Assumptions:	N/A					



PHOTO ID: 30



PHOTO ID: 31

VEGETATION AREA 5						
Classification	G. GRASSLAND					
Types Identified	Sown pasture G-26		Open tussock G-23			
Exclusion Clause	N/A					
Effective Slope	Measured	d/slope 5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	<10%	Shrub/Heath Height	-	Tree Height	Up to 30m	
Justification Comments:	Paddocks or grassland used for livestock grazing or road verges. Some areas are private land with some scattered trees.					
Post Development Assumptions:	Portions of the vegetation will be managed or removed to install assets, access roads, and the required APZs. The balance of the vegetation is expected to be retained.					



PHOTO ID: 32



PHOTO ID: 33



PHOTO ID: 34



PHOTO ID: 35



PHOTO ID: 36



PHOTO ID: 37

VEGETATION AREA 6	
Exclusion Clause	2.2.3.2 (e) Non-vegetated areas and (f) Low threat vegetation - minimal fuel condition.
Justification Comments:	Roads, structures, and low threat landscaping associated with existing structures.
Post Development Assumptions:	N/A

Figure A6.2.1

Classified Vegetation & Topography (Existing) North

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

AREA 1
Class (A) Forest
Effective Slope >0-5°

AREA 5
Class (G) Grassland
Effective Slope >0-5°

AREA 2
Class (B) Woodland
Effective Slope >0-5°

AREA 3
Class (A) Forest
Effective Slope >0-5°

AREA 6
Excluded

MELLONS RD
NOTTLE RD
SIMMONS RD
GREAT SOUTHERN HWY

10 11 12 13 14 15 16 17 18 19 20 24 25 26 28 29 36 37 8 9

------ LEGEND ------

- Subject Site
- Cadastral
- Photo and Direction
- 150m Assessment Area
- BESS Layout
- Solar Layout
- Substation

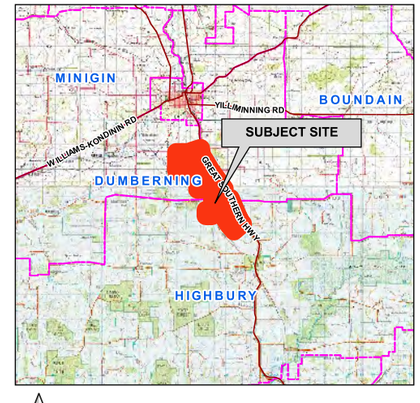
Classified Vegetation

- Class A - Forest
- Class B - Woodland
- Class E - Mallee-Mulga
- Class G - Grassland
- Exclusion 2.2.3.2

0 200 400 600 800

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 19-09-2024
SCALE (A3): 1 : 15000

BUSHFIRE PRONE PLANNING

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231010_3-1_VEG_Narrogin Solar Farm.qgz

Figure A6.2.2

Classified Vegetation & Topography (Existing) South

52 Contine Road
DUMBERNING
SHIRE OF NARROGIN

CONTINE RD
PARKS RD
BETTELEY RD
GREAT SOUTHERN HWY

AREA 1 Class (A) Forest Effective Slope >0-5°
AREA 2 Class (B) Woodland Effective Slope >0-5°
AREA 4 Class (E) Mallee-Mulga Effective Slope >0-5°
AREA 5 Class (G) Grassland Effective Slope >0-5°
AREA 6 Excluded

1 2 3 4 5 6 7 21 22 23 27 30 31 32 33 34 35

------ LEGEND ------

- Subject Site
- Cadastral
- Photo and Direction
- 150m Assessment Area
- BESS Layout
- Solar Layout
- Substation

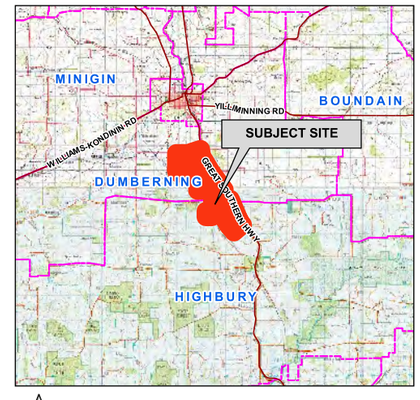
Classified Vegetation

- Class A - Forest
- Class B - Woodland
- Class E - Mallee-Mulga
- Class G - Grassland
- Exclusion 2.2.3.2

0 200 400 600

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

N

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Joy 19-09-2024
SCALE (A3): 1 : 11000

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A6.6 RADIANT HEAT MODELLING – CALCULATION INPUT / OUTPUT DATA

Table A6.6.1: Applied calculation input variables.

SUMMARY OF CALCULATION INPUT VARIABLES APPLIED TO THE DETERMINATION OF SEPARATION DISTANCES CORRESPONDING TO LEVELS OF RADIANT HEAT TRANSFER [1]													
Applied BAL Determination Method		METHOD 1 - SIMPLIFIED PROCEDURE (AS 3959:2018 CLAUSE 2.2) AND METHOD 2 - DETAILED PROCEDURE (AS 3959:2018 APPENDIX B)											
The Calculation Variables Corresponding to the BAL Determination Method Applied													
Methods 1 and 2		Method 1			Method 2								
Vegetation Classification		FDI	Effective Slope		Site Slope	FFDI or GFDI	Flame Temp.	Elevation of Receiver	Flame Width	Fireline Intensity	Flame Length	Modified View Factor	
			Applied Range	Determined									
Area	Class		degree range	degrees	degrees		K	metres	metres	kW/m	metres	% Reduction	
1	(A) Forest	80	Downslope >0-5	d/slope 5	upslope 5	80	Default	Default	Default	Default	Default	Default	
2	(B) Woodland	80	Downslope >0-5	d/slope 5	upslope 5	80	Default	Default	Default	Default	Default	Default	
3	(D) Scrub	80	Downslope >0-5	d/slope 5	upslope 5	80	Default	Default	Default	Default	Default	Default	
4	(E) Mallee/Mulga	80	Downslope >0-5	d/slope 5	upslope 5	80	Default	Default	Default	Default	Default	Default	
5	(G) Grassland	80	Downslope >0-5	d/slope 5	upslope 5	110	Default	Default	Default	Default	Default	Default	
6	Excluded cl 2.2.3.2(e & f)	-	-	-	-	-	-	-	-	-	-	-	

Note 1: Where the values are stated as 'default' these are either the values stated in AS 3959:2018, Table B1 or the values calculated as intermediate or final outputs through application of the equations of the AS 3959:2018 BAL determination methodology. They are not values derived by the assessor.

The summary 'printouts' of calculation input and output values for each area of classified vegetation are presented following the tables.

Note 2: Classified in accordance with AS 3959:2018 BAL determination methodology, or an accepted State specific classification and associated fuel loads.

Table A6.6.2: Vegetation separation distances corresponding to the radiant heat levels illustrated as BAL contours in Figure 4.1 (Section 4.1.3)

THE CALCULATED VEGETATION SEPARATION DISTANCES (METRES) CORRESPONDING TO THE STATED LEVEL OF RADIANT HEAT FLUX [1]									
Vegetation Classification		Bushfire Attack Levels						Specific Values	
		BAL-FZ	BAL-40	BAL-29	BAL-19	BAL12.5	BAL-LOW		
		Maximum Radiant Heat Flux							
Area	Class	>40 kW/m^2	40 kW/m^2	29 kW/m^2	19 kW/m^2	12.5 kW/m^2	N/A [2]	10 kW/m^2	2 kW/m^2
1	(A) Forest	<20	20-<27	27-<37	37-<50	50-<100	>100	60.4	-
2	(B) Woodland	<13	13-<17	17-<25	25-<35	35-<100	>100	43.2	-
3	(A) Forest	<20	20-<27	27-<37	37-<50	50-<100	>100	60.4	-
4	(E) Mallee/Mulga	<7	7-<9	9-<13	13-<20	20-<100	>100	24.8	-
5	(G) Grassland	<7	7-<9	9-<14	14-<20	20-<50	>50	25	-
6	Excluded cl 2.2.3.2(e & f)	-	-	-	-	-	-	-	-

Note 1: All calculation input variables are presented in Table A6.6.1.

Note 2: Classified in accordance with AS 3959:2018 BAL determination methodology, or an accepted State specific classification and associated fuel loads.

SUMMARY CALCULATOR INPUT AND OUTPUT VALUES FOR EACH AREA OF CLASSIFIED VEGETATION

DETERMINING 10 kW/m^2 SEPARATION DISTANCES

FLAMESOL
FPA AUSTRALIA

Calculated July 1, 2024, 6:40 pm (MDc v.4.9)

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	3.38 km/h
Vegetation classification	Forest	Flame length	26.22 m
Understorey fuel load	25 t/ha	Flame angle	48 °, 56 °, 62 °, 66 °, 67 ° & 75 °
Total fuel load	35 t/ha	Elevation of receiver	11.66 m, 13.38 m, 15.03 m, 16.57 m, 17.35 m & 24.03 m
Vegetation height	n/a	Fire intensity	61,280 kW/m
Effective slope	5 °	Transmissivity	0.852, 0.827, 0.797, 0.772, 0.76 & 0.705
Site slope	-5 °	Viewfactor	0.6165, 0.46, 0.3127, 0.2125, 0.1727 & 0.0465
Flame width	100 m	Minimum distance to < 40 kW/m²	22 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	28.7 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	39.5 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	52.5 m
		Minimum distance to < 10 kW/m²	60.4 m

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980
Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Class A Forest

FLAMESOL
FPA AUSTRALIA

Calculated September 13, 2024, 11:37 am (MDc v.4.9)

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.03 km/h
Vegetation classification	Woodland	Flame length	16.21 m
Understorey fuel load	15 t/ha	Flame angle	49 °, 58 °, 66 °, 70 °, 71 ° & 77 °
Total fuel load	25 t/ha	Elevation of receiver	7.34 m, 8.5 m, 9.720000000000001 m, 10.82 m, 11.44 m & 16.66 m
Vegetation height	n/a	Fire intensity	26,263 kW/m
Effective slope	5 °	Transmissivity	0.868, 0.848, 0.821, 0.796, 0.783 & 0.723
Site slope	-5 °	Viewfactor	0.6027, 0.4476, 0.3037, 0.2064, 0.1674 & 0.0454
Flame width	100 m	Minimum distance to < 40 kW/m²	13.9 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	18.5 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	26.5 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	36.7 m
		Minimum distance to < 10 kW/m²	43.2 m

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980
Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Class B Woodland

FLAMESOL FPA AUSTRALIA

Calculated September 13, 2024, 11:37 am (MDc v.4.9)

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	5.88 km/h
Vegetation classification	Malle	Flame length	8.06 m
Understorey fuel load	8 t/ha	Flame angle	50 °, 60 °, 68 °, 73 °, 75 ° & 80 °
Total fuel load	8 t/ha	Elevation of receiver	3.71 m, 4.33 m, 4.97 m, 5.65 m, 6.06 m & 9.800000000000001 m
Vegetation height	m	Fire intensity	24,316 kW/m
Effective slope	5 °	Transmissivity	0.885, 0.873, 0.854, 0.833, 0.82 & 0.748
Site slope	-5 °	Viewfactor	0.5925, 0.4349, 0.2921, 0.1966, 0.1596 & 0.0438
Flame width	100 m	Minimum distance to < 40 kW/m²	7 m
Windspeed	45 km/h	Minimum distance to < 29 kW/m²	9.5 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	14 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	20.5 m
		Minimum distance to < 10 kW/m²	24.8 m

Rate of Spread - Catchpole et al. 1998
Flame length - Byram, 1959
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Class E Mallee

FLAMESOL FPA AUSTRALIA

Calculated July 1, 2024, 6:21 pm (MDc v.4.9)

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	110	Rate of spread	20.19 km/h
Vegetation classification	Grassland	Flame length	8.16 m
Understorey fuel load	4.5 t/ha	Flame angle	51 °, 60 °, 68 °, 73 °, 75 ° & 80 °
Total fuel load	4.5 t/ha	Elevation of receiver	3.8 m, 4.38 m, 5.03 m, 5.71 m, 6.13 m & 9.9 m
Vegetation height	n/a	Fire intensity	46,945 kW/m
Effective slope	5 °	Transmissivity	0.884, 0.872, 0.854, 0.832, 0.819 & 0.748
Site slope	-5 °	Viewfactor	0.5914, 0.4357, 0.2914, 0.1969, 0.1601 & 0.0438
Flame width	100 m	Minimum distance to < 40 kW/m²	7.1 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	9.6 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	14.2 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	20.7 m
		Minimum distance to < 10 kW/m²	25 m

Rate of Spread - Noble et al. 1980
Flame length - Purton, 1982
Elevation of receiver - Douglas & Tan, 2005
Flame angle - Douglas & Tan, 2005
Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Class G Grassland

GLOSSARY

APPLIED TERMINOLOGY	
Consequence	The outcome of an event or situation expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain. In the emergency risk management context, consequences are generally described as the effects on persons, society, the environment and the economy. *(Source: DPLH 2019)* An impact on the natural, economic, built or social environments as a result of the hazard. The consequences are influenced by the vulnerability of elements at risk, by the exposure of elements at risk to the hazard, and by the characteristics of the hazard. *(Source: PIA, 2015).* The outcome of an event that affects objectives. Can be a range of consequences; can be certain or uncertain; can have positive or negative effects; can be expressed qualitatively or quantitatively; can escalate through knock-on effects. *(Source: ISO Guide 73:2009)*
Controls	A measure that maintains and/or modifies risk. Controls include, but are not limited to, any process, policy, device, practice, or other conditions and/or actions which maintain and/or modify risk. *(Source: AIDR Knowledge Hub; Glossary)* A control is any measure or action that modifies or regulates risk. Controls include any policy, procedure, practice, process, technology, technique, method, or device that modifies or regulates risk. Risk treatments become controls, or modify existing controls, once they are implemented. *(Source: Praxiom)* *Note: 'Protection Measures' and 'Risk Treatments' will be alternative terms used in this risk assessment report.*
Decision Maker	The Minister for Planning, State Administrative Tribunal, Western Australian Planning Commission, Development Assessment Panel, any other State decision-making authorities, and/or the relevant local government and their delegates that make decisions regarding the application of this Policy. *(Source: SPP 3.7)* For proposed development or use that is not subject to planning approval, the relevant decision makers are those tasked with the development and management of a development or use. Typically this might be an existing development/use for which an improved bushfire performance is being sought.
Elements At Risk	The population, buildings and civil engineering works economic activities, public services and infrastructure, etc. exposed to hazards. (Australian Institute for Disaster Resilience, 2019)
Exposure	Refers to the people and things in the path of potential hazards. *(Source: AIDR* LUPDRC*, 2020)* The elements within a given area that have been, or could be, subject to the impact of a particular hazard. Bushfire exposure can refer to property that may be endangered by a fire burning in another structure or by a bushfire. *(Source: AIDR Knowledge Hub; Glossary)* The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard prone areas. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest. *(Source: UNDRR, 2017)*

Hazard	A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socionatural in origin. • Natural hazards are predominantly associated with natural processes and phenomena (note: disasters often follow natural hazards, but there is no such thing a natural disaster); • Anthropogenic hazards are human-induced – being induced entirely or predominantly by human activities and choices; • Socionatural hazards are associated with a combination of natural and anthropogenic factors, including environmental degradation and climate change. Hazards may be single, sequential or combined in their origin and effects. Each hazard is characterized by its location, intensity or magnitude, frequency and probability. *(Source: UNDRR Terminology 2017)* A source of potential harm or a situation with a potential to cause loss. A potential or existing condition that may cause harm to people, or damage to property or the environment. A source of risk. *(Source: AIDR Knowledge Hub; Glossary)*
Hazardous Event	The manifestation of a hazard in a particular place during a particular period of time. [Severe hazardous events can lead to a disaster as a result of the combination of hazard occurrence and other risk factors.] (Source: *United Nations Office for Disaster Risk Reduction, 2017)*
Hazard Identification	The process of recognising that a hazard exists and defining its characteristics. *(Australian Institute for Disaster Resilience, 2019)*
Hazard - Bushfire	A fuel complex, defined by amount, type condition, arrangement, and location, that determines the degree of hazard. *(Source: AIDR Knowledge Hub; Glossary)* The term 'bushfire hazard' in this assessment report is intended to refer to both bushfire prone vegetation and the associated potential bushfire event itself. The term 'bushfire' is being applied as the common term for forest, scrub, shrub, and grass fire events.
Hazard - Urban Fire	1. Susceptibility of a material to burn. 2. The presence of combustible materials. 3. A process or activity posing a fire risk if not adequately controlled. *(Source: AIDR Knowledge Hub; Glossary)*
Hazardous Material	A substance or material which has been determined by an appropriate authority to be capable of posing an unreasonable risk to health, safety and property. *(Source: AIDR Knowledge Hub; Glossary)*
Impact	Describes as a quantitative or qualitative measure, the relative potential ability of a threat to adversely affect an exposed element or of a protection measure to reduce threat, exposure or vulnerability levels and consequently, risk levels.
Likelihood	Chance of something happening. The likelihood level reflects the probability of both the emergency event and the estimated consequences occurring as a result of the event. *(Source: AIDR NERAG, 2020)* In risk management terminology, the word 'likelihood' is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or

	mathematically - such as a probability or a frequency over a given time period. *(Source: ISO Guide 73:2009)* The chance of an event occurring. Likelihood may be represented as a statistical probability (such as Annual Exceedance Probability), or where this is not possible, it can be represented qualitatively using such measures as 'likely', 'possible', and 'rare'. *(Source: PIA, 2015).*
Mitigation	The lessening or minimizing of the adverse impacts of a hazardous event. The adverse impacts of hazards, in particular natural hazards, often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness. *(Source: UNDRR, 2017)*
Reliability	Refers to the expected reliability of a designed solution (protection measure). Over time it will be a function of: • Its Initial likely reliability; • Its durability which may or may not be a function of maintenance; • The level of maintenance required; • The likelihood of solution being modified over time; and • The influence of other adjoining/adjacent structures or stored materials that may be installed after the initial construction. (Adapted from Kelly M. et al; *Structural Design Options for Residential Buildings in Bushfire Areas,* Australasian Structural Engineering Conference November 2016)
Resilience	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management. (*United Nations Office for Disaster Risk Reduction, 2017)* Is that property of a building, system, or community that facilitates its return to a functional state following an overload. In the context of bushfire damage, resilience will be maximised when: • There is a high probability of an attacked building remaining fit for purpose; and • There is a low time and cost to make badly damaged buildings fit for purpose. (Adapted from Kelly M. et al; *Structural Design Options for Residential Buildings in Bushfire Areas,* Australasian Structural Engineering Conference November 2016)
Robustness	Refers to that property of structural systems that seeks to achieve proportionality of damage to the severity of an overloading event. It will be maximised when bushfire design solutions: • Have few 'weak links' that allow progressive spread of damage from minor sources; • Consist of materials and assemblies that retain physical properties when thermally loaded beyond their design capacity; and • Include protection of inherently vulnerable and brittle elements. Such as openings to internal parts of structures (including doors and windows) and essential services that maintain required functioning (e.g. cabling and plumbing). (Adapted from Kelly M. et al; *Structural Design Options for Residential Buildings in Bushfire Areas,* Australasian Structural Engineering Conference November 2016)

	As a design principle it means that the design and materials are not easily damaged or compromised, and do not require manual operation or intervention to work (Source: State Government of Queensland, CSIRO, 2020)
Redundancy	Refers to design that ensures the fate of the subject building/structure is not reliant on the effective performance of a single element. (State Government of Queensland, CSIRO, 2020) An example is a roof system that does not rely solely on the roof cladding to resist bushfire threats. It has additional layers of resistance including non-combustible roof/ceiling framing, insulation and ceiling lining, and the sealing/screening of gaps into internal operating spaces.
Risk	Disaster risk is the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity. *(Source: UNDRR, 2017)* Disaster risk is a product of a hazard (a sudden event or shock), exposure (the people and things in the path of potential hazards), vulnerability (the potential for those people and things to be adversely impacted by a hazard) and the capacity (the ability for those people and assets and systems to survive and adapt). *(Source: AIDR LUPDRC, 2020)* Risk is the chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood. In emergency management it is a concept used to describe the likelihood of harmful consequences arising from the interaction of hazards, communities and the environment. *(Source: PIA, 2015)*
Risk Management	Disaster risk management is the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses. *(Source: UNDRR, 2017)* Coordinated activities of an organisation or a government to direct and control risk. The risk management process includes the activities of: • Communication and consultation; • Establishing the context; • Risk Assessment (risk identification, risk analysis, risk evaluation); • Risk Treatment; and • Monitoring and Review. *(Source: AIDR NERAG, 2020)* Risk management vs. risk mitigation: Though risk management and risk mitigation are often used interchangeably, the two terms refer to slightly different things. Risk mitigation involves limiting the effect that risks can have (i.e. making less severe). It is a single component of the larger risk management process. Risk management refers to the overall practice of assessing and addressing the relevant risk. (*an explanation of the use of these terms as applied by Bushfire Prone Planning*)
Risk Identification	Process of finding, recognising and describing sources of risks, their causes and their potential consequences. *(Source: ISO Guide 73:2009)* It is a process used to find, recognise, and describe the risks that could affect the achievement of objectives. *(Source: Praxiom)*
Risk Source	An element which, alone or in combination, has the intrinsic potential to give rise to risk. *(Source: ISO Guide 73:2009)*
Risk Assessment	Disaster risk assessment is a qualitative or quantitative approach to determine the nature and extent of disaster risk by analysing potential hazards and evaluating existing

	conditions of exposure and vulnerability that together could harm people property, services and livelihoods and the environment on which they depend. Assessments include the identification of hazards; a review of the technical characteristics of hazards such as their location, intensity, frequency, and probability; the analysis of exposure and vulnerability, including the physical, social, health, environmental and economic dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities with respect to likely risk scenarios. *(Source: UNDRR, 2017)* The overall process of risk identification, risk analysis and risk evaluation. *(Source: ISO Guide 73:2009)*
Risk Analysis	The process to comprehend the nature of risk and determine the level of risk. Provides the basis for risk evaluation and decisions about risk treatment. *(Source: ISO Guide 73:2009)* Is a process that is used to understand the nature, sources, and causes of the risks that you have identified and to estimate the level of risk. It is also used to study impacts and consequences and to examine the controls that currently exist. How detailed your risk analysis ought to be will depend upon the risk, the purpose of the analysis, the information you have, and the resources available. *(Source: Praxiom)* In this risk assessment report, risk analysis is the part of the risk assessment process that assesses the hazard threat levels, identifies the protection measures (and their effectiveness) that can be applied and derives the levels of exposure and vulnerability of the identified elements at risk, based on the ability to apply protection measures. From this information indicative risk levels can be derived. Where relevant sets of risk factor criteria and a risk level matrix have been established by the relevant authorities, a determined risk level can be derived. The required risk level analysis can be conducted for either each exposed element separately and/or the proposed or existing development/use overall.
Risk Evaluation	The process used to determine risk management priorities by evaluating and comparing the level of risk against predetermined standards, target risk levels or other criteria. *(Source: PIA, 2015)* In this risk assessment report, it is the process of classifying the acceptability of the levels of risk, derived from the risk analysis, by reference to an established risk tolerance scale. The relevant tolerance scale will be that derived from the application of the 'as low as reasonably practicable' principle – 'ALARP' (refer to Appendix 1 for further information). This process can only be conducted when determined risk levels have been derived.
Risk Factor Criteria	In this risk assessment report, the risk factor criteria establish the parameters that will define the different hazard threat levels, the different levels of exposure of elements at risk and the different levels of vulnerability of elements at risk. Different sets of risk factor criteria can exist corresponding to different development types, uses and scale. They are applied as part of the risk analysis. These criteria are established by the relevant authorities as they must reflect societies preparedness to tolerate risk and be determined by those authorities exercising their responsibilities.
Risk Level Matrix	In this risk assessment report, the risk level matrix establishes how the assessed levels of hazard threats, exposure and vulnerability are to be analysed in deriving a determined risk level. It is applied as part of the risk analysis. The matrix is established by the relevant authorities as they must reflect societies preparedness to tolerate risk and be determined by those authorities exercising their responsibilities.
Risk Tolerance Scale	In this risk assessment report the applied risk tolerance scale defines the acceptability of determined risk levels based on the 'as low as reasonably practical' principle (ALARP).

	The risk tolerance scale can be applied within the risk assessment report when the required risk factor criteria and risk level matrix are available.
Risk - Inherent	In this risk assessment report, inherent risk is considered to be current risk after accounting for existing and any 'planned' protection measures (controls / risk treatments) but before the application of any additional protection measures that have been identified and recommended by the bushfire consultant – and which subsequently determines the residual risk (this approach is supported by the relevant information sourced from the two references below). 'Planned' protection measures are those that are incorporated into the site development plans and those that exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and for which a responsibility for their implementation has been created. If a BMP or BEP is yet to be developed or is being developed concurrently, the additional protection measures it contains (including any that are part of relevant 'acceptable solutions' established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), are considered to be additionally recommended protection measures. 1. *Source: www.fairinstitute.org* *"Confusion exists between Inherent Risk and Residual Risk … Here are the standard definitions of the two concepts:* • *Inherent risk represents the amount of risk that exists in the absence of controls.* • *Residual risk is the amount of risk that remains after controls are accounted for.* *Sounds straightforward. But these two terms seem to fall apart when put into practice. Applying the above definitions to the clients' scenario uncovered the fact that the 'inherent' risk being described was not a 'no controls' environment, but rather, one that only excluded some controls.* *The flaw with inherent risk is that in most cases, when used in practice, it does not explicitly consider which controls are being included or excluded. A truly inherent risk state, in our example, would assume no employee background checks or interviews are conducted and that no locks exist on any doors. This could lead to almost any risk scenario being evaluated as inherently high. Treating inherent risk therefore can be quite arbitrary. According to Jack Jones, author of Measuring and Managing Information Risk: A FAIR Approach and creator of the FAIR model, much more realistic and useful definitions would be:* • *Inherent risk is current risk level given the existing set of controls rather than the hypothetical notion of an absence of any controls; and* • *Residual risk would then be whatever risk level remain after additional controls are applied."* 2. *Source: Wikipedia:* *Inherent risk, in risk management is:* • *an assessed level of raw or untreated risk; that is, the natural level of risk inherent in a process or activity without doing anything to reduce the likelihood or mitigate the severity of a mishap, or the amount of risk before the application of the risk reduction effects of controls; or* • *Another definition is that inherent risk is the current risk level given the existing set of controls, which may be incomplete or less than ideal, rather than an absence of any controls.*

Risk - Residual	In this risk assessment report, residual risk is that which remains after the application of protection measures that are additional to those that already exist or are 'planned' and that establish the inherent risk (see Risk – Inherent in glossary) It is the disaster risk that remains in unmanaged form, even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained. The presence of residual risk implies a continuing need to develop and support effective capacities for emergency services, preparedness, response and recovery, together with socioeconomic policies such as safety nets and risk transfer mechanisms, as part of a holistic approach. *(Source: UNDRR, 2017)* It is the risk left over after you've implemented a risk treatment option. It's the risk remaining after you've reduced the risk, removed the source of the risk, modified the consequences, changed the probabilities, transferred the risk, or retained the risk. *(Source: Praxiom)* It is the risk remaining after any risk treatment has been applied to reduce its potential likelihood and/or its potential consequences. Residual risk can also be any risk that is chosen to be retained rather than treated *(Source: AIDR* LUPDRC*, 2020)* Residual risk can contain unidentified risk. Residual risk can also be known as retained risk. *(Source: ISO Guide 73:2009)*
Risk Level - Determined	Magnitude of a risk or a combination of risks. In this risk assessment report, as an outcome of the risk analysis, a determined risk level is derived from: 1. The determination of threat, exposure and vulnerability levels by reference to an established set of risk factor criteria that corresponds to each risk level (for each factor); and 2. The determination of the risk level by reference to an established risk level matrix that incorporates threat, exposure and vulnerability levels.
Risk Level - Indicative	Magnitude of a risk or a combination of risks. In this risk assessment report, as an outcome of the risk analysis, an indicative risk level is derived from analysis of the number of bushfire protection measures able to be implemented compared to the number of measures available, and the relative effectiveness of each at reducing threat, exposure and/or vulnerability levels. Overall, more applicable and applied measures is better and the measures with a higher effectiveness rating have greater weighting in the analysis.
Risk - Acceptable	Risks that do not need further treatment. The expression acceptable level of risk refers to the level at which it is decided that further restricting or otherwise altering the activity is not worthwhile e.g. additional effort will not result in significant reductions in risk levels. *(Source: DPLH, 2019)* That level of risk that is sufficiently low that society is comfortable with it. Society does not generally consider expenditure in further reducing such risks justifiable. *(Source: AIDR Knowledge Hub)* An acceptable risk is a risk that is sufficiently low to require no new treatments or actions to reduce the risk as communities can live with this level of risk without further action. *(Source: Queensland Government 2019: Natural hazards, risk and resilience – Bushfire: State Planning Policy – state interest guidance material)* Acceptable risk or tolerable risk is an important sub-term (of disaster risk). The extent to which a disaster risk is deemed acceptable or tolerable depends on existing social, economic, political, cultural, technical and environmental conditions. *(Source: UNDRR, 2017)*

	Note: It is generally accepted that nothing can be absolutely free of risk, everything under some circumstance can cause harm. There are differing levels of risk and consequently levels of safety. In practice, attaining zero risk is not possible. Nevertheless, after risk avoidance, reduction/mitigation, transfer or acceptance - the residual risk may be determined as acceptable, as judged by the participants in an activity and decision makers (who apply societies expectations). For certain land uses, the residual risk may exist at higher levels but still be judged by to be acceptable (or tolerable) on this basis.
Risk - Tolerable	The willingness to live with a risk to secure benefits and achieve objectives, on the understanding that it is being properly controlled. 'Tolerability' does not mean 'acceptability'. Tolerating a risk does not mean that it is regarded as negligible, or something we may ignore, but rather as something that needs to be kept under review and reduced further. *(Source: DPLH, Guidelines v1.4)* Certain levels of risk may be tolerated, provided that the risks are known and managed. *(Source: AIDR LUPDRC, 2020)* A tolerable risk is a risk that is low enough to allow the exposure to a natural hazard to continue while at the same time high enough to require new treatments or actions to reduce risk. Communities can live with level of risk but as much as is reasonably practical should be done to further reduce the risk. *(Source: Queensland Government 2019: Natural hazards, risk and resilience – Bushfire: State Planning Policy – state interest guidance material)* Risk tolerance is defined as the organisations or stakeholder's readiness to bear the risk, after risk treatment, in order to achieve its objectives. Risk tolerance can be influenced by legal or regulatory requirements. *(Source: ISO Guide 73:2009)* A level of risk that defines the ALARP region, as risks that should be driven to the broadly acceptable region. *(Source: PIA, 2015)*
Risk - Intolerable	A level of risk that is so high that require risk treatment measures whatever their cost, or the elimination of the risk. *(Source: PIA, 2015)* Risk that is unacceptable in any circumstances or at any level. *(Source: DPLH, 2019)*
Risk Treatment	Risk treatment options available as part of the risk management process are generally categorised as follows: • Risk Avoidance: Measures taken to avoid risks from natural hazards. Can include avoiding development in hazardous areas, relocating people or assets away from hazardous areas, or developing buffer zones to the hazard; • Risk reduction/mitigation: Measures undertaken to reduce the risks from natural hazards. Includes building control and development controls; • Risk Transfer: Measures taken to transfer the risk from natural hazards from one party to another; and • Risk Acceptance: The acceptance of risk from a natural hazard. Any realised losses will be borne by those parties exposed to the hazard. This is not specifically a treatment option as no action is taken, but it is an option for addressing risk. *(Source: AIDR LUPDRC, 2020)*
Retrofitting	Reinforcement or upgrading of existing structures to become more resistant and resilient to the damaging effects of hazards. Retrofitting requires consideration of the design and function of the structure, the stresses that the structure may be subject to from particular hazards or hazard scenarios and the practicality and costs of different retrofitting options. *(Source: UNDRR, 2017)*

Structural and Non-Structural Measures	Structural measures are any physical construction to reduce or avoid possible impacts of hazards, or the application of engineering techniques or technology to achieve hazard resistance and resilience in structures or systems. Non-structural measures are measures not involving physical construction which use knowledge, practice or agreement to reduce disaster risks and impacts, in particular through policies and laws, public awareness raising, training and education. Common non-structural measures include building codes, land-use planning laws and their enforcement, research and assessment, information resources and public awareness programmes. *(Source: UNDRR, 2017)*
Threats	The mechanisms by which hazards can impact exposed elements.
Vulnerability	The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. (*United Nations Office for Disaster Risk Reduction, 2017)* The characteristic or property of a community, system or object that makes it susceptible to the damaging effects of a specific hazard. Can be defined according to the responses of people, houses and assets in mitigating the impacts of a hazard. Specifically, it refers to the extent to which a community, building, services or location is likely to be damaged or disrupted by the impacts of a hazard, such as a bushfire. Building vulnerability refers to weak points in a building caused by its design, construction, use of materials and management (including maintenance). These weak points are identified in the context that they are not able to withstand the level of hazard they are exposed to. Climate and weather may directly influence the buildings vulnerability through several processes including (i) moisture content of combustible elements around and within buildings (ii) gaps between materials that may shrink and expand due to changes in moisture content and temperature (iii) wind action causing damage or dislocation of elements. *(Source: State Government of Queensland, CSIRO, 2020; Bushfire Resilient Building Guidance for Queensland Homes)*
'Vulnerable' Persons	These are persons who are considered to be at-risk members of the community and may be more susceptible to the impacts of bushfire. These persons are likely to present relocation (including evacuation) challenges in the event of a bushfire. Attributes of this group of persons includes: • Less physically or mentally able to relocate themselves; and/or • Are unfamiliar with their surroundings; and/or • Large numbers of persons in a building(s) or in the open, on a single site, such that the numbers present practical challenges.

REFERENCES

[1] Alex Filkov, Tom Duff, Trent Penman: Determining Threshold Conditions for Extreme Fire Behaviour; Annual report 2018-2019 - The Determinants of Crown Fire Runs During Extreme Wildfires in Broadleaf Forests in Australia, University of Melbourne & Bushfire and Natural Hazards CRC

[2] Alexander M.E., Cruz M.G.: The General Nature of Crown Fires (Synthesis on Crown Fire Behaviour in Conifer Forests), Fire Management Today Volume 73 No.4 2014.

[3] Alexander M.E., Cruz M.G.: The Start, Propagation and Spread Rate of Crown Fires (Synthesis on Crown Fire Behaviour in Conifer Forests), Fire Management Today Volume 73 No.4 2014.

[4] AS 3959:2018; Construction of buildings in bushfire prone areas

[5] Australian Government Department of Home Affairs (DHA), 2018; National Disaster Risk Reduction Framework.

[6] Australian Institute for Disaster Resilience (AIDR), 2020; Land use Planning for Disaster Resilient Communities (LUPDRC).

[7] Australian Institute for Disaster Resilience (AIDR), 2020; National Emergency Risk Assessment Guidelines (NERAG).

[8] Australian Institute for Disaster Resilience (AIDR); Knowledge Hub - Glossary

[9] Blanchi R., Leonard J.E. (2005) Investigation of Bushfire Attack Mechanisms Resulting in House Loss in the ACT Bushfire 2003, Bushfire CRC Report – CSIRO MIT Highett, Australia.

[10] Blanchi R., Leonard J., Leicester R.H., (2006) Bushfire risk at the rural–urban interface. In 'Proceedings of Bushfire Conference 2006: Life in a Fire-prone Environment: Translating Science into Practice', 6–9 June 2006, Brisbane, QLD. (Griffith University: Brisbane)

[11] Bowman D. (2021); Asking people to prepare for fire is pointless if they can't afford to do it. It's time we subsidised fire prevention; Article in The Conversation January 12, 2021.

[12] Bushfire Cooperative Research Centre (Melbourne); HighFire Risk Project [http://www.highfirerisk.com.au]

[13] Bushfire Resilient Building Guidance for Queensland Homes (2020); State Government of Queensland and CSIRO.

[14] Bushfire Verification Method - Handbook (ABCB, 2019), © Commonwealth of Australia and States and Territories 2019, published by the Australian Building Codes Board.

[15] Cheney N.P.: Fire behaviour during the Pickering Brook wildfire, January 2005 (Perth Hills Fires 71-80); Conservation Science W. Aust. 7 (3): 451-468 (2010)

[16] Cruz, MG (2021) The Vesta Mk 2 rate of fire spread model: a user's guide; CSIRO, Canberra, ACT. 76pp.

[17] CSIRO (2020) Climate and Disaster Resilience; Technical Report, July 2020

[18] CSIRO (2020) Climate and Disaster Resilience; Overview Report, 30 June 2020

[19] Department of Planning Lands and Heritage (DPLH), 2019; Coastal hazard risk management and adaptation planning guidelines.

[20] Design and Construction of Community Bushfire Refuges – Information Handbook; Australian Building Codes Board and Fire Services Commissioner Victoria, 2014.

[21] Filkov A.I., Duff T.J., Penman T.D. (2020) Frequency of Dynamic Fire Behaviours in Australian Forest Environments // Fire, 2020, 3,1 pp1-17

[22] Guidelines for Planning in Bushfire Prone Areas (Guidelines), Version 1.4, WAPC 2021

[23] Health and Safety Executive (HSE-UK), 2001; Reducing risks protecting people – HSE's decision making process.

[24] Health and Safety Executive (HSE-UK), Guidance - ALARP "at a glance"

[25] Howard T., Burrows N., Smith T., Daniel G., McCaw L. (2020); A framework for prioritising prescribed burning on public land in Western Australia. International Journal of Wildland Fire 2020, 29, 314-325.

[26] ISO Guide 73:2009; Risk Management – vocabulary

[27] Jason J Sharples, University of New South Wales Canberra. Risk Implications of Dynamic Fire Propagation – A Case Study of the Ginninderry Region (Preliminary Report June 2017)

[28] Jason J. Sharples et al. (2016) Natural hazards in Australia: extreme bushfire. Climatic Change (2016) 139:85–99 DOT 10.1007/s10584-016-1811-1

[29] J.E. Leonard, R. Blanchi, N. White, A. Bicknell, A. Sergeant, F. Reisen and M. Cheng (2006); Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires; Bushfire CRC Melbourne.

[30] Leonard J.E., Blanchi R., Bowditch P.A.; (2004) Bushfire Impact from a House's Perspective (CSIRO MIT)

[31] Leonard, J., Short, L. (2016) *Guidelines for Building in Bushfire Prone Areas – Wye River and Separation Creek* (v 2.0).

[32] Leonard et al, Wye River / Separation Creek – Post-bushfire building survey findings (2016) CSIRO Client Report EP16924.

[33] NASH Standard – Steel framed construction in bushfire prone areas. National Association for Steel Framed Housing 2014 (Amendment A 2015)

[34] National Construction Code Series, Volume 2. Australian Building Codes Board. 2015

[35] NOPSEMA (Australia's offshore energy regulator), 2020; ALARP and risk assessment guidance notes.

[36] Peace M, McCaw L, Santos B, Kepert J.D., Burrows N and Fawcett R.J.B.: Meteorological drivers of extreme fire behaviour during the Waroona bushfire, Western Australia, January 2016; Journal of Southern Hemisphere Earth Systems Science (2017) 67:2, 79-106. DOI: 10.22499/3.6702.002

[37] Pearce M., Kepert J.; Extreme Fire Behaviour: Reconstructing the Waroona Fire Pyrocumulonimbus and Ember Storms; Hazard Note Issue 48 June 2018 Bushfire and Natural Hazards CRC

[38] Planning Institute of Australia (PIA), 2015; National Land Use Planning Guidelines for Disaster Resilient Communities.

[39] Praxiom Research Group Limited; ISO 31000 2018 Risk management definitions in plain English.

[40] Prof. Jason J Sharples (School of Science. University of NSW, Canberra) Submission to the Senate Select Committee into Lessons to be Learned in Relation to the Australian Bushfire Season 2019-20

[41] Sharples J.J., McRae R.H.D., and Wilkes S.R.: Wind-terrain effects on the propagation of wildfires in rugged terrain: fire channelling; Article in International Journal of Wildland Fire · May 2012

[42] Sharples J.J., Mills G.A., McRae R.H.D., and Weber R.O.: Foehn-Like Winds and Elevated Fire Danger Conditions in Southeastern Australia; 2010 American Meteorological Society DOI: 10.1175/2010JAMC2219.1

[43] State Planning Policy 3.7 (SPP 3.7); Planning in bushfire prone areas, WAPC, 2015

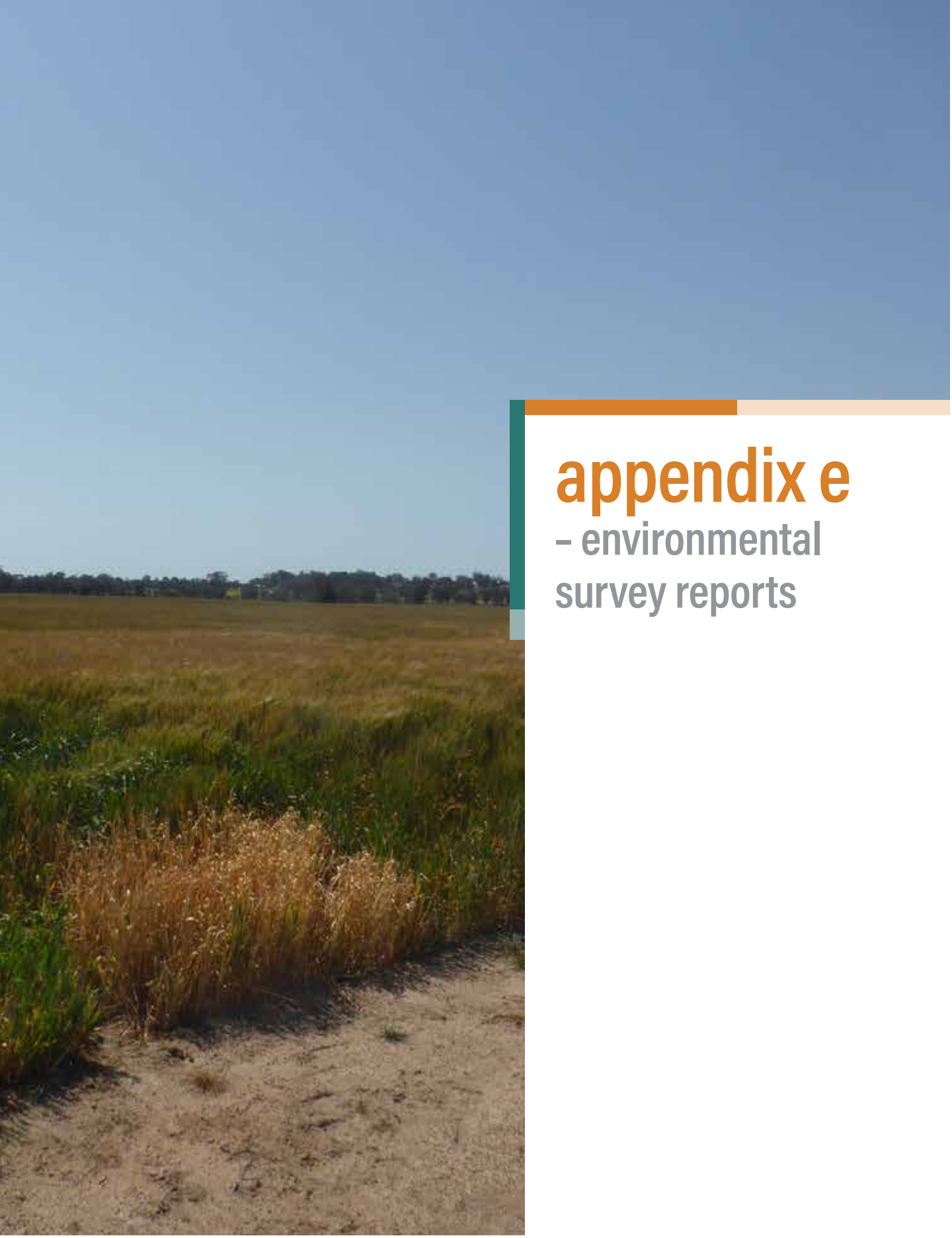
[44] United Nations Office for Disaster Risk Reduction (UNDRR), 2017; Report on Indicators and terminology relating to disaster risk reduction.

[45] United Nations Office for Disaster Risk Reduction (UNDRR); Global Platform for Disaster Risk Reduction (PreventionWeb) https://www.preventionweb.net/

[46] United Nations Office for Disaster Risk Reduction (UNDRR) – Understanding Disaster Risk. https://www.preventionweb.net/understanding-disaster-risk/component-risk/disaster-risk

[47] WA Department of Mines, Industry Regulation and Safety, 2020; Petroleum safety and major hazard facility – guide. ALARP demonstration.

[48] CSIRO Bushfire Best Practice Guide - https://research.csiro.au/bushfire/



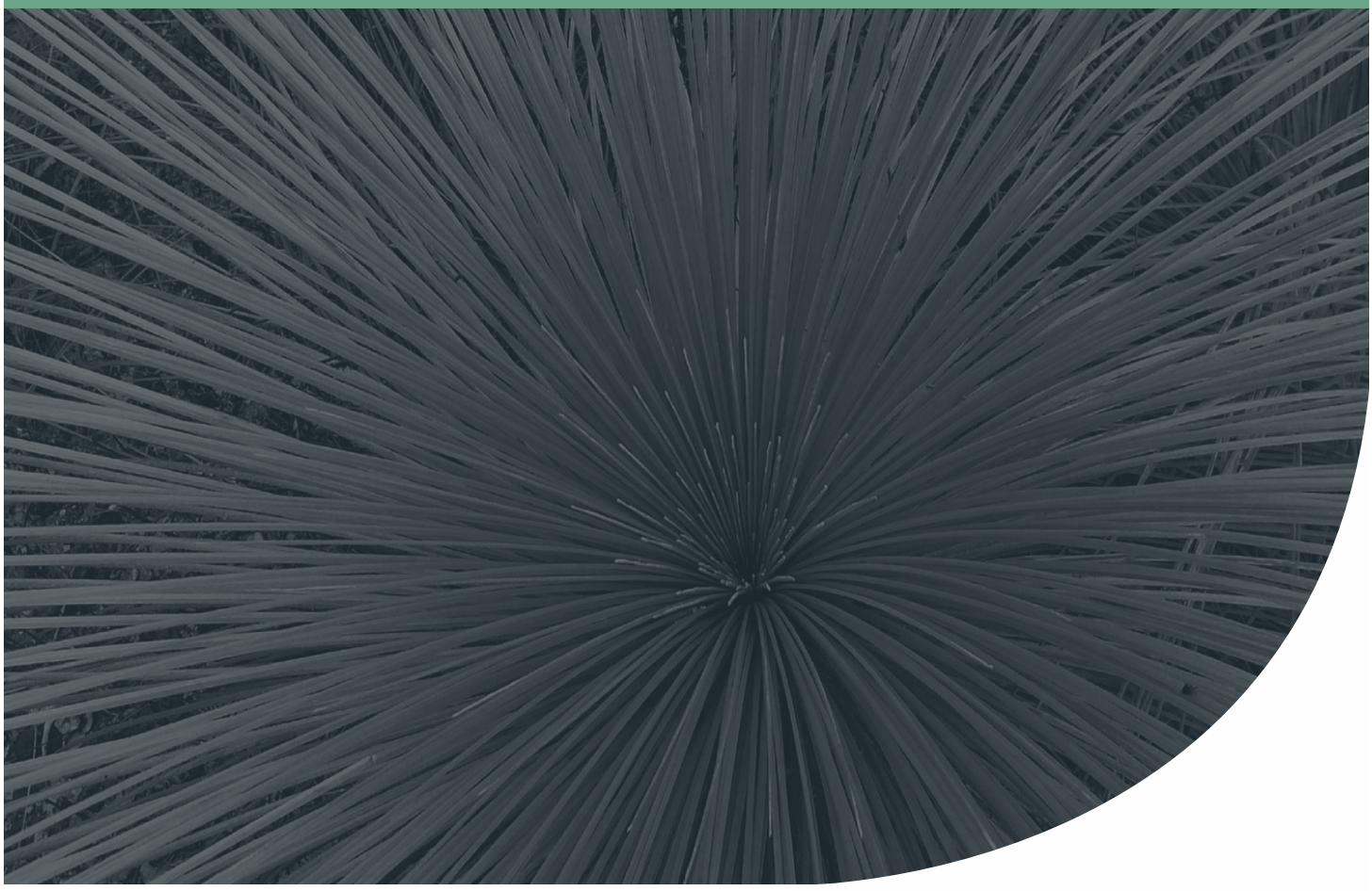
appendix e
– environmental survey reports

Basic Fauna and Targeted Black Cockatoo Assessment

Proposed Narrogin Solar Farm

Project No: EP22-083(02)

Prepared for ARP Solar
February 2023



Document Control

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Executive Summary

Emerge Associates were engaged by ARP Solar to conduct a basic fauna and a targeted black cockatoo assessment within part of Lot 21 Contine Road, part of Lot 7067 on Plan 126439 and part of the Parks Road reserve in Highbury (referred to herein as the 'site').

As part of the assessment a desktop review of relevant background information was completed and a field survey was undertaken on 29-30 November 2022. During the field survey opportunistic sightings of fauna were recorded and an assessment was made on the fauna habitat within the site and its suitability to provide habitat for conservation significant fauna. A targeted survey was also undertaken to determine the presence of habitat for threatened black cockatoo species.

Outcomes of the basic fauna survey include the following:

- The majority of the site (92.69%) supports highly disturbed **grassland** habitat which provides limited value to fauna species of conservation significance and is likely to primarily be used by common and widespread native and non-native fauna with non-specific habitat requirements. The highest fauna habitat values are associated with the **eucalypt forest** habitat which occurs over 6.2% of the site. The remainder of the site comprises the **scattered trees** habitat (1.11%).
- A total of 16 native fauna species were recorded within the site.
- While not recorded during the field survey, *Zanda latirostris* (Carnaby's black cockatoo, listed as endangered) is likely to occur in the site. Seven other species of conservation significance not recorded during the field survey may possibly occur in the site: *Apus pacificus* (pacific swift), *Calyptorhychus banksia naso* (forest red-tailed black cockatoo), *Dasyurus geoffroii* (chuditch), *Falco hypoleucos* (grey falcon), *Falco perigrinus* (peregrine falcon), *Phascogale calura* (red-tailed phascogale) and *Platycercus icterotis xanthogenys* (western rosella).

Outcomes of the targeted black cockatoo survey include the following:

- The site occurs within the modelled distribution of Carnaby's black cockatoo and forest red-tailed black cockatoo but outside of the modelled distribution of *Zanda baudinii* (Baudin's black cockatoo).
- The site contains 313 habitat trees, of which 16 contain hollows suitable for use by black cockatoos for breeding.
- No roosts or evidence of roosting by any species of black cockatoo was recorded within the site during the field survey. Tall native and non-native trees within the site represent suitable roosting habitat for species of black cockatoo.
- A total of 16.90 ha of native foraging habitat for Carnaby's black cockatoo was mapped within the site of which 41.36% is associated with primary foraging sources and 58.64% is associated with secondary foraging sources.
- A total of 6.99 ha of foraging habitat for forest red-tailed black cockatoo was mapped in the site of which all is from primary foraging sources.
- Additional areas of foraging habitat of similar or higher value occur adjacent to the site and in the wider local area.

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Appendices

Appendix A

Additional Information

Appendix B

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Appendix C

Black Cockatoo Foraging Plants

Appendix D

Conservation Significant Species and Likelihood of Occurrence Assessment

Appendix E

Species List

Appendix F

Black Cockatoo Habitat Tree Data

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Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
EPA	Environmental Protection Authority
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPaW	Department of Parks and Wildlife (now DBCA)
DAWE	Department of Agriculture, Water and the Environment (now DCCEEW)
WA Museum	Western Australian Museum

Table A2: Abbreviations – General terms

General terms	
EN	Endangered
IBRA	*Interim Biogeographic Regionalisation of Australia*
MI	Migratory
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
UFI	Unique feature identifier
VU	Vulnerable

Table A3: Abbreviations –Legislation

Legislation	
BAM Act	*Biosecurity and Agriculture Management Act 2007*
EBPC Act	*Environment Protection and Biodiversity Conservation Act 1999*
BC Act	*Biodiversity Conservation Act 2016*

Table A4: Abbreviations – units of measurement

Units of measurement	
DBH	Diameter at breast height
cm	Centimetre
ha	Hectare
km	Kilometre
m	Metre
m AHD	m in relation to the Australian height datum
mm	Millimetre

1 Introduction

1.1 Project background

Emerge Associates (Emerge) were engaged by ARP Solar to characterise the fauna and black cockatoo values within part of Lot 21 Contine Road, part of Lot 7067 on Plan 126439 and part of the Parks Road reserve in Highbury (referred to herein as the 'site'). The site is located approximately nine kilometres (km) south-east of Narrogin within the Shire of Narrogin.

The site is approximately 276.71 hectares (ha) in size and is bounded by Great Southern Highway to the east, Contine Road to the north and agricultural land to the west and south. The location and extent of the site is shown in **Figure 1**.

1.2 Purpose and scope of works

The scope of work was specifically to undertake a terrestrial vertebrate fauna assessment to the standard required of a 'basic' fauna survey and a 'targeted' black cockatoo survey with reference to the Environmental Protection Authority's (EPA's) technical guidance (EPA 2020) and the *Environment Protection and Biodiversity Conservation Act* black cockatoo referral guidelines (DAWE 2022).

As part of this scope of work, the following tasks were undertaken:

- Desktop assessment of relevant background information pertaining to the site and surrounds, including database and literature searches for fauna species.
- A field survey to identify fauna species and habitats within the site, including habitat for species of black cockatoo.
- Compilation of a list of fauna species with potential to occur within the site as identified from the desktop assessment and opportunistically recorded as part of the field survey.
- Identification of potential habitat for conservation significant fauna species and an assessment of likelihood of occurrence.
- Mapping of fauna and black cockatoo habitat.
- Documentation of the desktop assessment, survey methodology and results into a report.

2 Environmental context

2.1 Climate

Climate has a strong influence on the fauna habitat and species present in a region and a site. The south-west of Western Australia experiences a Mediterranean climate of hot dry summers and cool wet winters.

A total of 47.4 millimetre (mm) of rainfall was recorded during the month prior to the survey (October 2022) from the Narrogin weather station (no. 10614) which is the closest weather station located approximately 8 km north of the site (BoM 2023). This is higher than the average rainfall of 31 mm for the same period and weather station (BoM 2023).

Temperatures recorded in October 2022 ranged from a mean maximum of 20.1°C to a mean minimum of 7.2°C, as recorded by the Narrogin weather station which is the closest temperature recording weather station (BoM 2023). This is similar to the average maximum temperature of 21.2°C and average minimum temperature of 7.5°C for the same period and weather station (BoM 2023).

On the day of the survey temperatures at the Narrogin weather station ranged from a daily maximum of 34.1°C to a daily minimum of 10.6°C (BoM 2023). No rainfall was recorded on the day of the survey by the Narrogin weather station (BoM 2023).

2.2 Geomorphology and soils

Landform and soils influence fauna at regional and local scales. The site occurs within the Southern Zone of Rejuvenated Drainage landform, which is described as erosional surface of gently undulating rises to low hills with continuous stream channels that flow in most years. Soils are formed in colluvium or rock weathered in-situ (Purdie *et al.* 2004).

Two soil systems within the Southern Zone of Rejuvenated Drainage landform intersect the site, the Dellyanine and Arthur River Systems. The Dellyanine System is described as undulating rises and low hills on granite with grey sandy duplex, sandy gravel and red deep sandy duplex soils (DPIRD 2022a). The Arthur River System is described as broad valley floors with saline wet soils, salt lake soils and grey sandy duplex soils (DPIRD 2022a).

The soil types mapped within the site are shown in **Figure 2**.

The site is not known to contain any restricted landforms or unique geological features.

2.3 Topography

The elevation of the site ranges from 300 m in relation to the Australian height datum (mAHD) on the south-eastern side of the site to 336 mAHD on the western side of the site (DPIRD 2020) (**Figure 2**).

2.4 Hydrology and wetlands

Wetlands are areas of seasonally, intermittently or permanently waterlogged land such as poorly drained soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries (Wetlands Advisory Committee 1977). Many wetlands provide important fauna habitat and support high levels of fauna biodiversity and endemism.

Wetlands of national or international significance may be afforded special protection under Commonwealth or international agreements. The following lists of important wetlands were checked as part of this assessment:

- *Ramsar List of Wetlands of International Importance* (DBCA 2017a)
- *A Directory of Important Wetlands in Australia* (DBCA 2018*)*.

No Ramsar or listed 'important wetlands' are located within or near the site.

Examination of the Department of Water and Environmental Regulation (DWER) hydrography dataset (DWER 2018) shows 37 wetland or water related features occur within the site that are classified as:

- area subject to inundation
- drain minor
- earth dam, and
- watercourse – minor, non-perennial.

The Department of Biodiversity, Conservation and Attractions (DBCA) has developed the *Wheatbelt Wetlands Stage 1* dataset (DBCA 2017b). This dataset maps wetland features and classifies them based on their landform shape and water permanence.

A review of the *Wheatbelt Wetlands Stage 1* dataset indicated that four wetland features are located within the northern and eastern portions of the site. All four wetland features are mapped as having 'channelled valley bottom' landform shapes. The locations of the wetlands in the site are shown in **Figure 2**.

2.5 Regional vegetation

Vegetation types and resulting fauna habitats strongly influence the diversity and composition of fauna taxa present within an area. Native vegetation is described and mapped at different scales in order to illustrate patterns in its distribution. At a continental scale the *Interim Biogeographic Regionalisation of Australia* (IBRA) divides the Swan Coastal Plain into two floristic subregions (Environment Australia 2000).

The site is contained within the Avon Wheatbelt IBRA region and the Katanning subregion (previously referred to as Avon Wheatbelt 2). Vegetation within the Katanning subregion consists of proteaceous scrubheaths on residual lateritic uplands and derived sandplains, and mixed eucalypt, *Allocasuarina huegeliana* and Jam-York Gum woodlands on Quaternary alluvials and eluvials (DEC 2002).

Variations in native vegetation can be further classified based on regional vegetation mapping.

Beard *et al.* (2013) mapping shows the site comprises two vegetation associations, 'Narrogin 1023' within the northern portion and 'Wagin 1023' within the southern portion of the site. Both vegetation associations are described as consisting of York gum (*Eucalyptus loxophleba*) and salmon gum (*E. salmonophloia*) (Beard *et al.* 2013).

2.6 Historic land use

Review of historical images available from 1997 onwards shows that the majority of the site has historically been cleared to support agricultural land uses (WALIA 2023). No changes of vegetation are evident within the site since 1997.

2.7 Significant fauna

2.7.1 Threatened fauna

Certain fauna taxa that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, fauna taxa may be listed as 'threatened' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action likely to have a significant impact on a taxon listed under the EPBC Act requires Ministerial approval.

In Western Australia fauna species may also be classed as 'threatened' under the *Biodiversity Conservation Act 2016* (BC Act). It is an offence to 'take' or 'disturb' threatened fauna without Ministerial approval.

Threatened fauna species listed under the EPBC Act and/or BC Act are assigned a conservation status according to attributes such as population size and geographic distribution. Further information on threatened species and their categories is provided in **Appendix A**.

2.7.1.1 Black cockatoos

Three threatened species of black cockatoo occur in the south-west of WA (referred to herein collectively as 'black cockatoos'):

- *Zanda*[1] *latirostris* (Carnaby's black cockatoo) which is listed as 'endangered' under the EPBC Act and the BC Act.
- *Zanda*[2] *baudinii* (Baudin's black cockatoo) which is listed as 'endangered' under the EPBC Act and the BC Act.
- *Calyptorhynchus banksii naso* (forest red-tailed black cockatoo) which is listed as 'vulnerable' under the EPBC Act and the BC Act.

Black cockatoo habitat is conventionally separated into breeding, roosting and foraging categories:

- Black cockatoos nest in hollows that form in trees which are usually more than ~200 years old. 'Breeding habitat' comprises 'habitat trees' which are trees of a species known to support black

[1] Previously *Calyptorhynchus*
[2] Previously *Calyptorhynchus*

cockatoo breeding and which either have a suitably large enough nest hollow or have a large enough diameter at breast height (DBH) to indicate that a suitable nest hollow could develop in time (DAWE 2022). A minimum DBH for a habitat tree is defined as ≥50 centimetres (cm) for most tree species used by black cockatoos and ≥30 cm for *Eucalyptus wandoo* (wandoo) and *Eucalyptus salmonophloia* (salmon gum) (DAWE 2022). Breeding habitat is also generally expected to be located within 6 km of food and water resources (DPaW 2013).

- Roosting refers to black cockatoos congregating in a tree or group of trees to rest overnight. 'Roosting habitat' consists of groups or individual tall trees used for roosting. Roosts generally comprise the tallest trees in an area and can include native and non-native trees (DAWE 2022). They are often located within 6 km of water and food resources, with additional foraging ranges within 12 km (Shah 2006; Le Roux 2017; DAWE 2022). The use of a particular roost may vary depending on availability of food and water resources.
- Black cockatoos feed on the fruit and seeds of a range of native and non-native plant species. 'Foraging habitat' is vegetation that contains plant species known to be foraged on by black cockatoos.

Each black cockatoo species has a defined breeding season, with Baudin's black cockatoo breeding from August to January and Carnaby's black cockatoo breeding from July to December (DAWE 2022). Forest red-tailed black cockatoo breeds in October/November but may breed in March/April if there is good autumn rainfall (DAWE 2022). There is also evidence that forest red-tail black cockatoos breed throughout the year, with peaks in April – June and August – October (Johnstone *et al.* 2013).

2.7.2 Priority fauna

Fauna species that do not currently meet the criteria for listing as threatened but are potentially rare or threatened may be added to the DBCA *Priority Fauna List*. These species are classified into 'priority' levels based on threat. Whilst priority species are not under direct statutory protection, they are considered during State approval processes. Further information on priority species and their categories is provided in **Appendix A**.

2.7.3 Migratory fauna

Some fauna species that migrate to Australia and its external territories or pass though or over Australian waters during their annual migrations are protected under Commonwealth and State legislation. At a Commonwealth level, migratory fauna taxa may be listed as 'migratory' under *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action likely to have a significant impact on a taxon listed under the EPBC Act requires Ministerial approval. Further information on migratory species is provided in **Appendix A**.

2.7.4 Specially protected fauna

In Western Australia, fauna species that are of special conservation interest, including migratory species and cetaceans, species subject to international agreement or species otherwise in need of special protection may be listed as 'specially protected' under the BC Act. Further information on specially protected species and their categories is provided in **Appendix A**.

2.8 Pest fauna

The term 'pest fauna' can refer to any animal that requires some form of action to reduce its effect on the economy, the environment, human health and amenity. Pest fauna species are generally not native but some Australian or Western Australian fauna may also be considered pests.

A particularly invasive or detrimental pest species may be listed as a 'declared pest' pursuant to Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act), indicating that it warrants special management to limit its spread. Current pest status and control categories for Western Australia are provided in the *Western Australian Organism List* (DPIRD 2022b). Further information on categories of declared pests is provided in **Appendix A**.

2.9 DBCA managed or legislated land

DBCA has tenure of or interests in numerous areas of land across the state for a range of purposes. Tenure categories include national parks, nature reserves, conservation parks, marine parks, marine nature reserves, marine management areas, section 5(1)(g) reserves, state forest and timber reserves. These areas are mapped within the *Legislated Lands and Waters* (DBCA 2021b) and *Lands of Interest* (DBCA 2021a) datasets. The *Legislated Lands and Waters* (DBCA 2021b) dataset includes lands subject to the following legislation; the *Conservation and Land Management Act 1984* (CALM Act 1984), *Swan and Canning Rivers Management Act 2006* (SCRM Act) and lands identified under the *Land Administration Act 1997* (LA Act). The *Lands of Interest* (DBCA 2021a) dataset includes all other lands of which DBCA is recognised as the manager but is not vested under any act. These lands comprise of crown land and freehold land which DBCA has been acknowledged by the Department of Lands as the responsible agency.

An unnamed nature reserve (R 20985) is located approximately 820 m to the west of the site, as gazette under the CALM Act (DBCA 2021b).

2.10 Ecological linkages

Ecological linkages are linear landscape elements that allow the movement of fauna, flora and genetic material between areas of remnant habitat. This exchange of genetic material between vegetation remnants improves the viability of those remnants by allowing greater access to breeding partners and food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are ideally continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

Review of aerial imagery indicates that the vegetation within the site is separated from the ecological linkages by sealed roads.

2.11 Previous surveys

No previous surveys of the site are known to have been undertaken.

3 Methods

3.1 Desktop assessment

3.1.1 Basic fauna

A search was conducted for fauna species that have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DCCEEW 2023b), *NatureMap* (DBCA 2023), DBCA's conservation significant fauna database (30km radius, reference no. FAUNA#7280) and literature references.

3.1.2 Black cockatoo

A search was conducted for records of black cockatoos and potential black cockatoo habitat mapping occurring within 12 km of the site using a range of publicly available regional studies and datasets. Detailed information on each dataset considered as part of the desktop review is provided in **Appendix A**.

3.2 Field survey

Two ecologists from Emerge visited the site on the 29-30 November 2022 during the day to conduct the basic fauna survey and targeted black cockatoo field survey.

The weather conditions prior to and during the survey were hot and dry (refer to **Section 2.1** for recorded weather conditions).

3.2.1 Basic fauna

Transects were traversed across the site, during the day, and the characteristics of fauna habitat and presence of fauna species was recorded. Microhabitats such as logs, rocks and leaf litter were investigated and evidence of species presence such as tracks, scats, skeletal remains, foraging evidence or calls was also noted.

An opportunistic fauna species list was compiled and fauna habitat values were described, with particular reference to conservation significant fauna species with potential to occur within the site.

3.2.2 Targeted black cockatoo

Transects were traversed across the site and the presence of potential black cockatoo breeding, night roosting and foraging habitat was recorded. If observed, the presence of black cockatoos within or near the site was noted. Active searches for evidence of breeding, roosting and foraging activity such as chew marks, branch clippings, droppings, moulted feathers and chewed marri or banksia fruit were conducted.

3.2.2.1 Breeding habitat

A 'habitat tree' was defined as a native eucalypt that is typically known to support black cockatoo breeding such as *Corymbia calophylla* (marri), *Eucalyptus marginata* (jarrah), *E. patens* (blackbutt), *E. gomphocephala* (tuart), wandoo, salmon gum or to a lesser extent *E. rudis* (flooded gum), with a DBH ≥50 cm or DBH ≥30 cm for wandoo or salmon gum (DAWE 2022). As any tree that has a suitable hollow may provide breeding habitat for black cockatoos, other tree species were also considered to be habitat trees if they contained a suitable hollow.

To be suitable for use as breeding habitat by black cockatoos it was considered a hollow must:

- have an entrance opening of at least 10 cm but preferably 20-30 cm (Saunders *et al.* 1982; Groom 2010; Johnstone *et al.* 2013)
- be located at least 3 m from the ground (Saunders 1979b; Johnstone and Storr 1998; Groom 2010; Saunders 2014)
- be located in a trunk or branch that is generally large enough to contain a hollow that has a floor diameter of at least 40 cm and depth of 50-200 cm such that it could house an adult black cockatoo and nestlings (Saunders 1979a; Johnstone and Storr 1998; Saunders 2014; DPaW 2015)
- have vertical or near vertical orientation (Johnstone and Kirkby 2008; Johnstone *et al.* 2013).

Occasionally, native eucalypts were encountered that met DBH requirements but did not contain a trunk/branch of a sufficient size to support a hollow suitable for use by black cockatoos. For example, the tree may have been less than 3 m tall or had a trunk that forked between 1.3 m and 3 m in height and after the fork no limbs had a diameter of ≥50 cm or ≥30 cm for wandoo or salmon gum. These trees were not recorded as habitat trees as the likelihood they would form a suitable hollow was low.

Habitat trees were individually identified and the attributes outlined in **Table 1** were recorded for each tree.

Table 1: Attributes recorded for each habitat tree in the site

Attribute	Description
Image	Trees were individually photographed
GPS location	The location was recorded using a handheld GPS unit
Tree species	Species and common name were identified
Diameter at breast height (DBH) (cm)	DBH was measured at breast height (1.3 m) using a diameter tape
Hollows potentially suitable for breeding by a black cockatoo	Number of hollows potentially suitable for breeding by a black cockatoo recorded (assessed from ground level only)

Each habitat tree was assigned to a category based on current black cockatoo guidelines (DAWE 2022) listed in **Table 2**.

Table 2: Habitat tree categories (DAWE 2022)

Category	Specifications
Known nesting tree	Trees (live or dead but still standing) which contains a hollow where black cockatoo breeding has been recorded or which demonstrates evidence of breeding (i.e. showing evidence of use through scratches, chew marks or feathers).

Table 2: Habitat tree categories (DAWE 2022) (continued)

Category	Specifications
Suitable nesting tree	Trees with suitable nesting hollows present, although no evidence of use. Note that any species of tree may develop suitable hollows for breeding. Hollow confirmed by internal hollow inspection^.
Potential nesting tree	Trees that have a suitable DBH to develop a nest hollow, but do not currently have hollows. Trees suitable to develop a nest hollow in the future are 300-500 mm DBH. Note that many species of eucalypt may develop suitable hollows for breeding.

^Hollow determined to be suitable for use as breeding habitat by black cockatoos as listed above in **Section 3.2.2.1**

3.2.2.2 Roosting habitat

Roosting habitat is defined as a stand of tall (>8 m) native and/or non-native trees that are situated within 2 km of a water source (Glossop *et al.* 2011; DAWE 2022). If present, groups of tall native and non-native trees were assumed to provide roosting habitat. The presence of active or historical roosts in these trees was determined through evidence of roosting activity, such as branch clippings, droppings or moulted feathers.

Tall groups of native and non-native trees in the site within 1000 m of an existing large roost (>150 individuals) or 500 m of an existing small roost (<150 individuals) were assumed to be associated with that roost (Glossop *et al.* 2011).

3.2.2.3 Foraging habitat

Foraging habitat was identified by assessing vegetation in the site for plant species known to provide food for black cockatoos (Davies 1966; Saunders 1980; Johnstone and Storr 1998; Johnstone and Kirkby 1999; Groom 2011; Johnstone *et al.* 2011; DAWE 2022).

Foraging habitat was classified as either 'native' or 'non-native' based on the predominant vegetation's naturalised status. It was also classified as either 'primary' or 'secondary' based on black cockatoo foraging preferences. A list of plant species classified as primary or secondary food plants is provided as **Appendix C**.

As it is not always possible to separate out food plants from non-food plants, mapped foraging habitat may also include vegetation comprising non-food plants. The proportion of non-food plants in mapped foraging habitat was minimised as far as practicable.

Evidence of black cockatoo foraging, such as chewed fruits, was searched for within the site and allocated to a species where possible.

3.3 Data analysis

3.3.1 Desktop assessment

A total number of species that occur or potentially occur within the desktop assessment search area was calculated by adding the total count of non-conservation significant species provided by *NatureMap* to the combined number of conservation significant species provided by *NatureMap* and *Protected Matters Search Tool*. The habitat requirements of conservation significant vertebrate fauna

were specifically reviewed to verify they did in fact have potential to occur in the site (that is marine mammals and fish were omitted).

3.3.2 Fauna habitat

Fauna habitats were described according to the dominant flora species and vegetation type present, as determined from observations made during the field survey and information provided in the '*Detailed Flora and Vegetation Assessment*' (Emerge Associates 2023).

The identified fauna habitats were mapped on aerial photography with the boundaries interpreted from aerial photography, (Emerge Associates 2023) plant communities and notes taken in the field.

3.3.3 Likelihood of occurrence

Information on habitat preferences and distribution of conservation significant fauna species with potential occur within the site or wider area was reviewed and assessed against the general site conditions and fauna habitat types recorded during the field survey.

Based on the results of the desktop assessment and information recorded during the field survey, an assessment of the likelihood of occurrence of conservation significant fauna within the site was undertaken using the categories outlined in **Table 3**.

Table 3: Likelihood of occurrence assessment categories and definitions

Likelihood of occurrence	Definition
Recorded	The species was recorded during the current field survey or during previous field surveys.
Likely	The site contains suitable habitat for the species and it is likely the species may occur based on presence of a recent historical record within or close to the site.
Possible	The site contains habitat of at least marginal quality and/or extent for the species and the site is located within the known distribution range of the species which is supported by recent literature records from near the site.
Unlikely	The site contains no or marginal habitat for the species and/or no recent literature records occur near the site.

3.3.4 Black cockatoo habitat

3.3.4.1 Habitat trees

Habitat trees were classified according to the scheme outlined in **Table 2** and mapped on aerial imagery. A complete summary of the recorded attributes of habitat trees was compiled in a tabular format.

3.3.4.2 Foraging habitat value

Foraging habitat was described according to the dominant flora species or vegetation type present and mapped using boundaries interpreted from aerial photography and notes taken in the field. The foraging value of each patch of foraging habitat was attributed separately for each species of black cockatoo likely to occur in the site. Foraging value was assigned as outlined in **3.2.2.3**.

3.4 Nomenclature and sources of information

Taxonomy and nomenclature of scientific and common names for mammals, reptiles and amphibians follow *the Western Australian Museum* (WAM) *Checklist of the Terrestrial Vertebrate Fauna of Western Australia* (WAM 2022). For birds taxonomy and nomenclature of scientific and common names follows the Australian Faunal Directory (AFD) (DCCEEW 2023a). Where common names were not provided by the WAM or the AFD, these have been derived from other sources as noted.

Literature listed in **Appendix A** represent the main publications used to identify fauna species and habitats within the site.

3.5 Survey limitations

It is important to note the specific constraints imposed on surveys and the degree to which these may have limited survey outcomes. An evaluation of the survey methodology against standard constraints outlined in the EPA's document *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) is provided in **Table 4**.

Table 4: Evaluation of survey methodology against standard constraints outlined in the EPA's Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)

Constraint	Degree of limitation	Details
Level of survey	No limitation	A basic survey (desktop study and field survey) in combination with a targeted black cockatoo survey was undertaken. The level of survey and survey effort are considered adequate to assess the fauna and black cockatoo habitat values within the site.
Scope	No limitation	The survey focused on vertebrate fauna and habitat values, with particular focus on black cockatoos and other conservation significant taxa with potential to occur within the site.
Proportion of fauna identified, recorded and/or collected.	No limitation	All observed vertebrate fauna were identified.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	No limitation	Adequate information was available from database searches, previous surveys and literature references.
The proportion of the task achieved and further work which might be needed.	No limitation	The task was achieved in its entirety.
Experience level of personnel	No limitation	This fauna and black cockatoo assessment was undertaken by two qualified ecologists with over three years of zoological experience in Western Australia. Technical review was undertaken by a principal environmental consultant with over 20 years' experience in environmental science in Western Australia.

Table 4: Evaluation of survey methodology against standard constraints outlined in the EPA's Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)(continued)

Constraint	Degree of limitation	Details
Suitability of timing, weather and season	No limitation	Survey timing is not considered to be of great importance for basic fauna assessments but the weather conditions during the survey were ideal for detecting fauna species. The survey was undertaken during the black cockatoo peak breeding season to maximise the chance of detecting breeding behaviour.
Completeness	No limitation	The desktop assessment, field survey and targeted black cockatoo components of the survey were completed comprehensively.
Spatial coverage and access	No limitation	Site coverage was comprehensive (track logged).
	No limitation	All parts of the site could be accessed as required.
Survey intensity	No limitation	The intensity of the survey was adequate given the size of the site and the relatively low habitat value present.
Influence of disturbance	No limitation	The site is highly modified due to historical disturbance. However, no recent disturbance was noted that may have affected outcomes of the survey.
Adequacy of resources	No limitation	All resources required to perform the survey were available. The guidance currently available from Commonwealth and State agencies on the assessment of black cockatoo habitat is limited and relies heavily on technical experts preparing their own methodology.
Compliance with EPA (2020) guidance	Minor limitation	The EPA guidance requires that a full list of all fauna species with potential to occur within the site is compiled. As part of this assessment a comprehensive list of fauna species of conservation significance was compiled. Non-conservation taxa with potential to occur within the site were not compiled into a list but are provided as raw data in **Appendix B**. Given that all species with potential to occur within the site are still identified within the relevant appendices this is not considered to affect the outcomes of this assessment.

4 Results

4.1 General site conditions

The site has been highly disturbed and has been subject to previous clearing and agricultural use. Some remnant woodland vegetation remains with the majority of the site comprised of non-native grasses or cultivated species. Ongoing grazing occurs with domestic sheep having access to parts of the site.

Several non-perennial drains and channels occur in the central and western portions of the site which were drying up at the time of survey.

4.2 Fauna habitat

Three broad fauna habitats were identified within the site, as listed in in **Table 5**.

A description and the area of each habitat is provided in **Table 5** and representative photographs of each are provided in **Plate 1** to **Plate 3**. The location of each habitat is shown on **Figure 3**.

Table 5: Fauna habitats identified within the site

Fauna habitat	Description	Area (ha)
Eucalypt woodland	Open woodland of *Eucalyptus* spp. over native and non-native shrubs and grasses (**Plate 1**).	17.17
Scattered trees	Scattered native and non-native trees over non-native grasses (**Plate 2**).	3.06
Grassland	Heavily disturbed areas comprising predominantly grassland. Areas of hardstands, tracks, buildings or planted gardens were also included in this habitat type (**Plate 3**).	256.48



Plate 1: Eucalypt woodland habitat



Plate 2: Scattered trees habitat



Plate 3: Grassland habitat

4.3 Fauna

4.3.1 Desktop assessment

A total of 208 fauna species were identified from database searches as occurring or potentially occurring within 10 km of the site[3] as listed in **Appendix B.**

Of these species, 26 are conservation significant, including 12 threatened, six priority, seven migratory fauna and three other specially protected species as listed in **Appendix D**.

4.3.2 Species inventory

A total of 16 native and two introduced fauna species were directly or indirectly (from foraging evidence) recorded during the field survey.

A complete species list is provided in **Appendix E**.

4.3.3 Conservation significant fauna

No conservation significant fauna species were recorded within the site during the field survey.

Eight fauna species of conservation significance were considered to possibly or likely occur in the site based on habitat requirements, species distribution and site conditions, as shown in **Table 6**.

The remainder of the conservation significant fauna species identified in the desktop assessment (18 species) are considered unlikely to occur in the site due to lack of suitable habitat or because the site

[3] Includes native and non-native species

lies outside of the species known distribution. Fauna species classed as unlikely to occur are listed in **Appendix D**.

Table 6: Summary of conservation significant fauna species recorded or deemed possible or likely to occur within the site

Species name	Common name	Level of significance		Habitat	Likelihood of occurrence within the site
		BC Act	EPBC Act		
Birds					
Apus pacificus	Pacific swift	MI	MI	Aerial, migratory species that is most often seen over inland plains and sometimes above open areas, foothills or in coastal areas. Sometimes occurs over settled areas, including towns, urban areas and cities (Johnstone and Storr 1998).	**Possible**: May opportunistically occur in or fly over the site on commute but only for short periods of time.
Calyptorhynchus banksii naso	Forest red-tailed black cockatoo	VU	VU	*Eucalypt* and *Corymbia* forests, often in hilly interior. More recently also observed in more open agricultural and suburban areas including Perth metropolitan area. Attracted to seeding *Corymbia calophylla*, *Eucalyptus marginata*, introduced *Melia azedarach* and *Eucalyptus* spp. trees (Johnstone and Storr 1998).	**Possible:** Suitable roosting and foraging habitat present and potential breeding habitat.
Falco hypoleucos	Grey falcon	VU	-	Species occurs in arid and semi-arid Australia, where it inhabits timbered lowland plains. In particular Acacia shrublands and that are crossed by tree-lined water courses. Species has also been observed hunting in treeless areas and frequenting tussock grassland and open woodlands (TSSC 2020).	**Possible:** May opportunistically occur in or fly over the site on commute or while searching for prey but only for short periods of time.
Falco peregrinus	Peregrine falcon	MI	MI	Mainly found around cliffs along coasts, rivers, ranges and around wooded watercourses and lakes (Johnstone and Storr 1998).	**Possible**: May opportunistically occur in or fly over the site on commute or while searching for prey but only for short periods of time.
Platycercus icterotis xanthogenys	Western rosella (inland)	P4	-	Open eucalypt woodlands with heath understorey.	**Possible:** Suitable habitat (open eucalypt woodlands) occurs in the site.

Table 6: Summary of conservation significant fauna species recorded or deemed possible or likely to occur within the site (continued)

Species name	Common name	BC Act	EPBC Act	Habitat	Likelihood of occurrence within the site
Zanda latirostris	Carnaby's black cockatoo	EN	EN	Mainly proteaceous scrubs and heaths and adjacent eucalypt woodlands and forests; also plantations of *Pinus* spp. Attracted to seeding *Banksia* spp., *Dryandra* spp., *Hakea* spp., *Eucalyptus* spp., *Corymbia calophylla*, *Grevillea* spp., and *Allocasuarina* spp. (Johnstone and Storr 1998).	**Likely**: Suitable roosting and foraging habitat present and potential breeding habitat.
Mammal					
Dasyurus geoffroii	Chuditch	VU	VU	Wide range of habitats from woodlands, dry sclerophyll forests, riparian vegetation, beaches and deserts. Appears to utilise native vegetation along roadsides in the wheatbelt (DEC 2012b).	**Possible:** Suitable habitat (woodlands and roadside vegetation) occurs in the site.
Phascogale calura	Red-tailed phascogale	CD	VU	Historically occurred in a variety of woodland habitats but not restricted to remnants of mature *Eucalyptus wandoo* or *Allocasuarina huegeliana* woodlands in the south-western Wheatbelt where annual rainfall is 300-600 mm (Menkhorst & Knight 2011).	**Possible:** Suitable habitat (*eucalyptus wandoo* woodlands) occurs in the site.

4.4 Declared pests

No species listed as a declared pest (C3) pursuant to the BAM Act were identified within the site.

4.5 Black cockatoos

4.5.1 Desktop assessment

The site is located within the distribution range of Carnaby's black cockatoo and forest red-tailed black cockatoo but outside the Baudin's black cockatoo distribution range (DoEE 2016c, b, a).

The site is located within the Carnaby's black cockatoo modelled breeding range and occurs within a confirmed breeding area (Glossop *et al.* 2011; DoEE 2016b).

No breeding range information for forest red-tailed black cockatoo is provided in (DoEE 2016b). However, breeding often occurs within areas that contain a high number of marri trees (DAWE 2022)

Roosts associated with white-tailed black cockatoos occur within 9 km of the site. However, no roosts associated with forest red-tailed black cockatoo occur within 12 km of the site.

The results of the black cockatoo desktop assessment are summarised in **Table 7** and shown in **Figure 4**.

Table 7: Summary of black cockatoo background review

Category		Site context	Source
Species distribution		• Site is located within the modelled distribution range of Carnaby's black cockatoo and within its breeding range. • Site is not located within the modelled distribution range of Baudin's black cockatoo. • Site is located within the modelled distribution range of forest red-tailed black cockatoo.	(DoEE 2016a, b, c)
Carnaby's black cockatoo breeding areas (12 km radius surrounding breeding sites)		• One confirmed breeding area intersects the site.	(Glossop *et al.* 2011)
Important bird areas for Carnaby's black cockatoo		• The site is not located within an important bird area for Carnaby's black cockatoo and none occur nearby.	(DPaW 2013; BirdLife International 2022)
Roost site		• None within the site • Three roost sites within 12 km of the site (**Table 8)**: ◦ Three associated with white-tailed^ black cockatoos only. ◦ None associated with forest red-tailed black cockatoos only.	(Peck *et al.* 2022)
Foraging habitat	Carnaby's black cockatoo	• Potential native foraging habitat is mapped in the the site. • Additional areas of potential native foraging habitat mapped within the wider local area, including adjacent to the western, northern and eastern portion of the site.	(Emerge Associates 2021)
		• Highbury pine plantation mapped within 5 km of site boundary.	(Forest Products Commission 2020)
	Baudin's black cockatoo	• Site does not occur within Baudin's black cockatoo modelled distribution.	(Emerge Associates 2021)
	Forest red-tailed black cockatoo^	• Potential native foraging habitat is not mapped within the site. • Areas of potential native foraging habitat mapped within the wider local area, mainly to the west.	(Emerge Associates 2021)

^Carnaby's and/or Baudin's black cockatoo

Table 8: White-tailed black cockatoos recorded in roosts within 12 km of the site (Peck et al. 2022)

Roost ID	Year and number of individuals									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NARNARR002	NS	NS	16	19	36	NS	21	0	17	NS
NARNARR004	NS	NS	0	9	NS	0	NS	NS	0	NS
NARNARR005	NS	80	0	0	NS	NS	0	NS	45	NS

NS = not surveyed

4.5.2 Habitat

4.5.2.1 Breeding

A total of 313 black cockatoo habitat trees were recorded within the site as shown in **Figure 5**.

The habitat trees comprised 178 wandoo, 54 *Eucalyptus loxophleba* (york gum), 48 flooded gum, 10 *E. astringens* (brown mallet), 8 salmon gum, and 15 stag (dead) trees.

Of the 313 trees, 16 were determined to each contain a hollow suitable for black cockatoo breeding. However, hollows were only inspected at ground level and would ideally by inspected using a pole camera to better assess their suitability. The remaining 297 trees contained no suitable hollows for breeding by black cockatoos.

A summary of the habitat trees recorded within the site is provided in **Table 9** and an inventory in **Appendix F**.

Table 9: Habitat trees recorded within the site

Category	No. trees
Known nesting trees	0
Suitable nesting trees	16
Potential nesting trees	297
Total	313

4.5.2.2 Roosting

No secondary evidence of roosting was observed within the site during the survey.

4.5.2.3 Foraging

A total of 16.9 ha of foraging habitat for Carnaby's black cockatoo and 6.99 ha for forest red-tailed black cockatoo were recorded in the site as shown in **Figure 6** to **Figure 7**.

The majority of foraging habitat occurs as patches of eucalypt woodland and comprises a combination of primary, secondary and non-food plants. Dominant primary food plants are wandoo and salmon gum. The only significant secondary food plant observed was York gum for Carnaby's black cockatoo.

The extent of foraging habitat by value category is detailed in **Table 10**.

Table 10: Foraging habitat recorded within the site

Foraging habitat	Black cockatoo species and area of foraging habitat (ha)	
	Carnaby's	Forest red-tailed
Native primary	6.99	6.99
Native secondary	9.91	0
Non-native primary	0	0
Non-native secondary	0	0
Total	16.90	6.99

5 Discussion

5.1 Fauna and fauna habitat

The 16 native fauna species recorded within the site are all generally common and widespread across the Wheatbelt and therefore records for these species were not unexpected. The relatively small number of fauna species recorded during the survey is likely due to the the relatively low fauna habitat values present. The habitat values within the site have been modified by historical clearing for agricultural use which has resulted in the removal of most of the native vegetation.

Habitat values in the site are greatest with respect to areas of **eucalypt woodland** habitat, which covers approximately 6.2% of the site. This habitat provides a contiguous cover of predominantly native trees. However, this habitat is relatively small in extent and largely lacks native understorey vegetation, with only scattered individual understorey plants present. While this habitat still provides value to many common native fauna species, it is unlikely to be of importance to most fauna species given its agricultural setting.

The remainder of the site (approximately 93.8%) comprises **scattered trees** and **grassland habitat** These habitats are likely to be predominantly used by common and widespread native and non-native fauna with non-specific habitat requirements, which enable them to persist in highly modified environments.

5.2 Conservation significant fauna

Eight fauna species of conservation significance were considered likely or possibly to occur within the site.

Grey falcon, pacific swift and peregrine falcon are highly mobile species that may opportunistically fly over or forage in the site for short periods of time as part of a much larger home range. Neither pacific swift nor peregrine falcon would breed within the site and the grey falcon is unlikely to breed within the site. Any occurrence of these species in the site would likely be in the air space and largely independent from terrestrial habitat.

Chuditch is a carnivorous mammal that adapts to a wide range of habitats including woodlands and roadside vegetation in the wheatbelt. However, while the eucalypt woodland within the site could be considered suitable habitat, the lack of understorey means there are limited places for this species to rest during the day. Therefore, if this species were to occur, it would likely be as an infrequent visitor.

Red-tailed phascogale is a predominantly arboreal mammal that favours *Allocasuarina* or wandoo woodlands. Therefore, the eucalypt woodland within the site may provide suitable habitat. However, the habitat in the site is highly fragmented and may be less appealing than vegetation in the local area that features more contiguous canopy.

The western rosella is a bird that inhabits woodlands in the southwest. The eucalypt woodland habitat within the site would be suitable habitat for this species.

Carnaby's black cockatoo and forest red-tailed black cockatoo are discussed further in **Section 5.3**.

5.3 Black cockatoo habitat values

Although not recorded within the field survey, Carnaby's black cockatoo is likely to occur within the site as it lies within the species modelled distribution range, contains suitable foraging habitat and many recent records of this species occur around Narrogin. Forest red-tailed black cockatoo could possibly occur within the site as it contains suitable foraging habitat. However, the site is situated on the edge of the modelled distribution range so may not be as likely as Carnaby's black cockatoo.

The site is located outside of the modelled distribution range of Baudin's black cockatoo (DoEE 2016b) and while short incidental occurrences are possible, it is considered unlikely that the species would occur in the site.

5.3.1 Breeding

The site currently provides potential breeding habitat for black cockatoos based on observations made from ground level. However, it is likely that not all of those large hollows will be suitable due to the specific internal dimensions required by black cockatoos. Further investigation will be required with an internal hollow inspection to determine the precise breeding habitat value of the site.

The remaining live habitat trees in the site have the potential to form suitable hollows in the future. However, it will likely take many decades for hollows to form that are large enough to be suitable for use by black cockatoos for breeding.

As the site is located outside of the expected breeding distribution of Baudin's black cockatoo, the breeding habitat values are most relevant to Carnaby's black cockatoo and forest red-tailed black cockatoo.

5.3.2 Roosting

While no dusk roost survey was undertaken, no secondary evidence of roosting such as branch clippings, droppings or feathers were observed within the site. Additionally, no known roosting locations occur close to the site with the closest occurring near the Narrogin town center over 8 km away. Therefore, there is no reason to suspect that black cockatoos roost in the site. Nevertheless, the site contains many tall trees and groups of tall trees that have the potential to provide roosting habitat for black cockatoos.

5.3.3 Foraging

The site contains native foraging habitat for both Carnaby's black cockatoo and forest red-tailed black cockatoo.

The highest value foraging resource in the site is associated with the eucalypt woodland that consists of wandoo, which is considered a primary foraging resource for both Carnaby's black cockatoo and forest red-tailed black cockatoo, and salmon gum, a primary resource for Carnaby's black cockatoo. While similar vegetation occurs adjacent to the site and in the local area, these stands of eucalypts are likely important locally due to historical clearing of much of the wheatbelt's natural vegetation.

Secondary foraging habitat for Carnaby's black cockatoo is predominantly associated with the many York gum present. While there are records of Carnaby's black cockatoo consuming the fruit of this

tree (Groom 2011; DoEE 2017), it is a secondary option and not as important food source compared to wandoo or salmon gum. No secondary foraging sources for forest red-tailed black cockatoo occur in the site.

6 Conclusions

6.1 Fauna and fauna habitat

The majority of the site (92.69%) supports highly disturbed **grassland** habitat which provides limited value to fauna species of conservation significance and is likely to primarily be used by common and widespread native and non-native fauna with non-specific habitat requirements. The highest fauna habitat values are associated with the **eucalypt forest** habitat which occurs over 6.2% of the site. The remainder of the site comprises the **scattered trees** habitat (1.11%).

A total of 16 native fauna species were recorded within the site.

While not recorded during the field survey, Carnaby's black cockatoo (listed as endangered) is likely to occur in the site. Seven other species of conservation significance not recorded during the field survey may possibly occur in the site: chuditch, forest red-tailed black cockatoo, grey falcon, pacific swift, peregrine falcon, red-tailed phascogale and western rosella.

6.2 Black cockatoos

The site occurs within the modelled distribution of Carnaby's black cockatoo and forest red-tailed black cockatoo but outside of the modelled distribution of Baudin's black cockatoo.

The site contains 313 habitat trees, of which 16 contain hollows suitable for use by black cockatoos for breeding.

No roosts or evidence of roosting by any species of black cockatoo was recorded within the site during the field survey. Tall native and non-native trees within the site represent suitable roosting habitat for species of black cockatoo.

A total of 16.90 ha of native foraging habitat for Carnaby's black cockatoo was mapped within the site of which 41.36% is associated with primary foraging sources and 58.64% is associated with secondary foraging sources.

A total of 6.99 ha of foraging habitat for forest red-tailed black cockatoo was mapped in the site of which all is from primary foraging sources.

Additional areas of foraging habitat of similar or higher value occurs adjacent to the site and in the wider local area.

7 References

7.1 General references

Alan Tingay and Associates 1998, *A Strategic Plan for Perth's Greenways - Final Report*. December 1998.

Beard, J. S., Beeston, G. R., Harvey, J. M., Hopkins, A. J. M. and Shepherd, D. P. 2013, *The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir. Second edition.*, Conservation Science Western Australia, 9: 1-152.

BirdLife International 2022, *Important Bird Areas*, <http://datazone.birdlife.org/site/factsheet/northern-swan-coastal-plain-iba-australia>.

Bureau of Meteorology (BoM) 2023, *Climate Data Online*, <http://www.bom.gov.au/climate/data/>.

Davies, S. J. J. F. 1966, *The movements of the White-tailed Black Cockatoo (Calyptorhynchus baudinii) in south-western Australia*, Western Australian Naturalist 10: 33-42.

Department of Agriculture, Water and the Environment (DAWE) 2022, *Referral guideline for 3 WA threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black cockatoo*, Canberra.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017a, *Ramsar Sites (DBCA-010)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017b, *Wheatbelt Wetlands Stage 1 (DBCA-021)*, <https://catalogue.data.wa.gov.au/dataset/wheatbelt-wetlands-stage-1>.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018, *Directory of Important Wetlands in Australia - Western Australia (DBCA-045)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2021a, *Lands of Interest (DBCA-012)*.

Department of Biodiversity Conservation and Attractions (DBCA) 2021b, *Legislated Lands and Waters (DBCA-011)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2023, *NatureMap*, <https://static.dbca.wa.gov.au/pages/naturemap.html>.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2023a, *Australian Faunal Directory*.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2023b, *Protected Matters Search Tool*, <https://pmst.awe.gov.au/#/map>.

Department of Environment and Conservation (DEC) 2002, *A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002*, Perth.

Department of Environment and Energy (DoEE) 2016a, *Modelled distribution for Baudin's Cockatoo (Calyptorhynchus baudinii)*, Canberra.

Department of the Environment and Energy (DoEE) 2016b, *Modelled distribution for Carnaby's Cockatoo (Calyptorhynchus latirostris)*, Canberra.

Department of Environment and Energy (DoEE) 2016c, *Modelled distribution for Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso)*, Canberra.

Department of Environment and Energy (DoEE) 2017, *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) Calyptorhynchus latirostris, Baudin's Cockatoo (Vulnerable) Calyptorhynchus baudinii and Forest Red-tailed Black Cockatoo (Vulnerable) Calyptorhynchus banksii naso*, Canberra, Australia.

Department of Parks and Wildlife (DPaW) 2013, *Carnaby's Cockatoo (Calyptorphynchus latirostris) Recovery Plan*.

Department of Parks and Wildlife (DPaW) 2015, *How to design and place artificial hollows for Carnaby's cockatoo*, Perth.

Department of Primary Industries and Regional Development (DPIRD) 2020, *Contours 2 m and 10 m (DPIRD-072)*, Perth.

Department of Primary Industries and Regional Development (DPIRD) 2022a, *Soil Landscape Mapping - Systems (DPIRD-064)*.

Department of Primary Industries and Regional Development (DPIRD) 2022b, *Western Australian Organism List*, Perth, WA.

Department of Water and Environmental Regulation (DWER) 2018, *Hydrography Linear (Heirarchy) (DWER-031)*, Perth.

Emerge Associates 2021, *Potential Habitat Black Cockatoo Habitat Spatial Dataset*, Perth, WA.

Emerge Associates 2023, *Detailed Flora and Vegetation Assessment - Proposed Narrogin Solar Farm*, EP22-083(03)--004 SCM, Version 1.

Environment Australia 2000, *Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and Development of Version 5.1 - Summary Report*, Department of Environment and Heritage.

Environmental Protection Authority (EPA) 2020, *Technical Guidance - Terrestrial vertebrate fauna surveys for environmental impact assessment*, Joondalup, Western Australia.

Forest Products Commission 2020, *Forest Products Commission Plantations (FPC-001)*.

Glossop, B., Clarke, K., Mitchell, D. and Barrett, G. 2011, *Methods for mapping Carnaby's cockatoo habitat*, Department of Environment and Conservation, Perth.

Groom, C. 2010, *Artificial Hollows for Carnaby's Black Cockatoo: An investigation of the placement, use, monitoring and maintenance requirements of artificial hollows for Carnaby's black cockatoo*, Department of Environment and Conservation, Perth.

Groom, C. 2011, *Plants Used by Carnaby's Black Cockatoo*, Department of Environment and Conservation, Perth.

Johnstone, R., Kirby, T. and Sarti, K. 2013, *The breeding biology of the forest red-tailed black cockatoo Calyptorhynchus banksii naso Gould in south-western Australia. I. Characteristics of nest trees and nest hollows*, Pacific Conservation Biology, 19(2): 121-142.

Johnstone, R. E., Johnstone, C. and Kirkby, T. 2011, *Black Cockatoos on the Swan Coastal Plain: Carnaby's Cockatoo (Calyptorhynchus latirostris), Baudin's Cockatoo (Calyptorhynchus baudinii) and the Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) on the Swan Coastal Plain (Lancelin–Dunsborough), Western Australia. Studies on distribution, status, breeding, food, movements and historical changes.*, Department of Planning, Western Australia.

Johnstone, R. E. and Kirkby, T. 1999, *Food of the Red-tailed Forest Black Cockatoo Calyptorhynchus banksii naso in Western Australia*, Western Australian Naturalist, 22: 167-178.

Johnstone, R. E. and Kirkby, T. 2008, *Distribution, status, social organisation, movements and conservation of Baudin's Cockatoo (Calyptorhynchus baudinii) in South-west Western Australia*, Records of the Western Australian Museum, 25: 107-118.

Johnstone, R. E. and Storr, G. M. 1998, *Handbook of Western Australian Birds. Volume 1 - Non-Passerines (Emu to Dollarbird)*, Western Australian Museum, Perth.

Le Roux, C. 2017, *Nocturnal roost tree, roost site and landscape characteristics of Carnaby's Black-Cockatoo (Calyptorynchus latirostris) on the Swan Coastal Plain*, Edith Cowan University Research Online.

Peck, A., Barrett, G. and Williams, M. 2022, *The 2022 Great Cocky Count: a community-based survey for Carnaby's Black-Cockatoo (Calyptorhynchus latirostris), Baudin's Black-Cockatoo (Calyptorhynchus baudinii) and Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso)*, Birdlife Australia, Floreat, Western Australia.

Purdie, B., Tille, P. and Schoknecht, N. 2004, *Soil-landscape mapping in south-Western Australia: an overview of methodology and outputs. Resource Management Technical Report 280*, State of Western Australia.

Saunders, D. A. 1979a, *The Availability of Tree Hollows for Use as Nest Sites by White-tailed Black Cockatoos*, Australian Wildlife Research, 6: 205-216.

Saunders, D. A. 1979b, *Distribution and taxonomy of the white-tailed and yellow-tailed Black-Cockatoos Calyptorhynchus spp.*, Emu, 79(215-227).

Saunders, D. A. 1980, *Food and Movements of the Short-billed Form of the White-tailed Black Cockatoo*, Australian Wildlife Research, 7: 257-269.

Saunders, D. A., Mawson, P.R., Dawson, R. 2014, *Use of tree hollows by Carnaby's Cockatoo and the fate of large hollow-bearing trees at Coomallo Creek, Western Australia 1969-2013.*, Biological Conservation, 177: 185-193.

Saunders, D. A., Smith, G. T. and Rowley, I. 1982, *The availability and dimensions of Tree Hollows that Provide Nest Sites for Cockatoos (Psittaciformes) in Western Australia*, Australian Wildlife Research, 9: 541-556.

Shah, B. 2006, *Conservation of Carnaby's Black Cockatoo on the Swan Coastal Plain, Western Australia*, Birds Australia, Perth.

Western Australian Land Information Authority (WALIA) 2023, *Landgate Map Viewer Plus*.

Western Australian Museum (WAM) 2022, *Checklist of the Terrestrial Vertebrate Fauna of Western Australia*, Perth, WA.

Wetlands Advisory Committee 1977, *The status of reserves in System Six*, Environmental Protection Authority, Perth.

7.2 Online references

The online resources that have been utilised in the preparation of this report are referenced in **Section 7.1**, with access date information provided in **Table R 1**.

Table R 1 Access dates for online references

Reference	Date accessed	Website or dataset name
BirdLife International (2023)	27 January 2023	Important Bird Areas
BoM (2023)	27 January 2023	Climate Data Online
DAWE (2023)	12 August 2022	Protected Matters Search Tool
DBCA (2023)	12 August 2022	NatureMap
DCCEEW (2023)	27 January 2023	Australian Faunal Directory
WALIA (2023)	27 January 2023	Landgate Map Viewer

Figures

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Figure 2: Hydrography, Soils and Topography

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Figure 5: Black Cockatoo Habitat Trees

Figure 6: Carnaby's Black Cockatoo Foraging Habitat

Figure 7: Forest Red-tailed Black Cockatoo Foraging Habitat

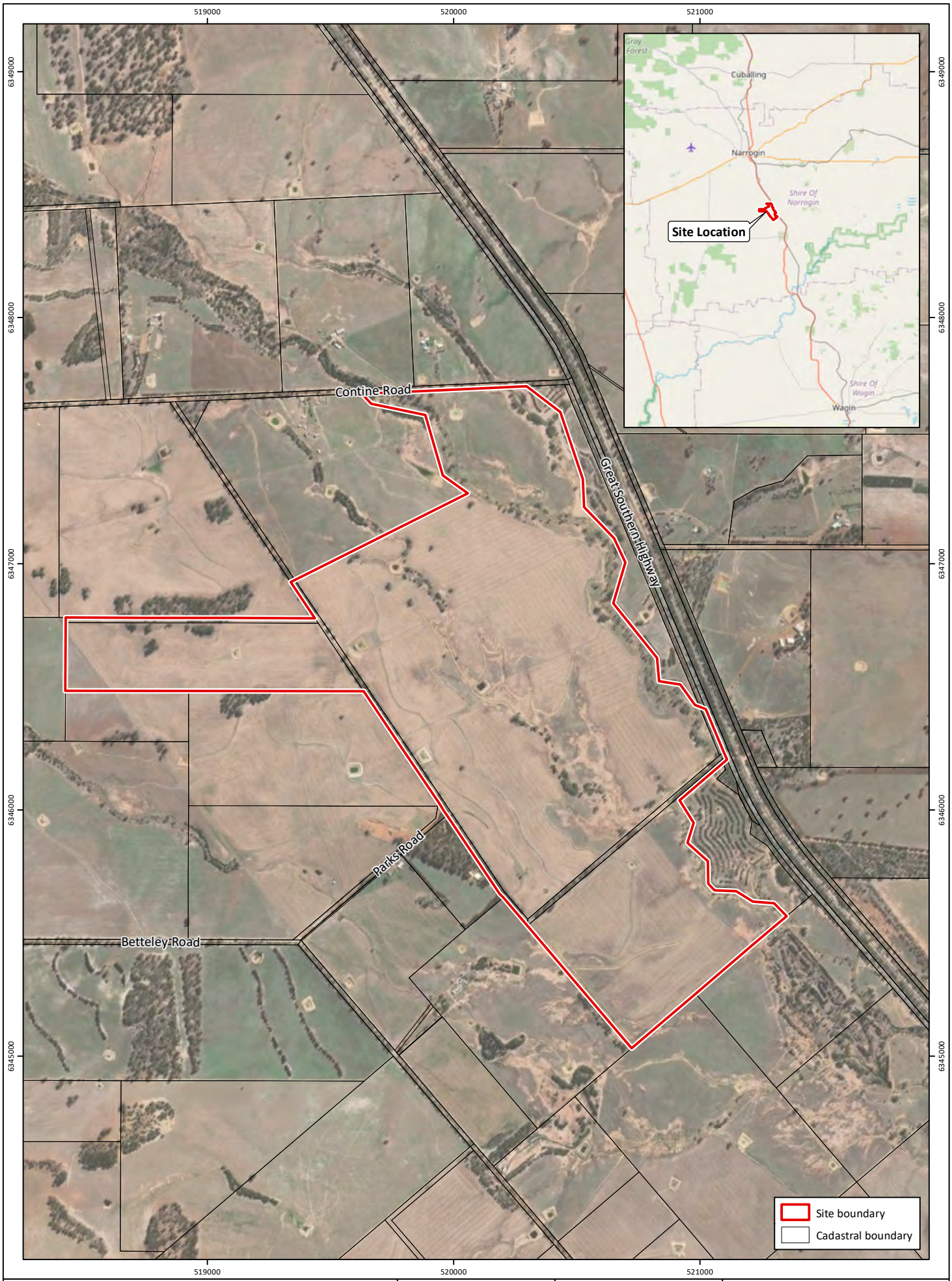


Figure 1: Site Location

Project:	Basic and Targeted Fauna Assessment Narrogin Solar Farm Environmental Support
Client:	ARP Australian Solar

Plan Number:
EP22-083(02)--F12

Drawn:	WJC
Date:	27/01/2023
Checked:	NAW
Approved:	TAA
Date:	03/02/2023

N

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Metres

Scale: 1:20,000@A4

GDA 1994 MGA Zone 50

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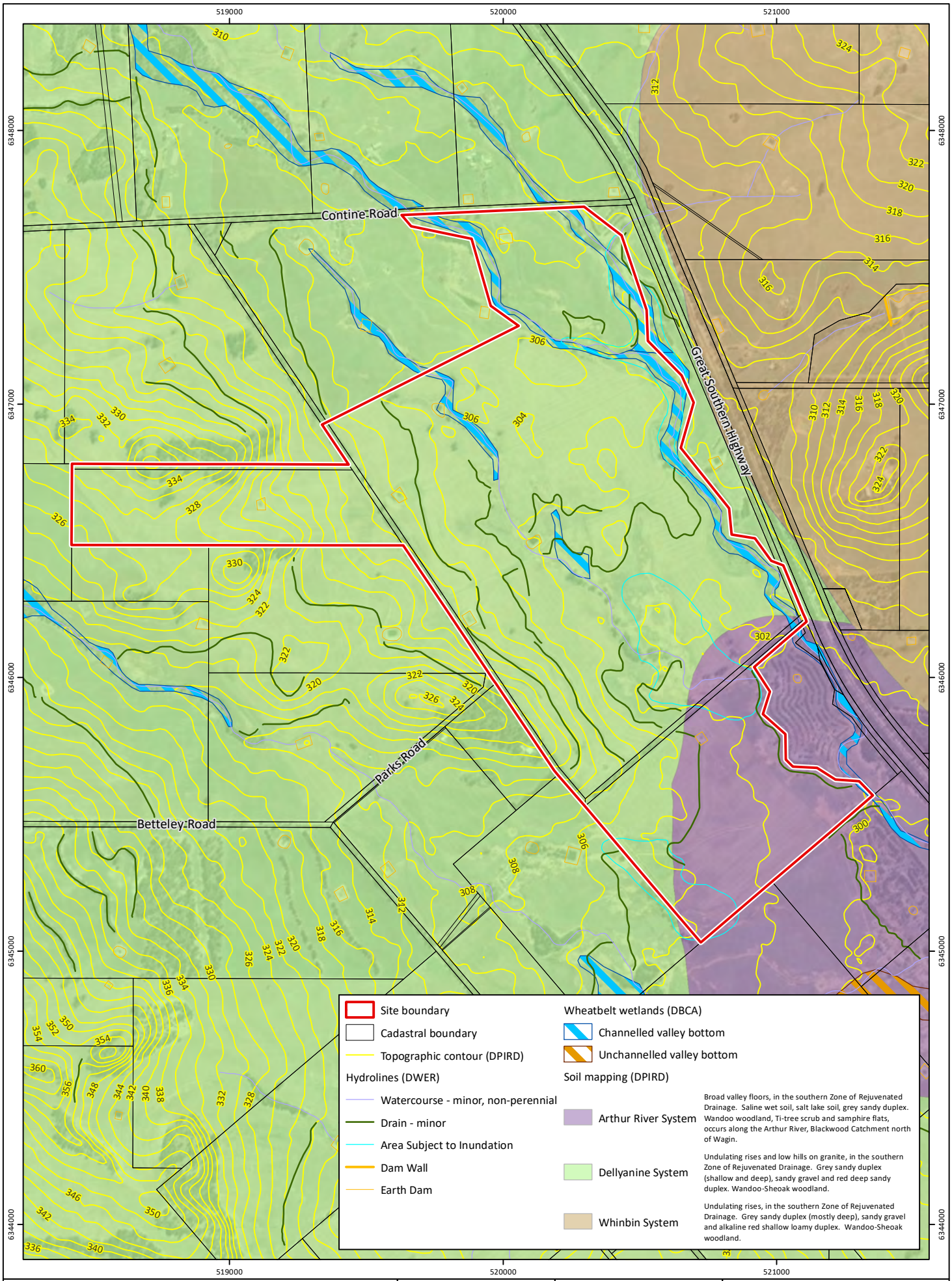


Figure 2: Hydrography, Soils and Topography

Project: Basic and Targeted Fauna Assessment
Narrogin Solar Farm Environmental Support

Client: ARP Australian Solar

Plan Number: EP22-083(02)--F13

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Checked:	NAW
Approved:	TAA
Date:	03/02/2023

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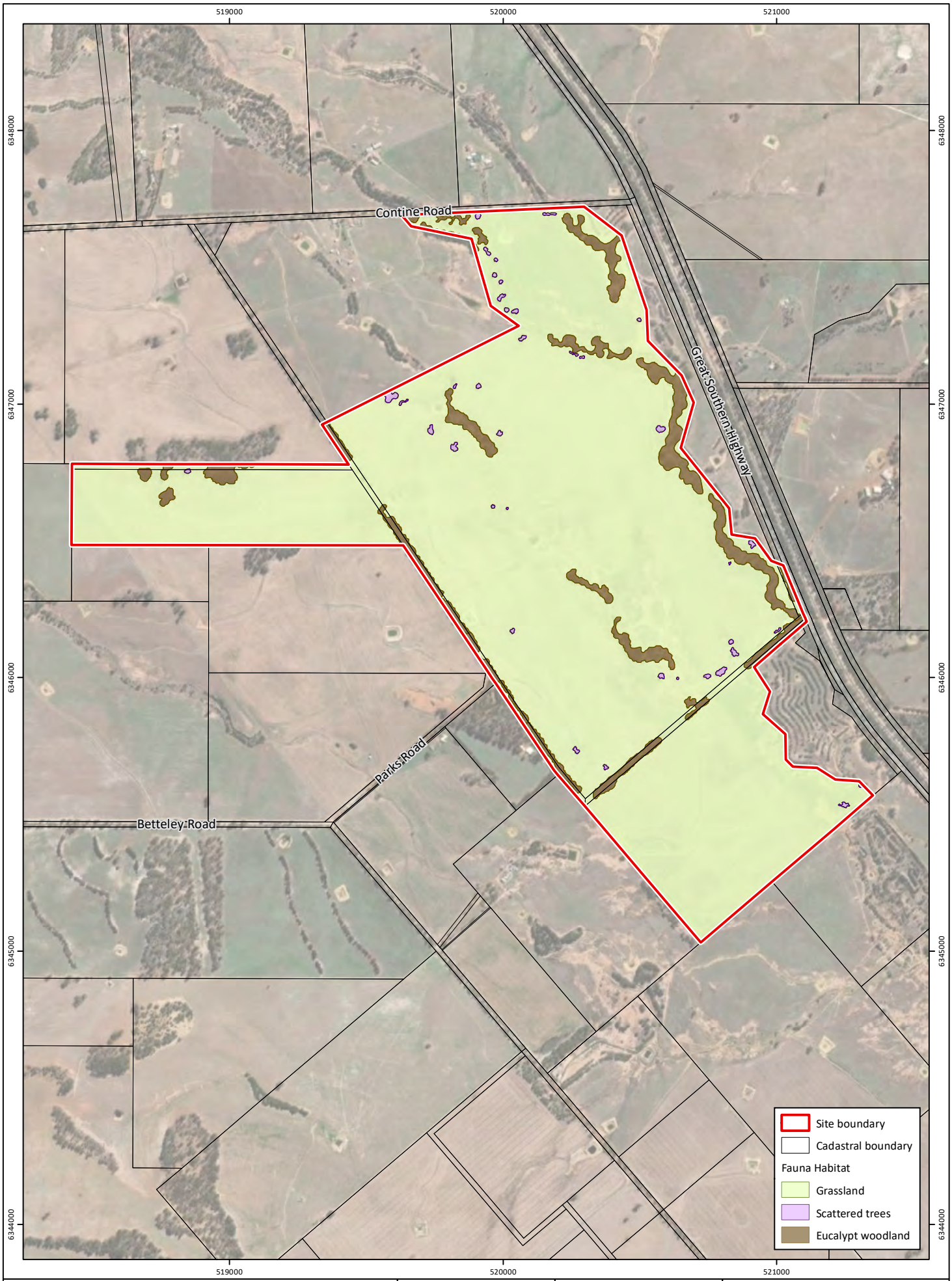


Figure 3: Fauna Habitat

Project: Basic and Targeted Fauna Assessment
Narrogin Solar Farm Environmental Support

Client: ARP Australian Solar

Plan Number:
EP22-083(02)--F15

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Date:	30/01/2023
Checked:	NAW
Approved:	TAA
Date:	03/02/2023

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Metres

Scale: 1:18,000@A4

GDA 1994 MGA Zone 50

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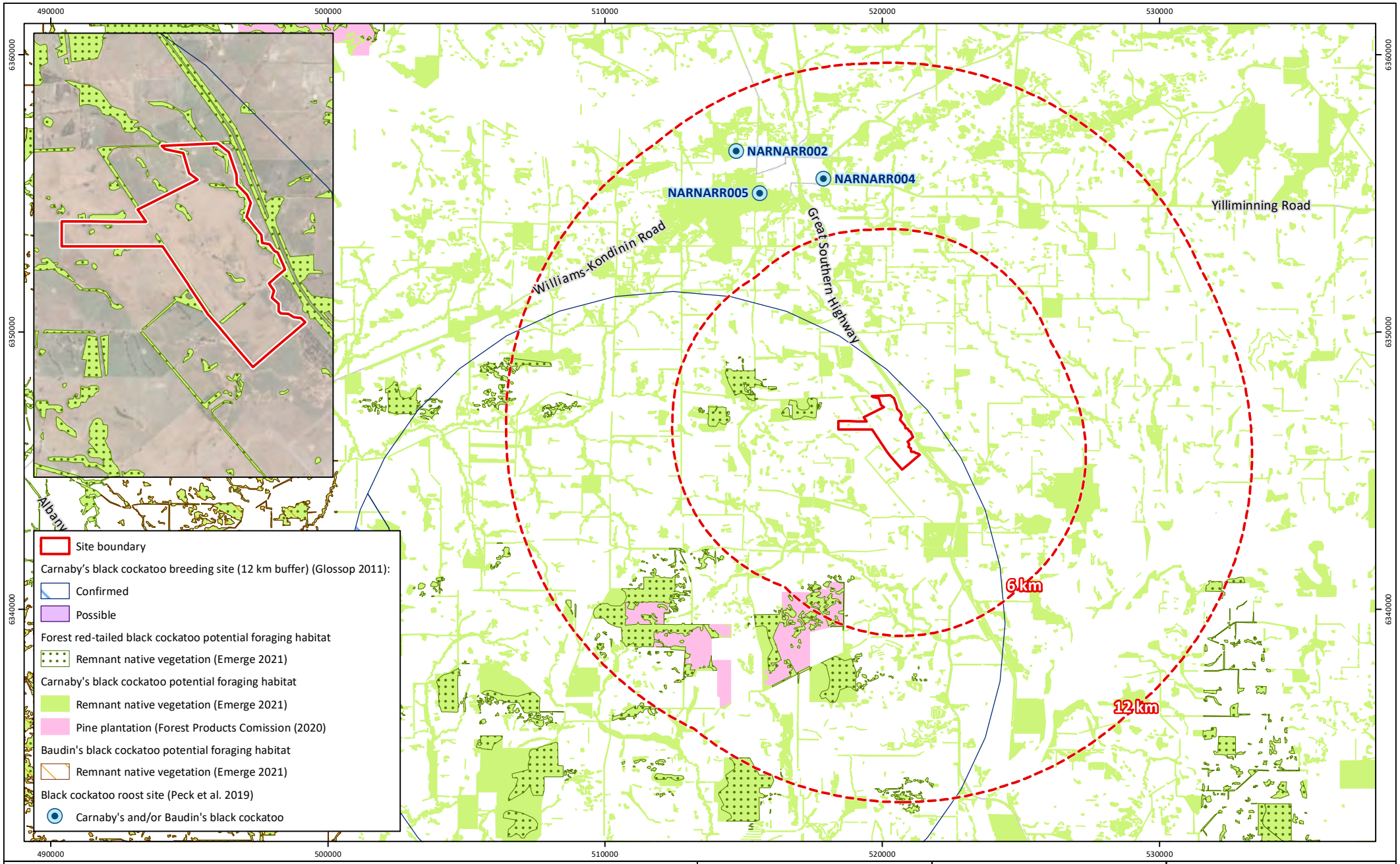


Figure 4: Black Cockatoo Habitat Context

Project: Basic and Targeted Fauna Assessment
Narrogin Solar Farm Environmental Support
Client: ARP Australian Solar

Plan Number:
EP22-083(02)--F16
Drawn: WJC
Date: 30/01/2023
Checked: NAW
Approved: TAA
Date: 03/02/2023

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Kilometers
Scale: 1:180,000@A4
GDA 1994 MGA Zone 50

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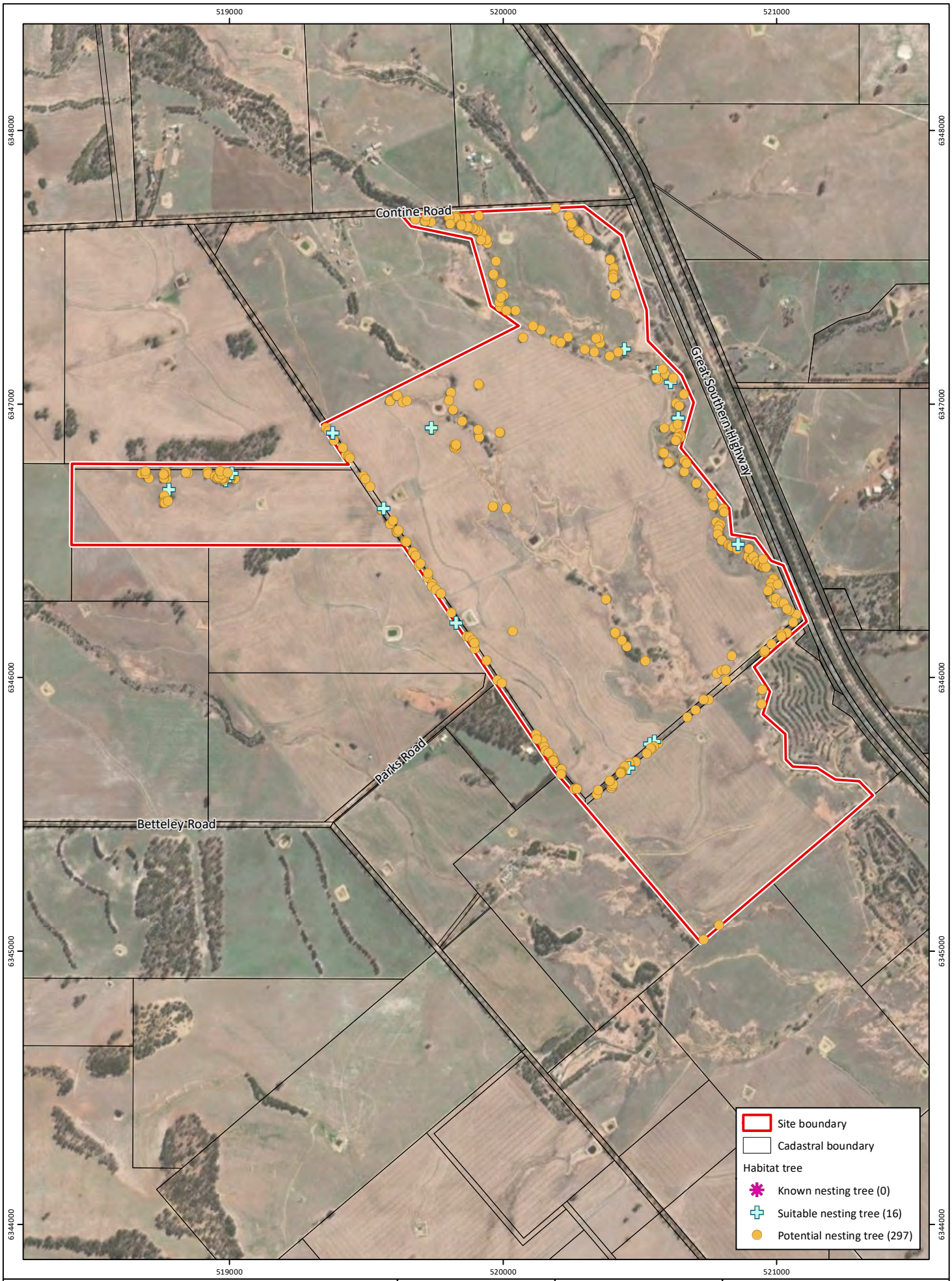


Figure 5: Black Cockatoo Habitat Trees

Project: Basic and Targeted Fauna Assessment
Narrogin Solar Farm Environmental Support

Client: ARP Australian Solar

Plan Number:
EP22-083(02)--F17

Drawn:	WJC
Date:	30/01/2023
Checked:	NAW
Approved:	TAA
Date:	03/02/2023

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0 200 400
Metres

Scale: 1:18,000@A4

GDA 1994 MGA Zone 50

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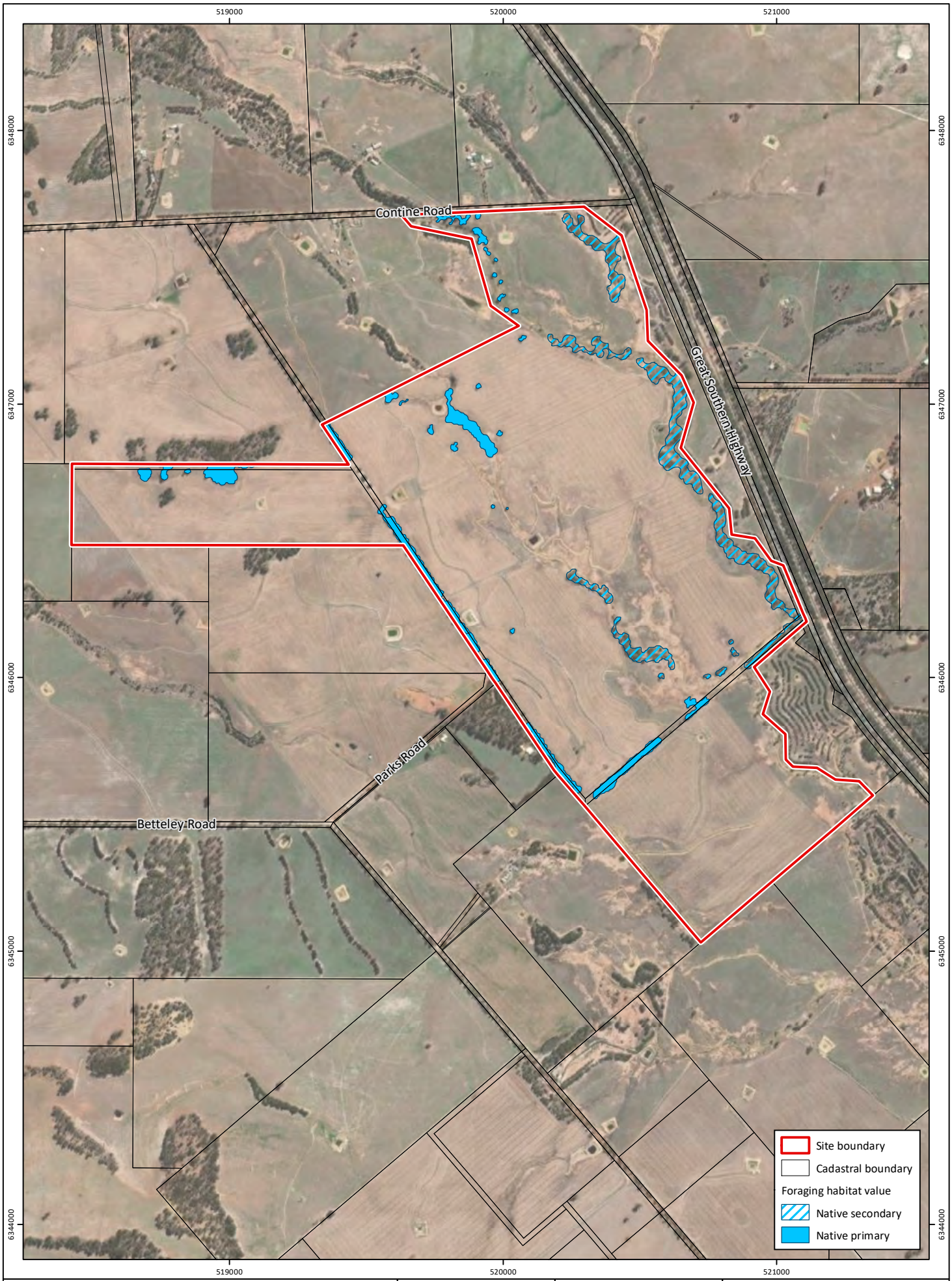


Figure 6: Carnaby's Cockatoo Foraging Habitat

Project: Basic and Targeted Fauna Assessment
Narrogin Solar Farm Environmental Support

Client: ARP Australian Solar

Plan Number:
EP22-083(02)--F18

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Date:	30/01/2023
Checked:	NAW
Approved:	TAA
Date:	03/02/2023

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Metres

Scale: 1:18,000@A4

GDA 1994 MGA Zone 50

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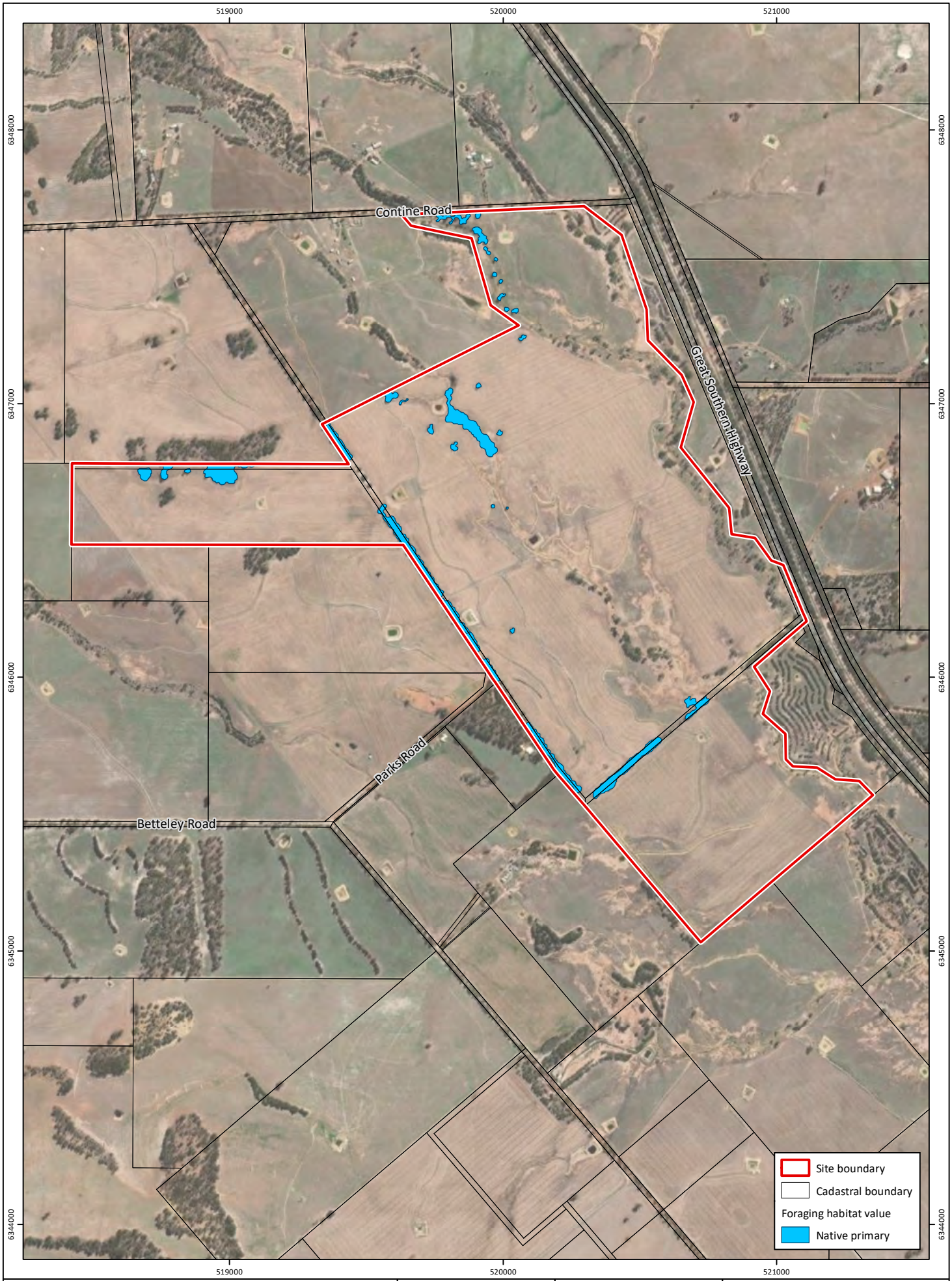


Figure 7: **Forest Red-tailed Black Cockatoo Foraging Habitat**

Project: Basic and Targeted Fauna Assessment
Narrogin Solar Farm Environmental Support

Client: ARP Australian Solar

Plan Number: EP22-083(02)--F19

Drawn:	WJC
Date:	30/01/2023
Checked:	NAW
Approved:	TAA
Date:	03/02/2023

N

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Metres

Scale: 1:18,000@A4

GDA 1994 MGA Zone 50

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Appendix A

Additional Information

Conservation Significant Fauna

Threatened and priority fauna

Fauna species considered rare or under threat warrant special protection under Commonwealth and/or State legislation. At the Commonwealth level, fauna species can be listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as 'threatened', 'migratory' or 'marine' as described in **Table 1**.

Migratory species comprise birds recognised under international treaties including:

- Japan Australia Migratory Bird Agreement 1981 (JAMBA)
- China Australia Migratory Bird Agreement 1998 (CAMBA)
- Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA)
- Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).

Fauna species listed as threatened and migratory are protected in Australia as 'matters of national environmental significance' (MNES) under the EPBC Act.

Table 1: Definitions of conservation significant fauna species pursuant to the EPBC Act

Conservation Code	Category
X	Threatened Fauna –Extinct There is no reasonable doubt that the last member of the species has died.
EW[#]	Threatened Fauna –Extinct in the Wild Taxa which are known only to survive in cultivation, captivity or as a naturalised population outside its past range, or taxa which have not been recorded in its known and/or expected habitat despite appropriate exhaustive surveys.
CR[#]	Threatened Fauna – Critically Endangered Taxa which are considered to be facing an extremely high risk of extinction in the wild.
EN[#]	Threatened Fauna – Endangered Taxa which are considered to be facing a very high risk of extinction in the wild.
VU[#]	Threatened Fauna – Vulnerable Taxa which are considered to be facing a high risk of extinction in the wild.
Migratory[#]	Migratory Fauna All migratory species that are: (i) native species; and (ii) from time to time included in the appendices to the Bonn Convention; and (b) all migratory species from time to time included in annexes established under JAMBA, CAMBA and ROKAMBA; and All native species from time to time identified in a list established under, or an instrument made under, an international agreement approved by the Minister.
Ma	Marine Fauna Species in the list established under s248 of the EPBC Act

[#]matters of national environmental significance (MNES) under the EPBC Act

In Western Australia, fauna taxa may be classed as 'threatened', 'extinct', or 'specially protected' under the *Biodiversity Conservation Act 2016* (BC Act), which is enforced by Department of Biodiversity Conservation and Attractions (DBCA) (DBCA 2019a). The definitions of these categories are provided in **Table 2**.

Table 2: Definitions of specially protected fauna schedules under the BC Act (DBCA 2019a)

Category	Conservation Code	Definition
Threatened	CR	Critically endangered Threatened species considered to be facing an extremely high risk of extinction in the wild in the immediate future.
	EN	Endangered Threatened species considered to be facing a very high risk of extinction in the wild in the near future.
	VU	Vulnerable Threatened species considered to be facing a high risk of extinction in the wild in the medium-term future.
Extinct	EX	Extinct Species where there is no reasonable doubt that the last member of the species has died.
	EW	Extinct in the wild Species that is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form. Note that no species are currently listed as EW.
Specially protected	MI	Migratory species Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth Includes birds that subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds.
	CD	Species of special conservation interest (conservation dependent fauna) Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
	OS	Other specially protected species Fauna otherwise in need of special protection to ensure their conservation.

Fauna species that may be threatened or near threatened but lack sufficient information to be legislatively listed may be added to the DBCA's *Priority Fauna List* (DBCA 2018b). Species listed under priorities 1-3 comprise possible threatened species that do not meet survey criteria or are otherwise data deficient. Species listed under priority 4 are those that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons (DBCA 2019a).

Priority fauna species are considered during State approval processes. Priority fauna categories and definitions are listed in **Table 3** (DBCA 2019a).

Table 3: Definitions of priority fauna categories on DBCA's Priority Fauna List (DBCA 2019a)

Conservation Code	Category
P1	Priority 1 – Poorly known Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	Priority 2 – Poorly known Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	Priority 3 – Poorly known Species that are known from several locations and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	(a) Priority 4 – Rare species Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Priority 4 – Near Threatened Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Priority 4 – Other Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Black cockatoos

Three threatened species of black cockatoo occur on the Swan Coastal Plain (referred to herein collectively as 'black cockatoos'):

- *Zanda*[1] *latirostris* (Carnaby's black cockatoo) which is listed as 'endangered' under the EPBC Act and the BC Act.
- *Zanda*[1] *baudinii* (Baudin's black cockatoo) which is listed as 'endangered' under the EPBC Act and the BC Act.
- *Calyptorhynchus banksii naso* (forest red-tailed black cockatoo) which is listed as 'vulnerable' under the EPBC Act and the BC Act.

There are a range of regional studies and spatial datasets available which provide information on black cockatoo records and potential habitat mapping. These are detailed below.

Species distribution and breeding range

Broad-scale maps are available for the modelled distribution of Baudin's black cockatoo, Carnaby's black cockatoo and forest red-tailed black cockatoo (DSEWPaC 2011; DoEE 2016a, b).

The modelled distribution maps also include 'known breeding areas' and 'predicted breeding range' for Baudin's black cockatoo and 'breeding range' and 'non-breeding range' for Carnaby's black cockatoo.

No breeding range modelling is available for forest red-tailed black cockatoo but the species is known to breed mainly in the jarrah forest region (DBCA 2017a) and in small populations on the Swan Coastal Plain within the Baldivis, Stake Hill, Lake McLarty and Capel area and increasingly in the Perth metropolitan area (DAWE 2020).

Breeding habitat

Department of Environment and Conservation (DEC, now Department of Biodiversity, Conservation and Attractions (DBCA)) and fauna experts, have identified and mapped Carnaby's black cockatoo habitat on the Swan Coastal Plain and Jarrah Forest regions (Glossop *et al.* 2011). This dataset includes mapping of Carnaby's black cockatoo breeding sites based on point records of breeding from a range of sources. Breeding sites were classified as 'confirmed' where eggs or chicks were recorded and 'possible' where observations relating to Carnaby's black cockatoo breeding that did not include actual records of eggs or chicks (e.g. chewed hollows or records of breeding or nesting behaviour by an expert observer).

A 12 km buffer applies to each site to 'reflect the flexible use of these areas by cockatoos and to indicate the important zone for access to potential feeding habitat' (Glossop *et al.* 2011). Glossop *et al.* (2011) state that the areas mapped in the dataset are not a comprehensive record of Carnaby's black cockatoo breeding and that many nesting sites are not known.

While this dataset only applies to Carnaby's black cockatoo, the information it contains is also applicable for Baudin's black cockatoo and forest red-tailed black cockatoo as they have similar

[1] Previously *Calyptorhynchus*

breeding habitat requirements. That is, breeding sites that are suitable for Carnaby's black cockatoo may also be suitable for Baudin's black cockatoo and forest red-tailed black cockatoo, if located within their distribution/breeding ranges.

BirdLife Australia also maintain a database of confirmed black cockatoo breeding sites which is accessible via a paid search system. BirdLife Australia have advised that their database is comprised of data collected during surveys by staff and volunteers of which most (>99%) surveys are of Carnaby's black cockatoo. They have also advised that the dataset is not comprehensive and that an absence of known nests does not necessarily indicate a lack of breeding activity.

The Carnaby's black cockatoo recovery plan also identifies 13 'important bird areas' for Carnaby's black cockatoo, which are identified as 'sites of global bird conservation importance' (DPaW 2013). These 'important bird areas' comprise sites supporting at least 20 breeding pairs or 1% of the population regularly utilising an area in the non-breeding part of the range.

Confirmed roost sites

BirdLife Australia undertakes annual monitoring of black cockatoo overnight roost sites as part of the annual 'Great Cocky Count' community-based survey. Information gathered from these monitoring events provides roost locations and recorded black cockatoo numbers (Peck *et al.* 2019).

Native foraging habitat

Glossop *et al*. (2011) also mapped 'areas requiring investigation as Carnaby's black cockatoo feeding habitat' for the Swan Coastal Plain and Jarrah Forest regions, based on regional vegetation mapping that may contain plant species known to be foraged upon by Carnaby's black cockatoo. Note that this dataset does not include observations or point records of Carnaby's black cockatoo feeding. This dataset represents areas of vegetation that may potentially provide foraging habitat for Carnaby's black cockatoo.

In order to account for clearing of native vegetation that has occurred since the Glossop *et al.* (2011) dataset was created and to incorporate updated vegetation mapping and information on foraging behaviour of Carnaby's black cockatoo, Emerge have revised this dataset to represent the most up to date information available. Furthermore, Emerge have used a similar methodology to Glossop *et al.* (2011) to define potential foraging habitat for Baudin's black cockatoo and forest-red tailed cockatoos.

Specifically, DBCA (2021), DBCA (2019b) and DPIRD (2018) regional vegetation complex mapping was used to determine which areas of remnant vegetation support plant species known to be foraged upon by Carnaby's black cockatoo, Baudin's black cockatoo or forest red-tailed cockatoos. Where these vegetation complexes intersect remnant vegetation mapped by DPIRD (2020) they were considered to represent potential foraging habitat for Carnaby's black cockatoo, Baudin's black cockatoo and/or forest red-tailed cockatoo.

Pine plantations also provide an important food source for Carnaby's black cockatoo, but were not included in the original Glossop *et al.* (2011) dataset. Mapping of pine plantations is available from the Forest Products Commission (Forest Products Commission 2020) and was considered in the assessment of Carnaby's black cockatoo foraging habitat.

Pest fauna

A number of legislative and policy documents exist in relation to pest fauna management at state and national levels. The *Biosecurity and Agriculture Management Act 2007* (BAM Act) is the principle legislation guiding pest fauna management in Western Australia and lists declared pest species.

Declared Pests

Part 2.3.23 of the BAM Act requires a person must not "*a) keep, breed or cultivate the declared pest; b) keep, breed or cultivate an animal, plant or other thing that is infected or infested with the declared pest; c) release into the environment the declared pest, or an animal, plant or other thing that is infected or infested with the declared pest; or d) intentionally infect or infest, or expose to infection or infestation, a plant, animal or other thing with a declared pest*".

Under the BAM Act, all declared pests are assigned a legal status, as described in **Table 4**. Species assigned to the 'declared pest, prohibited - s12' category are placed in one of three control categories, as described in **Table 5**.

The *Biosecurity and Agriculture Management Regulations 2013* specify keeping categories for species assigned to the 'declared pest - s22(2)' category, which relate to the purposes of which species can be kept, as well as the entities that can keep them. The categories are described in **Table 6**.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DAFWA 2016).

Table 4: Legal status of declared pest species listed under the BAM Act (DAFWA 2016)

Category	Description
Declared Pest Prohibited - s12	May only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.
Declared Pest s22(2)	Must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia

Table 5: Control categories of declared pest species listed under the BAM Act (DAFWA 2016)

Category	Description
C1	Exclusion Not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2	Eradication Present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3	Management Established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Table 6: Keeping categories of declared pest species listed under the BAM Act (DAFWA 2016)

Category	Description
Prohibited	Can only be kept under a permit for public display and education purposes, and/or genuine scientific research, by entities approved by the state authority.
Exempt	No permit or conditions are required for keeping.
Restricted	Organisms which, relative to other species, have a low risk of becoming a problem for the environment, primary industry or public safety and can be kept under a permit by private individuals.

Wetland Habitat

Geomorphic wetland types

On the Swan Coastal Plain DBCA (2017b) have used the geomorphic wetland classification system developed by Semeniuk (1987) and Semeniuk and Semeniuk (1995) to classify wetlands based on the landform shape and water permanence (hydro-period) as outlined in **Table 7**. DBCA maintains a dataset of the *Geomorphic Wetlands of the Swan Coastal Plain* (DBCA 2018a).

Table 7: Geomorphic Wetlands of the Swan Coastal Plain classification categories (DBCA 2017b)

Level of inundation	Geomorphology			
	Basin	Flat	Channel	Slope
Permanently inundated	Lake	-	River	-
Seasonally inundated	Sumpland	Floodplain	Creek	-
Seasonally waterlogged	Dampland	Palusplain	-	Paluslope

Literature

The main literature used for identifying fauna and fauna habitats is listed in **Table 8** below.

Table 8: Standard literature used for identifying fauna species and habitats.

Conservation Code	Category
Birds	Johnstone and Storr (1998b), Johnstone and Storr (1998a), Pizzey and Knight (2012), Slater *et al.* (2003)
Mammals	Menkhorst and Knight (2011), Triggs (2003)
Amphibia	Tyler and Doughty (2009), Bush *et al.* (2002)
Reptiles	Bush *et al.* (2002)

References

General references

Bush, B., Maryan, B., Browne-Cooper, R. and Robinson, D. 2002, *Reptiles and Frogs of the Perth Region*, UWA Press, Crawley.

department of biodiversity Conservation and Attractions (DBCA) 2017a, *Fauna Profile - Forest red-tailed black cockatoo Calyptorhynchus banksii naso*, Perth, Western Australia.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017b, *A methodology for the evaluation of wetlands on the Swan Coastal Plain*, draft prepared by the Wetlands Section of the Department of Biodiversity, Conservation and Attractions and the Urban Water Branch of the Department of Water and Environmental Regulation, Perth.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018a, *Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018b, *Threatened and Priority Fauna List 15 February 2018*, Perth.

Department of Biodiversity Conservation and Attractions (DBCA) 2019a, *Conservation Codes for Western Australian Flora and Fauna - last updated 3 January 2019*.

Department of Biodiversity Conservation and Attractions (DBCA) 2019b, *Vegetation Complexes - South West forest region of Western Australia (DBCA-047)*, Kensington.

Department of Biodiversity Conservation and Attractions (DBCA) 2021, *Vegetation Complexes - Swan Coastal Plain (DBCA_046)*, Perth, Western Australia.

Department of Environment and Energy (DoEE) 2016a, *Modelled distribution for Baudin's Cockatoo (Calyptorhynchus baudinii)*, Canberra.

Department of Environment and Energy (DoEE) 2016b, *Modelled distribution for Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso)*, Canberra.

Department of Parks and Wildlife (DPaW) 2013, *Carnaby's Cockatoo (Calyptorphynchus latirostris) Recovery Plan*.

Department of Primary Industries and Regional Development (DPIRD) 2018, *Pre-European Vegetation – Western Australia (DPIRD-006)*, South Perth.

Department of Primary Industries and Regional Development (DPIRD) 2020, *Current Extent of Native vegetation - Western Australia dataset (DPIRD-005)*, Perth, Western Australia.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011, *Modelled distribution of Carnaby's black cockatoo (Calyptorhynchus latirostris)*, Commonwealth of Australia, Canberra, Australian Capital Territory.

Forest Products Commission 2020, *Forest Products Commission Plantations (FPC-001)*.

Glossop, B., Clarke, K., Mitchell, D. and Barrett, G. 2011, *Methods for mapping Carnaby's cockatoo habitat*, Department of Environment and Conservation, Perth.

Johnstone, R. E. and Storr, G. M. 1998a, *Handbook of Western Australian Birds. Volume 2 - Passerines (Blue-Winged Pitta to Goldfinch)*, Western Australian Museum, Perth.

Johnstone, R. E. and Storr, T. 1998b, *Handbook of Western Australian Birds: Volume 1 - Non-passerines (Emu to Dollarbird)*, Western Australian Museum, Perth.

Menkhorst, P. and Knight, F. 2011, *Field guide to the mammals of Australia (Third edition)*, Oxford University Press Australia & New Zealand, Melbourne, VIC, Australia.

Peck, A., Barret, G. and Williams, M. 2019, *The 2019 Great Cocky Count: a community-based survey for Carnaby's Black-Cockatoo (Calyptorhynchus latirostris), Baudin's Black-Cockatoo (Calyptorhynchus baudinii) and Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso).* , Birdlife Australia, Floreat, Western Australia.

Pizzey, G. and Knight, F. 2012, *The Fieldguide to the Birds of Australia*, Harper Collins Publishers, Sydney, Australia.

Semeniuk, C. A. 1987, *Wetlands of the Darling System - a geomorphic approach to habitat classification*, Journal of the Royal Society of Western Australia, 69: 95-112.

Semeniuk, C. A. and Semeniuk, V. 1995, *A Geomorphic Approach to Global Classification for Inland Wetlands*, Vegetatio, 118(1/2): 103-124.

Slater, P., Slater, P. and Slater, R. 2003, *The Slater Field Guide to Australian Birds*, Reed New Holland, Australia.

Triggs, B. 2003, *Tracks, Scats and Other Traces A Field Guide to Australian Mammals*, Oxford University Press Australia, Melbourne, Victoria.

Tyler, M. J. and Doughty, P. 2009, *Field Guide to Frogs of Western Australia*, Western Australian Museum, Perth, Western Australia.

Appendix B

Database Search Results

Australian Government
Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 12-Aug-2022

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	19
Listed Migratory Species:	6

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	7
Commonwealth Heritage Places:	None
Listed Marine Species:	10
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	4
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	5
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity	Buffer Status
Peel-yalgorup system	100 - 150km upstream from Ramsar site	In buffer area only

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Eucalypt Woodlands of the Western Australian Wheatbelt	Critically Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area	In feature area
Zanda latirostris listed as Calyptorhynchus latirostris Carnaby's Black Cockatoo, Short-billed Black-cockatoo [87737]	Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
MAMMAL			
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area	In feature area
Myrmecobius fasciatus Numbat [294]	Endangered	Species or species habitat known to occur within area	In buffer area only
Phascogale calura Red-tailed Phascogale, Red-tailed Wambenger, Kenngoor [316]	Vulnerable	Species or species habitat known to occur within area	In feature area
PLANT			
Acacia insolita subsp. recurva Yornaning Wattle [64495]	Endangered	Species or species habitat may occur within area	In buffer area only
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area	In feature area
Banksia oligantha Wagin Banksia [20697]	Endangered	Species or species habitat may occur within area	In buffer area only
Boronia capitata subsp. capitata a shrub [29156]	Endangered	Species or species habitat likely to occur within area	In feature area
Caladenia dorrienii Cossack Spider-orchid [6596]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Darwinia carnea Mogumber Bell, Narrogin Bell [9736]	Endangered	Species or species habitat known to occur within area	In feature area
Daviesia euphorbioides Wongan Cactus [3477]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pultenaea pauciflora Narrogin Pea [14013]	Vulnerable	Species or species habitat known to occur within area	In feature area
Roycea pycnophylloides Saltmat [21161]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Verticordia fimbrilepis subsp. fimbrilepis Shy Featherflower [24631]	Endangered	Species or species habitat known to occur within area	In feature area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Unknown		
Commonwealth Land - [52050]	WA	In buffer area only
Commonwealth Land - [51610]	WA	In buffer area only
Commonwealth Land - [51609]	WA	In buffer area only
Commonwealth Land - [50996]	WA	In buffer area only
Commonwealth Land - [50995]	WA	In buffer area only
Commonwealth Land - [51611]	WA	In buffer area only
Commonwealth Land - [50993]	WA	In buffer area only

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis			
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Highbury	Nature Reserve	WA	In buffer area only
Manning Road	Nature Reserve	WA	In buffer area only
Sandalwood Block Timber Reserve	5(1)(g) Reserve	WA	In buffer area only
Unnamed WA20985	Nature Reserve	WA	In buffer area only

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Widening maintenance zones for 3 roads, Wheatbelt region, WA	2016/7698	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Narrogin Link Road Stage 3 - North Extension, WA	2016/7664	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

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Please feel free to provide feedback via the Contact Us page.

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Category	Status	Taxon
AMPHIBIAN		Heleioporus albopunctatus
		Heleioporus albopunctatus Gray, 1841
		Myobatrachus gouldii
		Neobatrachus kunapalari
		Neobatrachus pelobatoides
		Neobatrachus sp.
		Pseudophryne guentheri
		Pseudophryne guentheri Boulenger, 1882
BIRD		Acanthiza apicalis
		Acanthiza chrysorrhoa
		Acanthiza inornata
		Acanthiza uropygialis
		Acanthorhynchus superciliosus
		Accipiter cirrocephalus
		Anas gracilis
		Anas superciliosa
		Anthochaera carunculata
		Anthochaera lunulata
		Aquila audax
		Barnardius zonarius
		Burhinus grallarius
		Cacatua tenuirostris
		Calyptorhynchus banksii
	VU	Calyptorhynchus banksii subsp. naso
	EN	Calyptorhynchus baudinii
	EN	Calyptorhynchus latirostris
		Calyptorhynchus sp. 'white-tailed black cockatoo'
		Chenonetta jubata
		Climacteris rufa
		Colluricincla harmonica
		Columba livia
		Coracina novaehollandiae
		Corvus coronoides
		Cracticus tibicen
		Dacelo novaeguineae
		Daphoenositta chrysoptera
		Dicaeum hirundinaceum
		Elanus axillaris
		Elseyornis melanops
		Eolophus roseicapillus
		Eopsaltria griseogularis
		Falco berigora
		Falco berigora subsp. berigora
		Falco cenchroides
		Fulica atra
		Gerygone fusca
		Glossopsitta porphyrocephala
		Glyciphila melanops

Category	Status	Taxon
		Grallina cyanoleuca
		Hieraaetus morphnoides
		Hirundo neoxena
	VU	Leipoa ocellata
		Lichenostomus ornatus
		Lichenostomus virescens
		Lichmera indistincta
		Lichmera indistincta subsp. indistincta
		Lophoictinia isura
		Melithreptus brevirostris
		Melithreptus chloropsis
		Melithreptus lunatus
		Merops ornatus
		Microcarbo melanoleucos
		Myiagra inquieta
		Neophema elegans
		Ninox novaeseelandiae
		Ocyphaps lophotes
		Oreoica gutturalis subsp. gutturalis
		Pachycephala pectoralis
		Pachycephala pectoralis subsp. fuliginosa
		Pachycephala rufiventris
		Pachycephala rufiventris subsp. rufiventris
		Pardalotus punctatus
		Pardalotus striatus
		Petrochelidon nigricans
		Petroica boodang
		Petroica goodenovii
		Petroica multicolor subsp. campbelli
		Phalacrocorax sulcirostris
		Phaps chalcoptera
		Phaps elegans
		Phylidonyris niger
		Phylidonyris novaehollandiae
		Platalea flavipes
	P4	Platycercus icterotis subsp. xanthogenys
		Podargus strigoides subsp. brachypterus
		Polytelis anthopeplus
		Pomatostomus superciliosus
		Pomatostomus superciliosus subsp. ashbyi
		Purpureicephalus spurius
		Rhipidura albiscapa
		Rhipidura leucophrys
		Sericornis frontalis
		Smicrornis brevirostris
		Strepera versicolor
		Streptopelia senegalensis
		Tachybaptus novaehollandiae

Category	Status	Taxon
		Tadorna tadornoides
		Todiramphus sanctus
		Turnix varius
		Tyto alba subsp. delicatula
		Zosterops lateralis
FISH		Galaxias occidentalis
INVERT		Aname mainae
		Argiope trifasciata
		Australutica sp. 1
		Backobourkia heroine
		Cormocephalus aurantiipes
		Ctenopalpus bicruciatus
		Dingosa simsoni
		Enoplognatha sp.
		Gamasomorpha sp. 7
		Gamasomorpha sp. 8
		Habronestes sp. 13
		Habronestes sp. 2
		Habronestes sp. 3
		Hoggicosa storri
		Isopedella cana
		Lampona cylindrata
		Latrodectus hasseltii
		Lycidas sp. 1
		Lycidas sp. 2A
		Lycidas sp. 3
		Lycidas sp. 4
		Lycosa leuckartii
		Lycosa sp. 15
		Lycosa sp. 17
		Lycosa sp. 6
		Maratus vespertilio
		Missulena granulosa
		Missulena occatoria
		Neostorena sp. 19
		Nephila edulis
		Nicodamus mainae
		Nostera sp. 1
		Opopaea sp. 1
		Oratemnus curtus
		Pachysaga munggai
		Phoroncidia sp. 6
		Raveniella cirrata
		Storena formosa Thorell, 1870
		Storosa sp. 1
		Tasmanicosa leuckartii
		Textracella sp. 1
		Urodacus novaehollandiae

Category	Status	Taxon
MAMMAL	CR	Bettongia penicillata subsp. ogilbyi
		Cercartetus concinnus
		Chalinolobus gouldii
		Felis catus
		Isoodon obesulus subsp. fusciventer
		Macropus fuliginosus
		Macropus irma
	VU	Macrotis lagotis
		Mus musculus
	EN	Myrmecobius fasciatus
	P4	Notamacropus irma
		Notomys alexis
		Nyctophilus geoffroyi
	CD	Phascogale calura
		Rattus fuscipes
		Rattus rattus
		Sminthopsis crassicaudata
		Sminthopsis gilberti
		Tachyglossus aculeatus
		Trichosurus vulpecula
		Trichosurus vulpecula subsp. vulpecula
		Vespadelus regulus
		Vulpes vulpes
REPTILE	P3	Acanthophis antarcticus
		Christinus marmoratus
		Crenadactylus ocellatus subsp. ocellatus
		Cryptoblepharus buchananii
		Cryptoblepharus plagiocephalus
		Ctenotus impar
		Delma australis
		Delma fraseri
		Diplodactylus calcicolus
		Diplodactylus granariensis
		Diplodactylus granariensis Storr, 1979
		Diplodactylus granariensis subsp. granariensis
		Echiopsis curta
		Egernia kingii
		Egernia napoleonis
		Eremiascincus richardsonii
		Hesperoedura reticulata
		Lerista distinguenda
		Menetia greyii
		Menetia greyii Gray, 1845
		Morelia spilota subsp. imbricata
		Morethia obscura
		Oedura reticulata Bustard, 1969
		Parasuta gouldii
		Pogona minor subsp. minor

Category	Status	Taxon
		Pseudechis australis
		Pseudonaja affinis subsp. affinis
		Pygopus lepidopodus
		Ramphotyphlops australis
		Ramphotyphlops bituberculatus
		Ramphotyphlops waitii
		Simoselaps bertholdi
		Tiliqua occipitalis

Appendix C

Black Cockatoo Foraging Plants

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Acacia baileyana	Cootamundra wattle	Secondary	-	-	Groom 2011
Acacia pentadenia	Karri wattle	Secondary	-	-	Groom 2011
Acacia saligna	Orange wattle	Secondary	-	-	Groom 2011
Agonis flexuosa	Peppermint tree	Secondary	-	-	Groom 2011
Allocasuarina fraseriana	Sheoak	-	Secondary	Secondary	Johnstone & Storr 1998; Johnstone *et al.* 2010; Johnstone 2017; DoEE 2017
Allocasuarina spp.		Secondary	-	Secondary	Johnstone *et al.* 2010; Groom 2011; DSEWPaC 2012; DoEE 2017
Anigozanthos flavidus	Tall kangaroo paw	-	Secondary	-	Johnstone *et al.* 2010; DSEWPaC 2012; DoEE 2017
Araucaria heterophylla	Norfolk island pine	Secondary	-	-	Groom 2011; DoEE 2017
Banksia ashbyi	Ashby's banksia	Primary	Secondary	-	Saunders 1980; Groom 2011; DoEE 2017
Banksia attenuata	Slender banksia	Primary	Secondary	-	Saunders 1980; Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia baxteri	Baxter's banksia	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia carlinoides	Pink dryandra	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia coccinea	Scarlet banksia	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia dallanneyi	Couch honeypot dryandra	Primary	Secondary	-	Groom 2011; DoEE 2017
Banksia ericifolia	Heath-leaved banksia	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia fraseri		Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia gardneri	Prostrate banksia	Primary	Secondary	-	Groom 2011; DoEE 2017
Banksia grandis	Bull banksia	Primary	Secondary	-	Saunders 1980; Johnstone & Storr 1998; Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia hookeriana	Hooker's banksia	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia ilicifolia	Holly banksia	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; Johnstone & Storr 1998; DoEE 2017
Banksia kippistiana		Primary	Secondary	-	Groom 2011; DoEE 2017
Banksia leptophylla		Primary	Secondary	-	Groom 2011; DoEE 2017
Banksia lindleyana	Porcupine banksia	Primary	Secondary	-	Johnstone *et al.* 2010; DoEE 2017

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Banksia littoralis	Swamp banksia	Primary	Secondary	-	Saunders 1980; Groom 2011Johnstone & Storr 1998; Johnstone *et al.* 2010; DoEE 2017
Banksia menziesii	Firewood banksia	Primary	Secondary	-	Saunders 1980; Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia mucronulata	Swordfish dryandra	Primary	Secondary	-	Groom 2011; DoEE 2017
Banksia nivea	Honeypot dryandra	Primary	Secondary	-	Saunders 1980; Groom 2011; DoEE 2017
Banksia nobilis	Golden dryandra	Primary	Secondary	-	Saunders 1980; Groom 2011; DoEE 2017
Banksia praemorsa	Cut-leaf banksia	Primary	Secondary	-	Saunders 1980; Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia prionotes	Acorn banksia	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia prolata		Primary	Secondary	-	Johnstone *et al.* 2010; DoEE 2017
Banksia quercifolia	Oak-leaved banksia	Primary	Secondary	-	Johnstone & Storr 1998; Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia sessilis	Parrot bush	Primary	Secondary	-	Saunders 1980; Johnstone & Storr 1998; Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia speciosa	Showy banksia	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia spp.		Primary	Secondary	-	Saunders 1979; DSEWPaC 2012; DoEE 2017
Banksia squarrosa	Pingle	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Banksia tricuspis	Pine banksia	Primary	Secondary	-	Groom 2011; DoEE 2017
Banksia undata	Urchin dryandra	Primary	Secondary	-	Groom 2011; DoEE 2017
Banksia verticillata	Granite banksia	Primary	Secondary	-	Saunders 1980; Groom 2011; DoEE 2017
Brassica campestris	Canola	Secondary	-	-	Groom 2011; DoEE 2017
Callistemon spp.		Secondary	Secondary	-	Johnstone *et al.* 2010; DoEE 2017
Callistemon viminalis	Captain cook bottlebrush	Secondary	-	-	Groom 2011
Callitris sp.		Secondary	-	-	Johnstone *et al.* 2010; Groom 2011
Carya illnoinensis	Pecan	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; Groom 2014; DoEE 2017
Casuarina cunninghamiana	River sheoak	Secondary	-	-	Groom 2011
Citrullus lanatus	Pie or afghan melon	Secondary	-	-	Johnstone *et al.* 2010; Groom 2011

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Corymbia calophylla	Marri	Primary	Primary	Primary	Johnstone & Storr 1998; Johnstone & Kirkby 1999; Johnstone *et al.* 2010; DSEWPaC 2012; DoEE 2017; Johnstone 2017; Saunders 1979; Johnstone & Kirkby 2008
Corymbia citriodora	Lemon scented gum	Secondary	Secondary	Secondary	Johnstone *et al.* 2010; DSEWPaC 2012; Groom 2011; Johnstone 2017
Corymbia ficifolia	Red flowering gum	Secondary	-	-	Groom 2011
Corymbia haematoxylon	Mountain marri	Secondary	-	Secondary	Groom 2011; DoEE 2012; DoEE 2017
Corymbia maculata	Spotted gum	-	-	-	-
Darwinia citriodora	Lemon-scented darwinia	Secondary	Secondary	-	Groom 2011; Johnstone *et al.* 2010
Diospryros sp.	Sweet persimmon	Secondary	Secondary	-	Johnstone *et al.* 2010; Groom 2011; DSEWPaC 2012; DoEE 2017
Eremophila glabra	Tarbush	Secondary	-	-	Groom 2011
Erodium aureum		Secondary	-	-	Groom 2011
Erodium botrys	Long storksbill	Secondary	Secondary	-	Groom 2011; Johnstone & Storr 1998; Johnstone *et al.* 2010
Erodium spp.		Secondary	Secondary	-	Johnstone *et al.* 2010; DoEE 2017
Eucalyptus caesia	Silver princess	Secondary	-	Secondary	Johnstone *et al.* 2010; Groom 2011; DSEWPaC 2012; DoEE 2017; Johnstone 2017
Eucalyptus camaldulensis	River red gum	-	-	Secondary	DoEE 2012; DoEE 2017
Eucalyptus decipiens	Red heart/moit	-	-	Secondary	Johnstone 2017
Eucalyptus diversicolor	Karri	-	-	Primary	Johnstone *et al.* 2010; DSEWPaC 2012; DoEE 2017; Johnstone & Storr 1998
Eucalyptus erythrocorys	Illyarrie	Secondary	-	Secondary	DSEWPaC 2012; DoEE 2017; Johnstone 2017, Johnstone *et al.* 2010
Eucalyptus gomphocephala	Tuart	Secondary	-	Secondary	Johnstone *et al.* 2010; Groom 2011; DSEWPaC 2012; DoEE 2017
Eucalyptus grandis	Flooded gum, rose gum	-	-	Secondary	DoEE 2012; DoEE 2017
Eucalyptus lehmannii	Bushy yate	-	-	Secondary	Johnstone 2017
Eucalyptus leucoxylon	Yellow gum	Secondary	-	-	Groom 2014

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Eucalyptus loxophleba	York gum	Secondary	-	-	Johnstone *et al.* 2010; Groom 2011; DSEWPaC 2012; DoEE 2017
Eucalyptus marginata	Jarrah	Primary	Secondary	Primary	Saunders 1980; Johnstone *et al.* 2010; Groom 2011; DSEWPaC 2012; DoEE 2017; Johnstone & Storr 1998; Johnstone & Kirkby 1999; Johnstone 2017
Eucalyptus patens	Blackbutt	Primary	-	Primary	Johnstone & Storr 1998; Johnstone & Kirkby 1999; Johnstone *et al.* 2010; DSEWPaC 2012; DoEE 2017; Johnstone 2017; Groom 2011
Eucalyptus pleurocarpa	Tallerack	Secondary	-	-	Groom 2011
Eucalyptus preissiana	Bell-fruited mallee	Secondary	-	-	Groom 2011
Eucalyptus robusta	Swamp mahogany	Secondary	-	-	Johnstone *et al.* 2010; Groom 2011
Eucalyptus salmonophloia	Salmon gum	Primary	-	-	Johnstone *et al.* 2010; Groom 2011; DSEWPaC 2012; DSEWPaC 2012; DoEE 2017
Eucalyptus staeri	Albany blackbutt	-	-	Secondary	Johnstone & Storr 1998
Eucalyptus todtiana	Coastal blackbutt	Secondary	-	-	Saunders 1980; Johnstone *et al.* 2010; Groom 2011; Johnstone & Kirkby 2008
Eucalyptus wandoo	Wandoo	Primary	Secondary	Primary	Saunders 1980; Johnstone *et al* . 2010; Groom 2011; DSEWPaC 2012; DoEE 2017
Ficus sp.	Fig	Secondary	-	-	Groom 2011
Grevillea armigera	Prickly toothbrushes	Primary	-	-	Groom 2011
Grevillea bipinnatifida	Fuschia grevillea	Primary	-	-	Groom 2011
Grevillea hookeriana	Red toothbrushes	Primary	-	-	Groom 2011
Grevillea hookeriana subsp. api	Black toothbrushes	Primary	-	-	Groom 2011
Grevillea paniculata	Kerosene bush	Primary	-	-	Groom 2011
Grevillea paradoxa	Bottlebrush grevillea	Primary	-	-	Groom 2011
Grevillea petrophiloides	Pink poker	Primary	-	-	Groom 2011
Grevillea robusta	Silky oak	Primary	-	-	Johnstone *et al.* 2010; Groom 2011

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Grevillea spp.		Primary	-	-	Saunders 1979; Johnstone *et al.* 2010; DSEWPaC 2012; DoEE 2017
Grevillea wilsonii	Native fuchsia	-	Secondary	-	Johnstone *et al.* 2010
Hakea auriculata		Primary	-	-	Saunders 1980; Groom 2011
Hakea candolleana		Primary	-	-	Groom 2011
Hakea circumalata	Coastal hakea	Primary	-	-	Groom 2011
Hakea commutata		Primary	-	-	Groom 2011
Hakea conchifolia	Shell-leaved hakea	Primary	-	-	Groom 2011
Hakea costata	Ribbed hakea	Primary	-	-	Groom 2011
Hakea cristata	Snail hakea	Primary	Secondary	-	Groom 2011; Johnstone *et al.* 2010
Hakea cucullata	Snail hakea	Primary	-	-	Groom 2011
Hakea cyclocarpa	Ramshorn	Primary	-	-	Saunders 1980; Groom 2011
Hakea eneabba		Primary	-	-	Groom 2011
Hakea erinacea	Hedgehog hakea	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011
Hakea falcata	Sickle hakea	Primary	-	-	Groom 2011
Hakea flabellifolia	Fan-leaved hakea	Primary	-	-	Groom 2011
Hakea gilbertii		Primary	-	-	Saunders 1980; Groom 2011
Hakea incrassata	Golfball or marble hakea	Primary	-	-	Johnstone *et al.* 2010; Groom 2011
Hakea lasiantha	Woolly flowered hakea	Primary	-	-	Johnstone *et al* . 2010; Groom 2011
Hakea lasianthoides		Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011
Hakea laurina	Pin-cushion hakea	Primary	-	-	Johnstone *et al.* 2010; Groom 2011
Hakea lissocarpha	Honeybush	Primary	Secondary	-	Saunders 1980; Johnstone *et al.* 2010; Groom 2011
Hakea marginata		-	Secondary	-	Johnstone *et al.* 2010
Hakea megalosperma	Lesueur hakea	Primary	-	-	Groom 2011
Hakea multilineata	Grass leaf hakea	Primary	-	-	Groom 2011
Hakea neospathulata		Primary	-	-	Groom 2011
Hakea obliqua	Needles and corks	Primary	-	-	Saunders 1980; Groom 2011
Hakea oleifolia	Dungyn	Primary	-	-	Groom 2011

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Hakea pandanicarpa subsp. crassifolia	Thick-leaved hakea	Primary	-	-	Groom 2011
Hakea petiolaris	Sea urchin hakea	Primary	-	-	Groom 2011
Hakea polyanthema		Primary	-	-	Groom 2011
Hakea preissii	Needle tree	Primary	-	-	Groom 2011
Hakea prostrata	Harsh hakea	Primary	Secondary	-	Saunders 1980; Johnstone *et al.* 2010; Groom 2011
Hakea psilorrhyncha		Primary	-	-	Groom 2011
Hakea ruscifolia	Candle hakea	Primary	Secondary	-	Saunders 1980; Groom 2011; Johnstone *et al.* 2010
Hakea scoparia	Kangaroo bush	Primary	-	-	Groom 2011
Hakea smilacifolia		Primary	-	-	Groom 2011
Hakea spp.		Primary	Secondary	-	Saunders 1979; DSEWPaC 2012; DoEE 2017
Hakea stenocarpa	Narrow-fruited hakea	Primary	Secondary	-	Johnstone et al. 2010; Groom 2011
Hakea sulcata	Furrowed hakea	Primary	-	-	Groom 2011
Hakea trifurcata	Two-leaved hakea	Primary	Secondary	-	Saunders 1980; Johnstone *et al.* 2010; Groom 2011
Hakea undulata	Wavy-leaved hakea	Primary	Secondary	-	Saunders 1980; Johnstone *et al.* 2010; Groom 2011
Hakea varia	Variable-leaved hakea	Primary	Secondary	-	Saunders 1980; Groom 2011
Harpephyllum caffrum	Kaffir plum	-	-	Secondary	Johnstone 2017
Helianthus annuus	Sunflower	Secondary	-	-	Johnstone *et al.* 2010; Groom 2011
Hibiscus sp.	Hibiscus	Secondary	-	-	Groom 2011
Isopogon scabriusculus		Secondary	-	-	Groom 2011
Jacaranda mimosifolia	Jacaranda	Secondary	Secondary	-	Johnstone *et al.* 2010; Groom 2011
Jacksonia furcellata	Grey stinkwood	Secondary	-	-	Groom 2011
Kingia australis	Kingia	-	Secondary	-	Johnstone *et al.* 2010
Lambertia inermis	Chittick	Secondary	-	-	Johnstone & Storr 1998; Groom 2011
Lambertia multiflora	Many-flowered honeysuckle	Secondary	-	-	Saunders 1980; Groom 2011

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Liquidamber styraciflua	Liquid amber	Primary	-	Secondary	Johnstone *et al.* 2010; Groom 2011; Groom 2014; Personal observation
Lupinus sp.	Lupin	Secondary	-	-	Saunders 1980; Groom 2011
Macadamia integrifolia	Macadamia	Primary	Secondary	-	Johnstone *et al.* 2010; Grooms 2011; Groom 2014
Malus domestica	Apple	Secondary	Secondary	-	Johnstone *et al* . 2010; Johnstone & Storr 1998; DSEWPaC 2012; DoEE 2017; Groom 2011
Melaleuca leuropoma		Secondary	-	-	Saunders 1980; Groom 2011
Melia azedarach	Cape lilac or white cedar	Secondary	-	Primary	Johnstone *et al.* 2010; Groom 2011
Mesomeleana spp.		Secondary	-	-	Johnstone *et al.* 2010; Groom 2011
Olea europea	Olive	-	-	Secondary	Johnstone 2017
Persoonia longifolia	Snottygobble	-	-	Secondary	Johnstone & Storr 1998; Johnstone & Kirkby 1999; Johnstone *et al.* 2010; DSEWPaC 2012; DoEE 2017
Pinus canariensis	Canary island pine	Primary	-	-	Johnstone *et al.* 2010; Groom 2011
Pinus caribea	Caribbean pine	Primary	-	-	Johnstone *et al.* 2010; Groom 2011
Pinus pinaster	Pinaster or maritime pine	Primary	-	-	Groom 2011
Pinus radiata	Radiata pine	Primary	Secondary	-	Johnstone *et al.* 2010; Groom 2011
Pinus spp.		Primary	Secondary	-	Johnstone & Storr 1998; Saunders 1979; Johnstone *et al.* 2010; DSEWPaC 2012; DoEE 2017
Protea 'Pink Ice'		Secondary	-	-	Groom 2011
Protea repens		Secondary	-	-	Groom 2011
Protea spp.		Secondary	-	-	Johnstone *et al.* 2010
Prunus amygdalus	Almond tree	Secondary	-	-	Johnstone & Storr 1998; Johnstone *et al.* 2010; Groom 2011; DoEE 2017
Pyrus communis	European pear	-	Secondary	-	Johnstone & Storr 1998; Johnstone *et al.* 2010; DSEWPaC 2012; DoEE 2017
Quercus spp.	Oak	-	Secondary	-	Johnstone *et al.* 2010

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Raphanus raphanistrum	Wild radish	Secondary	-	-	Groom 2011; DoEE 2017
Reedia spathacea		-	Secondary	-	Johnstone *et al.* 2010
Rumex hypogaeus	Doublegee	Secondary	-	-	Saunders 1980
Stenocarpus sinuatus		Secondary	-	-	Johnstone *et al.* 2010
Syzygium smithii	Lilly pilly	Secondary	-	-	Groom 2014
Tipuana tipu	Tipu or rosewood tree	Primary	-	-	Groom 2011, Groom 2014
Xanthorrhoea preissii	Grass tree	Secondary	Secondary	-	Groom 2011; Johnstone *et al.* 2010
Xylomelum occidentale	Woody pear	Secondary	-	-	Groom 2014

CBC=Carnaby's black cockatoo, BBC=Baudin's black cockatoo and FRTBC=Forest red-tailed black cockatoo

References

Department of the Environment and Energy (DoEE) 2017, 'Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo, Commonwealth of Australia.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012, EPBC Act referral guidelines for three threatened black cockatoo species, Australian Government, Canberra.

Groom, C. 2011, Plants Used by Carnaby's Black Cockatoo, Department of Environment and Conservation, Perth.

Groom C. J , Mawson P. R , Roberts J. D. and Mitchell N. J. 2014, Meeting an expanding human population's needs whilst conserving a threatened parrot species in an urban environment, WIT Transactions on Ecology and The Environment, 191: 1199-1212.Johnstone, R. E. and Storr, G. M. 1998, *Handbook of Western Australian Birds. Volume 1 - Non-Passerines (Emu to Dollarbird)*, Western Australian Museum, Perth.

Johnstone, R. E. and Kirkby, T. 1999, Food of the Red-tailed Forest Black Cockatoo *Calyptorhynchus banksii naso* in Western Australia, Western Australian Naturalist, 22: 167-178.

Johnstone, R. E. and Kirkby, T. 2008, Distribution, status, social organisation, movements and conservation of Baudin's cockatoo (*Calyptorhynchus baudinii*) in South-west Western Australia, Records of the Western Australian Museum, 25: 107-118.

Johnstone, R. E. and Storr, G. M. 1998, Handbook of Western Australian Birds. Volume 1 - Non-Passerines (Emu to Dollarbird), Western Australian Museum, Perth.

Johnstone, R. E., Johnstone, C. and Kirkby, T. 2010, Black Cockatoos on the Swan Coastal Plain: Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) on the Swan Coastal Plain (Lancelin–Dunsborough), Western Australia. Studies on distribution, status, breeding, food, movements and historical changes., Department of Planning, Western Australia.

Johnstone, R. E., Kirkby, T. and Sarti, K. 2017, The distribution, status movements and diet of the forest red-tailed black cockatoo in the south-west with emphasis on the greater Perth region, Western Australia, The West Australian Naturalist, 30(4): 193-219.

Saunders, D. A. 1979, Distribution and taxonomy of the white-tailed and yellow-tailed Black-Cockatoos *Calyptorhynchus* spp., Emu, 79(215-227).

Saunders, D. A. 1980, Food and Movements of the Short-billed Form of the White-tailed Black Cockatoo, Australian Wildlife Research, 7: 257-269.

Appendix D

Conservation Significant Species and Likelihood of Occurrence Assessment

Species name	Common name	Level of significance		Habitat	Likelihood of occurrence
		WA	EPBC Act		
Birds					
Actitis hypoleucos	Common sandpiper	MI	MI	Edge of sheltered waters salt or fresh, e.g. estuaries, mangrove creeks, rocky coasts, near-coastal saltlakes (including saltwork ponds), river pools, lagoons, claypans, drying swamps, flood waters, dams and sewage ponds. Preferring situations where low perches are available (Johnstone & Storr 1998).	**Unlikely** No suitable habitat occurs in the site.
Apus pacificus	Fork-tailed swift	MI	MI	Aerial, migratory species that is most often seen over inland plains and sometimes above open areas, foothills or in coastal areas. Sometimes occurs over settled areas, including towns, urban areas and cities (Pizzey & Knight 2012).	**Possible** May opportunistically occur in or fly over the site on commute or while searching for prey.
Calidris acuminata	Sharp-tailed sandpiper	MI	MI	Occurs in tidal mudflats, saltmarshes and mangroves, as well as, shallow fresh, brackish or saline inland wetlands. It is also known from floodwaters, irrigated pastures and crops, sewage ponds, saltfields.	**Unlikely** No suitable habitat occurs in the site.
Calidris ferruginea	Curlew sandpiper	CR	CR (MI)	Mainly shallows of estuaries and near-coastal saltlakes (including saltwork ponds) and drying near-coastal freshwater lakes and swamps. Also beaches and near-coastal sewage ponds.	**Unlikely** No suitable habitat occurs in the site.

Species name	Common name	Level of significance		Habitat	Likelihood of occurrence
		WA	EPBC Act		
Calidris melanotos	Pectoral sandpiper	MI	MI	Mainly fresh waters (swamps, lagoons, river pools, irrigation channels and sewage ponds); also samphire flats around estuaries and saltlakes (Johnstone & Storr 1998).	**Unlikely** No suitable habitat occurs in the site.
Calidris ruficollis	Red-necked stint	MI	MI	Tidal mudflats, saltmarshes, sandy or shelly beaches, saline and freshwater wetlands (coastal and inland), saltfields, sewage ponds (Pizzey and Knight 2012).	**Unlikely** No suitable habitat occurs in the site.
Calyptorhynchus banksii naso	Forest red-tailed black cockatoo	VU	VU	Eucalypt and Corymbia forests, often in hilly interior. More recently also observed in more open agricultural and suburban areas including Perth metropolitan area. Attracted to seeding Corymbia calophylla, Eucalyptus marginata, introduced Melia azedarach and Eucalyptus spp. trees.	**Possible** On the edge of modelled distribution and suitable habitat occurs in site.
Falco hypoleucos	Grey falcon	VU	-	Species occurs in arid and semi-arid Australia, where it inhabits timbered lowland plains. In particular Acacia shrublands and that are crossed by tree-lined water courses. Species has also been observed hunting in treeless areas and frequenting tussock grassland and open woodlands (TSSC 2020).	**Possible** May opportunistically occur in or fly over the site on commute or while searching for prey.

Species name	Common name	Level of significance		Habitat	Likelihood of occurrence
		WA	EPBC Act		
Falco peregrinus	Peregrine falcon	OS	-	Mainly found around cliffs along coasts, rivers, ranges and around wooded watercourses and lakes (Johnstone and Storr 1998).	**Possible** May opportunistically occur in or fly over the site on commute or while searching for prey.
Leipoa ocellata	Malleefowl	VU	VU	Scrubs and thickets of Eucalyptus spp., Melaleuca lanceolata and Acacia linophylla; also other dense litter-forming shrublands. Attracted to fallen wheat in stubbles and along roads (Johnstone and Storr 1998).	**Unlikely** No suitable habitat occurs in site.
Motacilla cinerea	Grey wagtail	MI	MI	In Australia mostly near running water in disused quarries, sandy and rocky streams in escarpments and rainforests, sewage ponds, ploughed fields and airfields (Pizzey & Knight 2012).	**Unlikely** No suitable habitat occurs in the site.
Platycercus icterotis xanthogenys	Western rosella (inland)	P4	-	Open euclaypt woodlands with heath understorey.	**Possible** Suitable habitat occurs in the site.
Zanda baudinii	Baudin's black cockatoo	EN	EN	Mainly eucalypt forests. Attracted to seeding Corymbia calophylla, Banksia spp., Hakea spp., and to fruiting apples and pears (Johnstone and Storr 1998).	**Unlikely** Site outside of current modelled distribution.

Species name	Common name	Level of significance		Habitat	Likelihood of occurrence
		WA	EPBC Act		
Zanda latirostris	Carnaby's black cockatoo	EN	EN	Mainly proteaceous scrubs and heaths and adjacent eucalypt woodlands and forests; also plantations of Pinus spp. Attracted to seeding Banksia spp., Hakea spp., Eucalyptus spp., Corymbia calophylla, Grevillea spp., and Allocasuarina spp. (Johnstone and Storr 1998).	**Likely** Inside modelled distribution and suitable habitat in site.
Mammals					
Bettongia penicillata ogilbyi	Woylie	CR	EN	Woodlands and adjacent heaths with a dense understorey of shrubs, particularly Gastrolobium spp. (TSSC 2018).	**Unlikely** No suitable habitat (dense understorey) occurs in the site.
Dasyurus geoffroii	Chuditch	VU	VU	Wide range of habitats from woodlands, dry sclerophyll forests, riparian vegetation, beaches and deserts. Appears to utilise native vegetation along roadsides in the wheatbelt (DEC 2012b).	**Possible** Suitable habitat occurs in site.
Falsistrellus mackenziei	Western false pipistrelle	P4	-	High rainfall forests dominated by jarrah, karri, marri, and tuart. Occupies hollow logs for breeding and resting (Van Dyck and Strahan 2008). Also known to utilise Banksia woodland on the Swan Coastal Plain (Hosken and O'Shea 1995).	**Unlikely** No suitable habitat occurs in the site.
Isoodon fusciventer	Quenda	P4	-	Dense scrubby, often swampy, vegetation with dense cover up to one metre high (DEC 2012)	**Unlikely** No suitable habitat (dense understorey) occurs in the site.

Species name	Common name	Level of significance		Habitat	Likelihood of occurrence
		WA	EPBC Act		
Macrotis lagotis	Bilby	VU	VU	Open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises and hummock grassland (spinifex) growing on sandplains and dunes, drainage systems, salt lake systems and other alluvial areas (DBCA 2017a).	**Unlikely** Outside of current distribution and lack of suitable habitat.
Myrmecobius fasciatus	Numbat	EN	EN	Generally dominated by Eucalyptus spp. that provide hollow logs and branches for shelter and termites for food (van Dyck & Strahan 2008).	**Unlikely** No suitable habitat (dense understorey) occurs in the site.
Notamacropus eugenii derbianus	Tammar wallaby	P4	-	Dry sclerophyll forest, Banksia spp. woodlands and shrublands, typically favouring dense low vegetation that provides dense cover (Christensen and Strahan 1983).	**Unlikely** No suitable habitat (dense understorey) occurs in the site.
Notamacropus irma	Western brush wallaby	P4	-	Dry sclerophyll forest, Banksia spp. woodlands and shrublands, typically favouring dense low vegetation that provides dense cover (Christensen and Strahan 1983).	**Unlikely** No suitable habitat (dense understorey) occurs in the site.
Phascogale calura	Red-tailed phascogale	CD	VU	Historically occurred in a variety of woodland habitats but not restricted to remnants of mature Eucalyptus wandoo or Allocasuarina huegeliana woodlands in the south-western Wheatbelt where annual rainfall is 300-600 mm (Menkhorst & Knight 2011).	**Possible** Suitable habitat occurs in the site.

Species name	Common name	Level of significance		Habitat	Likelihood of occurrence
		WA	EPBC Act		
Phascogale tapoatafa wambenger	South-western brush-tailed phascogale	CD	-	Dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover (Triggs 2003).	**Unlikely** Species occurs more southwest.
Pseudocheirus occidentalis	Western ringtail possum	CR	CR	On the Swan Coastal Plain in Agonis flexuosa woodlands and Agonis flexuosa/ Eucalyptus gomphocephala forests. Also Eucalyptus marginata forests (DBCA 2017).	**Unlikely** Species occurs more southwest and lack of suitable habitat.
Reptiles					
Acanthophis antarcticus	Southern death adder	P3	-	Mostly in woodlands, grasslands and heaths. In the Darling Range this species is typically found within Eucalyptus marginata woodlands adjacent to granite outcrops and along densely vegetated creeks (Bush et al. 2007).	**Unlikely** No suitable habitat occurs within the site.

Note: CE=critically endangered, EN=endangered, VU=vulnerable, CD=conservation dependent, MI=migratory, OS=other specially protected, P1=Priority 1, P2=Priority 2, P3=Priority 3, P4=Priority 4. Species recorded or considered to potentially occur within the site are shaded green.

References

Bush, B., Maryan, B., Browne-Cooper, R. and Robinson, D. 2007, Reptiles and Frogs in the Bush: Southwestern Australia, UWA Press, Nedlands.
Bray, D. J. and Gomon, M. F. 2018, Pouch Lamprey, Geotria australis.
Christensen, P. and Strahan, R. 1984, The Australian Museum Complete Book of Australian Mammals, Angus and Robertson Publishers, Sydney.
Cronin, L. 2007, Cronin's Key Guide to Australian Wildlife, Oxford University Press, Oxford, United Kingdom.
Department of Biodiversity, Conservation and Attractions (DBCA) 2017, Fauna Profile: Western Ringtail Possum Pseudocheirus occidentalis, Perth, Western Australia.
Johnstone, R. E. and Storr, G. M. 1998, Handbook of Western Australian Birds. Volume 1 - Non-Passerines (Emu to Dollarbird), Western Australian Museum, Perth.
Marchant, S. and Higgins, P. J. 1993, Handbook of Australian, New Zealand and Antarctic Birds. Volume two - Raptors to Lapwings, Oxford University Press, Melbourne, Victoria.
Morgan, D. L., Beatty, S. J., Klunzinger, M. W., Allen, M. G. and Burnham, Q. E. 2011, Field Guide to the Freshwater Fishes, Crayfishes and Mussels of South

Species name	Common name	Level of significance		Habitat	Likelihood of occurrence
		WA	EPBC Act		

Western Australia, SERCUL, Perth, Western Australia.
Morcombe, M. 2004, Field Guide to Australian Birds, Steve Parish Publishing, Archerfield, Queensland.
Nevill, S. 2005, Guide to the Wildlife of the Perth Region, Simon Nevill Publications, Perth, Western Australia.
Pizzey, G. and Knight, F. 2012, The Fieldguide to the Birds of Australia, Harper Collins Publishers, Sydney, Australia.
Rentz, D. C. F. 1993, Tettigoniidae of Australia 2. The Austrosaginae, Zaprochilinae and Phasmodinae, CSIRO.
Threatened Species Scientific Committee (TSSC) 2018, Conservation advice for Bettongia penicillata (woylie), Department of the Environment, Canberra.
Triggs, B. 2003, Tracks, Scats and Other Traces A Field Guide to Australian Mammals, Oxford University Press Australia, Melbourne, Victoria.
Department of Environment and Conservation (DEC) 2012, Fauna profiles, Quenda Isoodon obesulus (Shaw, 1797), Perth.
Van Dyck, S. and Strahan, R. 2008, The Mammals of Australia, Queensland Museum, Brisbane.
Wilson, S. and Swan, G. 2008, A Complete Guide to Reptiles of Australia, Reed New Holland, Sydney.

Appendix E

Species List

Fauna List
Proposed Narrogin Solar Farm

Category	Status	Species name	Common name	Record type
Birds		*Gumnorhina tibicen*	Australian magpie	Sight
		Corvus coronoides	Australian raven	Sight
		Banardius zonarius	Australian ringneck	Sight
		Chenonetta jubata	Australian wood duck	Sight
		Artamus cinereus	Black-faced woodswallow	Sight
		Neophema elegans	Elegant parrot	Sight
		Eolophus roseicapilla	Galah	Sight
		Cacatua sanguinea	Little corella	Sight
		Anas superciliosa	Pacific black duck	Sight
		Cracticus nigrogularis	Pied butcherbird	Sight
		Pardalotus striatus	Striated pardalote	Call
		Smicrornis brevirostris	Weebill	Call
		Gerygone fusca	Western gerygone	Call
		Egretta novaehollandiae	White-faced heron	Sight
		Rhipidura leucophrys	Willy wagtail	Sight
Mammals	*	*Canis familiaris*	Dog	Tracks
	*	*Ovis aries*	Sheep	Sight
Reptiles		*Tiliqua rugosa*	Bobtail	Sight

Note:* = introduced

Appendix F

Black Cockatoo Habitat Tree Data

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	520766.33	6346641.96	65	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520769.85	6346629.09	64	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520780.55	6346568.98	53	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520795.29	6346559.31	52	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520789.11	6346552.67	64	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520787.04	6346541.92	65	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520785.32	6346524.41	60	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520800.12	6346502.20	120	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520824.55	6346485.74	57	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520832.58	6346480.74	65	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520837.43	6346479.73	54	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520856.09	6346468.71	110	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520896.75	6346442.24	58	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520908.13	6346436.23	57	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520906.35	6346432.47	57	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520916.18	6346441.98	40	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520926.88	6346422.56	72	Stag	Potential nesting tree		NAW
-	520936.57	6346414.77	52	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520938.34	6346410.34	34	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520949.35	6346405.99	49	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520952.43	6346404.87	51	Stag	Potential nesting tree		NAW
-	520956.37	6346412.74	76	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520961.39	6346403.41	52	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520990.72	6346362.33	53	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520988.38	6346359.68	52	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520978.64	6346345.18	50	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520979.26	6346328.77	64	Stag	Potential nesting tree		NAW
-	520969.43	6346317.92	55	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520967.46	6346317.15	53	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520988.97	6346287.51	90	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520998.37	6346271.63	58	*Eucalyptus loxophleba*	Potential nesting tree		NAW

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	520954.56	6346092.80	55	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520957.37	6346096.89	52	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520816.31	6345989.21	72	Stag	Potential nesting tree		NAW
-	520751.16	6345919.06	53	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520733.51	6345918.33	56	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520704.57	6345880.03	50	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520673.98	6345855.04	51	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520566.85	6345759.92	56	*Eucalyptus wandoo*	Potential nesting tree		NAW
791	520553.23	6345767.60	63	*Eucalyptus wandoo*	Suitable nesting tree	West facing hollow	NAW
-	520537.15	6345756.88	70	*Eucalyptus wandoo*	Suitable nesting tree	South facing hollow	NAW
-	520551.42	6345748.20	50	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520543.55	6345738.91	49	*Eucalyptus wandoo*	Potential nesting tree		NAW
1973	520539.26	6345742.13	39	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520526.43	6345724.20	48	*Eucalyptus wandoo*	Potential nesting tree		NAW
1969	520484.90	6345691.36	38	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520461.73	6345687.75	64	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520458.99	6345670.24	62	*Eucalyptus wandoo*	Suitable nesting tree	North facing hollow	NAW
-	520444.05	6345674.82	44	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520436.64	6345655.10	42	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520432.06	6345654.44	36	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520432.06	6345653.33	30	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520430.27	6345650.12	54	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520782.37	6346016.00	60	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520800.89	6346026.05	50	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520814.15	6346028.46	52	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520837.24	6346080.30	74	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520376.68	6346287.24	33	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519828.73	6346837.13	53	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519823.05	6346841.46	49	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519821.64	6346841.13	46	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519824.00	6346852.10	47	*Eucalyptus wandoo*	Potential nesting tree		NAW

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	519826.51	6346847.66	39	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519828.67	6346852.76	39	*Eucalyptus wandoo*	Potential nesting tree		NAW
949	519739.58	6346905.15	33	*Eucalyptus wandoo*	Potential nesting tree		NAW
950	519741.37	6346912.02	36	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519738.38	6346912.70	54	*Eucalyptus wandoo*	Suitable nesting tree	South west facing hollow	NAW
951	519352.55	6346913.13	58	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519362.24	6346902.25	38	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519381.60	6346867.62	80	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519425.67	6346813.65	72	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519557.43	6346612.85	54	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519587.87	6346562.12	31	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519610.23	6346535.80	51	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519613.87	6346530.70	73	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519693.20	6346411.03	52	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519725.51	6346364.62	40	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519741.53	6346342.20	33	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519740.77	6346334.66	43	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519755.88	6346322.88	32	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519811.18	6346237.18	47	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519828.76	6346201.01	50	*Eucalyptus wandoo*	Suitable nesting tree		NAW
-	519868.25	6346149.82	72	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519897.21	6346105.31	59	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519978.78	6345989.84	35	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519939.89	6346061.43	45	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519995.48	6345979.61	43	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520120.24	6345791.67	37	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520129.16	6345773.02	40	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520143.53	6345767.34	35	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520181.14	6345708.84	58	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520187.55	6345690.20	87	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520213.83	6345663.43	40	*Eucalyptus wandoo*	Potential nesting tree		NAW

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	520212.68	6345647.58	36	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520261.03	6345593.05	80	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520764.24	6346668.90	58	*Eucalyptus rudis*	Potential nesting tree		SCM
-	520804.94	6346617.27	76	*Eucalyptus rudis*	Potential nesting tree		SCM
-	520807.53	6346606.17	64	*Eucalyptus rudis*	Potential nesting tree		SCM
-	520859.11	6346486.33	109	*Eucalyptus rudis*	Suitable nesting tree	Feathers at entrance to hollow	SCM
-	520899.71	6346472.28	62	*Eucalyptus rudis*	Potential nesting tree		SCM
-	520951.18	6346433.59	58	*Eucalyptus rudis*	Potential nesting tree		SCM
-	521004.60	6346342.57	53	*Eucalyptus rudis*	Potential nesting tree		SCM
-	520998.79	6346290.48	65	*Eucalyptus rudis*	Potential nesting tree		SCM
-	521017.71	6346273.92	57	*Eucalyptus rudis*	Potential nesting tree		SCM
-	521028.07	6346272.23	58	*Eucalyptus rudis*	Potential nesting tree		SCM
-	521073.09	6346231.12	50	*Eucalyptus rudis*	Potential nesting tree		SCM
-	521046.50	6346243.92	63	*Eucalyptus rudis*	Potential nesting tree		SCM
-	521038.49	6346250.37	56	*Eucalyptus rudis*	Potential nesting tree		SCM
-	521061.64	6346201.21	51	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	521038.58	6346162.79	63	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	521016.90	6346157.96	72	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	521018.75	6346149.42	54	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520982.37	6346123.22	50	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520948.29	6345955.56	109	*Eucalyptus rudis*	Potential nesting tree		SCM
-	520945.38	6345903.35	78	*Eucalyptus rudis*	Potential nesting tree		SCM
-	520790.23	6345093.84	54	*Eucalyptus rudis*	Potential nesting tree		SCM
-	520733.06	6345041.30	95	*Eucalyptus rudis*	Potential nesting tree		SCM
-	520342.80	6345572.37	43	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520347.31	6345588.32	54	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520396.08	6345597.09	105	Stag	Potential nesting tree		SCM
-	520400.20	6345603.07	49	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520403.11	6345608.72	61	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520390.15	6345622.82	55	*Eucalyptus wandoo*	Potential nesting tree		SCM

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	520520.41	6346060.01	79	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520452.90	6346112.15	58	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520434.93	6346134.91	35	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520412.29	6346161.23	31	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520410.52	6346165.45	31	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520035.93	6346170.43	62	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520012.47	6346618.25	55	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519964.01	6346623.11	43	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519963.73	6346626.55	48	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519990.62	6346895.00	51	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519988.38	6346896.34	67	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	519913.53	6346878.64	37	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519908.92	6346906.25	36	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519851.16	6346936.86	39	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519913.92	6347069.43	58	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519911.03	6347072.10	43	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519810.19	6347041.37	54	Stag	Potential nesting tree	Hollow visibly blocked	SCM
-	519803.12	6347012.23	48	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519818.37	6346979.49	51	*Eucalyptus astringens*	Potential nesting tree		SCM
-	519377.17	6346894.57	85	*Eucalyptus wandoo*	Suitable nesting tree		SCM
-	519414.24	6346841.06	53	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519434.91	6346810.20	75	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519439.48	6346804.43	75	*Eucalyptus wandoo*	Potential nesting tree	Hollow would be suitable, currently inhabited by bees though	SCM
-	519490.52	6346735.92	50	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519496.20	6346726.60	47	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519514.26	6346697.96	43	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519563.33	6346618.49	111	*Eucalyptus wandoo*	Suitable nesting tree	hollow would need to be inspe	SCM
-	519598.92	6346575.73	73	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519618.83	6346539.22	36	*Eucalyptus wandoo*	Potential nesting tree		SCM

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	519643.32	6346499.71	51	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519646.95	6346496.37	44	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519669.48	6346460.41	44	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519671.44	6346460.07	34	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519680.94	6346445.20	40	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519698.35	6346416.34	49	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519726.02	6346382.36	43	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519774.15	6346306.66	42	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519877.78	6346148.80	47	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519891.00	6346131.92	52	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519890.82	6346134.70	64	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519894.73	6346126.60	52	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520124.41	6345776.03	38	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520151.34	6345746.59	58	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520155.88	6345731.17	50	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520167.08	6345725.50	35	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520183.27	6345699.97	46	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520184.95	6345696.86	48	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520184.48	6345694.98	30	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520270.09	6345592.36	35	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519012.98	6346738.41	57	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519019.12	6346725.65	62	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519002.13	6346725.91	36	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519006.06	6346733.66	47	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	518992.89	6346732.91	50	*Eucalyptus wandoo*	Potential nesting tree	Bees from crack in trunk	NAW
-	518985.58	6346720.73	76	*Eucalyptus wandoo*	Suitable nesting tree	Hollow in upper branch north facing	NAW
-	518980.36	6346720.96	42	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	518982.99	6346731.15	45	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	518973.84	6346734.94	41	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	518981.72	6346751.66	41	*Eucalyptus wandoo*	Potential nesting tree		NAW

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	518977.10	6346729.17	53	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519009.64	6346745.18	68	*Eucalyptus wandoo*	Suitable nesting tree	Top hollow	NAW
-	518848.25	6346748.71	53	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	518771.44	6346727.24	43	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	518760.14	6346728.92	100	*Eucalyptus astringens*	Potential nesting tree		NAW
-	518706.34	6346728.47	53	*Eucalyptus astringens*	Potential nesting tree		NAW
-	518779.30	6346686.76	71	*Eucalyptus astringens*	Suitable nesting tree	Possible fork hollow.	NAW
-	519587.09	6347012.88	78	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519587.18	6347010.56	38	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519610.57	6347030.91	41	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519614.02	6347031.01	42	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520046.17	6347341.10	67	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	519989.22	6347354.63	68	Stag	Potential nesting tree		NAW
-	520004.25	6347397.06	105	*Eucalyptus wandoo*	Potential nesting tree	Whole trunk hollowed out and open	NAW
-	519994.91	6347442.98	68	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519974.24	6347523.40	41	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519941.96	6347588.20	50	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519939.19	6347602.07	46	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519922.42	6347624.61	32	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519909.65	6347636.16	48	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519898.16	6347637.85	48	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519889.68	6347644.29	50	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519862.72	6347663.64	62	*Eucalyptus salmonophloia*	Potential nesting tree		NAW
-	519867.30	6347663.74	56	*Eucalyptus wandoo*	Potential nesting tree	Hollows too small	NAW
-	519859.37	6347670.63	73	*Eucalyptus salmonophloia*	Suitable nesting tree	North facing hollow	NAW
-	519871.63	6347681.58	77	*Eucalyptus salmonophloia*	Potential nesting tree		NAW
-	519912.18	6347688.48	57	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519843.61	6347679.64	31	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519839.31	6347680.43	73	*Eucalyptus salmonophloia*	Potential nesting tree		NAW
-	519828.86	6347687.76	35	*Eucalyptus salmonophloia*	Potential nesting tree		NAW

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	519827.65	6347686.21	30	*Eucalyptus salmonophloia*	Potential nesting tree		NAW
-	519826.60	6347679.45	87	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519802.98	6347680.72	32	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	519800.55	6347682.17	80	*Eucalyptus salmonophloia*	Potential nesting tree		NAW
-	519803.73	6347683.27	43	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520239.39	6347686.93	50	*Eucalyptus loxophleba*	Potential nesting tree	Estimated due to bees	NAW
-	520253.98	6347651.42	50	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520289.12	6347618.65	51	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520392.71	6347528.08	62	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520404.13	6347496.46	63	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520402.88	6347475.84	70	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520403.24	6347471.52	72	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520402.19	6347459.55	50	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520411.22	6347401.10	55	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520444.15	6347200.71	83	*Eucalyptus loxophleba*	Suitable nesting tree		NAW
-	520420.50	6347190.01	64	Stag	Potential nesting tree	Hollows too small	NAW
-	520354.90	6347222.73	58	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520351.30	6347241.70	52	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520340.18	6347241.61	88	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520237.92	6347245.70	50	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520188.95	6347232.61	58	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520073.52	6347242.60	107	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520567.17	6347118.75	66	Stag	Suitable nesting tree	South facing hollow	NAW
-	520593.87	6347110.27	59	Stag	Potential nesting tree		NAW
-	520613.61	6347081.62	64	*Eucalyptus loxophleba*	Suitable nesting tree		NAW
-	520633.53	6347002.76	78	*Eucalyptus wandoo*	Potential nesting tree		NAW
-	520625.87	6346915.64	58	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520590.84	6346911.83	53	*Eucalyptus rudis*	Potential nesting tree		NAW
-	520584.77	6346823.93	50	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520589.06	6346820.82	69	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520610.29	6346789.18	64	*Eucalyptus loxophleba*	Potential nesting tree		NAW

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	520605.14	6346785.31	78	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520662.80	6346752.71	54	*Eucalyptus loxophleba*	Potential nesting tree		NAW
-	520707.16	6346708.71	76	*Eucalyptus rudis*	Potential nesting tree		NAW
-	518920.08	6346753.89	33	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518922.59	6346743.91	64	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518947.60	6346734.55	51	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518956.09	6346729.76	44	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518964.30	6346726.87	76	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518973.18	6346728.95	52	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518959.83	6346733.53	40	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518971.15	6346742.59	43	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518966.78	6346754.35	42	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518993.39	6346748.32	42	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518841.34	6346748.72	55	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518768.49	6346749.75	38	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518760.45	6346746.32	63	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518758.58	6346742.45	76	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518678.82	6346745.82	47	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518693.58	6346745.79	51	*Eucalyptus astringens*	Potential nesting tree		SCM
-	518693.69	6346753.44	38	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	518761.32	6346664.51	55	*Eucalyptus astringens*	Potential nesting tree		SCM
-	518760.25	6346642.45	54	*Eucalyptus astringens*	Potential nesting tree		SCM
-	518759.96	6346637.90	56	*Eucalyptus astringens*	Potential nesting tree		SCM
-	518764.92	6346638.23	62	*Eucalyptus astringens*	Potential nesting tree		SCM
-	518775.48	6346645.41	53	*Eucalyptus astringens*	Potential nesting tree		SCM
-	519633.68	6347005.58	43	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519648.35	6347010.66	60	Stag	Potential nesting tree		SCM
-	520012.36	6347341.17	91	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519986.54	6347371.60	45	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519993.21	6347390.32	63	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519967.60	6347470.75	42	*Eucalyptus wandoo*	Potential nesting tree		SCM

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	519966.20	6347473.86	61	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519919.66	6347598.45	58	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	519877.26	6347646.87	32	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519871.75	6347647.99	32	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519846.55	6347658.02	74	*Eucalyptus salmonophloia*	Potential nesting tree		SCM
-	519848.03	6347652.25	39	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519806.95	6347658.87	40	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519737.75	6347666.33	57	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519716.45	6347666.82	30	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519654.12	6347697.10	122	*Eucalyptus rudis*	Potential nesting tree		SCM
-	519679.39	6347675.21	58	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	519720.98	6347687.54	57	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520192.93	6347716.29	85	Stag	Potential nesting tree		SCM
-	520251.85	6347662.07	52	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520274.95	6347630.87	55	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520278.68	6347625.76	79	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520311.51	6347602.63	79	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520390.67	6347174.44	69	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520333.63	6347189.74	94	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520299.84	6347199.24	74	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520211.44	6347224.58	82	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520139.33	6347269.63	36	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520109.57	6347285.21	45	*Eucalyptus wandoo*	Potential nesting tree		SCM
-	520567.11	6347088.59	107	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520560.40	6347094.59	68	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520583.82	6347128.36	57	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520622.14	6347094.58	62	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520661.24	6347034.85	51	Stag	Potential nesting tree		SCM
-	520645.46	6346992.42	68	Stag	Potential nesting tree		SCM
-	520640.42	6346948.64	64	*Eucalyptus rudis*	Suitable nesting tree		SCM
-	520638.60	6346927.03	54	*Eucalyptus rudis*	Potential nesting tree		SCM

Tag No.	Easting	Northing	DBH (cm)	Species	BC Hollow Category	Notes	Recorder
-	520645.25	6346893.76	79	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520651.39	6346882.88	61	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520647.93	6346878.12	53	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520637.93	6346877.59	63	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520633.71	6346868.17	68	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520631.56	6346867.62	82	*Eucalyptus loxophleba*	Potential nesting tree		SCM
-	520662.79	6346792.95	78	*Eucalyptus rudis*	Potential nesting tree		SCM
-	520671.45	6346783.62	74	Stag	Potential nesting tree		SCM

Detailed Flora and Vegetation Survey Narrogin Solar Farm, Narrogin



Prepared for: Land Insights

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April 2024

EXECUTIVE SUMMARY

This report has been prepared by Del Botanics Environmental Consulting on behalf of Land Insights to present the results of a spring Detailed Flora and Vegetation Survey within Lots 27, 28, 1195, 1976, 6349, 7207 Wanerie Rd and Lots 2921, 2922, 3014, 3015, 3017 Great Southern Highway, Dumberning. The survey area also includes a 3 kilometre long by 2-metre-wide road reserve along Great Southern Highway from 1976 Wanerie Rd to the Narrogin Substation. The location of the site is shown on **Figures 1** and **2.**

The recent Flora and Vegetation Assessment undertaken in the area described above identified 72 flora species. Weed species comprised of 25% of the total flora recorded. The vegetation condition across the site is "Completely Degraded - Good".

No species of Threatened (T), or Priority Flora pursuant to the *Biodiversity Conservation* (BC) Act 2016 or the *Environment Protection and Biodiversity Conservation* (EPBC) Act 1999 were located during the time of the survey.

One Threatened Ecological Community, the Critically Endangered *Eucalypt Woodlands of the Western Australian Wheatbelt,* is likely to occur in the survey area. No other TEC's listed by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) or Department of Biodiversity, Conservation and Attractions (DBCA) were located during the time of the survey.

STATEMENT OF LIMITATIONS

This environmental report has been prepared in accordance with the scope of services set out in the original quotation. In preparing the report, Del Botanics Environmental Consulting has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Del Botanics Environmental Consulting has not verified the accuracy or completeness of the data to the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Del Botanics Environmental Consulting will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed.

In accordance with the scope of services, Del Botanics Environmental Consulting has relied on the data and have conducted environmental field monitoring in the preparation of the report. The nature and extent of monitoring conducted is described in the report. Within the limitations imposed by the scope of services, the monitoring and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care. No other warranty, express or implied, is made.

The report has been prepared for the benefit of the Client and for no other party. Del Botanics Environmental Consulting assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report. Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

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1. INTRODUCTION

1.1 BACKGROUND

This report has been prepared by Del Botanics Environmental Consulting on behalf of Land Insights to present the results of a spring Detailed Flora and Vegetation Survey within Lots 27, 28, 1195, 1976, 6349, 7207 Wanerie Rd and Lots 2921, 2922, 3014, 3015, 3017 Great Southern Highway, Dumberning. The survey area also included an area of road reserve, approximately 3km long by 2m wide, along Great Southern Highway, from 1976 Wanerie Rd to the Narrogin Substation. The location of the site is shown on **Figures 1** & **2**. The site is approximately 200 kilometres south of the Perth central area and 4.8km south of Narrogin.

The botanical survey of the flora species and vegetation was undertaken on 20th and 26th November 2023, the total survey area within the lots is approximately 730 ha. The survey area along the road reserve is approximately 0.6 ha.

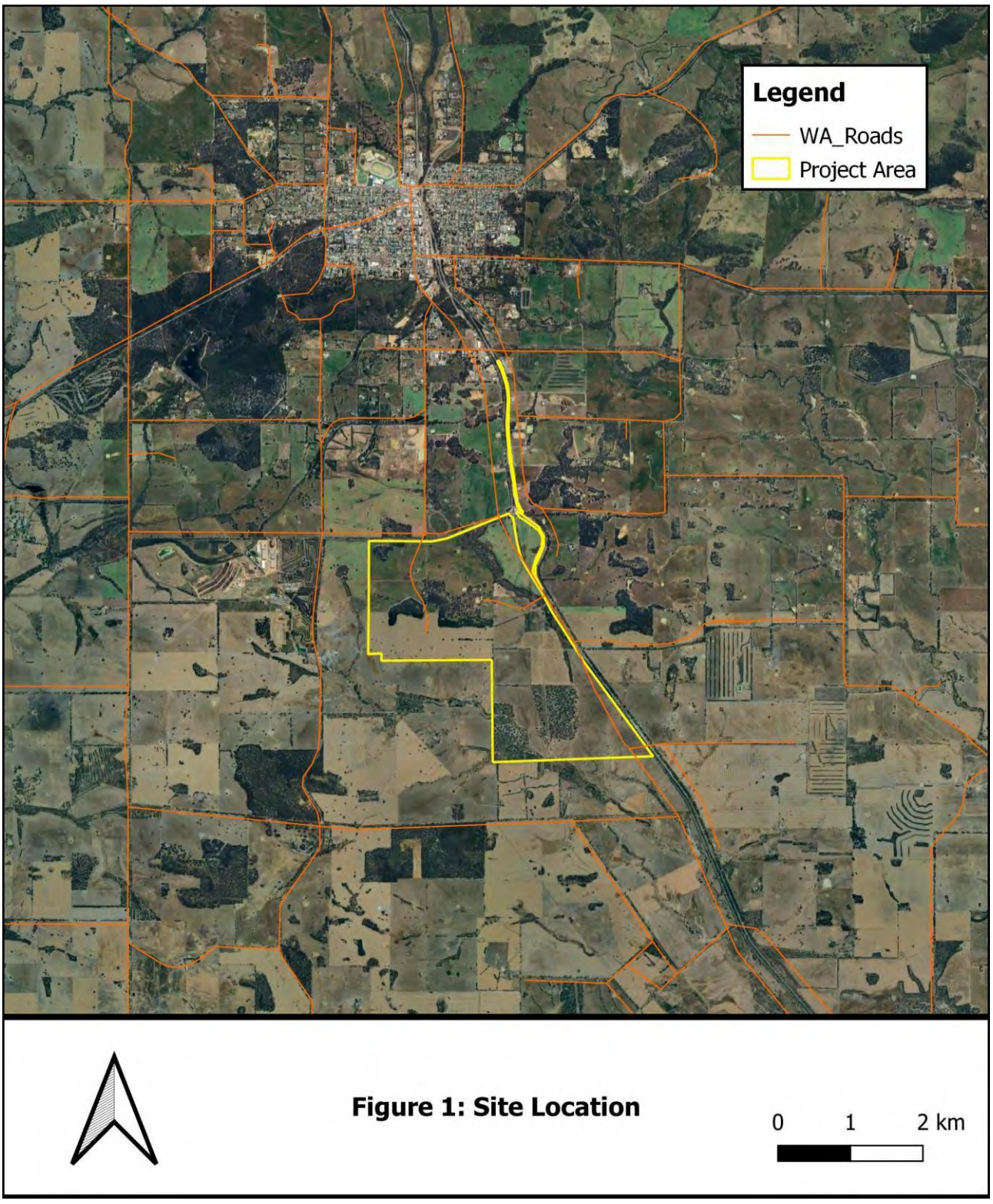


Figure 1: Site Location

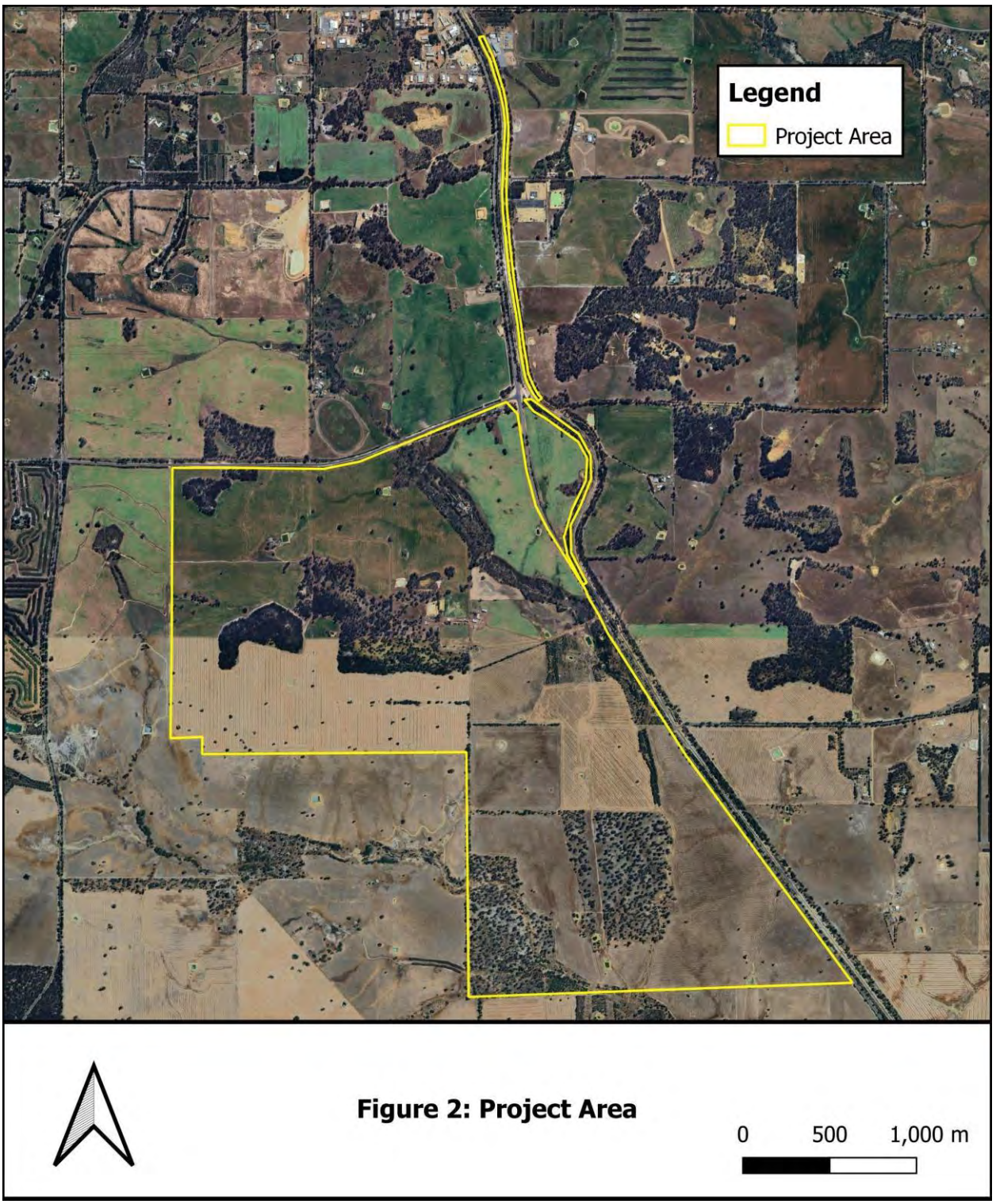


Figure 2: Project Area

1.2 PURPOSE OF THIS REPORT

This report was prepared to present the results of the flora and vegetation survey within the area described above. The flora species and vegetation were used to determine the significance of the site.

In summary this report provides:

- Threatened Flora (T) and Threatened Ecological Communities (TEC's) Department of Biodiversity, Conservation and Attractions (DBCA) and a Department of Climate Change, Energy, the Environment and Water (DCCEEW) database search to determine results for the site;
- A spring botanical survey; and
- An assessment of vegetation communities and conditions.

2. EXISTING ENVIRONMENT

2.1 LANDFORM, TOPOGRAPHY AND SOILS

Soil-landscape system mapping of Western Australia describes broad soil and landscape characteristics from regional to local scales. The survey area is within the Dellyanine System.

The Dellyanine System consists of undulating rises and low hills on granite in the southern zone of rejuvenated drainage. Soils consist of grey sandy duplex (shallow and deep), sandy gravel and red deep sandy duplex soils. The vegetation associated with this soil landscape is Wandoo-Sheoak woodland (Department of Agriculture and Food WA, 2012).

2.2 VEGETATION

The survey area lies in the Drummond Botanical Subdistrict within the Southwest Botanical Province as described by Beard (1990). Flora composition has been described by Beard (1990) as predominantly consisting of Banksia Low Woodlands on leached sands with Melaleuca swamps where ill drained and Woodlands of Eucalyptus spp. on less leached soils.

2.2.1 Regional vegetation

The Biogeographic Regionalisation of Australia (IBRA) divides Australia into 89 bioregions based on major biological and geographical/geological attributes. Western Australia has 26 biogeographic regions and 53 subregions based on dominant landscape characteristics of climate, lithology, geology, landform and vegetation.

The study area occurs in the Avon Wheatbelt Bioregion. The Avon Wheatbelt Bioregion comprises areas of active drainage dissecting a tertiary plateau in the Yilgarn Craton with gently undulating landscape of low relief. Proteaceous scrub-heaths, rich in endemics, on residual lateritic uplands and derived sandplains; mixed Eucalyptus spp., *Allocasuarina huegeliana* and Jam-York Gum woodlands occur on quaternary alluvials and eluvials. The southeastern boundary of the bioregion has been modified

incorporating a small portion into the Mallee region and has been extensively cleared for agriculture (Hill, 1996).

2.2.2 Vegetation Association

A systematic survey of native vegetation in Western Australia was undertaken by J. S. Beard (along with others) during the 1970s, which described vegetation systems in the south-west of Western Australia at a scale of 1:250,000. Beard's vegetation maps attempted to depict the vegetation as it might have been prior to European settlement in terms of type and extent (Beeston et al., 2001). The Beard Vegetation Association dataset, also referred to as the pre-European native vegetation extent dataset, was digitised by Shepherd et al., (2002).

One Beard vegetation association was mapped across the Survey Area: Association 1023 consists of medium woodland of York gum, Wandoo and Salmon gum (Beard, 1980).

2.3 CLIMATE

The closest Bureau of Meteorology (BoM) weather station is approximately 9.6 km north of the survey area at Narrogin WA (Site No.010614). The long-term mean minimum temperature for Narrogin ranged from 5.2˚C in August to 14.4˚C in February between 1913 and 2024. The long-term mean maximum temperature ranged from 14.7˚C in July to 31.1˚C in January between 1913 to 2024 (Bureau of Meteorology, 2024).

The long-term annual average rainfall is 488.1 millimetres (mm) from 1913 to 2024 (Bureau of Meteorology, 2020). Weather data for the 12-month period preceding the survey is presented in **Figure 3** below.

The temperature recorded in September 2023 was within the normal climatic conditions historically recorded for this area and over the last five years. The rainfall recorded in November 2023 was 9.4mm less than recorded in November 2022, however, this was consistent with the annual average rainfall recorded between 1991 to 2023. The rainfall seemed to follow a 7–8-year pattern, which delivered a significantly lower recorded rainfall every 7-8th year for the last 30 years. These results overall would not have a significant impact on the flora recorded within the survey area.

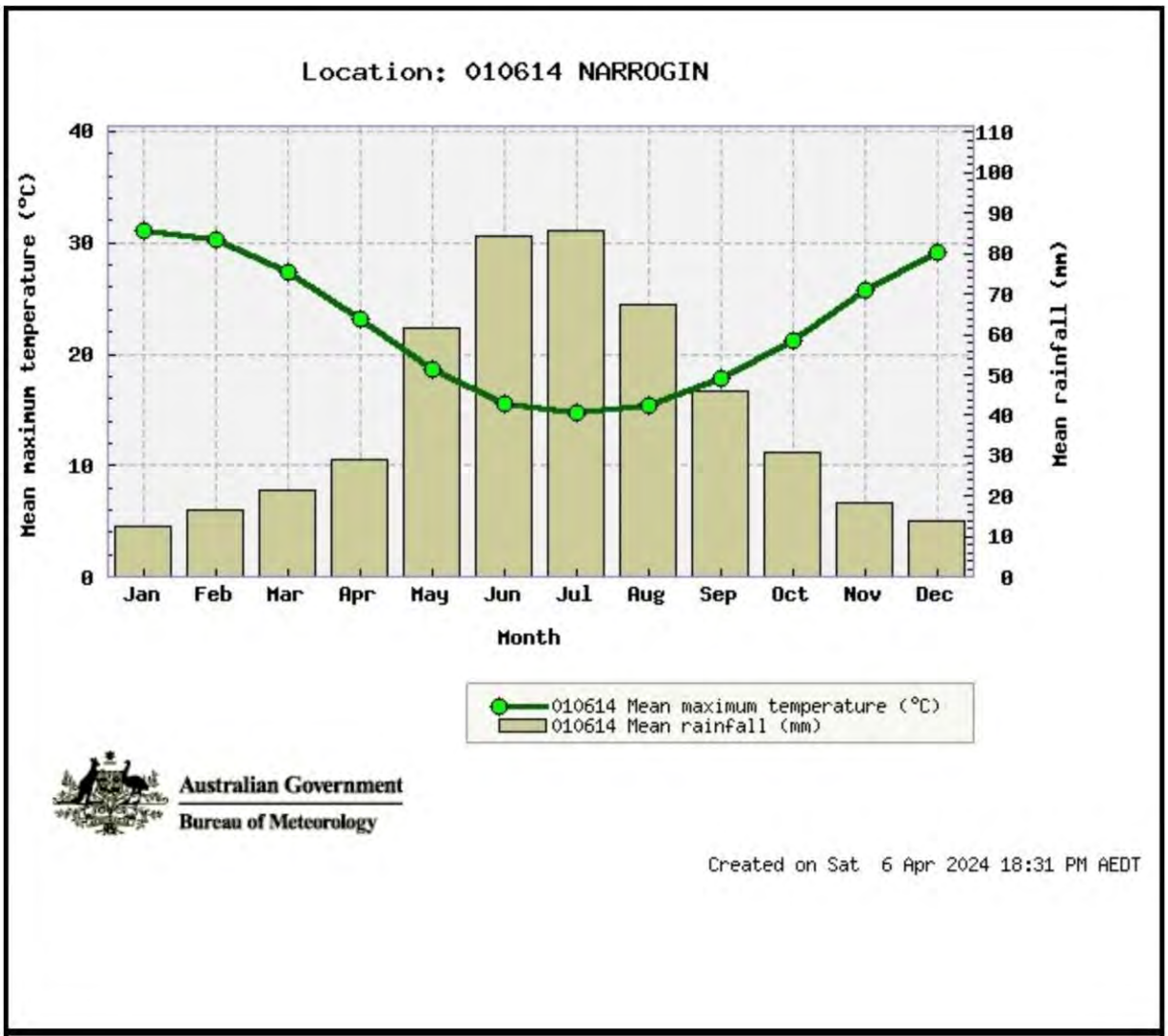


Figure 3: Weather Data

3. FLORA AND VEGETATION ASSESSMENT

3.1 VEGETATION METHODS

A Detailed Flora and Vegetation Survey was undertaken on the 20th and 26th November 2023. The site was surveyed for flora species including, Threatened Flora (T), Priority Flora (PF), potential areas of Threatened Ecological Communities (TEC's) and vegetation condition. Each variation or difference in vegetation was recorded with three 10 metre by 10 metre quadrats. Data was recorded to statistically determine vegetation communities and condition. In total, nine quadrats were assembled to record each vegetation community. Each quadrat recorded flora species, heights, percentage cover and percentage dead and alive. Quadrats were not assembled permanently; quadrat data is available in **Appendix B.**

The survey methodology was undertaken in accordance with EPA Position Statement No.3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* and EPA Guidance Statement No. 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia.*

All plant specimens collected during the field survey were dried, pressed and then sorted in accordance with the requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys.

The use of standard data collection forms ensured the data was collected in a systematic and consistent manner. At each quadrat the following information was recorded:

- Vegetation condition;
- Vegetation community;
- Flora species;
- Local disturbances;
- Topography;
- Soils; and
- Age since fire.

The vegetation communities occurring on this site were described in detail. Aerial photography was used to extrapolate and map plant communities in combination with running notes made during the course of the survey.

3.2 DECLARED RARE AND PRIORITY FLORA

Species of flora acquire “Threatened” “Presumed Extinct” or “Priority” conservation status where populations are restricted geographically or threatened by local processes.

The Department of Biodiversity, Conservation and Attractions (DBCA) recognise these threats and subsequently applies regulations towards population protection and species conservation. The DBCA enforces regulations under the *Biodiversity Conservation Act 2016* to conserve Threatened species and protect significant populations. Priority Flora species are potentially rare or threatened and are classified in order of threat. Threatened and Priority Flora category definitions are listed in **Table 1**.

The likelihood of each flora species and vegetation community occurring onsite is determined by background research on the known soil types and vegetation communities. This information together with botanical knowledge provides an informative result on whether the flora species is likely to occur on the site.

Table 1: Definition of Threatened and Priority Flora Species (DEC 2012)

Conservation Code	Category
T	**Threatened Flora (Declared Rare Flora – Extant)**. Schedule 1 under the Wildlife Conservation Act 1950 Rare Flora Notice Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such. **Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:** **CR**: Critically Endangered - considered to be facing an extremely high risk of extinction in the wild. **EN**: Endangered –considered to be facing a very high risk of extinction in the wild. **VU**: Vulnerable - considered to be facing a high risk of extinction in the wild
X	**Presumed Extinct Flora (Declared Rare Flora – Extinct)** Schedule 2 under the Wildlife Conservation Act 1950 Rare Flora Notice Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.
P1	**Priority One: Poorly known species** Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes
P2	**Priority Two: Poorly-known species** Species that are known from one or a few collections or sight records, some of which are on land not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State Forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	**Priority Three: Poorly known species** Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	**Priority Four: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	**Priority Five: Conservation Dependent species** Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years

A search of the Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap database identified twenty-three species of significance likely to occur within a 10km radius of the area. These species are listed in **Table 2** below.

Table 2: NatureMap listed species.

Species Name	Conservation Status	Likely to occur onsite	Survey undertaken in flowering time
Acacia brachyphylla var. *recurvata*	P3	Yes	No
Acacia lanei	P3	Yes	No
Andersonia bifida	P2	Yes	Yes
Andersonia carinata	P2	No	No
Anthotium odontophyllum	P3	Yes	Yes
Babingtonia maleyae	P2	Yes	Unknown
Banksia porrecta	P4	No	No
Caladenia x triangularis	P4	Unknown	Unknown
Darwinia carnea	CR	Yes	Yes
Gastrolobium ovalifolium	P4	Yes	No
Gastrolobium rotundifolium	P3	Yes	No
Gastrolobium stipulare	P4	Yes	No
Gastrolobium tomentosum	P4	Yes	Yes
Lasiopetalum rotundifolium	EN	Yes	Unknown
Leucopogon darlingensis subsp. *rectus*	P2	Unknown	Unknown
Lysiosepalum aromaticum	P2	Yes	Yes
Pultenaea pauciflora	VU	Yes	Yes
Stylidium expeditionis	P4	Yes	Yes
Stylidium tylosum	P2	Yes	Yes
Synaphea platyphylla	P3	No	No
Verticordia fimbrilepis subsp. *fimbrilepis*	VU	Yes	Yes
Verticordia huegelii var. *tridens*	P3	Yes	Yes
Xanthorrhoea brevistyla	P4	Yes	Yes

3.2.1 Environment Protection and Biodiversity Conservation Act (1999) – Species level significance

The *Environment Protection and Biodiversity Conservation* (EPBC) *Act*, 1999, promotes the conservation of biodiversity by providing strong protection for plants at a species level. Section 178 and 179 provides the lists and categories of threatened species under the Act and is presented in **Table 3** below.

Table 3: Categories of Threatened Species (EPBC Act, Section 179, 1999)

1	**Extinct** A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
2	**Extinct in the Wild** A native species is eligible to be included in the **extinct in the wild** category at a particular time if, at that time:(a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
3	**Critically Endangered** A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
4	**Endangered** A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
5	**Vulnerable** A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
6	**Conservation Dependant** A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

A search using the Department of Climate Change, Energy, the Environmental and Water (DCCEEW) Protected Matters Tool was undertaken within a 10km radius of the site. The search result noted twelve flora species of significance likely to occur in the area. Nine flora species have been listed as Endangered; and three species are listed as Vulnerable. These species are listed in **Table 4** below.

Table 4: DCCEEW Protected Matters listed flora species.

Species Name	Conservation Code	Likely to occur onsite	Survey undertaken in flowering time
Acacia insolita subsp. *recurva*	Endangered	Unknown	Unknown
Andersonia gracilis	Endangered	No	No
Banksia oligantha	Endangered	No	No
Boronia capitata subsp. *capitata*	Endangered	No	Yes
Caladenia dorrienii	Endangered	Yes	Yes
Calectasia pignattiana	Vulnerable	Yes	No
Darwinia carnea	Endangered	Yes	Yes
Daviesia euphorbioides	Endangered	No	No
Diuris micrantha	Vulnerable	Yes	No
Pultenaea pauciflora	Vulnerable	Yes	Yes
Roycea pycnophylloides	Endangered	Yes	No
Verticordia fimbrilepis subsp. *fimbrilepis*	Endangered	Yes	Yes

3.2.2 Department of Biodiversity, Conservation and Attractions (DBCA) Database Search

In addition to the background searches undertaken through the DBCA NatureMap and the DCCEEW Protected Matters searches, a Threatened and Priority Flora search was undertaken through the DBCA. The search is undertaken on records from the Threatened and Priority Flora Database (TPFL) and the WA Herbarium database (WAHerb), which provides known locations of each species. The results are provided below in **Table 5**. The search was conducted within a 10km radial area from the central coordinate. No species listed were recorded during the survey.

Table 5: DBCA Threatened and Priority Flora Search Results

Taxon	Conservation Status DBCA	EPBC	Likely to occur onsite	Survey undertaken in flowering time
Acacia brachyphylla var. *recurvata*	3		Yes	No
Acacia cuneifolia	4		Yes	No
Acacia deflexa	3		Yes	No
Acacia insolita subsp. *recurva*	T	CR	Unknown	Unknown
Acacia kingiana	X		Yes	No
Acacia lanei	3		Yes	No
Andersonia bifida	2		Yes	Yes
Andersonia carinata	2		No	No
Anthotium odontophyllum	3		Yes	Yes
Asterolasia hyalina	2		Unknown	Unknown
Babingtonia maleyae	2		Yes	Unknown
Banksia acuminata	4		Yes	Unknown
Banksia cynaroides	4		Yes	Yes
Banksia fasciculata	3		No	No
Banksia meganotia	3		Yes	No
Banksia oligantha	T	EN	No	No
Banksia porrecta	4		No	No

Banksia rufa subsp. *obliquiloba*	3		Yes	No
Banksia rufistylis	2		No	No
Banksia subpinnatifida var. *subpinnatifida*	2		No	No
Caladenia caesarea subsp. *transiens*	1		No	No
Caladenia integra	4		Yes	No
Caladenia x triangularis	4		Unknown	Unknown
Calectasia pignattiana	T	EN	Yes	No
Conostylis drummondii	T	EN	Yes	Yes
Darwinia carnea	T	CR	Yes	Yes
Darwinia sp. Dryandra (G.J. Keighery 9295)	4		Yes	Yes
Daviesia uncinata	3		Yes	No
Dicrastylis reticulata	3		Yes	Yes
Eucalyptus loxophleba x wandoo	4		Yes	Unknown
Frankenia drummondii	3		No	No
Gastrolobium ovalifolium	4		Yes	No
Gastrolobium rotundifolium	3		Yes	No
Gastrolobium stipulare	4		Yes	No
Gastrolobium tomentosum	4		Yes	Yes
Hibbertia priceana	T	EN	Yes	No
Lasiopetalum rotundifolium	T	EN	Yes	Unknown
Leucopogon darlingensis subsp. *rectus*	2		Unknown	Unknown
Leucopogon florulentus	3		Yes	Yes
Lysiosepalum aromaticum	2		Yes	Yes
Persoonia hakeiformis	2		Yes	Yes
Pterostylis echinulata	3		Unknown	Unknown
Pultenaea indira subsp. *pudoides*	2		Yes	Unknown
Pultenaea pauciflora	T	VU	Yes	Yes
Stylidium exappendiculatum	3		Unknown	Unknown
Stylidium expeditionis	4		Yes	Yes
Stylidium rhipidium	3		Yes	Yes
Stylidium squamellosum	2		Yes	Yes
Stylidium tenuicarpum	4		Yes	Yes
Stylidium tylosum	2		Yes	Yes
Styphelia papillosa	3		Unknown	Unknown
Synaphea brachyceras	3		Yes	No
Synaphea platyphylla	3		No	No
Tetratheca retrorsa	3		Yes	No
Thysanotus cymosus	3		Yes	No
Thysanotus tenuis	3		No	No
Trymalium monospermum	2		Yes	Unknown
Verticordia fimbrilepis subsp. *fimbrilepis*	T	VU	Yes	Yes
Verticordia huegelii var. *tridens*	3		Yes	Yes
Xanthorrhoea brevistyla	4		Yes	Yes

3.3 THREATENED ECOLOGICAL COMMUNITIES

In Western Australia Threatened Ecological Communities (TEC's) are assessed through a procedure coordinated by the DBCA and are assigned to one of the categories outlined below in **Table 6**. While they are not afforded direct statutory protection at a state level (unlike Threatened Flora under the *Biodiversity Conservation Act* 2016) their significance is acknowledged through other State environmental approval processes (i.e. Environmental Impact Assessment pursuant to Part IV of the *Environmental Protection Act* 1986). Scheduled TEC's are afforded statutory protection at a federal level pursuant to the EPBC Act. DBCA has been identifying and listing threatened ecological communities since 1994 through the non-statutory process.

The Minister for Environment previously listed ecological communities as threatened through a non-statutory process if the community was presumed to be totally destroyed or at risk of becoming totally destroyed. The *Biodiversity Conservation Act 2016* (BC Act) provides for the statutory listing of threatened ecological communities (TECs) by the Minister. The new legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

The Department has been identifying and listing TECs since 1994 through the non-statutory process. The WA Minister for Environment has endorsed 69 ecological communities as threatened in the following categories:

- 20 critically endangered
- 17 endangered
- 28 vulnerable
- 4 presumed totally destroyed.

25 of these are listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. As of January 2019, an additional 393 ecological communities (community types and sub-types) with insufficient information available to be considered a TEC, or which are rare but not currently threatened, have been placed on the Priority list and referred to as Priority Ecological Communities (PECs)**.**

Table 6: Categories of DBCA's Threatened Ecological Communities

PD	**Presumably Totally Destroyed** An ecological community that has been adequately searched for but for which no representative occurrences have been located.
CE	**Critically Endangered** An ecological community that has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
E	**Endangered** An ecological community that has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future.
V	**Vulnerable** An ecological community that has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

The EPBC Act provides for the strong protection of TEC's, which are listed under section 181 of the Act and are described as 'Critically Endangered', 'Endangered' or 'Vulnerable' under section 182. Schedules of protected TEC's maintained pursuant to the EPBC Act are based on the same Floristic Community Type's (FCT's) as adopted by DBCA, however not all TEC's listed by the DBCA are scheduled under the EPBC Act.

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Report indicated there is one known Threatened Ecological Community (TEC) likely to occur within a 5km radius of the area, the TEC is listed in **Table 7** below.

Table 7: DCCEEW listed Threatened Ecological Community

Species Name	Conservation Code	Likely to occur on site
Eucalypt Woodlands of the Western Australian Wheatbelt	Critically Endangered	Yes

3.3.1 Department of Biodiversity, Conservation and Attractions (DBCA) Database Search

In addition to the background searches undertaken through the DCCEEW Protected Matters search a Threatened Ecological Community (TEC) search was undertaken through the DBCA. The search is undertaken on records from the DBCA, which provides known locations of TEC's. The results noted one known TEC to occur within a 10km radial area from the central coordinate. This information is provided in **Table 8** below.

Table 8: DBCA listed Threatened Ecological Community

Species Name	Conservation Code	Likely to occur on site
Eucalypt woodlands of the Western Australian Wheatbelt	Priority 3 [DBCA] Critically Endangered [EPBC]	Yes

4. FLORA AND VEGETATION ASSESSMENT RESULTS

A total of 72 taxa, comprising of 20 families and 52genera were recorded on site. A list of these species has been provided in **Appendix A**. Species representation was greatest among the Poaceae, Fabaceae and Asteraceae families.

4.1 INTRODUCED SPECIES

Eighteen introduced flora species were recorded on the site, shown in **Table 9** below. This represents 25% of the total number of flora species recorded on site. No species are listed as Declared Pest species under the Biosecurity and Agriculture Management Act 2007 (BAM Act). Definitions are provided in **Appendix C.**

Table 9: Introduced Flora Recorded in the Survey Area

Taxa	Common Name	BAM Act	WoNS
**Acacia pycnantha*	Victorian Golden Wattle	Permitted - s11	
**Aira caryophyllea*	Silver haired Grass	Permitted - s11	
**Avena barbata*	Wild Oats	Permitted - s11	
**Briza maxima*	Blowfly Grass	Permitted - s11	
**Briza minor*	Shivery Grass	Permitted - s11	
**Bromus diandrus*	Great Brom	Permitted - s11	
**Chamaecytisus palmensis*	Tagasaste	Permitted - s11	
**Ehrharta longiflora*	Annual Veldt Grass	Permitted - s11	
**Ehrharta calycina*	Perennial Veldt Grass	Permitted - s11	
**Freesia leichtlinii* subsp. *alba* × *leichtlinii* subsp. *leichtlinii*	Freesia	Permitted - s11	
**Lolium perenne*	Rye Grass	Permitted - s11	
**Lolium rigidum*	Annual Rye grass	Permitted - s11	
**Medicago polymorpha*	Burr Medic	Permitted - s11	
**Orobanche* sp.		Not listed	
**Poaceae* sp.		Not listed	
**Romulea rosea*	Guildford Grass	Permitted - s11	
**Ursinia anthemoides*	Ursinia	Permitted - s11	
**Vulpia* sp.		Not listed	

4.2 THREATENED AND PRIORITY FLORA

No species of Threatened (T) or Priority Flora were recorded during the survey; No other flora, pursuant to the *Biodiversity Conservation* (BC) Act 2016 or the *Environment Protection and Biodiversity Conservation* (EPBC) Act 1999 or listed by the Department of Biodiversity, Conservation and Attractions (DBCA) were located during the time of the survey.

The botanical survey was undertaken in spring to coincide with the majority of the flowering times of the threatened species. Although the desktop assessment determined that a number of priority and threatened species are likely to occur within the environment found on the site, due to continual grazing and the degraded nature of the vegetation, it is now highly unlikely for any of these species to occur within the survey area.

4.3 THREATENED ECOLOGICAL COMMUNITIES

It is likely that the listed TEC, *Eucalypt woodlands of the Western Australian Wheatbelt,* occurs within the survey area. The soil complex within the survey area supports the eucalypt woodland community. The vegetation surveyed in Quadrats 3 and 4, recorded eucalypt woodlands in "Good" or better vegetation condition and of an appropriate size of more than 2 hectares, which meet the thresholds for this TEC. The data presented in these quadrats using the dominant vegetation stratum, also indicates that the percentage cover for native and weed species also meets the criteria for determining the presence of the TEC Eucalypt Woodlands of the Western Australian Wheatbelt.

No other Threatened Ecological Communities listed by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) or Department of Biodiversity, Conservation and Attractions (DBCA) were located during the time of the survey.

4.4 LOCAL VEGETATION COMMUNITIES

Vegetation structure recorded in each vegetation community is used to determine the coverage class as described below in **Table 10.** These vegetation structure classes are defined in the Technical Guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment* (2016).

Table 10: Vegetation Structure Classes

Life Form/ Height Class	Canopy Cover (percentage)			
	100% - 70%	70% - 30%	30% - 10%	10% - 2%
Trees 10-30m Trees < 10m	Closed Forest Low Closed Forest	Open Forest Low Open Forest	Woodland Low Woodland	Open Woodland Low Open Woodland
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2m Shrubs 1-2m Shrubs <1m	Closed Tall Scrub Closed Heath Closed Low Heath	Tall Open Scrub Open Heath Open Low Heath	Tall Shrubland Shrubland Low Shrubland	Tall Open Shrubland Open Shrubland Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland

Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

Three vegetation communities were represented on the site at a local level, which are described below in **Table 11.** Photographic representations of the vegetation community are shown in the quadrat data sheets in **Appendix B**. The vegetation communities, conditions and quadrat locations are shown on **Figures 4** & **5.**

Table 11: Local Vegetation Communities recorded within Lots 27, 28, 1195, 1976, 6349, 7207 Wanerie Rd and Lots 2921, 2922, 3014, 3015, 3017 Great Southern Highway, Dumberning, November 2023.

Community Description
Vegetation Community 1 –Marri – Wandoo Woodland
Open forest of *Corymbia calophylla* with *Eucalyptus wandoo* and occasional *Allocasuarina huegeliana* over shrubland of *Banksia sessilis* and *Hibbertia* spp over grassland of **Avena barbata*, **Ehrharta longiflora*. and **Briza maxima*
Community Description
Vegetation Community 2 –Wandoo Woodland
Open forest of *Eucalyptus wandoo* over shrubland of *Acacia acuminata* and *Mirbelia spinosa* over open grassland of *Neurachne alopecuroidea* **Ehrharta calycina*, **Lolium perenne* and **Rytidosperma* sp
Community Description
Vegetation Community 3 –Brown Mallet- Wandoo Woodland -
Open forest of *Eucalyptus astringens* and *Eucalyptus wandoo* over very open grassland of **Ehrharta calycina*, **Lolium perenne* and * *Bromus diandrus*

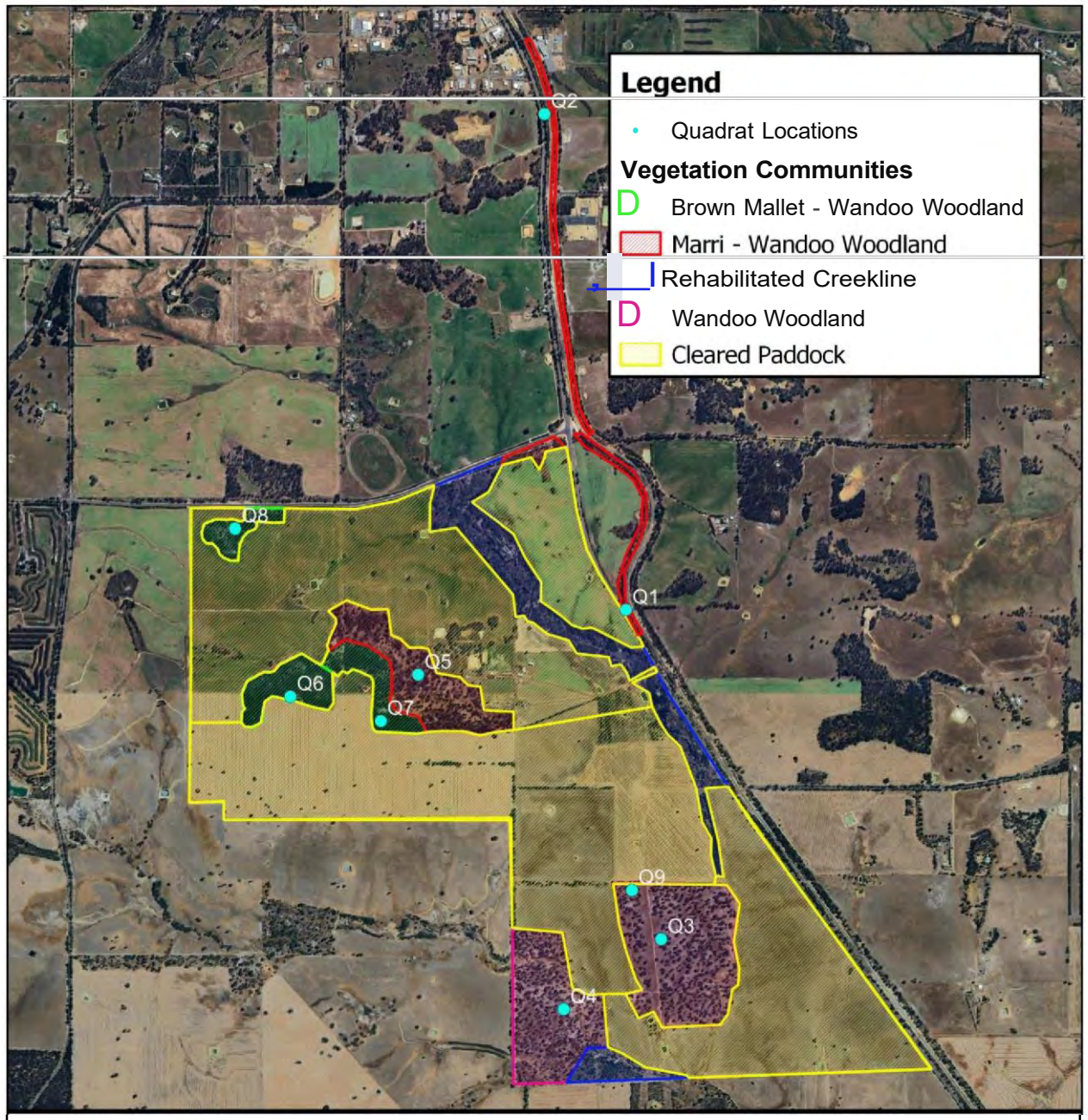


Figure 4: Vegetation Communities and Quadrat Locations

4.5 VEGETATION CONDITION

Many bushland remnants have been historically degraded and current land use activities continue degradation and fragmentation processes. As a result, these remnants are especially susceptible to disturbances arising from indirect impacts such as surrounding developments and human activity. Degradation is caused by a wide range of factors, including isolation and edge effects, weed invasion, plant diseases, changes in fire frequency and behaviour, landscape fragmentation, increased predation on native fauna by feral animals, resulting in a decrease in species richness and general modification of ecological function (Urban Bushland Council, 2018).

The site has had significant historic land disturbances, primarily for agricultural purposes. The site has been predominately cleared, resulting in isolated patches of remnant trees with weed dominated understorey. The site has also been impacted by historic fires.

The vegetation condition was rated according to the Vegetation Condition Scale used in the Technical Guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment* (2016). The definitions are described in **Table 12** below.

Table 12: Vegetation Condition Scale

Vegetation Condition	South West and Interzone Botanical Provinces	Eremaean and Northern Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds
Poor		Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition

	management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs

The vegetation condition recorded across the site was "Completely Degraded - Good". Vegetation condition mapping is provided on **Figure 5.**

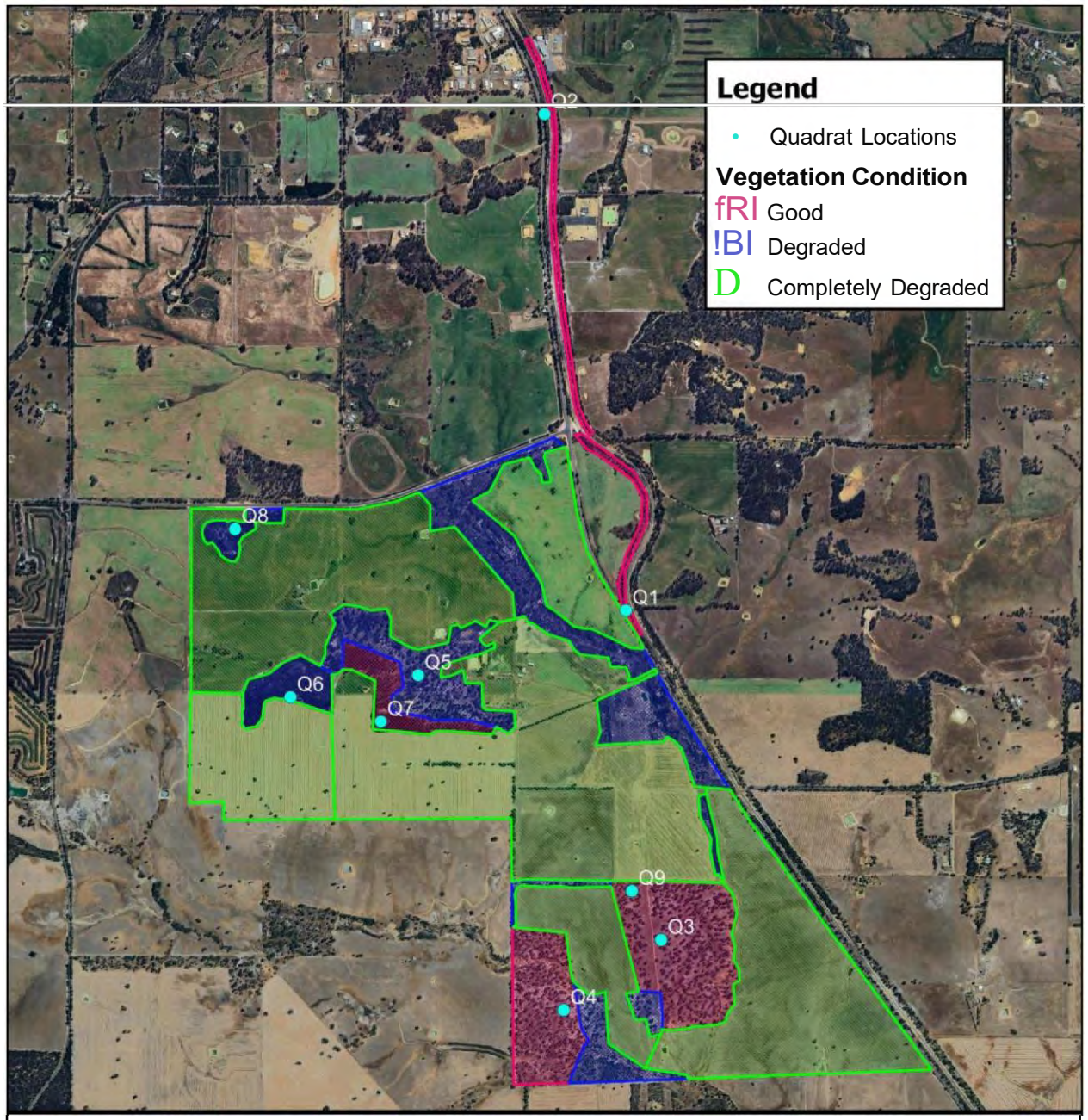


Figure 5: Vegetation Condition and Quadrat Locations

5. CONCLUSIONS AND RECOMMENDATIONS

The Detailed Flora and Vegetation survey undertaken on Lots 27, 28, 1195, 1976, 6349, 7207 Wanerie Rd and Lots 2921, 2922, 3014, 3015, 3017 Great Southern Highway, Dumberning and a length of the Great Southern Highway road reserve, approximately 3km long by 2m wide from 1976 Wanerie Rd to the Narrogin Substation, identified a total of 72 taxa representing 52 genera and 20 families. Weeds species comprised of 25% of the total flora recorded. The vegetation condition across the site is "Completely Degraded - Good".

Three vegetation communities were recorded at a local level during the survey. Vegetation consisted of Open forest of *Corymbia calophylla* with *Eucalyptus wandoo* and occasional *Allocasuarina huegeliana* over shrubland of *Banksia sessilis* over grassland of **Avena barbata, *Ehrharta longiflora*. and **Briza maxima.* Open forest of *Eucalyptus wandoo* over shrubland of *Acacia acuminata* and *Mirbelia spinosa*over open grassland of *Neurachne alopecuroidea* **Ehrharta calycina, *Lolium perenne* and **Rytidosperma* sp and open Forest of *Eucalyptus astringens* and *Eucalyptus wandoo* over very open grassland of **Ehrharta calycina, *Lolium perenne* and * *Bromus diandrus*. These communities are highly disturbed remnants of the Beard described Association 1023, consisting of medium woodland of York gum, Wandoo and Salmon gum vegetation previously existing in the area.

No species of Threatened (T), or Priority Flora pursuant to the *Biodiversity Conservation* (BC) Act 2016 or the *Environment Protection and Biodiversity Conservation* (EPBC) Act 1999 were located during the time of the survey.

One Threatened Ecological Community *Eucalypt woodlands of the Western Australian Wheatbelt*, occurs within the survey area. No other TEC's listed by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) or Department of Biodiversity, Conservation and Attractions (DBCA) were located during the time of the survey.

Based on the results of this survey, Del Botanics Environmental Consulting proposes the following recommendations:

- Undertake a Black Cockatoo Habitat Assessment;
- Where possible retain vegetation in Good or better condition; and
- Retain the Threatened Ecological Community *Eucalypt woodlands of the Western Australian Wheatbelt.*

6. REFERENCES

Beard J. S. (1990). *Plant life of Western Australia*. Kangaroo Press, Perth.

Bureau of Meteorology (2023) *Monthly climate data statistics*

DataWa (2024), Government of Western Australia.

Department of Agriculture and Food WA (2012) *Soil-landscape systems of Western Australia (GIS dataset)*. Perth, Australia.

English, V. and Blyth, J. (1997). *Identifying and conserving Threatened Ecological Communities in the South West Botanical Province*. ANCA National Reserves System Cooperative Program, Project Number N702.

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (s 266B) Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community, DEE, Perth.

Environmental Protection Authority (2001a). Position Statement No. 2. *Environmental Protection of Native Vegetation in Western Australia*. EPA, Perth.

Environmental Protection Authority (2001b). Position Statement No. 3. *Terrestrial biological surveys as an element of biodiversity protection*. EPA, Perth.

Environmental Protection Authority (2003a). Guidance statement No. 10. *Guidance for the Assessment of Environmental Factors – Level of assessment for proposals affecting natural areas within the System 6 Region and Swan Coastal Plain portion of the System 1 Region*. EPA, Perth.

Environmental Protection Authority (2003b). Guidance statement No. 51. *Guidance for the Assessment of Environmental Factors –Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia*. EPA, Perth.

Urban Bushland Council WA Inc. (2018) Threats to Bushland

Western Australian Herbarium (2023). *FloraBase - The Western Australian Flora*. Department of Biodiversity, Conservation and Attractions

APPENDIX A
VASCULAR PLANT SPECIES RECORDED

APPENDIX A:
VASCULAR PLANT SPECIES RECORDED AT NARROGIN SOLAR FARM 2023
*(*Denotes a weed species)*

Family	**Genus/Species**
Amaranthaceae	*Ptilotus manglesii*
	Ptilotus drummondii
	Ptilotus ? polystachyus
Asparagaceae	*Dichopogon fimbriatus*
	Lomandra sp.
	Lomandra micrantha
	Lomandra effuse
	Thysanotus patersonii
Asteraceae	**Ursinia anthemoides*
	Asteraceae sp.
	Erymophyllum tenellum
	Lagenophora huegelii
	Panaetia lessonii
	Lawrencella rosea
Casuarinaceae	*Allocasuarina huegeliana*
	Casuarina glauca
Crassulaceae	*Crassula* sp.
Cyperaceae	*Lepidosperma leptostachyum*
	Morelotia octandra
Dilleniaceae	*Hibbertia* sp.
Droseraceae	*Drosera menziesii*
Fabaceae	**Acacia pycnantha*
	**Chamaecytisus palmensis*
	**Medicago polymorpha*
	Acacia acuminata
	Bossiaea eriocarpa
	Bossiaea ornata
	Gastrolobium obovatum
	Jacksonia sternbergiana
	Kennedia prostrata
	Mirbelia spinosa
Goodeniaceae	*? Dampiera* sp
	Lechenaultia ? biloba
Hemerocallidaceae	*Dianella revoluta*
	Tricoryne elatior
Iridaceae	**Freesia leichtlinii* subsp. *alba* × *leichtlinii* subsp. *leichtlinii*
	**Romulea rosea*
Myrtaceae	*Corymbia calophylla*
	Eucalyptus astringens
	Eucalyptus wandoo
	Melaleuca viminea
	Melaleucas hamulosa
Orobanchaceae	**Orobanche* sp.
Pittosporaceae	*Billardiera heterophylla*
	Billardiera venusta
Poaceae	**Aira caryophyllea*

	**Avena barbata*
	**Briza maxima*
	**Briza minor*
	**Bromus diandrus*
	**Ehrharta calycina*
	**Ehrharta longiflora*
	**Lolium perenne*
	**Lolium rigidum*
	**Poaceae* sp.
	**Vulpia* sp.
	Amphipogon turbinatus
	Austrostipa elegantissima
	Austrostipa hemipogon
	Austrostipa ? mollis
	Austrostipa sp.
	Austrostipa scabra
	Austrostipa tenuifolia
	Chloris truncata
	Neurachne alopecuroidea
	Rytidosperma sp.
Proteaceae	*Banksia sessilis*
	Hakea prostrata
Restionaceae	*Desmocladus flexuosus*
Rhamnaceae	*Cryptandra arbutiflora*
Rubiaceae	*Opercularia vaginata*
	?Opercularia sp

APPENDIX B
QUADRAT DATA

Del Botanics

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Q1	**Date:** 20/11/2023	**Site:** Narrogin Solar Farm
GPS Datum: 50 518345.18 6350925.11	**Topography:** Mid slope	**Litter cover:** 30 % twigs, 80 % leaves 10% logs
Age since fire: >10 yrs	**Disturbance:** Hi **Med** Lo	**Soils:** Brown/Orange/Silty/Clay
Vegetation Description: *Eucalyptus Wandoo – Allocasuarina huegeliana* Woodland		
Vegetation Condition: Good		
Observations: Road Verge		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
Top	*Eucalyptus wandoo*	3000	100		65
	Allocasuarina huegeliana	400	100		1.5
	Banksia sessilis	300		100	1
Middle					
Bottom	*Billardiera venusta*	T	100		45
	**Avena barbata*	100		100	7
	**Briza maxima*	20		100	2
Sp2	*Lawrencella rosea*				
	Lomandra micrantha				
Sp4	*Austrostipa tenuifolia*				
	**Ehrharta longiflora*				
	Austrostipa hemipogon				
	Billardiera heterophylla				
	**Ursinia anthemoides*				
	**Lolium rigidum*				

	Chloris truncata				
	Austrostipa elegantissima				
	**Romulea rosea*				
Sp3	*Lomandra micrantha*				
	Bossiaea ornata				
Opp	*Neurachne alopecuroidea*				
Opp	*Ptilotus manglesii*				
Opp	*Jacksonia sternbergiana*				

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FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Q2	**Date:** 20/11/2023	**Site:** Narrogin Solar Farm
GPS Datum: 50 517882.42 6353538.39	**Topography:** Mid slope	**Litter cover:** 40 % twigs, 90 % leaves 10% logs
Age since fire: >10 yrs	**Disturbance: Hi** Med Lo	**Soils:** Peaty brown
Vegetation Description: Marri - Wandoo		
Vegetation Condition: Good - Degraded		
Observations: Road Verge		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
Top	*Corymbia calophylla*	3000	90	10	50
	Eucalyptus wandoo	2000	100		25
Middle	*Banksia sessilis*	400	80	20	30
	**Acacia pycnantha*	300	20	80	6
Bottom	*Lepidosperma leptostachyum*	40	100		5
	**Freesia leichtlinii* subsp. *alba* × *leichtlinii* subsp. *leichtlinii*	20		100	5
	**Ehrharta longiflora*	40		100	3
	Dianella revoluta				
	Desmocladus flexuosus				
	Bossiaea eriocarpa				
	Neurachne alopecuroidea				
	? Dampiera sp				
	Morelotia octandra				
	**Romulea rosea*				

	**Avena barbata*				
	Lechenaultia?biloba				
	**Briza maxima*				
	Ehrharta calycina				
Opp	*Gastrolobium obovatum*				
	**Chamaecytisus palmensis*				
	Hakea prostrata				
Sp5	*?Opercularia*				
Sp6	*Lomandra micrantha*				

Del Botanics

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Q3	**Date:** 20/11/2023	**Site:** Narrogin Solar Farm
GPS Datum: 50 518517.03 6349174.61	**Topography:** Mid slope	**Litter cover:** 10 % twigs, 40 % leaves 10% logs
Age since fire: >10 yrs	**Disturbance:** Hi **Med** Lo	**Soils:** Brown Silt
Vegetation Description: Wandoo Woodland		
Vegetation Condition: Good		
Observations: Open Woodland, high number of habitat trees, possible TEC Wheatbelt Woodlands		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
Top	*Eucalyptus wandoo*	3000	90	10	80
Middle	*Acacia acuminata*	200	100	8	0.5
Bottom	*Neurachne alopecuroidea*	40	100		5
Sp7	*Rytidosperma* sp.	40		100	2
	**Lolium perenne*	30		100	2.5
	Austrostipa elegantissima				
	**Ursinia anthemoides*				
	**Bromus diandrus*				
	**Aira caryophyllea*				
	Ptilotus manglesii				
	Panaetia lessonii				
	**Romulea rosea*				
Opp	*Dichopogon fimbriatus*				

Sp8	*Ptilotus drummondii*				
	Poaceae sp				
Sp9	*Austrostipa* sp.				
	Lomandra sp				
	**Ehrharta longiflora*				
	**Briza minor*				
	**Avena barbata*				
	Lagenophora huegelii				
	Kennedia prostrata				
	Asteraceae sp				
Sp11	*Amphipogon turbinatus*				
Sp12	*Austrostipa ?scabra*				

Del Botanics

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Q4	**Date:** 20/11/2023	**Site:** Narrogin Solar Farm
GPS Datum: 50 517998.79 6348827.20	**Topography: Mid slope**	**Litter cover:** 30 % twigs, 75 % leaves 10% logs
Age since fire: >10 yrs	**Disturbance:** Hi **Med** Lo	**Soils:** Peaty Brown
Vegetation Description: Wandoo Woodland		
Vegetation Condition: Good		
Observations: Good Habitat Trees, Possibly TEC		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
Top	*Eucalyptus wandoo*	3000	100		70
Middle					
Bottom	*Rytidosperma* sp.	40	100		1.5
	Neurachne alopecuroidea	40	100		7
	Lomandra micrantha	50	100		1.5
	Lagenophora huegelii				
	**Ursinia anthemoides*				
	**Romulea rosea*				
	Tricoryne elatior				
	Opercularia vaginata				
	Austrostipa elegantissima				
	**Lolium perenne*				
	Vulpia sp				
	Desmocladus flexuosus				
	Asteraceae sp				

SP9	*Austrostipa* sp.				
	Amphipogon turbinatus				
	Thysanotus patersonii				
	Dichopogon fimbriatus				

Del Botanics

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Q5	**Date:** 26/11/2023	**Site:** Narrogin Solar Farm
GPS Datum: 50 517230.73 6350591.45	**Topography:** Mid slope	**Litter cover:** 10 % twigs, 85 % leaves 0% logs
Age since fire: >10 yrs	**Disturbance: Hi** Med Lo	**Soils:** Brown Loam
Vegetation Description: Marri-Wandoo Woodland		
Vegetation Condition: Degraded		
Observations: Limited understorey		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
Top	*Corymbia calophylla*	2000	100		50
	Eucalyptus wandoo	2000	100		30
Middle					
Bottom	*Rytidosperma* sp.	50	100		2
	Hibbertia sp.	30	100		2
	Drosera menziesii				
	**Aira caryophyllea*				
	Neurachne alopecuroidea				
	Lomandra sp				
	Morelotia octandra				
	**Romulea rosea*				
	Austrostipa elegantissima				
	Dichopogon fimbriatus				
	Dianella revoluta				
Opp	*Crassula* sp.				

Opp	*Bossiaea ornata*				
Sp20	*Ptilotus ? polystachyus*				
Sp21	*Eremophyllum tenellum*				
Sp22	*Cryptandra arbutiflora*				
Sp23	*Austrostipa ? mollis*				

Del Botanics

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Q6	**Date:** 26/11/2023	**Site:** Narrogin Solar Farm
GPS Datum: 50 516554.06 6350475.06	**Topography:** Upper slope	**Litter cover:** 30 % twigs, 95 % leaves 10% logs
Age since fire: >10 yrs	**Disturbance: Hi** Med Lo	**Soils:** Brown Loam
Vegetation Description: Brown Mallet -Wandoo Woodland		
Vegetation Condition: Degraded		
Observations:		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
Top	*Eucalyptus wandoo*	2000	100		60
	Eucalyptus astringens	100	100		10
Middle					
Bottom	**Ehrharta longiflora*	30		100	15
	**Lolium perenne*				
	**Aira caryophyllea*				
Sp20	*Ptilotus ? polystachyus*				

Del Botanics

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Q7	**Date:** 26/11/2023	**Site:** Narrogin Solar Farm
GPS Datum: 50 517302.06 6350346.44	**Topography:** Upper Slope	**Litter cover:** 30 % twigs, 85 % leaves 30% logs
Age since fire: >10 yrs	**Disturbance: Hi** Med Lo	**Soils:** Brown Loam
Vegetation Description: Brown Mallet-Wandoo Woodland		
Vegetation Condition: Degraded		
Observations: Fire 40 years ago, increase in juvenile trees, limited understorey		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
Top	*Eucalyptus astringens*	1500	100		30
	Eucalyptus wandoo	1500	100		40
Middle					
Bottom	*Ptilotus ? polystachyus*	16		100	0.5
	**Bromus diandrus*	30		100	1
	**Aira caryophyllea*	15		100	1.5
	**Avena barbata*				
	**Lolium perenne*				

Del Botanics

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Q8	**Date:** 26/11/2023	**Site:** Narrogin Solar Farm
GPS Datum: 50 516260.09 6351366.20	**Topography:** Upper slope	**Litter cover:** 10 % twigs, 75 % leaves 5% logs
Age since fire: >10 yrs	**Disturbance: Hi** Med Lo	**Soils:** Brown Loam
Vegetation Description: Brown Mallet-Wandoo Woodland		
Vegetation Condition: Degraded		
Observations: Fire 40 years ago, increase in juvenile trees, limited understorey		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
Top	*Eucalyptus wandoo*	1500	100		30
	Eucalyptus astringens	1500	100		15
Middle					
Bottom	**Ehrharta longiflora*	15		100	2
	**Lolium perenne*				
	**Aira caryophyllea*				

Del Botanics

FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Q9	**Date:** 26/11/2023	**Site:** Narrogin Solar Farm
GPS Datum: 50 518361.65 6349448.28	**Topography:** Lower Slope	**Litter cover:** 10 % twigs, 65 % leaves 10% logs
Age since fire: >10 yrs	**Disturbance: Hi** Med Lo	**Soils:** Brown Loam
Vegetation Description: Wandoo Woodland		
Vegetation Condition: Degraded - Good		
Observations: Historic Logging		



Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
Upper	*Eucalyptus wandoo*	2000	100		35
Middle	*Mirbelia spinosa*	60	100		4
Bottom	**Ehrharta longiflora*	40		100	20
	Rytidosperma sp.	60	100		2
	**Bromus diandrus*	30		100	2
	Austrostipa elegantissima				
	Lomandra sp.				
	**Ursinia anthemoides*				
	Orobanche sp.				
Opp	*Dianella revoluta*				
	**Romulea rosea*				
	Vulpia sp.				
	**Lolium perenne*				
	**Medicago polymorpha*				
	**Avena barbata*				

	Neurachne alopecuroidea				
Sp20	*Ptilotus ? polystachyus*				

APPENDIX C

BAM ACT DEFINITIONS

BAM Act Definitions

Legal status

Each listed organism is declared under the Biosecurity Management act with certain legal requirements:

Declared Pest, Prohibited - s12

Prohibited organisms are declared pests by virtue of section 22(1), and may only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.

Permitted - s11

Permitted organisms must satisfy any applicable import requirements when imported. They may be subject to an import permit if they are potential carriers of high-risk organisms.

Declared Pest - s22(2)

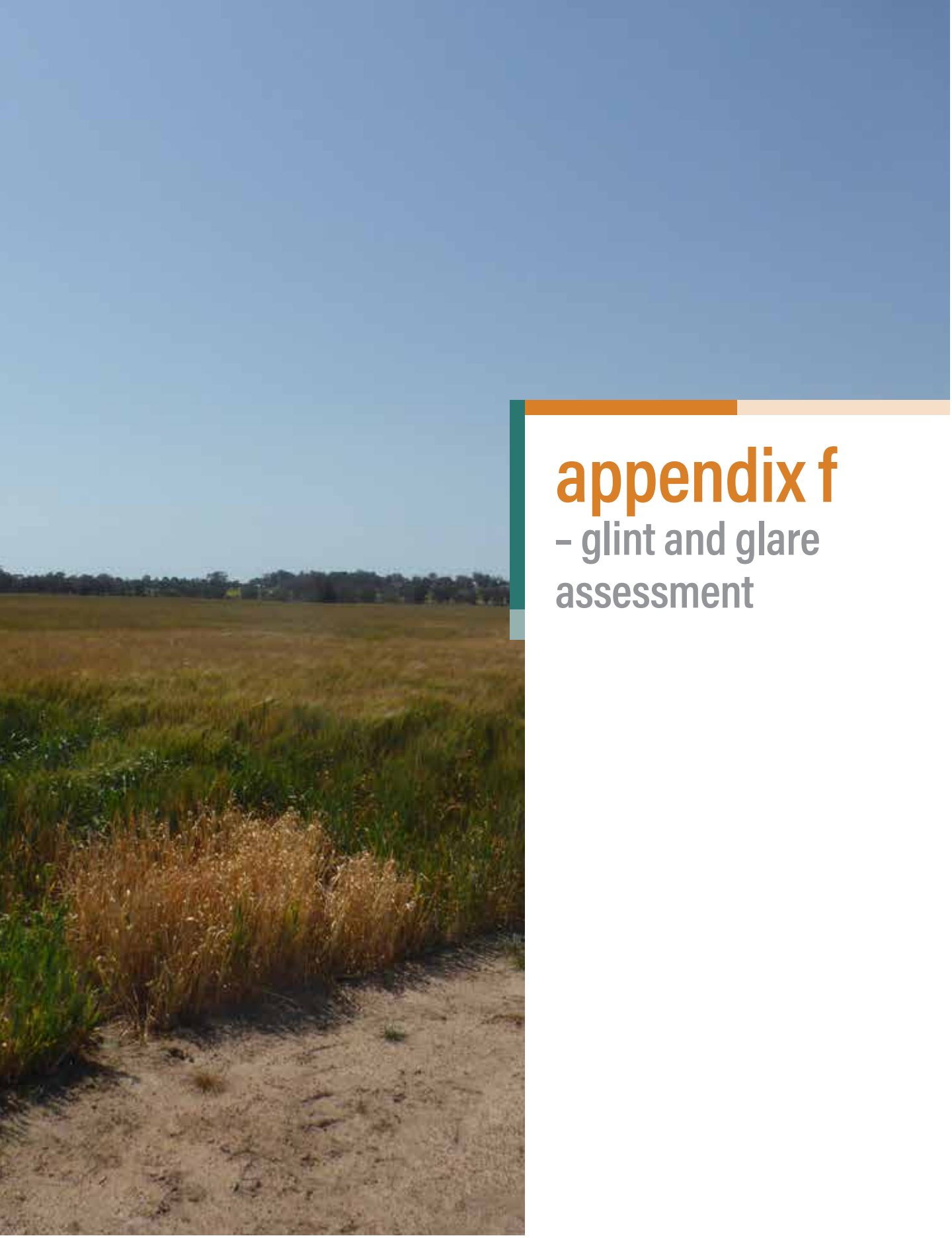
Declared pests must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia.

Permitted, Requires Permit - r73

Regulation 73 permitted organisms may only be imported subject to an import permit. These organisms may be subject to restriction under legislation other than the *Biosecurity and Agriculture Management Act 2007*. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.

Unlisted - s14

If you are considering importing an unlisted organism/s you will need to submit the name/s for assessment, as unlisted organisms are automatically prohibited entry



appendix f

– glint and glare assessment

Narrogin Solar and BESS Project

Glint and Glare Assessment

Land Insights

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Mt Lawley WA 6929

Prepared by:

SLR Consulting Australia

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North Sydney NSW 2060, Australia

SLR Project No.: 610.031585

11 November 2024

Revision: R01-v1.2

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
R01-v1.2	11 November 2024	Prameena Karunairaj	Neihad Al-Khalidy	Neihad Al-Khalidy
R01-v1.1	18 December 2023	Peter Hayman	Peter Georgiou	Peter Georgiou
R01-v1.1	5 December 2023	Peter Hayman	Peter Georgiou	Peter Georgiou
	Click to enter a date.			
	Click to enter a date.			

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Land Insights (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

Executive Summary

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Narrogin Solar Pty Ltd to carry out a Reflective Glare assessment of the proposed 200MW Narrogin Solar Farm and BESS, herein the "Project".

The Project, located 3.5 km south of the outskirts of Narrogin, running along the western side of the Great Southern Highway. Wanerie Road runs along the northern perimeter of the Project site.

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility.
- Night-time Illumination glare from 24/7 operational security lighting within the facility (if such lighting is required).

The analysis of potential glare from the proposed solar facility has yielded the following outcomes:

Aviation Glare

- NONE of the working runways at Narrogin Aerodrome will receive glare from the proposed solar facility. This is primarily because of
  - the distance separation of the runways relative to the Project, and
  - the orientation of flight landing paths.

Surrounding Residential Receivers

- NO surrounding residential receivers will receive ANY reflections from the proposed solar facility. This is primarily because of:

  Either …

  - the distance separation of the receivers relative to the Project;

  Or …

  - the extensive existing vegetation close to many of the surrounding residences.

Surrounding Road and Rail Traffic

- When existing vegetation surrounding the site is taken into account, there will be no glare on Contine Road, Link Road, Mellons Road, Narrakine Road South, the N-K-W Rail Line and Wanerie Road.
- There is potential for glare along Parks Road and the Great Southern Highway.
- Two mitigation options are available to completely eliminate the above-mentioned remaining glare potential:
  - Vegetation Screening – refer **Figure 20**.

  OR

  - Back-Tracking Rest Angle Modification to PV Array 1 (limit the AFTERNOON Rest Angle to 5°) and PV Array 11 (limit the MORNING Rest Angle to 5°)
- The two mitigation options are summarised in **Table 4**:

Night-Time Illumination Glare

It is understood that there will be no perimeter lighting for the Project, but potentially some security lighting. If night-time lighting is ultimately incorporated into the Project, the potential for any future nuisance glare should be NIL assuming:

- the general light spill minimisation design principles found in AS/NZS 4282-2023 are followed; and
- a goal of limiting light spill to no more than 1 lux falling on the nearby residential facades during night-time curfew hours is adopted.

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Appendices

Appendix A Residential Receiver Coordinates

Acronyms and Abbreviations

PV Panel	Photovoltaic (PV) panels are designed to absorb solar energy and retain as much of the solar spectrum as possible in order to produce electricity.
Glare	Glare refers to the reflections of the sun off any reflective surface, experienced as a source of excessive brightness relative to the surrounding diffused lighting. Glare covers reflections: . Which can be experienced by both stationary and moving observers (the latter referred to as "glint"). . Which are either specular or diffuse.
Specular	A reflection which is essentially mirror-like – there is virtually no loss of intensity or angle dispersion between the incoming solar ray and outgoing reflection.  Specular Reflection
Diffuse	A reflection in which the outgoing reflected rays are dispersed over a wide ("diffuse") range of angle compared to the incoming (parallel) solar rays, typical of "rougher" surfaces.  Diffuse Reflection
KVP	Key View Points (KVPs) are offsite locations where receivers of interest have the potential to experience adverse reflective glare.
Glare **AS/NZ 1158.2:2020**	Condition of vision in which there is a discomfort or a reduction in the ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrast in the field of vision. Glare can include: (a) Disability Glare – glare that impairs the visibility of objects without necessarily causing discomfort. (b) Discomfort Glare – glare that causes discomfort without necessarily impairing the visibility of objects.
Threshold Increment (TI) **AS/NZ 4282:2023**	TI is the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Higher TI values correspond to greater disability glare.

1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Narrogin Solar Farm Pty Ltd to carry out a Reflective Glare assessment of the proposed Narrogin Solar and Battery Hybrid Project, herein the "Project".

The Project, located 3.5 km south of the outskirts of Narrogin, running along the western side of the Great Southern Highway. Wanerie Road runs along the northern perimeter of the Project site.

The Project will comprise:

- A number of blocks ("sub-arrays") of panels following the various natural and man-made breaks throughout the site, split into northern and southern sections and mounted on a single-axis tracking support system.
- BESS (Battery Energy Storage System) units, inverters, cabling, and a project substation.

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility.
- Night-time Illumination glare from 24/7 operational security lighting within the facility (if such lighting is required).

1.1 Structure of Report

The remainder of this report is structured as follows:

- Section 2 describes the Project and surrounding environment.
- Section 3 outlines the requirements of the impact assessment.
- Section 4 provides background information regarding the calculation of reflectivity and glare.
- Section 5 presents the analysis, results and mitigations (if required) covering Aviation Glare, Road Traffic Disability Glare and Residential Nuisance Glare.
- Section 6 presents a qualitative analysis covering night-time illumination glare.

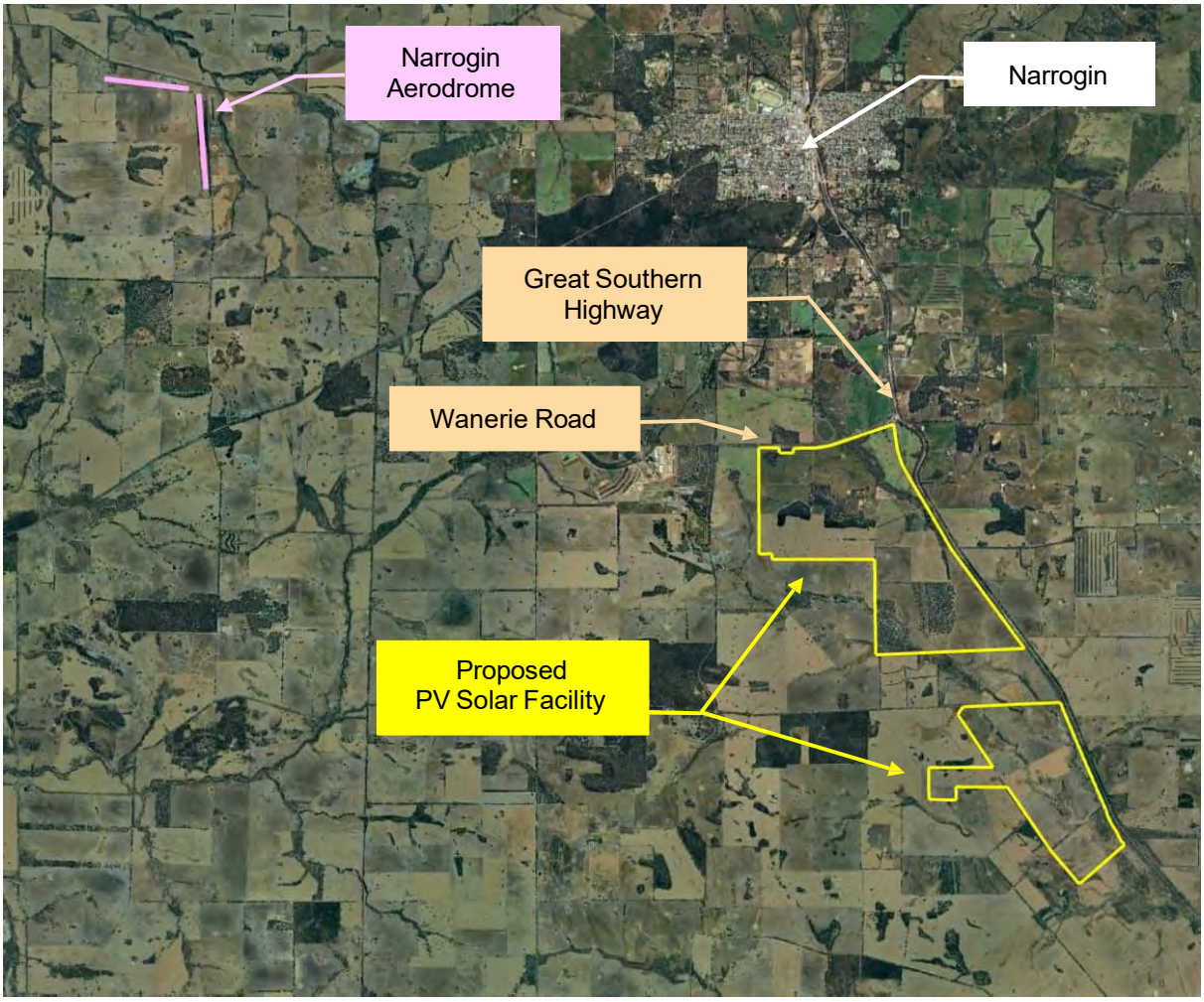
2.0 Proposed Narrogin Solar Facility

2.1 Site Location

The Project is seeking development approval for a 200 MW solar facility located 3.5 km south of the outskirts of Narrogin and running along the western side of the Great Southern Highway - refer location map shown in **Figure 1**. Wanerie Road runs along the northern perimeter of the Project site.

In terms of the relative heights of the solar facility and surrounds, ground elevations are gently undulating, with a general fall in elevation from north to south and west to east.

Figure 1 Narrogin Solar Facility – Location Map



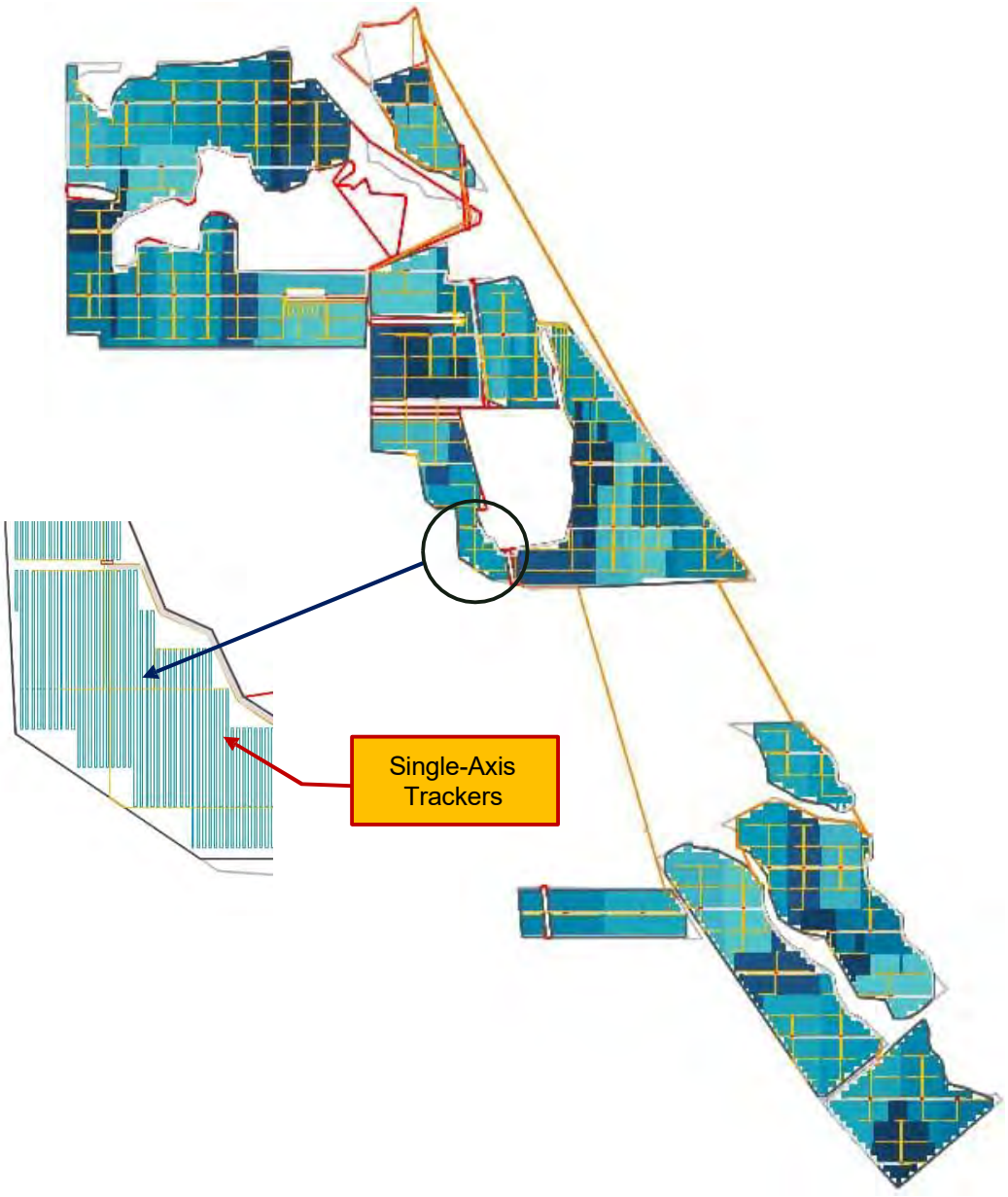
2.2 Site Description and Key Project Components

From a Reflective Glare point of view, the key components of the Project are:

- The photovoltaic (PV) modules in relation to their daytime reflective glare potential; and
- The facility's security/emergency lighting design in relation to potential night-time illumination glare issues, if such 24/7 lighting is incorporated into the Project – note: detailed plans of this are not yet available.

The proposed ground-mounted array (refer **Figure 2**) would consist of "1P" mode panels supported on a single-axis tracking system, oriented north-south.

Figure 2 Site Layout



The mounting system for the panels is shown in **Figure 3**.

- The system has a normal tracking range of … ±60°
- The median height of the panels is … 2.0 m
- The system can enable Back-Tracking with a Rest Angle of … 0°
- The Ground Coverage Ratio is … ~40-44%

Figure 3 Single-Axis "1P" Tracking Support System



3.0 Requirements

Aviation Glare

With regard to Aviation Glare, the Forge Solar SGHAT software tool has been accepted by regulatory bodies globally and throughout Australia. The SGHAT impact criteria are:

- Airport Traffic Control Tower (ATCT): NO GREEN or YELLOW Glare
- Aircraft Landing: NO YELLOW Glare (GREEN is permissible)

For this assessment, Narrogin aerodrome has been assessed.

Residential Nuisance Glare

For Residential Nuisance Glare, criteria are now available in the newly-released New South Wales (NSW) Large Scale Solar Energy (LSSE) Guideline (2022). The LSSE Guideline classifies Residential Nuisance Glare into “High”, “Moderate” and “Low” impact levels by minutes per day and/or hours per year. **Figure 4** summarises the three impact levels and associated amenity objectives.

- When applying the LSSE Guideline to Residential Nuisance Glare, it is standard industry practice to use the occurrence of predicted SGHAT YELLOW glare, noting that SGHAT GREEN glare (a) implies LOW potential for an after-image and (b) is acceptable in terms of aviation glare for pilots on final landing approach.

Figure 4 Extract from NSW Large-Scale Solar Energy Guideline (2022)

Table 2: Impact rating and performance objectives for glare impacts to residential dwellings

High glare impact	Moderate glare impact	Low glare impact
> 30 minutes per day > 30 hours per year	< 30 minutes & > 10 minutes per day < 30 hours & > 10 hours per year	< 10 minutes per day < 10 hours per year
Significant amount of glare that should be avoided.	Implement mitigation measures to reduce impacts as far as practicable.	No mitigation required.

Road and Rail Traffic Disability Glare

There are no SGHAT nor LSSE Guideline criteria for Road and Rail Traffic Disability Glare.

Accordingly, when considering motorists and/or rail operators, the occurrence of SGHAT YELLOW glare for ANY number of minutes per day or hours per year is taken by SLR as necessitating consideration of mitigation. An exception occurs if the reflection condition occurs at a time of day when the difference in angle (viewed by the motorist) between an incoming solar ray and its associated reflection is less than around 10°, in which case a motorist’s view would be completely dominated by the radiance level of the sun’s direct solar rays.

4.0 Background

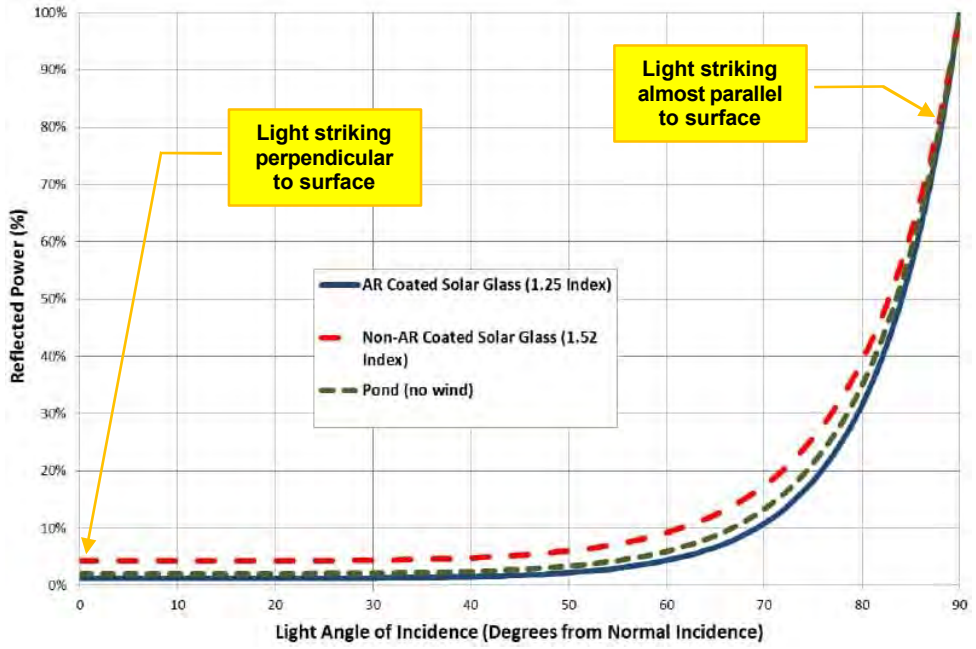
4.1 Solar Panel Reflectivity

Solar PV panels are designed to capture (absorb) the maximum possible amount of light within the layers below the front (external) surface, and hence minimise reflections off the surface of each panel. Reflections are a function of:

- the angle at which the light is incident onto the panel (which will vary depending on the specific location, time of day and day of the year), and
- the index of refraction of the front surface of the panel and associated degree of diffuse (non-directional) versus specular (directional or mirror-like) reflection, which is a function of surface texture of the front module (reflecting) surface.

Representative reflectivity curves are shown in **Figure 5**.

Figure 5 Typical Reflectivity Curves as a Function of Incidence Angle



- When an incoming solar ray strikes the surface of a solar PV panel close to perpendicular to the panel surface (ie low angle of “incidence”), reflectivity is minimal, less than 5% for all solar panel surface types.
- It is only when an incoming solar ray strikes the panel at large “incidence” angles, ie closer to parallel to the panel, that reflectivity values increase. When this happens, reflections become noticeable and potentially at “glare” level – this can occur for <u>all</u> solar panel surface types.
- However, for very high incidence angles, it would almost always be the case that the observer (motorist, train driver, resident, etc) would perceive reflections coming from virtually the same direction as the incoming solar rays themselves. Such a condition would not constitute a glare situation as the intensity of the incoming solar ray itself would dominate the field of vision perceived by the observer.

4.2 Project Site Angles – Annual Variations

One of the challenging issues encountered with daytime solar panel glare is the varying nature of the associated reflections, whose occurrence will vary with time of day and day of the year as the sun's rays follow varying incoming angles between the two extremes of:

- Summer solstice – sunrise incoming rays from just south of east, maximum angle altitude rays at midday, sunset incoming rays from just south of west.
- Winter solstice – sunrise incoming rays from almost northeast, minimum angle altitude rays at midday, sunset incoming rays from almost northwest.

Any solar glare analysis must take into account the complete cycle of annual reflection variations noted above. The potential range of incoming solar angles at the Project site relevant to daytime glare is shown in **Figure 6**, with critical angles summarised in **Table 1**.

Figure 6 Project Site Incoming Solar Angle Variations

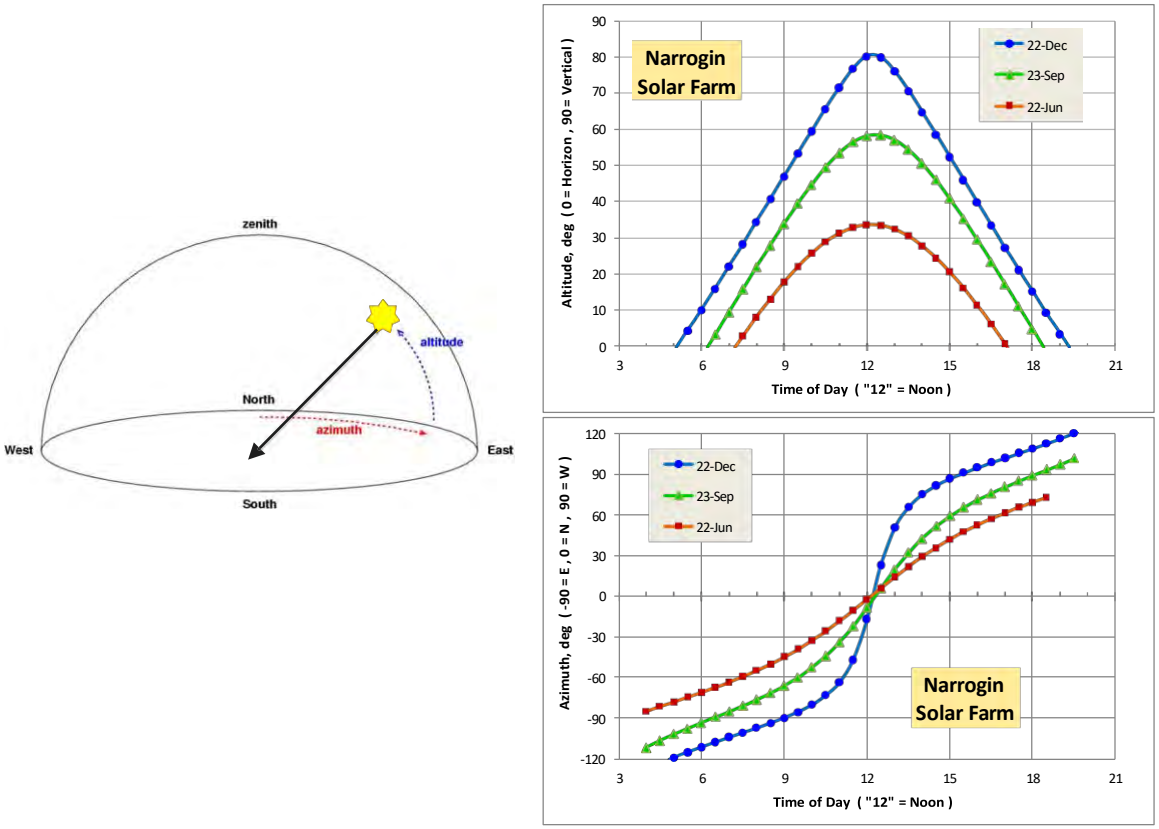


Table 1 Key Annual Solar Angle Characteristics for Project Site

Day of Year	Sunrise	Sunset	Sunrise-Sunset Azimuth Range	Max Altitude
Summer Solstice [1]	5:07 am	7:18 pm	±118° East & West of North	80°
Equinox	6:15 am	6:22 pm	±91° East & West of North	58°
Winter Solstice	7:15 am	5:04 pm	±61.5° East & West of North	33.5°

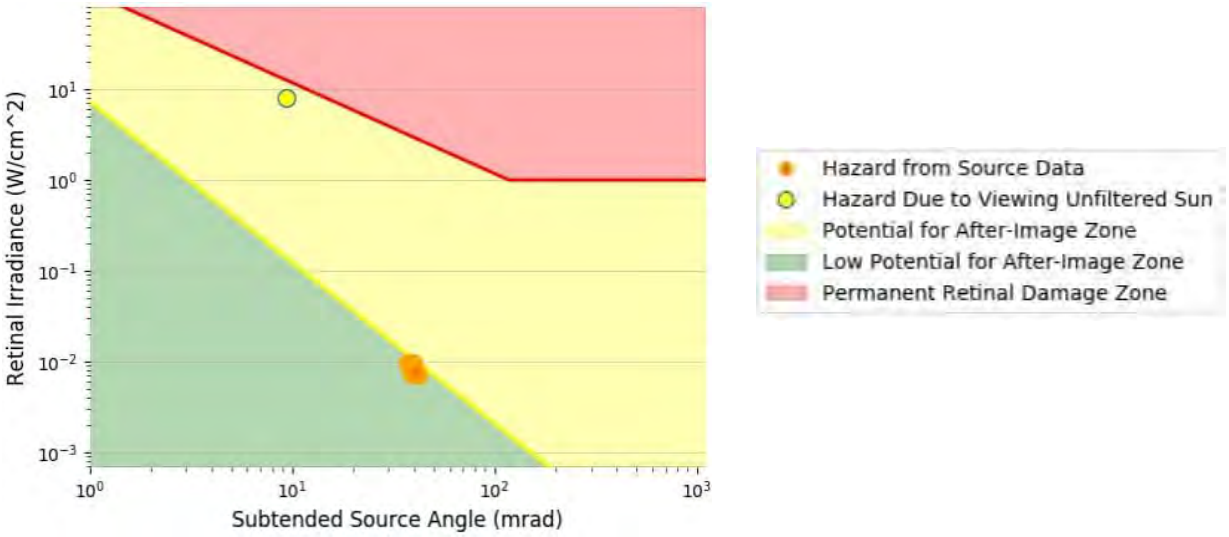
Note 1: Times of day do not take into account Daylight Savings Time

4.3 Modelling Outputs

Modelling has been undertaken using the Forge Solar SGHAT software suite. This provides output in the form of an ocular hazard analysis plot, a sample of which is shown in **Figure 7**.

The analysis displayed in this plot is derived from solar simulations that extend over the entire calendar year in 1-minute intervals, sunrise to sunset.

Figure 7 Example Solar Glare Ocular Hazard Plot (SGHAT Software Output)



The following is noted regarding **Figure 7**.

- SGHAT ocular impact is a function of both the "retinal irradiance" (ie the light seen by the eye) and "subtended source angle" (ie how wide an arc of view the light appears to be arriving from).
- SGHAT ocular impact falls into three categories:
  - . GREEN: low potential to cause "after-image"
  - . YELLOW: potential to cause temporary "after-image"
  - . RED: potential to cause retinal burn (permanent eye damage)
- "After Image" is the term applied to a common retinal phenomenon that most people have experienced at some point or other, such as the effect that occurs when a photo with flash is taken in front of a person who then sees spots in front of their eyes for a few seconds. A more extreme example of "after-image" occurs when staring at the sun. "After-image" (also known as "photo bleaching") occurs because of the de-activation of the cells at the back of the eye's retina when subjected to a very bright light.
- The SGHAT plot provides an indication of the relative intensity of both the incoming reflection and the sources of light itself (ie the sun).

  . The occurrence of glare is shown in the plot as a series of **orange circles**, one circle for each minute that a reflection is visible.

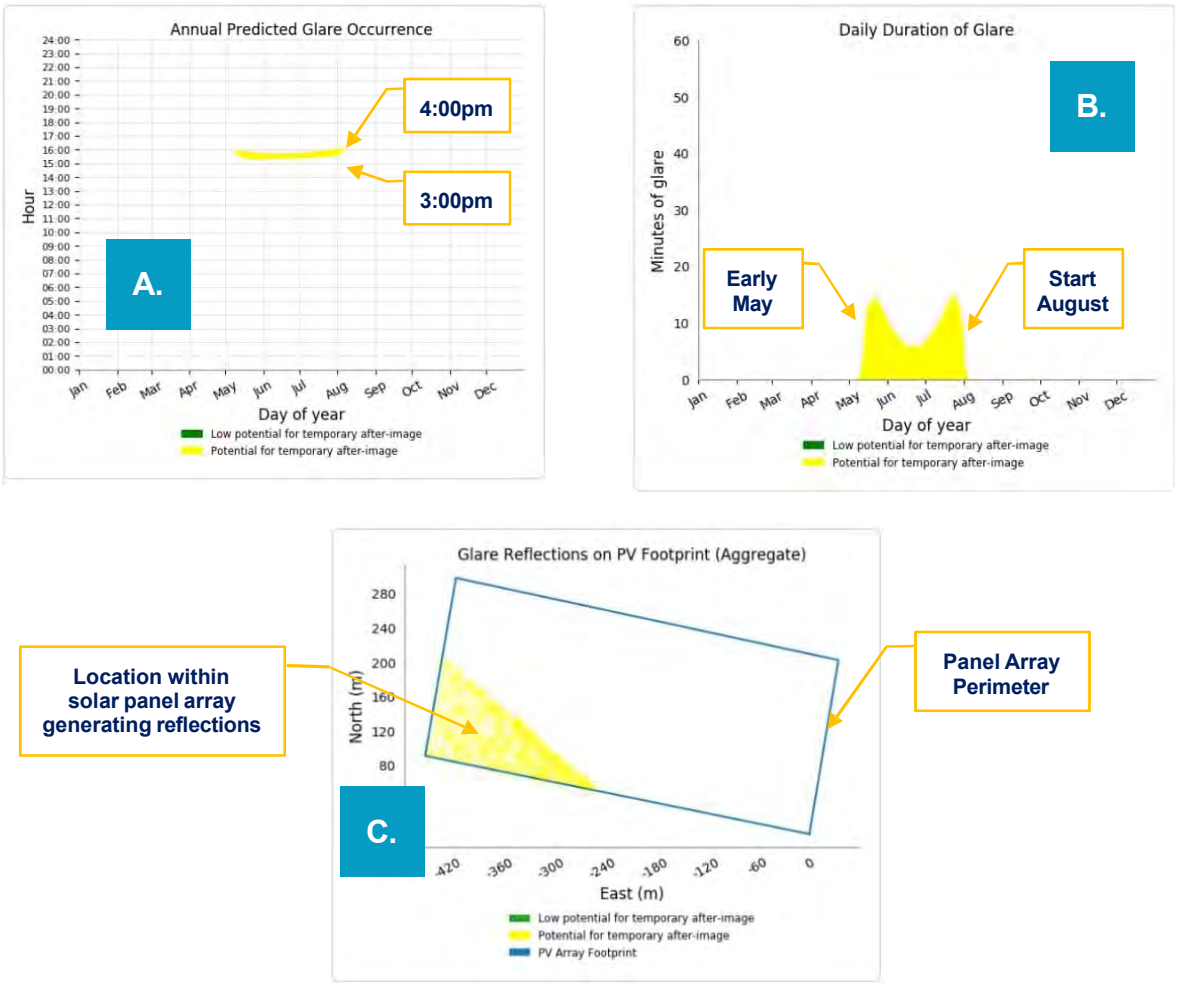
  . A reference point is also shown in each SGHAT plot, the **yellow circle** with the **green outline**, representing the hazard level of viewing the sun without filtering, ie staring at the sun.
- In **Figure 7**, it can be seen that the reflection visible by the receiver is roughly 1,000 times less intense than the light from the sun.

- Finally, in relation to PV Solar facilities, it is important to note that the third SGHAT Ocular Plot "RED" category is not possible, since standard PV modules do not focus reflected sunlight.

In addition to the above "assessment" output, the SGHAT software package also produces information which reveals the extent of visibility of reflections at any chosen receiver position, regardless of whether the reflections constitute a glare condition or not. An example is shown in **Figure 8**.

- **Figure 8-A** shows the am/pm time periods when reflections occur at a specific receptor throughout the year, in this case between around 3:30 pm and 4:00 pm.
- **Figure 8-B** shows the months during the year and the minutes per day when reflections occur at a specific position, in this case from early-May to the start of August, for periods ranging up to 13 minutes per day.
- Finally, **Figure 8-C** shows where within the solar farm panel array the reflection rays of interest are emanating from, in this case from panels near the southwest corner.

Figure 8 Example Solar Glare Output Plots (SGHAT Software Output)



4.4 Other Factors Relevant to Glare Prediction

Weather

SGHAT model calculations (and indeed all commercially available glare models) assume CLEAR skies all year round.

Narrogin receives approximately 3,150 hours of sunshine per annum, implying that the sky is either overcast or mostly cloudy almost 28% of the time throughout the year.

This means that the total annual minutes of duration for any potential glare conditions predicted using SGHAT (or any “clear sky” glare model) should be reduced by an appropriate “overcast” factor, resulting in overall lower impacts.

- This however would only reduce the likely impact over the entire year.
- The maximum duration on any one day predicted by SGHAT would not be affected.

Terrain

Terrain features such as natural obstacles (vegetation, tree lines, etc) are not explicitly considered within SGHAT.

These however can be added to the simulation as so-called “obstructions” which can model tree lines for example as solid (obstructing) walls. In this case, it would be assumed that the vegetation has dense coverage and is of an evergreen species.

Topography

Similarly, topography is not modelled within SGHAT.

This can only be overcome by an examination of the Viewshed Analysis typically undertaken for such projects, which reveals which surrounding receivers (roadways, houses, etc) will be able to actually ”see” the solar panels within a proposed facility and hence experience reflections.

Alternatively, the “Elevation Profile” function available in Google Earth (or alternative mapping tools) may be able to identify sensitive receivers which do not have a view of the proposed facility.

5.0 Glare Impacts

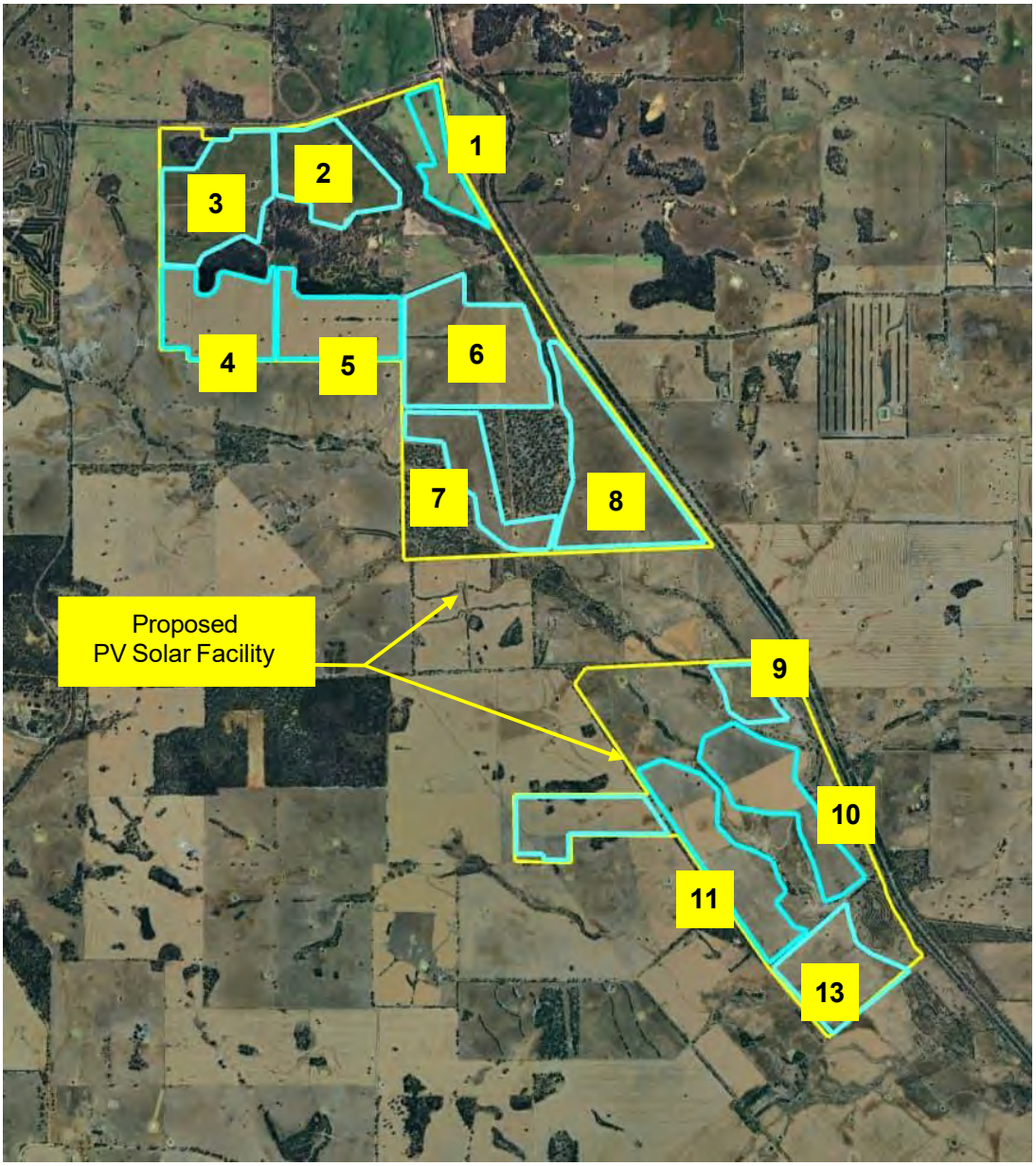
5.1 Modelling Inputs

The Project was initially modelled with a number of smaller “sub-arrays”, refer **Figure 9**, encompassing the actual area of solar panel locations (refer **Figure 2**).

- This was done to better follow the local topography at the site and give more detailed information as to which specific sub-areas of the facility might be responsible for potential glare occurrences.

The height used to model the panels in each sub-array, based on the “1P” model panel geometry was 2.0 m - refer **Figure 3**.

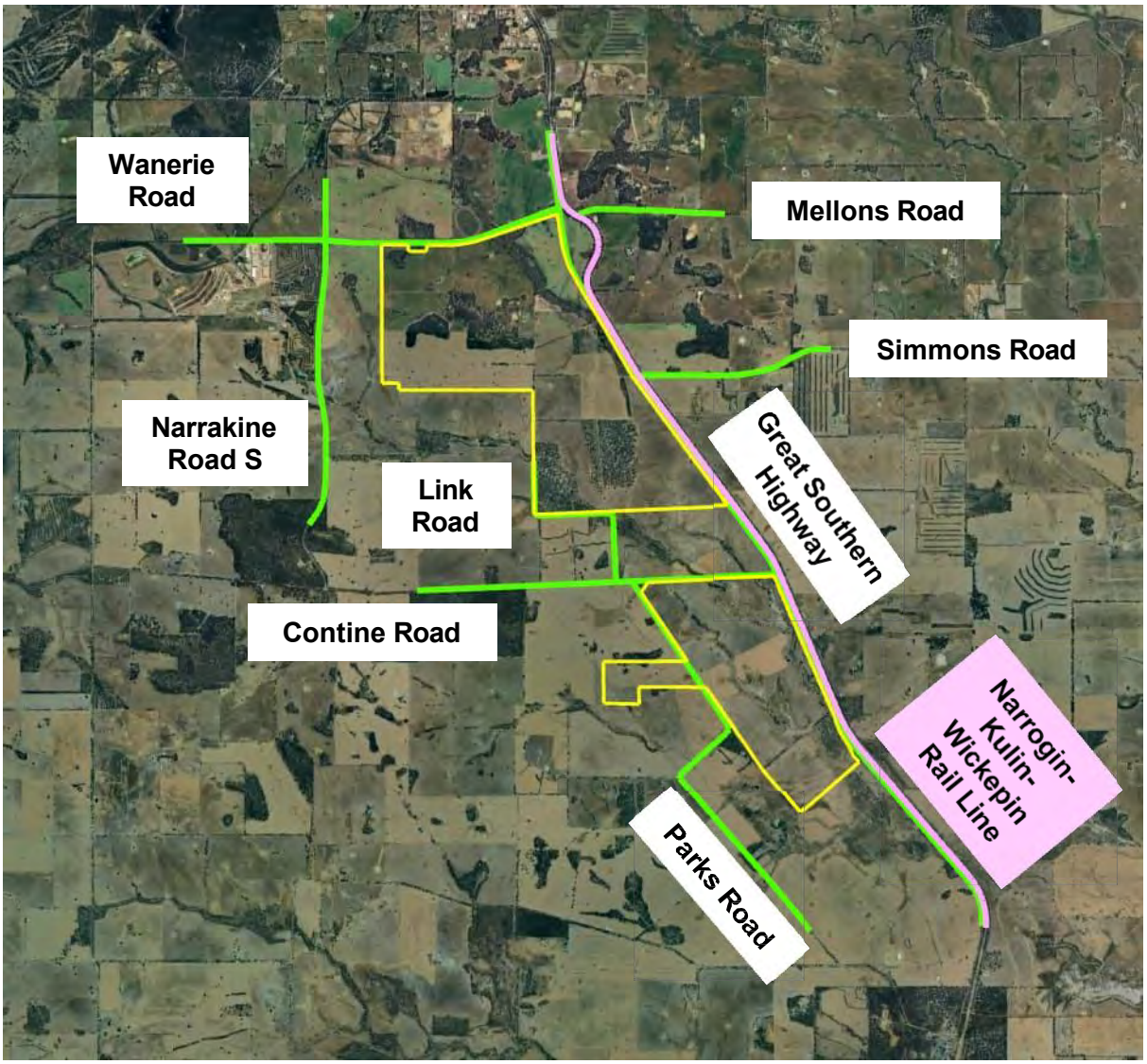
Figure 9 Modelled Sub-Arrays 1-13



The roadways included in the analysis are shown in **Figure 11**.

- A motorist viewing height of 2.3 m was used for Great Southern Highway, appropriate for heavy vehicles.
- A motorist viewing height of 1.8 m was used for all other roads.
- A rail operator viewing height of 3.0 m was used for the rail line.

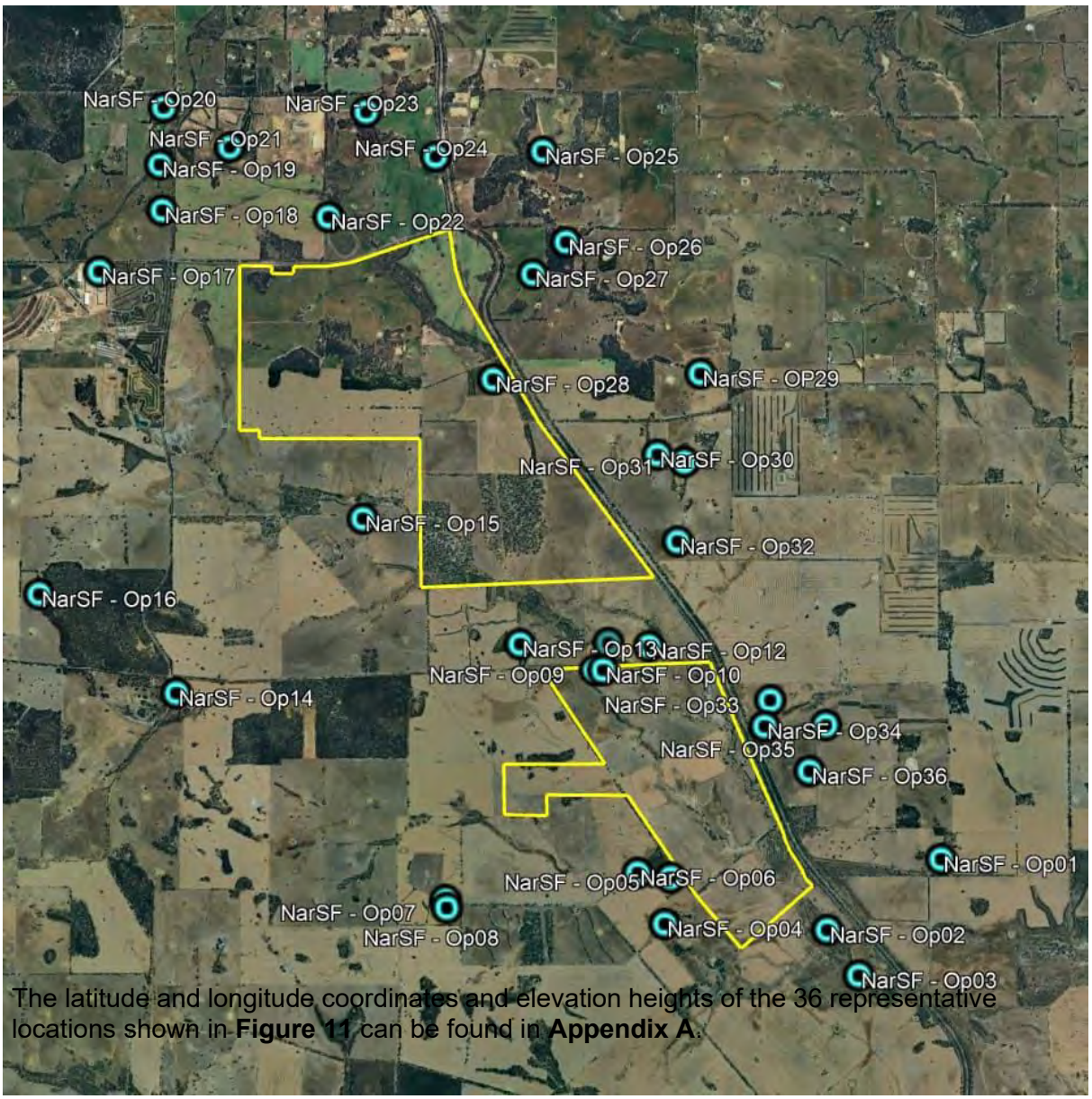
Figure 10 Roadways Surrounding the Project Site



36 representative sensitive receptors (residential locations) were chosen to be included in the analysis. They are shown in **Figure 11**, labelled NarSF Op1 to NarSF Op36.

- For surrounding sensitive receptors, the observer height was set at 1.5 m above the ground.

Figure 11 Surrounding Representative Receiver Locations



The latitude and longitude coordinates and elevation heights of the 36 representative locations shown in **Figure 11** can be found in **Appendix A**.

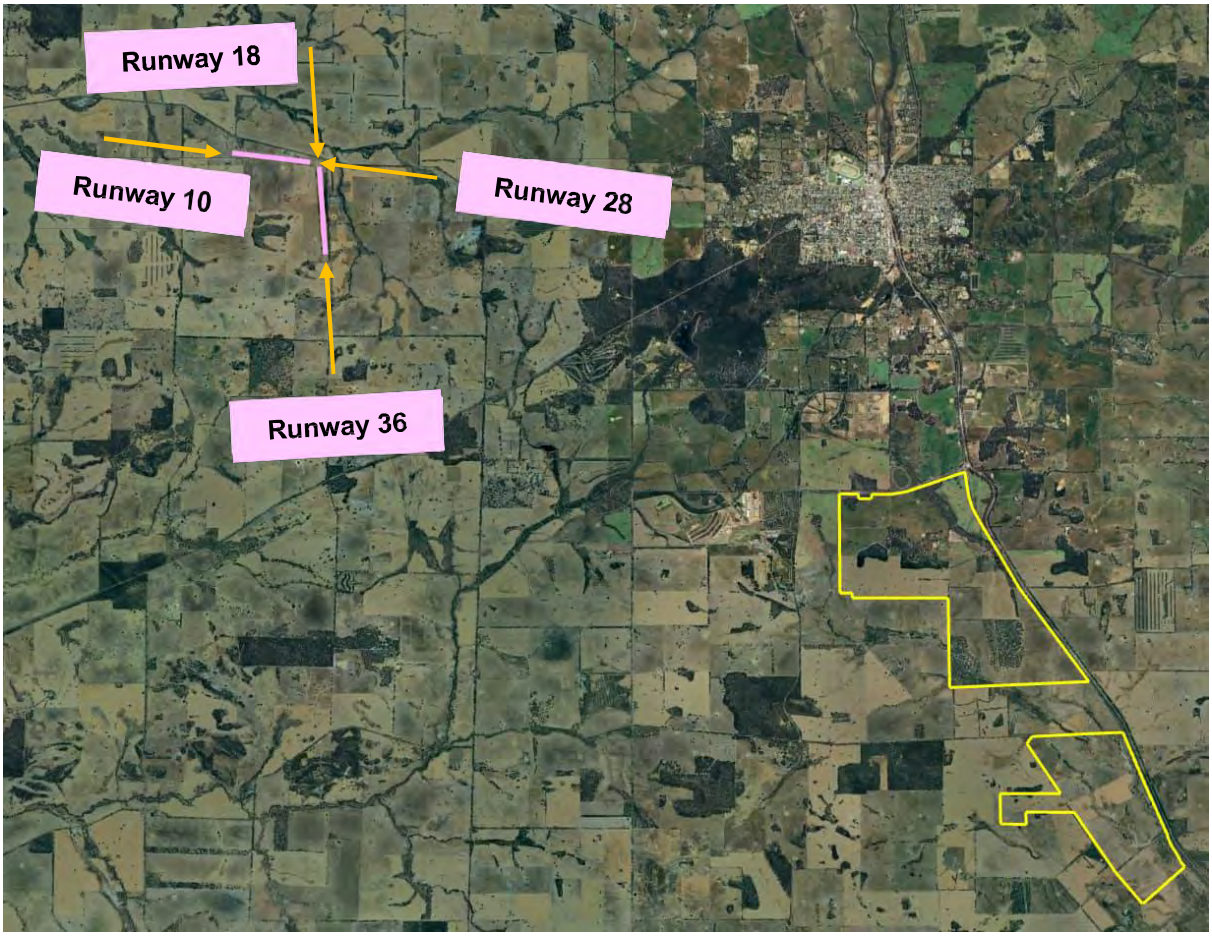
The closest aerodrome, Narrogin Airport (ICAO “YNRG”), has two runways – refer **Figure 12**:

- Runway R10/28 Asphalt 1,250 m
- Runway R18/36 Grass 1,200 m

The assessment variables used for the analysis are:

- Landing Glide Path Length 3,218 m 3° glide angle
- Threshold Height 15 m Runway R10 and R28
- Threshold Height 11 m Runway R18 and R36

Figure 12 Narrogin Aerodrome Runways Assessed for Aviation Glare



5.2 SGHAT Modelling Results

5.2.1 "Baseline" Simulation

The SGHAT glare simulation model was run with the road receivers shown in **Figure 10**, the residential receivers shown in **Figure 11** and for the flight landing paths shown in **Figure 12**.

This initial "Baseline" run did NOT take into account:

- any intervening sections of topography which could obscure the view of the facility for passing motorists or neighbouring residential receivers.
- any existing vegetation that would similarly obstruct the view of the facility for passing motorists or neighbouring residential receivers.

Table 2 shows the total annual minutes of potential SGHAT "Yellow" glare, with both the individual sub-array minutes of glare and the yearly total over all panel sub-arrays.

For residential receivers, colour coding indicates the impact level according to **Figure 4** (LSSE Guideline, 2022) - Low (light green), Moderate (orange) and High (red).

Table 2 Annual Minutes of SGHAT YELLOW Glare – "Baseline" Simulation

Receptor	PV Sub-Array													Yearly Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Runway R10 (asphalt)														
Runway R28 (asphalt)														
Runway R18 (grass)														
Runway R36 (grass)														
Contine Road				261	489				606					**1,356**
Great Southern Hwy	1277			236	248				882	1656				**4,299**
Link Road				524	701		628							**1,853**
Mellons Road														
Narrakine Road South			39	244	296									**579**
Parks Road									25	1184	11056		1519	**13,784**
N-K-W Rail Line	1147			380	404				886	1768				**4,585**
Simmons Road	606													**606**
Wanerie Road		3564	326											**3,890**
OP01														
OP02														
OP03														
OP04														
OP05										254	2524		695	**3473**
OP06										103			418	521
OP07														
OP08														
OP09				110										110
OP10				123										123
OP11				146										146
OP12				90										90

Receptor	PV Sub-Array													Yearly Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
OP13				17										17
OP14														
OP15				356										356
OP16				115										115
OP17						160								160
OP18														
OP19														
OP20														
OP21														
OP22														
OP23														
OP24														
OP25														
OP26														
OP27														
OP28														
OP29														
OP30														
OP31														
OP32														
OP33														
OP34														
OP35														
OP36														

Discussion

Table 2 shows the following.

Aviation Glare

- There will be no SGHAT YELLOW glare on any of the four working runways at Narrogin Aerodrome Airport.

Residential Nuisance Glare

- There will be no SGHAT YELLOW glare on Receivers Op01-04, Op07-08, Op14 and Op18-36.
- There will be less than 10 hours annual (600min) of SGHAT YELLOW glare on Receivers Op06, Op09-13 and Op15-17. These receivers are therefore within the “LOW” category of the LSSE Guideline (2022), ie NO mitigation required.
- One residence, Op05 is predicted to receive more than 1,800 hours of SGHAT YELLOW glare, placing this residence in the “HIGH” category of the LSSE Guideline (2022), ie mitigation should be considered. Note again that this result was obtained in the absence of any existing vegetation or obstructing topography.

Road and Rail Traffic Disability Glare

- There will be no SGHAT YELLOW glare on Mellons Road.
- Moderate amounts of SGHAT YELLOW glare are predicted for Narrakine Road South and Simmons Road.
- Significant amounts of SGHAT YELLOW glare are predicted for the Great Southern Highway, Link Road, the N-K-W Rail Line, Parks Road and Wanerie Road.

5.2.2 "Baseline" + "Existing Vegetation" Simulation

As noted above, the "Baseline" glare simulation did not include any existing vegetation surrounding the site. In fact, a significant amount of vegetation exists at the site. – refer examples shown in **Figure 13**.

Figure 13 Examples of Site and Surrounding Vegetation



To account for existing vegetation, “obstructions” were added to the SGHAT simulation model, as shown in **Figure 14**. These varied from 4 m up to 8 m. Not all existing vegetation close to the site was included in this simulation. Vegetation was only included close to receivers that had been identified in the “Baseline” simulation as potentially receiving reflections from the facility.

Figure 14 SGHAT Screens Representing Existing Vegetation

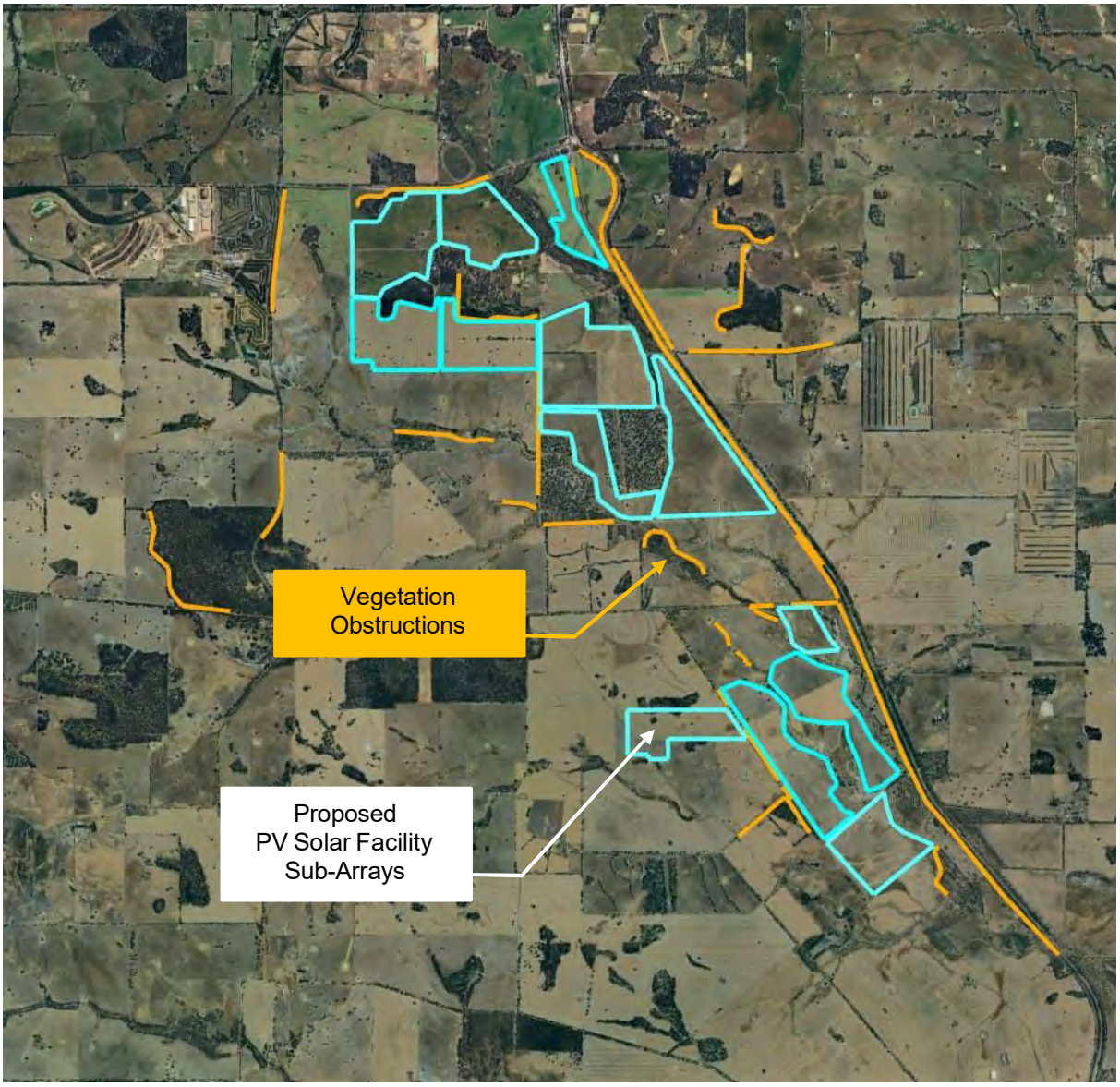


Table 3 shows the total annual minutes of potential SGHAT “Yellow” glare, with both the individual sub-array minutes of glare and the yearly total over all panel sub-arrays.

For residential receivers, colour coding indicates the impact level according to **Figure 4** (LSSE Guideline, 2022) - Low (light green), Moderate (orange) and High (red). Residential receivers predicted to experience NIL glare have been grouped to simplify **Table 3**.

Table 3 Annual Minutes of SGHAT YELLOW Glare – "Baseline + Existing Vegetation" Simulation

Receptor	PV Sub-Array													Yearly Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Runway R10 (asphalt)														
Runway R28 (asphalt)														
Runway R18 (grass)														
Runway R36 (grass)														
Contine Road														
Great Southern Hwy	**962**													**962**
Link Road														
Mellons Road														
Narrakine Road South														
Parks Road											**5387**		**382**	**5769**
N-K-W Rail Line														
Simmons Road														
Wanerie Road														
OP01 to OP05														
OP06													41	41
OP07 to OP36														

Discussion

Table 3 shows the following.

Aviation Glare

- There will be no SGHAT YELLOW glare on any of the four working runways at Narrogin Aerodrome Airport.

Residential Nuisance Glare

- There will be no SGHAT YELLOW glare on Receivers OP01-OP05 and OP-7-OP36.
- There will be less than 10 hours annual (600 min) of SGHAT YELLOW glare on Receiver OP06. This receiver is therefore within the "LOW" category of the LSSE Guideline (2022), ie NO mitigation required.

Road and Rail Traffic Disability Glare

- There will be no SGHAT YELLOW glare on Contine Road, Link Road, Mellons Road, Narrakine Road South, the N-K-W Rail Line and Wanerie Road.
- Significant amounts of SGHAT YELLOW glare are predicted for Parks Road and the Great Southern Highway.

5.3 Potential Glare – Further Detailed Analysis

Section 5.2 showed that the areas of concern in terms of potential glare at the facility were:

- Road Traffic Disability Glare – Great Southern Highway
- Road Traffic Disability Glare – Parks Road

5.3.1 Great Southern Highway Reflections

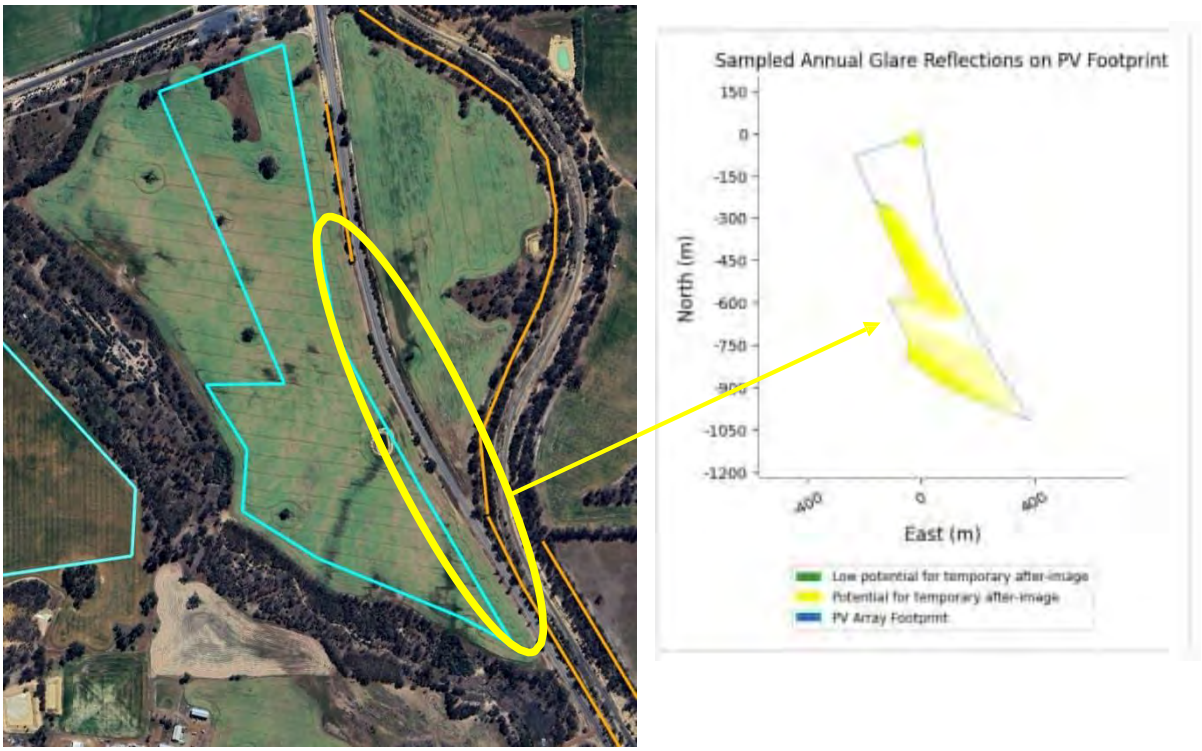
Table 3 shows that the reflections of concern for the Great Southern Highway arise from:

- PV Sub-Array 1

Reflections from PV Sub-Array 1 – refer **Figure 16**

- Reflections occur for sections of the highway which do not have the benefit of vegetation on the west side of the highway adjacent to PV Sub-Array 1.

Figure 15 Great Southern Highway Reflections from PV Sub-Array 1



5.3.2 Parks Road Reflections

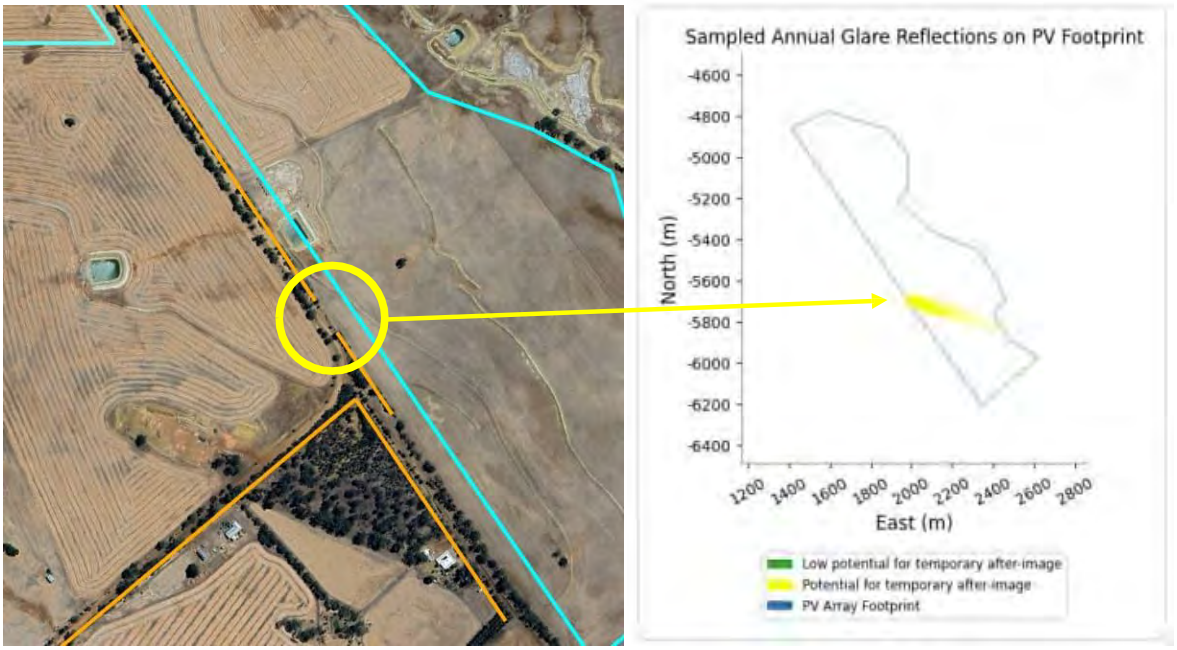
Table 3 shows that the reflections of concern for Parks Road arise from:

- PV Sub-Array 11 and PV Sub-Array 13

Reflections from PV Sub-Array 11 – refer **Figure 16**

- Reflections occur in the gap between the line of existing vegetation on the east side of Parks Road adjacent to PV Sub-Array 11.

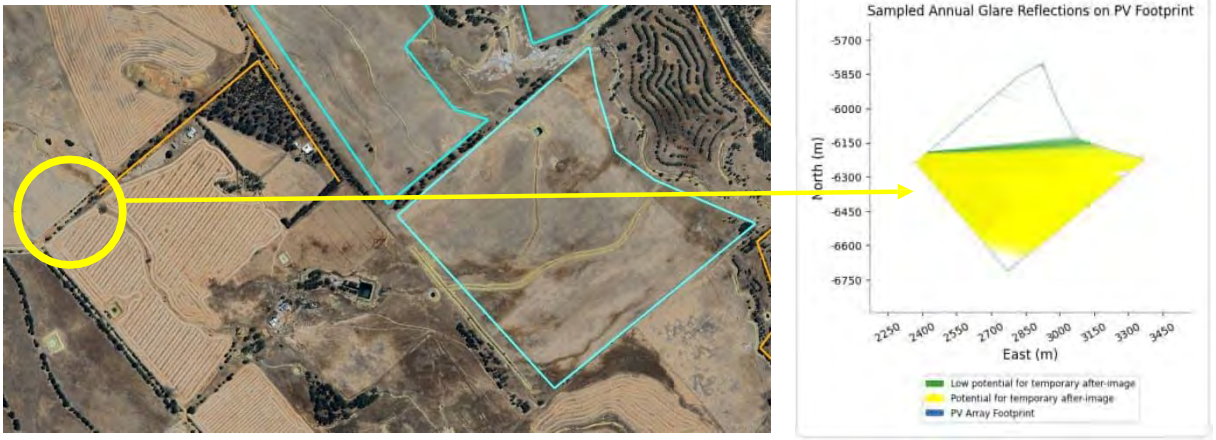
Figure 16 Parks Road Reflections from PV Sub-Array 11



Reflections from PV Sub-Array 13 – refer **Figure 17**

- Reflections occur along the section of Parks Road close to sunrise where the existing vegetation on the south side of the roadway ends.

Figure 17 Parks Road Reflections from PV Sub-Array 13

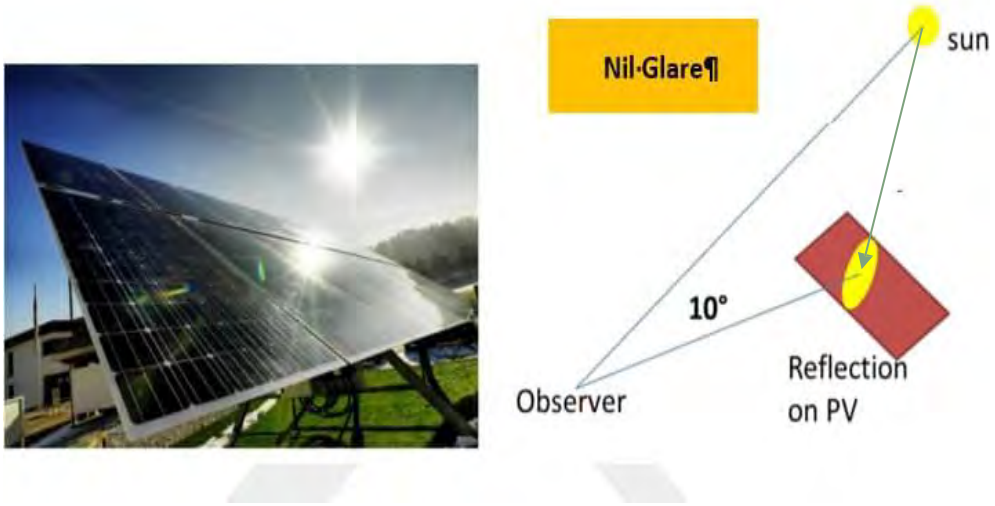


The predicted reflections shown in **Figure 16** and **Figure 17** were examined further to assess whether they had the potential to cause Road Traffic Disability Glare.

The context of this assessment was made in light of the observation made in **Section 3.1**, where it was noted that for very high incidence angles, it would almost always be the case that an observer would perceive reflections coming from virtually the same direction as the incoming solar rays themselves. Such a condition would not constitute a glare situation as the intensity of the incoming solar ray itself would dominate the field of vision perceived by the observer.

In fact, this latter condition has evolved into a globally adopted "acceptability" glare axiom, , namely that a glare condition can only exist if the angle difference between an incoming solar ray and its associated reflection is greater than approximately 10° – refer **Figure 18**.

Figure 18 Nil Glare Condition Applicable to High Incidence Angle Reflections

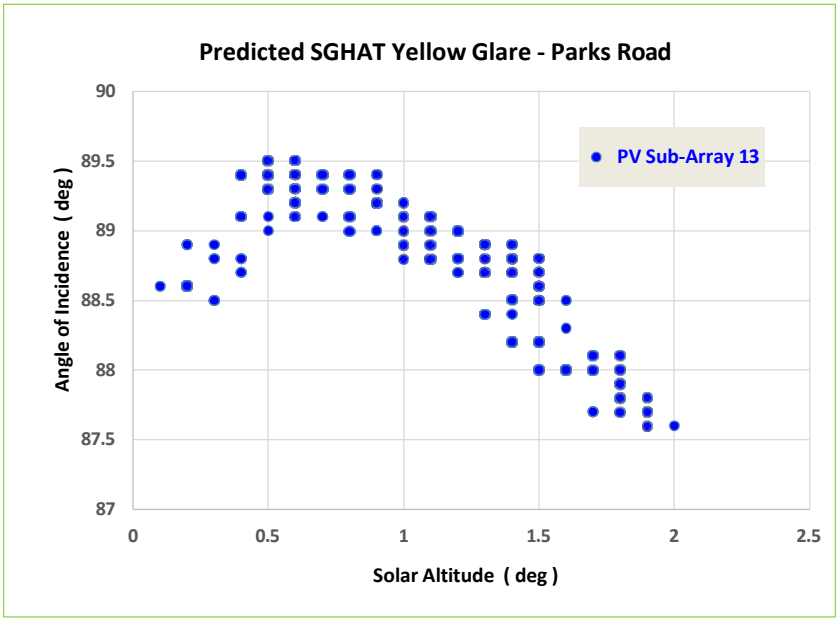


In terms of the predicted reflections onto Parks Road from PV Sub-Array 13, the following can be seen in **Figure 19**:

- All PV Sub-Array 13 reflections impacting Parks Road occur for very low ALTITUDE angles (less than 2°), ie right at the time of sunrise. At those times, the INCIDENCE angles are very high (>87.5°).
- The resulting difference between the angle of incoming direct solar rays and associated reflections would be much lower than 10°.

On this basis, predicted reflections on Parks Road would not constitute a glare condition.

Figure 19 Altitude and Incidence Angles for Predicted Dogleg Drive Reflections



5.4 Mitigation Options

The analysis of potential glare from the proposed solar facility has yielded the following

- Great Southern Highway & PV Sub-Array 1
- Parks Road & PV Array 11

On the basis of the detailed reflection examination in **Section 5.3**, two mitigation options were trialled to eliminate the following potential glare conditions:

- Vegetation Screening
- Back-Tracking Rest Angle Modification

5.4.1 Mitigation Option 1 – Vegetation Screening

The “Baseline” + “Existing Vegetation” simulation showed that perimeter screening via vegetation is an effective tool for eliminating potential road glare conditions.

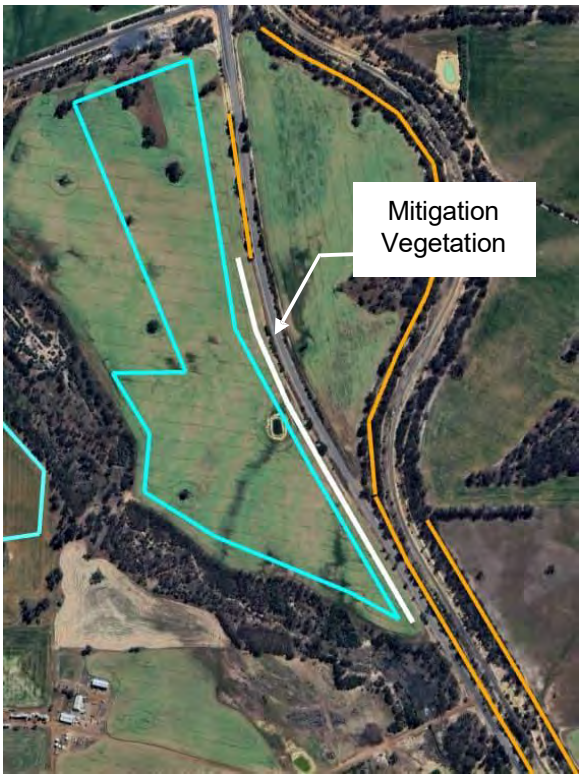
On this basis, a “Mitigation Screening” simulation was carried out by adding new 4 m high vegetation along the Great Southern Highway and Parks Road as shown in **Figure 20**.

With the added mitigation vegetation screening:

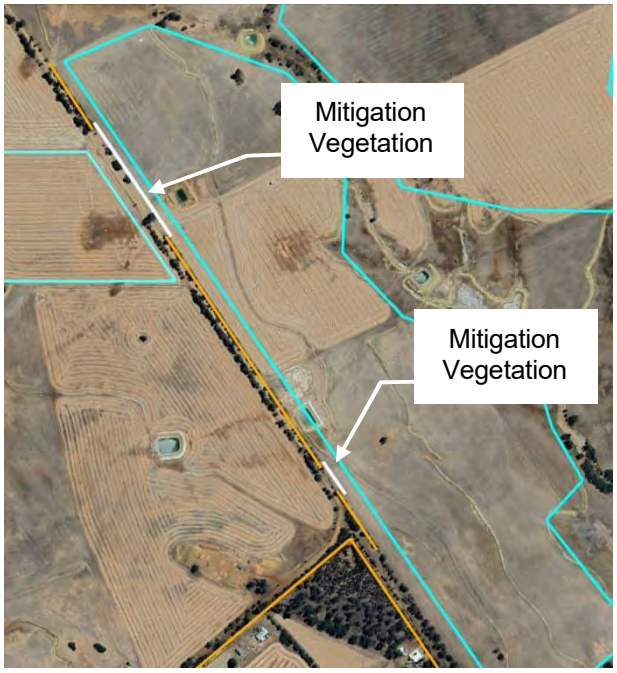
- There was NIL SGHAT glare on the Great Southern Highway and NIL SGHAT glare on Parks Road.

Figure 20 Proposed Mitigation Vegetation Screening

Great Southern Highway Screening



Parks Road Screening



5.4.2 Mitigation Option 2 – Back-Tracking Rest Angle

The second mitigation simulation was run by altering the Back-Tracking Rest Angle from its assumed 0° Rest Angle position.

In this case, the “Rest Angle Mitigation” simulation was run with the “Baseline” geometry, ie NOT taking advantage of the EXISTING vegetation in and around the site.

A number of Rest Angles were trialled, starting at 1°, 2°, 3°, etc.

The following was found:

- There was NIL SGHAT glare for ALL receivers (Aviation, Road and Rail Traffic, and Residential Receivers) for a 5° Rest Angle.

The above is an important finding because it concludes that, in the future, should any of the EXISTING vegetation be “lost” (due to drought, bushfire, etc) the screening benefit of the existing vegetation can be replaced by simply adjusting the Back-Tracking Rest Angle of the facility at any relevant PV Sub-Array.

5.5 Glare Analysis Summary

The analysis of potential glare from the proposed solar facility has yielded the following outcomes:

Narrogin Aerodrome

- NONE of the working runways at Narrogin Aerodrome will receive glare from the proposed solar facility.
- This is primarily because of (i) the distance separation of the runways relative to the Project, and (ii) orientation of flight landing paths.

Surrounding Residential Receivers

- NO surrounding residential receivers will receive ANY reflections from the proposed solar facility.
- This is primarily because of either (i) the distance separation of the receivers relative to the Project, or (ii) the extensive existing vegetation close to many of the surrounding residences.

Surrounding Road and Rail Traffic

- When existing vegetation surrounding the site is taken into account, there will be no glare on Contine Road, Link Road, Mellons Road, Narrakine Road South, the N-K-W Rail Line and Wanerie Road.
- There is potential for glare along Parks Road and the Great Southern Highway.
- Two mitigation options are available to eliminate the above-mentioned glare potential – these are summarised in **Table 4**:
  - Vegetation Screening – refer **Figure 20**.

  OR

  - Back-Tracking Rest Angle Modification to PV Array 1 (limit the AFTERNOON Rest Angle to 5°) and PV Array 11 (limit the MORNING Rest Angle to 5°)

Table 4 Proposed Mitigation Strategy

PV Sub-Array (refer Fig.9)	Recommended Mitigation
2-10 & 12-13	NO mitigation required
1	Add vegetation screening as per **Figure 20** **OR** Limit the AFTERNOON Rest Angle to 5°: mid-April to end-August At all other times of the year, no limits on Rest Angle (morning and afternoon)
11	Add vegetation screening as per **Figure 20** **OR** Limit the MORNING Rest Angle to 5°: start October to mid-March At all other times of the year, no limits on Rest Angle (morning and afternoon)

6.0 Night-Time Illumination Glare

6.1 Background and Criteria

Guidance on the management of light spill from outdoor lighting impacting on residents, transport users, transport signalling systems and astronomical observations, can be found in:

- AS/NZS 4282-2023 *Control of the Obtrusive effects of Outdoor Lighting*.

The adverse effects of light spill from outdoor lighting are influenced by several factors:

- Topology: light spill is more likely to be perceived as obtrusive if the lighting installation is located higher up than the observer. Lighting installations are usually directed towards the ground and an observer could hence have a direct view of the luminaire.
- Surrounding Terrain: hills, trees, buildings, fences and general vegetation have a positive effect by shielding the observer from the light installation.
- Existing Lighting Environment: light from a particular light source is seen as less obtrusive if it is located in an area where the lighting levels are already high, eg in cities. The same lighting installation would be seen as far more bothersome in a less well-lit rural residential area.
- Zoning: a residential area is seen as more sensitive compared to commercial areas where high lighting levels are seen as more acceptable.

Typical illuminance levels for a variety of circumstances are given in **Table 5** for comparison.

Table 5 Typical Illuminance Levels for Various Lighting Scenarios

Lighting Scenario	Horizontal Illuminance (lux)
Moonless overcast night	0.0001
Quarter Moon	0.01
Full Moon	0.1
Twilight	10
Indoor office	300
Overcast day	1,000
Indirect sunlight clear day	10,000-20,000
Direct sunlight	100,000-130,000

Key objectives for technical lighting parameters in AS/NZS 4282-2023 are summarised in **Table 6**.

- Limits for luminous intensity for *curfew hours* apply in directions where views of bright surfaces of luminaires are likely to be troublesome to residents, from positions where such views are likely to be maintained.
- The vertical illuminance limits for *curfew hours* apply in the plane of the windows of habitable rooms or dwellings on nearby residential properties.
- The vertical illuminance criteria for *pre-curfew hours* apply at the boundary of nearby residential properties in a vertical plane parallel to the boundary.

- Limits for luminous intensity for *pre-curfew* hours apply to each luminaire in the principal plane, for all angles at and above the control direction.
- Values given in **Table 6** are for the direct component of illuminance, ie no reflected light is taken into account.

Table 6 Recommended Maximum Values of Light Technical Parameters (AS4282-2023)

Light Technical Parameter	Time of Operation	Zone "A4"	Zone "A3"	Zone "A2"	Zone "A1"	Zone "A0"
Illuminance in vertical plane (E_v)	Pre-curfew hours	25 lx	10 lx	**5 lx**	2 lx	ALARP [1]
	Curfew hours	5 lx	2 lx	**1 lx**	0.1 lx	0 lx
Luminous Intensity emitted by luminaires (I)	Pre-curfew hours	25,000 Cd	12,500 Cd	**7,500 Cd**	2,500 Cd	ALARP [1]
	Curfew hours	2,500 Cd	2,500 Cd	**1,000 Cd**	500 Cd	0 Cd

Zone A0	"Intrinsically Dark", eg UNESCO Starlight Reserve; IDA Dark Sky Parks; major optical observatories; no road lighting, unless specifically required by the relevant road controlling authority
Zone A1	"Dark", eg relatively uninhabited rural areas; no road lighting, unless specifically required by the relevant road controlling authority
Zone A2	"Low District Brightness", eg sparsely inhabited rural and semi-rural areas
Zone A3	"Medium District Brightness", eg suburban areas in towns and cities
Zone A4	"High District Brightness", eg town and city centres and other commercial areas; residential areas abutting commercial areas
ALARP	As low as reasonably practical

The Project is located in a rural area with the potential to impact on surrounding residential properties.

- These properties would be classed as being in a Zone "A2" area – refer **Table 6**.

The applicable limits for adverse spill light will also depend on the time of operation for the lighting installation, ie Pre-curfew or Curfew hours.

For the Project, it is understood that perimeter lighting will not be incorporated into the Project, but there may some night-time security lighting, suggesting the application of the more restrictive limit relevant to *Curfew hours*.

Accordingly:

- Light spill from the Project onto the facades of the surrounding residential dwellings should be kept below 1 lux during Curfew hours as required by AS/NZS 4282-2023.



6.2 Night-Time Illumination Glare – Assessment and Mitigation

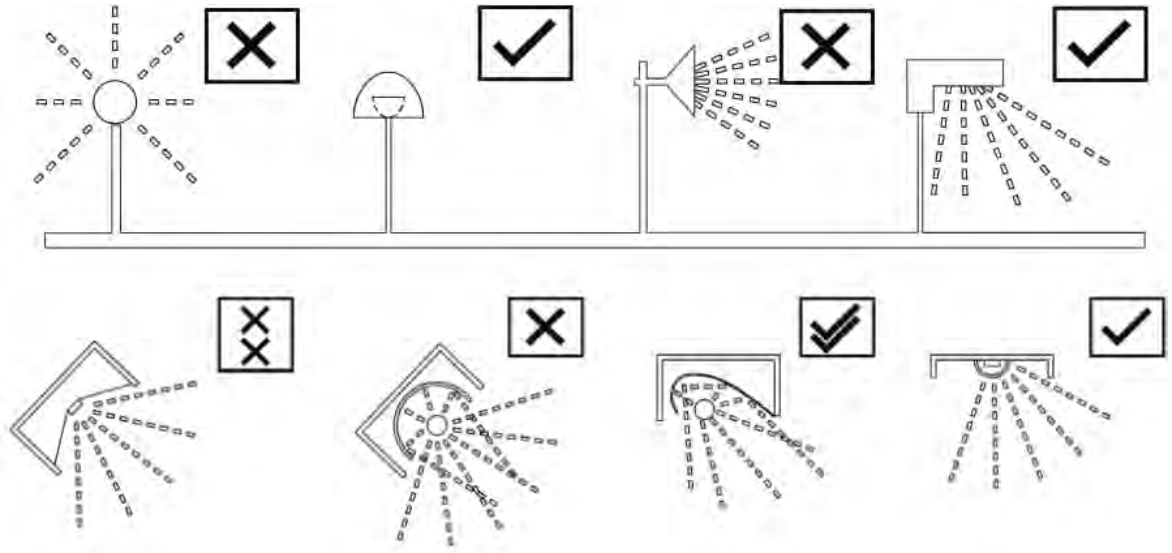
Areas within the Project site have been marked for emergency equipment, fire access routes and egress, etc, and some of these may need to be operational 24/7, potentially requiring some limited night-time security lighting. All night-time security lighting will be motion sensor activated.

The only potential for future night-time illumination glare would be associated with the nearest thoroughfares and residential and other sensitive receivers to the Project.

AS/NZS 4282-2023 sets out general principles that should be applied when designing outdoor light to minimise the potential adverse effects of a light installation - refer **Figure 21**. They are aimed at achieving the best lighting performance (taking into account safety considerations) while having a minimal impact on surrounding properties, carriageways and nocturnal fauna. It is expected that the following will be applied to the design of the project lighting.

- Direct lights downward as much as possible and use luminaires that are designed to minimise light spill, eg full cut-off luminaires where no light is emitted above the horizontal plane, ideally keeping the main beam angle less than 70°. Less spill-light means that more of the light output can be used to illuminate the area and a lower power output can be used, with corresponding energy consumption benefits, but without reducing the illuminance of the area.
- Do not waste energy and increase light pollution by over-lighting.
- Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit.

Figure 21 Luminaire Design Features that Minimise Light Spill (refer AS/NZS 4282-2023, Section A.6.3)



In terms of any future potential night-time lighting, the adopted goal of limiting night-time light spill to no more than 1 lux falling on the nearby residential facades during curfew hours is expected to be **easily achieved** given (i) the distances to the nearest residential and other receivers from the Project's infrastructure, and (ii) the general design principles noted above.

Accordingly, the potential for any future nuisance glare should be NIL.

7.0 Feedback

At SLR, we are committed to delivering professional quality service to our clients. We are constantly looking for ways to improve the quality of our deliverables and our service to our clients. Client feedback is a valuable tool in helping us prioritise services and resources according to our client needs.

To achieve this, your feedback on the team's performance, deliverables and service are valuable and SLR welcome all feedback via https://www.slrconsulting.com/en/feedback. We recognise the value of your time and we will make a $10 donation to our 2023 Charity Partner - Lifeline, for every completed form.

Appendix A Residential Receiver Coordinates

Narrogin Solar Farm

Glint and Glare Assessment

Land Insights

SLR Project No.: 610.031585

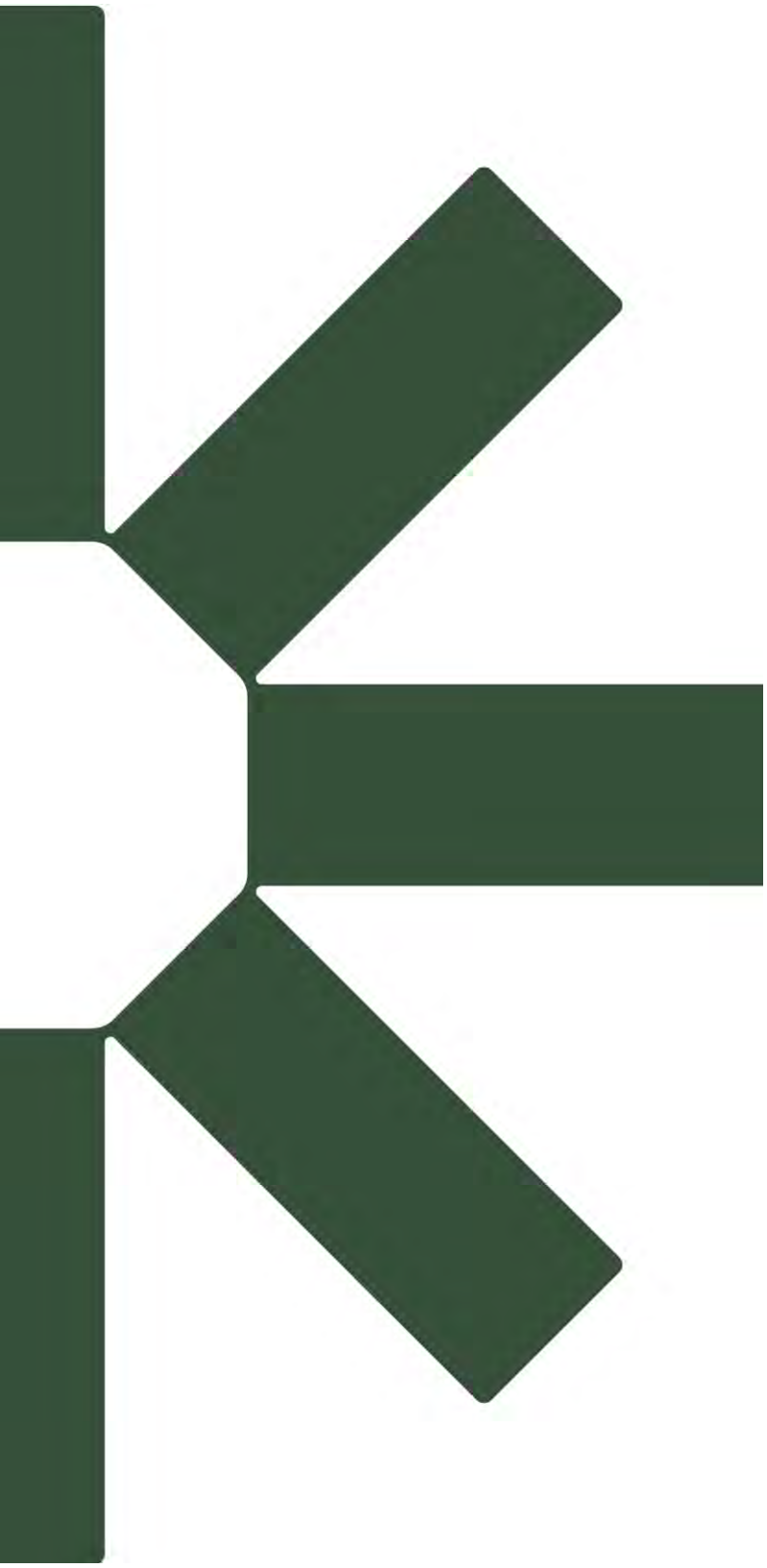
18 December 2023

Revision: R01-v1.1

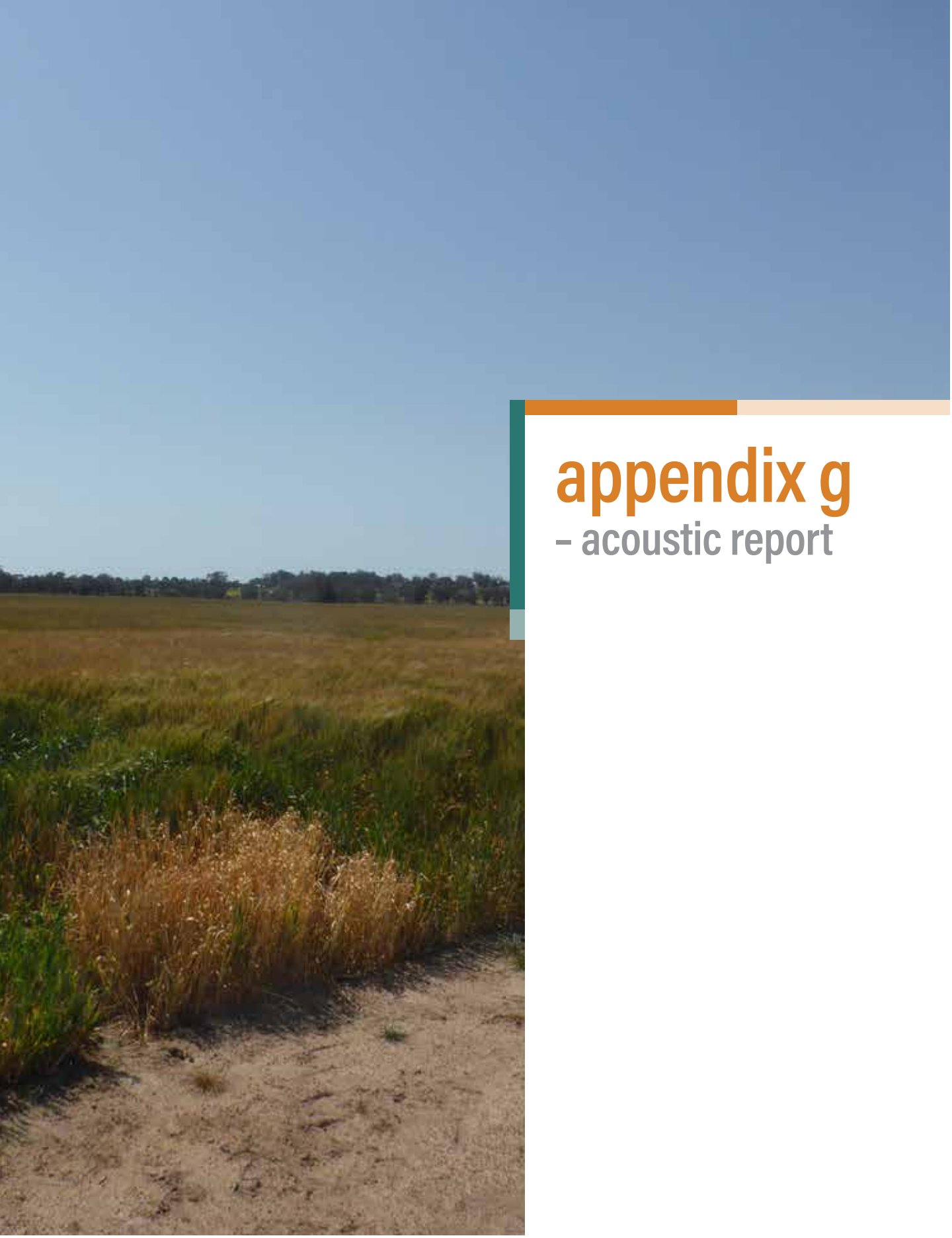
The latitude and longitude coordinates, and elevation height of the representative residential receivers examined in this study are shown in **Table A-1**.

Table A-1 Latitude, Longitude and Elevation of Surrounding Sensitive Receivers

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-33.025196	117.242129	320.36	1.50
OP 2	2	-33.031212	117.230945	307.72	1.50
OP 3	3	-33.034878	117.234101	304.94	1.50
OP 4	4	-33.030714	117.214505	313.02	1.50
OP 5	5	-33.026801	117.215009	322.33	1.50
OP 6	6	-33.026441	117.211683	321.47	1.50
OP 7	7	-33.029154	117.192637	342.24	1.50
OP 8	8	-33.028495	117.192709	340.83	1.50
OP 9	9	-33.009272	117.207393	312.90	1.50
OP 10	10	-33.009164	117.208455	311.28	1.50
OP 11	11	-33.007009	117.209276	312.31	1.50
OP 12	12	-33.007234	117.213237	311.07	1.50
OP 13	13	-33.007202	117.199954	319.62	1.50
OP 14	14	-33.011418	117.165467	345.94	1.50
OP 15	15	-32.996343	117.184099	322.19	1.50
OP 16	16	-33.002857	117.151899	391.73	1.50
OP 17	17	-32.975099	117.157421	373.90	1.50
OP 18	18	-32.970086	117.163558	386.83	1.50
OP 19	19	-32.966399	117.163427	377.47	1.50
OP 20	20	-32.961774	117.163986	386.14	1.50
OP 21	21	-32.964744	117.170727	368.76	1.50
OP 22	22	-32.970640	117.180423	349.92	1.50
OP 23	23	-32.961776	117.184474	386.56	1.50
OP 24	24	-32.965497	117.191694	371.05	1.50
OP 25	25	-32.965196	117.202606	381.43	1.50
OP 26	26	-32.972993	117.204765	375.56	1.50
OP 27	27	-32.975743	117.201285	352.91	1.50
OP 28	28	-32.984590	117.197479	328.08	1.50
OP 29	29	-32.984144	117.218216	362.97	1.50
OP 30	30	-32.991272	117.214044	342.92	1.50
OP 31	31	-32.991632	117.216292	360.14	1.50
OP 32	32	-32.998404	117.216150	329.18	1.50
OP 33	33	-33.011925	117.225115	321.13	1.50
OP 34	34	-33.014127	117.224560	312.67	1.00
OP 35	35	-33.013941	117.231042	329.26	1.50
OP 36	36	-33.017769	117.228819	328.10	1.50



Making Sustainability Happen



appendix g
– acoustic report

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Environmental Noise Assessment - Narrogin Solar and Battery Project

52 Contine Road, Dumberning

Reference: 231084581-01d.docx

Prepared for:
Narrogin Solar Pty Ltd.

Reference: 231084581-01d.docx

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This report has been prepared in accordance with the scope of services described in the contract or agreement between Lloyd George Acoustics Pty Ltd and the Client. The report relies upon data, surveys, measurements and results taken at or under the particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client. Furthermore, the report has been prepared solely for use by the Client, and Lloyd George Acoustics Pty Ltd accepts no responsibility for its use by other parties.

Date	Rev	Description	Author	Verified
10-Jan-24	0	Draft Issued to Client	Rob Connolly	Matt Moyle
16-May-24	A	Increased Plant Numbers and Running Scenarios - Issued to Client	Rob Connolly	Terry George
19-Jul-24	B	Decreased Plant Numbers and New Noise Emission Data - Issued to Client	Rob Connolly	-
7-Oct-24	C	Included use of low pressure drop acoustic louvres.	Rob Connolly	Terry George
24-Oct-24	D	Final Release	Rob Connolly	-

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1. INTRODUCTION

Lloyd George Acoustics was engaged by Narrogin Solar Pty Ltd. to undertake an environmental noise assessment for Narrogin Solar Farm and BESS to be located at and in the vicinity of 52 Contine Road, Dumberning - refer *Figure 1-1*.

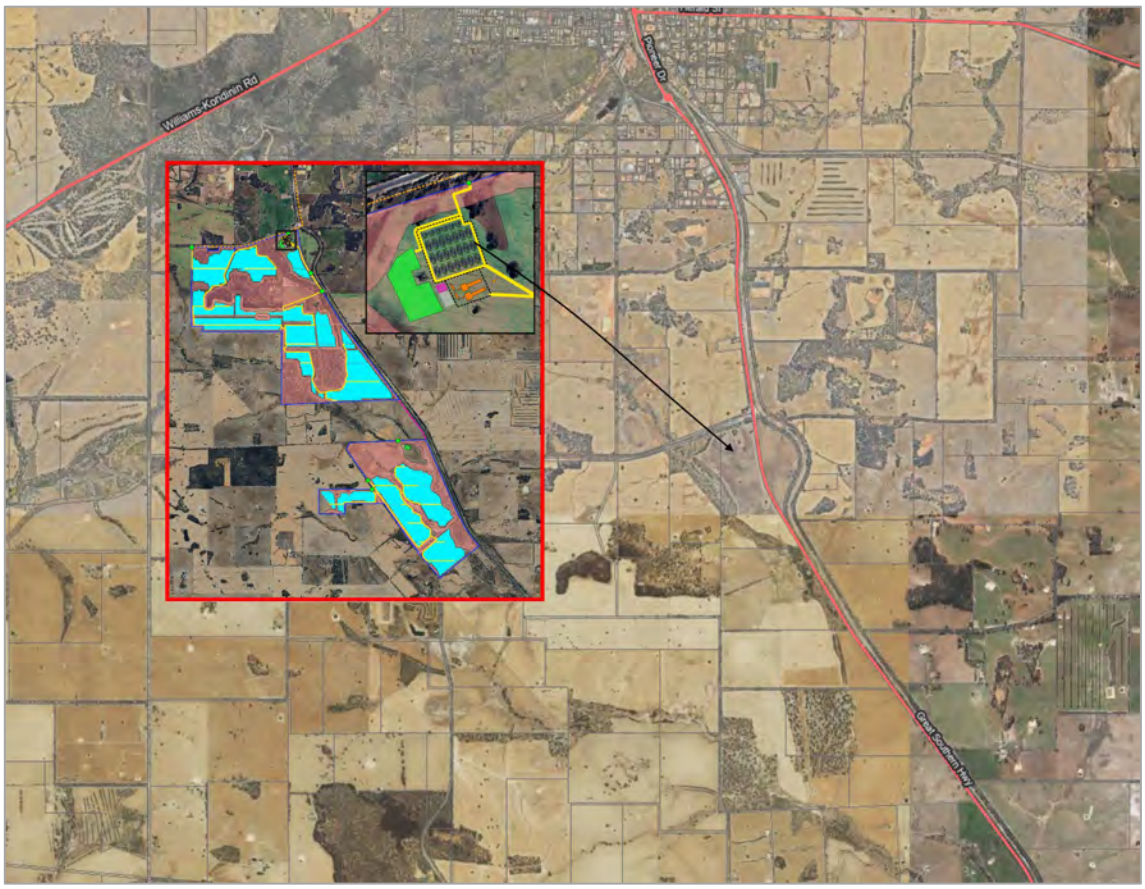


Figure 1-1: Subject Site Location (Source: DPLH PlanWA)

This facility will comprise of approximately 144 battery energy storage systems (BESS) held in 20 foot containers, 48 BESS inverters on 70 skids, 48 solar inverters on skids and two high voltage (HV) substations. HVAC is included within the BESS containers to assist with cooling the equipment, as well as high speed fans on each battery pack. Fan speeds of 100% are considered only likely during the daytime in extreme heat and load conditions, with 80% run speeds expected at other times. A site plan is attached in *Appendix A*.

With regard to noise emissions, consideration is given to noise from the proposed BESS fans, inverter fans units and transformers/substation at neighbouring properties, against the prescribed standards of the *Environmental Protection (Noise) Regulations 1997*.

Appendix B contains a description of some of the terminology used throughout this report.

2. CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations) as follows:

*"**7. Prescribed standard for noise emissions***

(1) Noise emitted from any premises or public place when received at other premises –

(a) must not cause, or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) must be free of –

(i) tonality; and

(ii) impulsiveness; and

(iii) modulation,

when assessed under regulation 9.

(2) For the purposes of subregulation (1)(a), a noise emission is taken to significantly contribute to a level of noise if the noise emission … exceeds a value which is 5 dB below the assigned level at the point of reception."

Tonality, impulsiveness and modulation are defined in regulation 9 (refer *Appendix C*). Under regulation 9(3), *"Noise is taken to be free of the characteristics of tonality, impulsiveness and modulation if -*

(a) the characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) the noise emission complies with the standard prescribed under regulation 7(1)(a) after the adjustments in the table [Table 2-1] … are made to the noise emission as measured at the point of reception."

Table 2-1 Adjustments Where Characteristics Cannot Be Removed

Where Noise Emission is Not Music*			Where Noise Emission is Music	
Tonality	Modulation	Impulsiveness	No Impulsiveness	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

* These adjustments are cumulative to a maximum of 15 dB.

The assigned levels (prescribed standards) for all premises are specified in regulation 8(3) and are shown in *Table 2-2*. The L_{A10} assigned level is applicable to noises present for more than 10% of a representative assessment period, generally applicable to "steady-state" noise sources. The L_{A1} is for short-term noise sources present for less than 10% and more than 1% of the time. The L_{Amax} assigned level is applicable for incidental noise sources, present for less than 1% of the time.

Table 2-2 Baseline Assigned Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial Premises	All hours	60	75	80
Industrial and Utility Premises	All hours	65	80	90

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

The influencing factor (IF), in relation to noise received at noise sensitive premises (refer *Figure 3-2*), has been calculated as 0 dB. *Table 2-3* shows the determined assigned levels at the receiving locations.

Table 2-3 Assigned Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
0 dB IF Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45	55	65
	0900 to 1900 hours Sunday and public holidays (Sunday)	40	50	65
	1900 to 2200 hours all days (Evening)	40	50	55
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35	45	55
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Industrial and Utility Premises	All hours	65	80	90

It must be noted the assigned levels above apply outside the receiving premises and at a point at least 3 metres away from any substantial reflecting surfaces.

The assigned levels are statistical levels and therefore the period over which they are determined is important. The Regulations define the Representative Assessment Period (RAP) as "*a period of time of not less than 15 minutes, and not exceeding 4 hours, determined by* an *inspector* or *authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission"*. An inspector or authorised person is a person appointed under Sections 87 & 88 of the *Environmental Protection Act 1986* and include Local Government Environmental Health Officers and Officers from the Department of Water Environmental Regulation. Acoustic consultants or other environmental consultants are not appointed as an inspector or authorised person. Therefore, whilst this assessment is based on a 4-hour RAP, which is assumed to be appropriate given the nature of the operations, this is to be used for guidance only.

3. NOISE MODELLING METHODOLOGY

Computer modelling has been used to predict the noise emissions from the development to all nearby receivers. The software used was *SoundPLAN 9.0* with the CONCAWE (ISO 17534-3 improved method) selected, as they include the influence of meteorological conditions. Input data required in the model are listed below and discussed in *Section 3.1* to *Section 3.4*:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and
- Source sound power levels.

3.1. Meteorological Conditions

Meteorological information utilised is provided in *Table 3-1* and is considered to represent worst-case conditions for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

Table 3-1: Modelling Meteorological Conditions

Parameter	Day (7.00am to 7.00pm)[2]	Night (7.00pm to 7.00am)[2]
Temperature (°C)	20	15
Humidity (%)	50	50
Wind Speed (m/s)	4	3
Wind Direction[1]	All	All
Pasquil Stability Factor	E	F

Notes:

1. The modelling package allows for all wind directions to be modelled simultaneously.
2. The conditions above are as defined in *Guideline: Assessment of Environmental Noise Emissions*; May 2021

Alternatives to the above default conditions can be used where one year of weather data is available and the analysis considers the worst 2% of the day and night for the month of the year in which the worst-case weather conditions prevail (source: *Draft Guideline on Environmental Noise for Prescribed Premises*, May 2016). In most cases, the default conditions occur for more than 2% of the time and therefore must be satisfied.

3.2. Topographical Data

Topographical data was adapted from publicly available information (e.g. *Google*) in the form of spot heights. The site buildings have been included in the model, including the BESS units, inverters and transformers. Receivers are modelled 1.4m above ground level. The BESS containers have the chiller units located to one end, which are covered by a wire mesh so are treated as acoustically transparent i.e. having no noise attenuation properties. This louvre is taken to cover approximately half of the surface area at this end. There is also a vertical opening mesh area to the north and south sides of BESS container at the chiller, which again are

considered acoustically transparent. The BESS containers are oriented with the chillers located to the south, south-west and south-east. No site perimeter walls are included in the modelling.

Figure 3-1 shows a 3D overview of the noise model, with *Figure 3-2* showing a 2D overview with the nearest residential receivers to the noise emitting equipment included in the model.

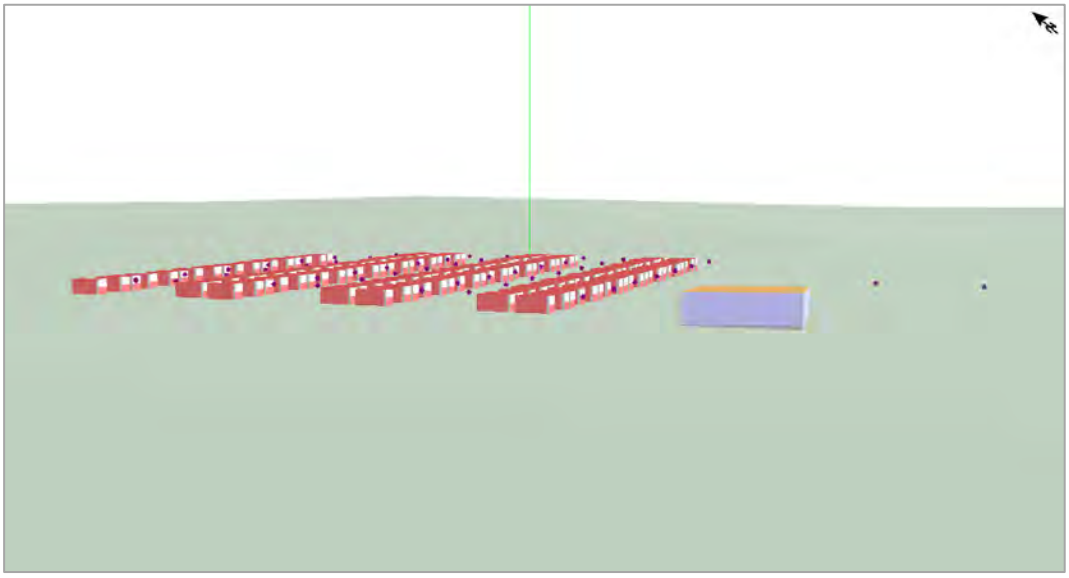


Figure 3-1: 3D Overview of Nearfield Noise Model (note chiller open louvres oriented to S, S/E, S/W)



Figure 3-2: Overview of Nearest Residences

3.3. Ground Absorption

The ground absorption has been assumed to be 0.7 (70%) as an average as it is predominantly paddocks and forest, noting that 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

3.4. Source Sound Levels

The source sound power levels from each side of the BESS and inverters were derived from the Manufacturer's supplied data (*Noise Measurement Test Report for CSI-SolBank-S-5016-2h 4700 kWh with Kelvin/BTMS-600-ES Chiller installed, dated 2024.4.18*) and are provided in *Table 3-2*. HV transformer sound power was derived from *Figure AA1 and AA4 Derivation L_{wA} (Reduced Maximum)* of '*AS2374.6-1994 Power Transformers – Determination to transformer and reactor sound levels'*. The project is in an early stage of development and as such the final selection and number of each type of equipment is subject to change.

Table 3-2: Source Sound Power Levels, dB(A)

Description	A-Weighted Octave Band Centre Frequency (Hz)								Overall dB(A)
	63	125	250	500	1k	2k	4k	8k	
BESS with HVAC/compressors On - 100 Percent Run Speed - ≤150 units									
Container End (S) @ Chiller Louvre, each.	78	92	85	83	82	81	78	72	**88**
Container Sides (S/E, S/W) @ Chiller Louvre, each.	66	79	73	70	69	68	65	59	**75**
Container Sides + Roof Radiated Sound Power, each.	56	69	63	60	59	58	55	49	**65**
BESS & Solar Inverters, 100 Percent Run Speed - 48 BESS units & 48 Solar Inverter units, per unit.	67	67	80	81	82	83	76	76	**88**
BESS with HVAC/compressors On - 80 Percent Run Speed - ≤150 units									
Container End (S) @ Chiller Louvre	74	87	81	78	77	76	73	67	**83**
Container Sides (S/E, S/W) @ Chiller Louvre, each.	66	79	73	70	69	68	65	59	**75**
Container Sides + Roof Radiated Sound Power, each.	56	69	63	60	59	58	55	49	**65**
BESS & Solar Inverters, 80 Percent Run Speed - 48 BESS units & 48 Solar Inverter units, per unit. Note that de-centralised Solar Inverters are off at night-time.	62	62	75	76	77	78	71	71	**83**
Other									
100 MVA HV Transformer, - 2 units, each.	97	99	94	94	88	83	78	71	**94**

The following is noted in relation to *Table 3-2*:

- BESS sound power is based on manufacturers' SPL data at 2m and 15 m distance from source for both 100 percent and 80 percent run-speed;
- Inverter sound power data is calculated based on unit dimensions and SPL data @ distance provided by the manufacturers. Conversion takes place in *SoundPlan 9.0* software;
- The BESS containers are modelled as industrial noise sources with sound power calibrated to the SPL levels;
- Inverters and transformers are modelled as point sources at a height of 2.5 metres above ground height;
- BESS containers are 6.1 m long x 2.44 m wide x 2.9m high;
- BESS Containers have an open wire mesh covered louvre to the south end and two vertical openings on the S/E and S/W end. This is where the chillers are located to cool the batteries. The louvre to the south is modelled as a surface area of 3.7 m^2 with the openings to S/W and S/E modelled as 1.5 m^2 each;
- All sources are modelled to be operating concurrently;
- During normal operations, an L_{10} parameter has been used as these operations are predicted to occur for more than 24-minutes in a 4-hour period.

4. RESULTS

The noise levels were predicted for three scenarios:

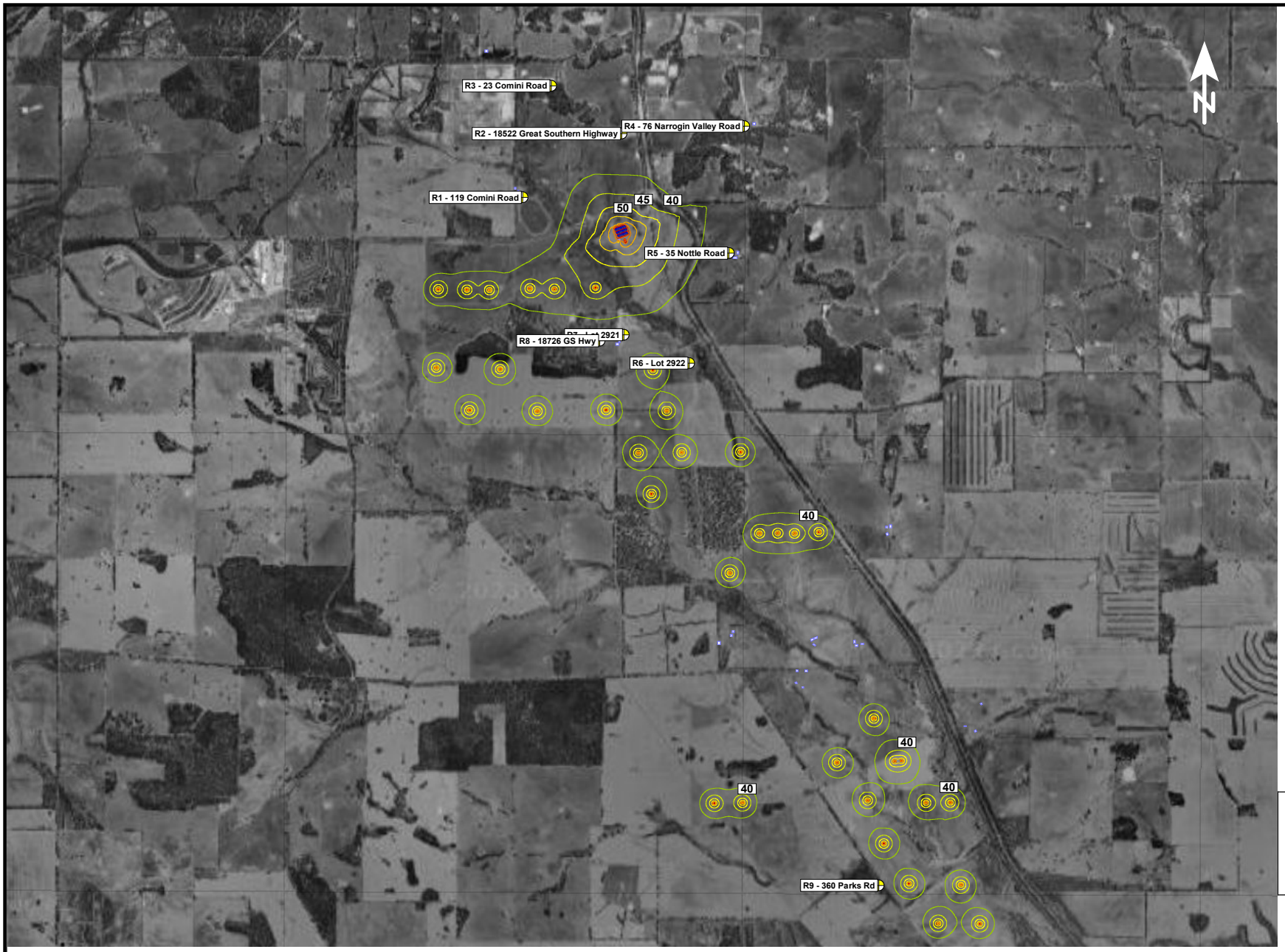
- Scenario 1: Daytime/Evening Worst-Case Operations – All BESS with HVAC/compressors, BESS Inverters, and Solar Inverter running at 100 percent with HV transformer substations concurrently operating (L_{10}). Meteorological conditions are set to daytime.
- Scenario 2: Daytime/Evening Reduced Operations – All BESS with HVAC/compressors, BESS Inverters, and Solar Inverter running at 80 percent with HV transformer substations concurrently operating (L_{10}). Meteorological conditions are set to daytime.
- Scenario 3: Night-time Operations – All BESS with HVAC/compressors and BESS Inverters running at 80 percent, distributed solar Inverter off with HV transformer substations concurrently operating (L_{10}). Meteorological conditions are set to night-time.

The results for Scenarios 1 to 3 are provided in *Table 4-1*. Noise contour plots are also provided in *Figure 4-1* to *Figure 4-3* showing noise levels at ground floor.

Table 4-1: Scenario 1-3 Predicted Levels, dB(A)

Receiver	Scenario 1 (L_{10})	Scenario 2 (L_{10})	Scenario 3 (L_{10})
R1 - 119 Comini Road	33	29	29
R2 - 18522 Great Southern Highway	34	31	31
R3 - 23 Comini Road	28	24	25
R4 - 76 Narrogin Valley Road	26	23	23
R5 - 35 Nottle Road	36	32	32
R6 - Lot 2922	35	31	29
R7 - Lot 2921	37	34	34
R8 - 18726 Great Southern Highway	37	33	33
R9 - 360 Parks Road	35	29	4

Figure 4-1



Predicted Noise level
L_{A10} dB

- = 40
- = 45
- = 50
- = 55
- = 60
- = 65
- = 70

N

Signs and symbols

- Industrial Source
- Point source
- Receiver
- Building

Scale 1:50000

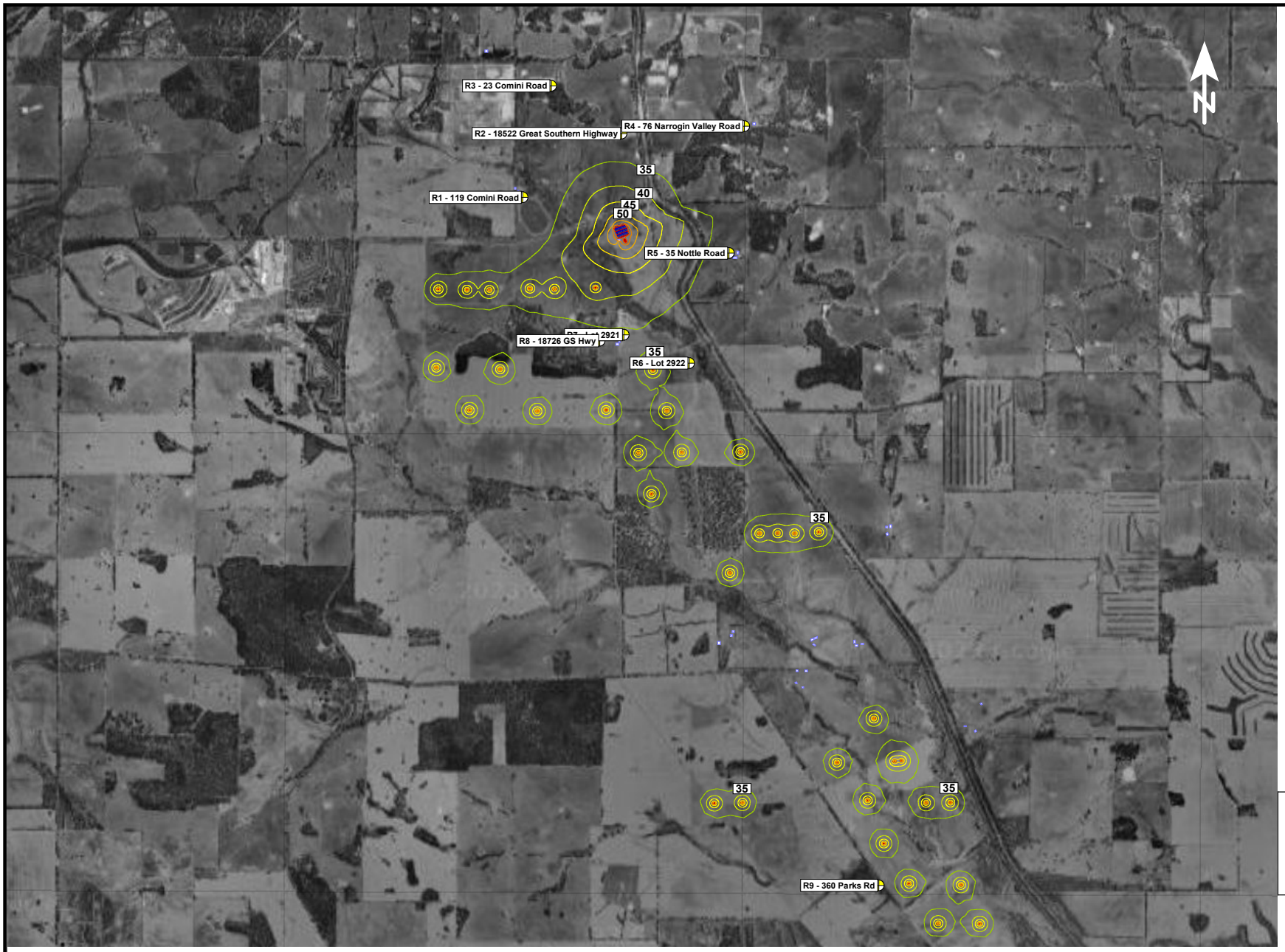
0 0.25 0.5 1 1.5 2 km

Narrogin Solar Farm – Daytime Worst Case Operations - Predicted Noise Levels

L_{A10} Noise Level Contours - All BESS, All BESS & Solar Inverters, HV Transformers Active At 100 Percent
No Tonality Penalty Included - 1.5m Above Ground

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Figure 4-2



Predicted Noise level
L_{A10} dB

- = 35
- = 40
- = 45
- = 50
- = 55
- = 60
- = 65

N

Signs and symbols

- Industrial Source
- Point source
- Receiver
- Building

Scale 1:50000

0 0.25 0.5 1 1.5 2 km

Narrogin Solar Farm – Daytime/Evening Reduced Operations - Predicted Noise Levels

L_{A10} Noise Level Contours - All BESS 80 Percent, All Inverters 80 Percent, HV Transformers 100 Percent
No Tonality Penalty Included - 1.5m Above Ground

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Figure 4-3



Predicted Noise level
L_{A10} dB

- = 30
- = 35
- = 40
- = 45
- = 50
- = 55
- = 60

N

Signs and symbols

- Industrial Source
- Point source
- Receiver
- Building

Scale 1:50000

0 0.25 0.5 1 1.5 2 km

Narrogin Solar Farm – Night-time Reduced Operations - Predicted Noise Levels

L_{A10} Noise Level Contours - All BESS 80 Percent, All BESS Inverters 80 Percent, HV Transformers 100 Percent
No Tonality Penalty Included - 1.5m Above Ground

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5. ASSESSMENT

5.1. Scenario 1 – Daytime/Evening Worst-Case Operations

Table 5-1 provides the noise levels for Scenario 1, for worst-case daytime operations. Intrusive noise characteristics may exist; so noise levels are adjusted by +5 dB for possible tonal characteristics, however tonality is generally less detectable during the daytime period as a result of the expected higher background noise levels.

Table 5-1: Scenario 1 Worst-Case Operations: Daytime/Evening Assessment, dB L_{A10}

Receiver	Predicted Total	Adjusted Level*	Assigned Day Level	Assigned Sunday/Evening Level	Assessment
R1 - 119 Comini Road	33	**38**	45	40	*Complies / Complies*
R2 - 18522 Great Southern Highway	34	**39**	45	40	*Complies / Complies*
R3 - 23 Comini Road	28	**33**	45	40	*Complies / Complies*
R4 - 76 Narrogin Valley Road	26	**31**	45	40	*Complies / Complies*
R5 - 35 Nottle Road	36	**41**	45	40	*Complies / +1 dB*
R6 - Lot 2922	35	**40**	45	40	*Complies / Complies*
R7 - Lot 2921	37	**42**	45	40	*Complies / +2 dB*
R8 - 18726 Great Southern Highway *(involved landowner)*	37	**42**	45	40	*Complies / +2 dB*
R9 - 360 Parks Road	35	**40**	***45***	***40***	*Complies / Complies*

* Adjusted by + 5 dB for tonality

As can be seen, compliance is achieved at all of the 9 identified receivers during the daytime, however there are exceedances predicted at 3 of the 9 identified noise sensitive receivers during Sunday/evening period, noting these exceedances wouldn't exist if the noise was not assessed as tonal. All three of these exceedances are marginal, being 1-2 dB above the assigned level. Advice is presented in *Section 7* to mitigate the noise, so as to meet the criteria.

5.2. Scenario 2 – Daytime/Evening Reduced Operations

Table 5-2 provides the noise levels for Scenario 2, for reduced daytime operations. Intrusive noise characteristics may exist; so noise levels are adjusted by +5 dB for possible tonal characteristics, however tonality is generally less detectable during the daytime period as a result of the expected higher background noise levels.

Table 5-2: Scenario 2 Reduced Operations: Daytime/Evening Assessment, dB L_{A10}

Receiver	Predicted Total	Adjusted Level*	Assigned Day Level	Assigned Sunday/Evening Level	Assessment
R1 - 119 Comini Road	29	**34**	45	40	*Complies / Complies*
R2 - 18522 Great Southern Highway	31	**36**	45	40	*Complies / Complies*
R3 - 23 Comini Road	24	**29**	45	40	*Complies / Complies*
R4 - 76 Narrogin Valley Road	23	**28**	45	40	*Complies / Complies*
R5 - 35 Nottle Road	32	**37**	45	40	*Complies / Complies*
R6 - Lot 2922	31	**36**	45	40	*Complies / Complies*
R7 - Lot 2921	34	**39**	45	40	*Complies / Complies*
R8 - 18726 Great Southern Highway *(involved landowner)*	33	**38**	45	40	*Complies / Complies*
R9 - 360 Parks Road	29	**34**	45	40	*Complies / Complies*

* Adjusted by + 5 dB for tonality

As can be seen, compliance is achieved at all of the 9 identified receivers during the daytime and Sunday/evening period with 80 percent runspeed, being the most common scenario.

5.3. Scenario 3 – Night-time Operations

Table 5-3 provides the noise levels for Scenario 3, for night-time operations. Intrusive noise characteristics are expected; so noise levels are adjusted by +5 dB for possible tonal characteristics.

Table 5-3: Scenario 3 Night-time Assessment, dB L_{A10}

Receiver	Predicted Total	Adjusted Level*	Assigned Day Level	Assessment
R1 - 119 Comini Road	29	**34**	35	*Complies*
R2 - 18522 Great Southern Highway	31	**36**	35	*+1 dB*
R3 - 23 Comini Road	25	**30**	35	*Complies*
R4 - 76 Narrogin Valley Road	23	**28**	35	*Complies*
R5 - 35 Nottle Road	32	**37**	35	*Complies*
R6 - Lot 2922	29	**34**	35	*Complies*
R7 - Lot 2921	34	**39**	35	*+4 dB*
R8 - 18726 Great Southern Highway (involved landowner)	33	**38**	35	*+3 dB*
R9 - 360 Parks Road	4	**9**	35	*Complies*

* Adjusted by + 5 dB for tonality

As can be seen, there are exceedances during the night-time period at 6 of the 9 identified noise sensitive receivers, with 1 being marginal at +1dB. Advice is presented in *Section 7* to mitigate the noise, so as to meet the criteria.

6. DISCUSSION

Table 6-1 provides a breakdown of the noise contribution of each source group type at each of the 8 identified noise sensitive receivers for the worst-case operations during the daytime period. Note that no tonal penalty is applied to the predicted noise levels. It is noted that for the most part, the BESS are the dominant noise source followed by the BESS Inverters.

Table 6-1: Breakdown of Noise Source Group Contributions, dB L_{A10}

Receiver	BESS	BESS Inverters	Solar Inverters	HV Transformers	Total
R1 - 119 Comini Road	**29**	**29**	25	24	**33**
R2 - 18522 Great Southern Highway	**31**	29	17	24	**34**
R3 - 23 Comini Road	**24**	**24**	15	18	**28**
R4 - 76 Narrogin Valley Road	20	**23**	13	22	**26**
R5 - 35 Nottle Road	**35**	28	20	25	**36**
R6 - Lot 2922	31	26	**32**	21	**35**
R7 - Lot 2921	**36**	29	28	26	**37**
R8 - 18726 Great Southern Highway	**35**	28	30	25	**37**
R9 - 360 Parks Road	6	-	**35**	-	**35**

The dominant noise impact at the majority of NSR's is from the BESS units, followed by the BESS located inverters.

7. NOISE MITIGATION

To achieve compliance at all times, up to a 4 dB reduction is required to the overall L_{A10} noise levels at some of the noise sensitive receptors. This can be achieved by replacing the current open mesh covered louvres to the chiller end and the partial NW/SW side openings with *Fantech* (or equivalent) low pressure loss acoustic louvres model #ASB or similar with the following minimum insertion loss, refer *Table 7-1*. Note that all air gaps will need to be sealed with acoustic grade sealant to ensure that there is no noise leakage through any other area of the container other than radiated noise from the container itself, currently assessed as having a sound power of L_{wA} 65 dB.

Table 7-1: Minimum Static Insertion Loss dB, Octave Band Centre Frequency (Hz)

Description	Minimum Static Insertion Loss dB, Octave Band Centre Frequency (Hz)								Overall dB(A)
	63	125	250	500	1k	2k	4k	8k	
Fantech ASB Acoustic Louvre	1	3	7	11	12	10	10	9	

8. POST MITIGATION WORKS RESULTS

The results for Scenarios 1 to 3 with the addition of acoustic louvres to all air intake/outlets with minimum insertion loss as specified, refer *Table 8-1*, are provided in *Table 8-1*.

Table 8-1: Scenario 1-3 Predicted Levels, dB(A)

Receiver	Scenario 1 with Acoustic Louvre (L_{10})	Scenario 2 with Acoustic Louvre (L_{10})	Scenario 3 with Acoustic Louvre (L_{10})	Assessment
R1 - 119 Comini Road	37	33	33	*Complies at all times*
R2 - 18522 Great Southern Highway	36	33	33	*Complies at all times*
R3 - 23 Comini Road	32	28	28	*Complies at all times*
R4 - 76 Narrogin Valley Road	30	27	27	*Complies at all times*
R5 - 35 Nottle Road	37	33	33	*Complies at all times*
R6 - Lot 2922	39	34	31	*Complies at all times*
R7 - Lot 2921	39	35	34	*Complies at all times*
R8 - 18726 Great Southern Highway	39	35	34	*Complies at all times*
R9 - 360 Parks Road	40	34	7	*Complies at all times*

9. POST MITIGATION WORKS RESULTS

With the proposed works, refer Section 7 the resultant noise impact at all 9 identified noise sensitive receivers is predicted to be compliant, refer Section 8.

LGA understands from other projects that the highest usage time is generally in the evening, however inverters could still run at up to 80% load at night-time. During detailed design it is assumed that more detailed usage periods, load and noise data would be available, meaning that the scenarios could be remodelled with greater precision, which may result in lower noise emissions.

It is worth noting that the investigation is inherently conservative, in that it assumes that all plant are concurrently operational, downwind conditions are occurring and tonality is present. Given the distances between the BESS and NSR's, there is a reasonable possibility that tonality may not be evident and may not be applicable as a noise characteristic penalty. This will be in part dependent on current background noise levels, which are unknown as no noise monitoring has been undertaken.

Appendix A – Development Plans

Narrogin Solar Farm Overview

- Project Boundary
- Restricted Area
- Site Access
- Access Roads
- Switchyard

BESS Layout

- Inverter
- Battery Container
- Solar Array
- Proposed Substation Easement Route
- Project Connection Easement
- Fences
- Construction & Laydown Areas
- O&M Building
- Parking Area
- Water Tank

Prepared by: Juan Nasta
Date: 17/10/2024
References: OpenStreetMap and its contributors, Western Australia Land Information Authority, Google Satellite, RenewMap.

PRIVATE AND CONFIDENTIAL

0 500 1,000 m

ACE POWER
Australian Clean Energy

Appendix B – Terminology

The following is an explanation of the terminology used throughout this report:

- **Decibel (dB)**

The decibel is the unit that describes the sound pressure levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

- **A-Weighting**

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A, dB.

- **Sound Power Level (L_w)**

Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure level at known distances. Noise modelling incorporates source sound power levels as part of the input data.

- **Sound Pressure Level (L_p)**

The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc. and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

- **L_{ASlow}**

This is the noise level in decibels, obtained using the A-frequency weighting and the S (slow) time weighting. Unless assessing modulation, all measurements use the slow time weighting characteristic.

- **L_{AFast}**

This is the noise level in decibels, obtained using the A-frequency weighting and the F (fast) time weighting. This is used when assessing the presence of modulation.

- **L_{APeak}**

This is the greatest absolute instantaneous sound pressure level in decibels using the A-frequency weighting.

- **L_{Amax}**

An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

- **L_{A1}**

The L_{A1} level is the A-weighted noise level exceeded for 1 percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

- **L_{A10}**

The L_{A10} level is the A-weighted noise level exceeded for 10 percent of the measurement period and is considered to represent the “intrusive” noise level.

- **L_{A90}**

The L_{A90} level is the A-weighted noise level exceeded for 90 percent of the measurement period and is considered to represent the “background” noise level.

- **L_{Aeq}**

The equivalent steady state A-weighted sound level (“equal energy”) in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the “average” noise level.

- **One-Third-Octave Band**

Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20000 Hz inclusive.

- **Representative Assessment Period**

Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

- **L_{Amax} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded at any time.

- **L_{A1} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded for more than 1 percent of the representative assessment period.

- **L_{A10} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded for more than 10 percent of the representative assessment period.

- **Tonal Noise**

A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

– the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

- **Modulating Noise**

A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

– a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band; and

(b) is present for at least 10% of the representative assessment period; and

(c) is regular, cyclic and audible.

- **Impulsive Noise**

An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness means:

– a variation in the emission of a noise where the difference between L_{Apeak} and L_{Amax} is more than 15 dB when determined for a single representative event.

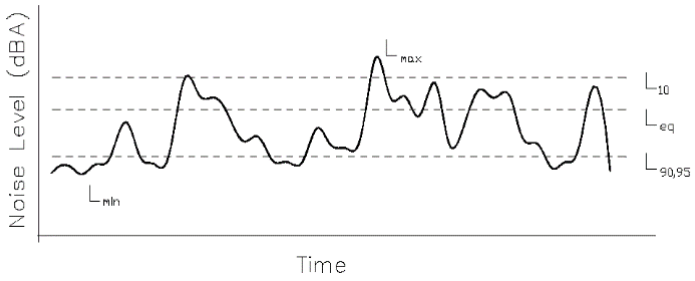
- **Major Road**

Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

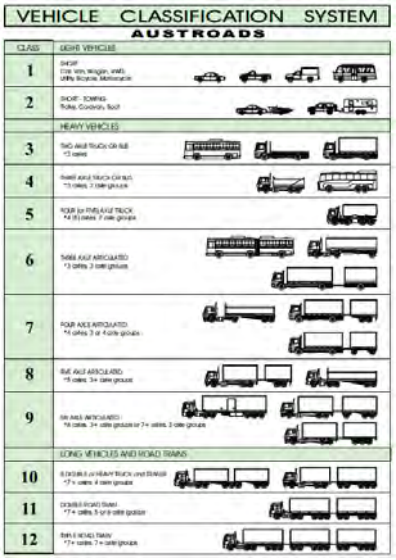
- **Secondary / Minor Road**

Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

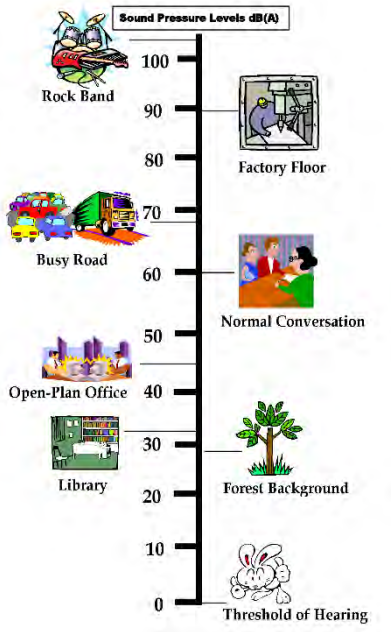
- **Chart of Noise Level Descriptors**

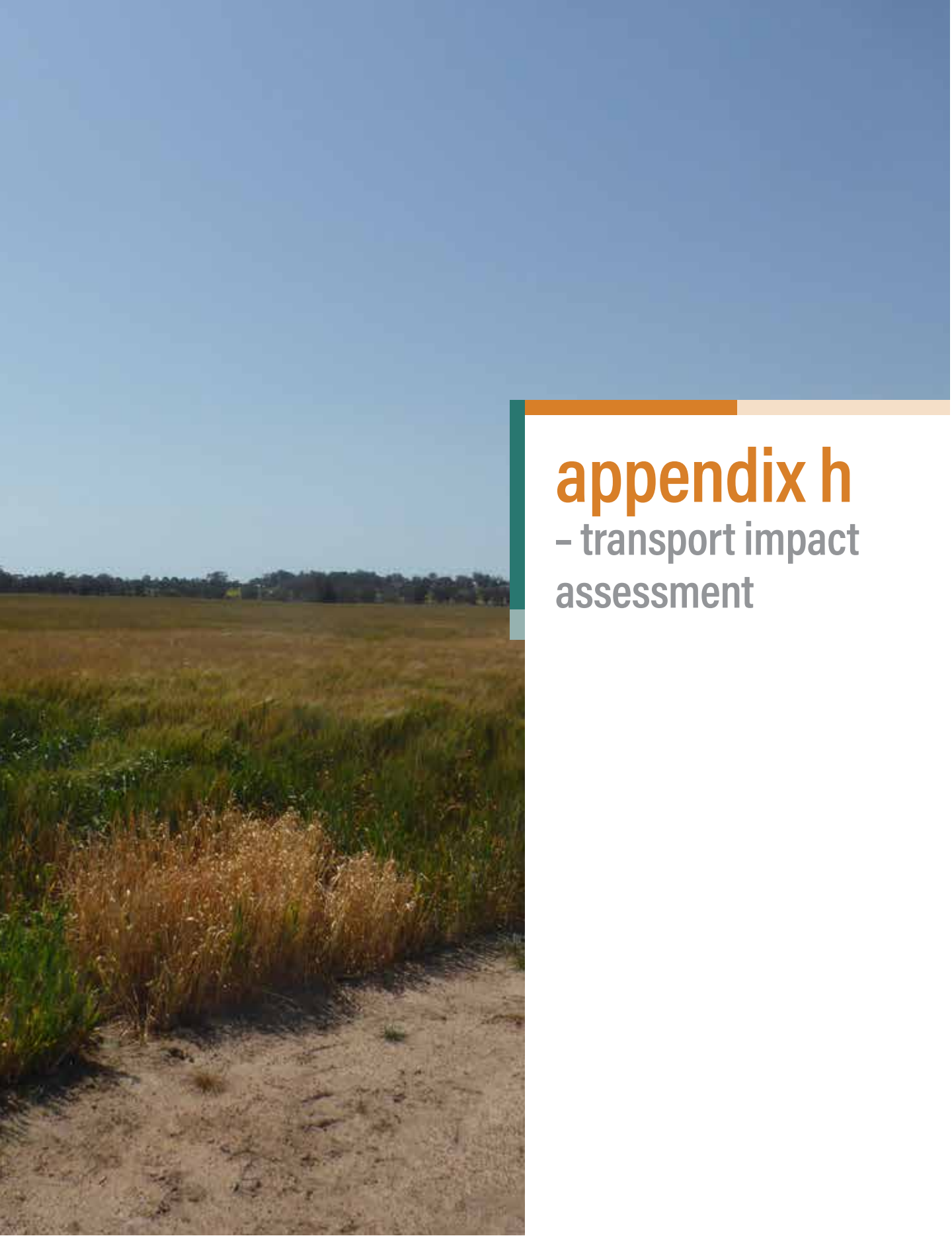


- **Austroads Vehicle Class**



- **Typical Noise Levels**





appendix h

– transport impact assessment



Transport Impact Assessment

Project:	Proposed Narrogin Solar Pty Ltd Great Southern Highway, Narrogin
Client:	Land Insights
Author:	Liomar De Leon
Date:	7th November 2024
Shawmac Document #:	2311003-TIS-001

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C	L. De Leon	-	L. De Leon	04/09/2024
D	L. De Leon	P. Nguyen	L. De Leon	07/11/2024

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1 Introduction

1.1 Proponent

Narrogin Solar Pty Ltd are proposing to establish a Solar farm and Batter storage system to the south of Narrogin, Western Australia.

Shawmac Pty Ltd has been engaged to prepare a Transport Impact Statement (TIS) in accordance with the Western Australian Planning Commission (WAPC) *Transport Impact Assessment Guidelines Volume 4 – Individual Developments*. The assessment considers the following key matters:

- Details of the proposed development.
- Vehicle access and parking.
- Provision for service vehicles.
- Hours of operation.
- Daily traffic volumes and vehicle types.
- Traffic management on frontage streets.
- Site specific and safety issues.

1.2 Site Location

The development is separated into two sites west of Great Southern Highway in Dumberning and Highbury to the south of Narrogin. The local authority is the Shire of Narrogin.

The general site location is shown in Figure 1. An aerial view of the existing site is shown in Figure 2.

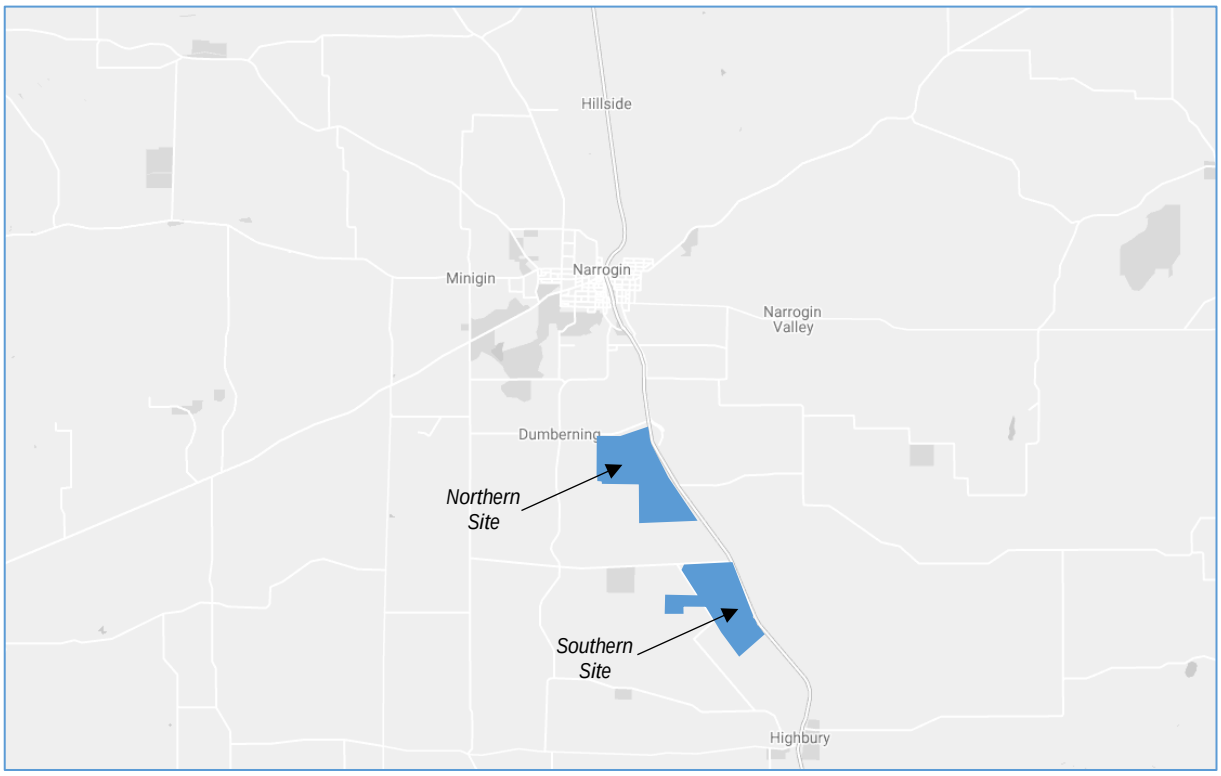


Figure 1: Site Location

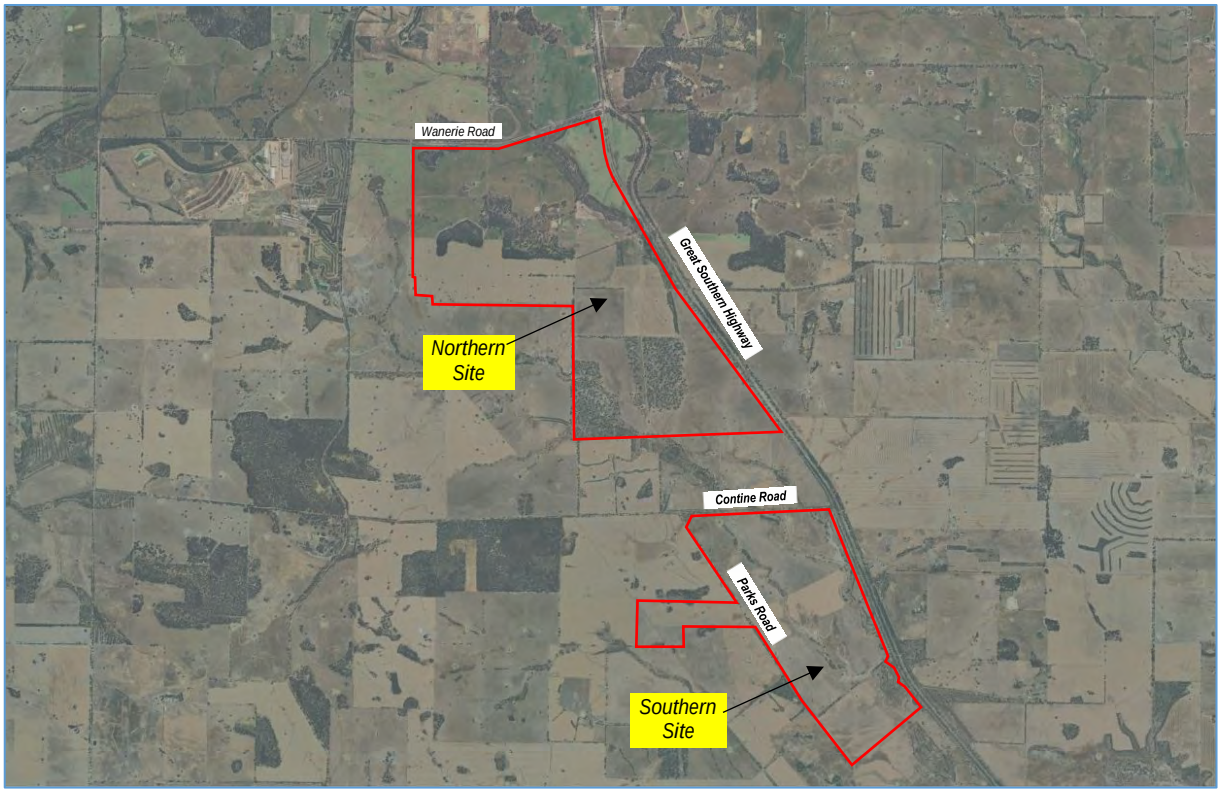


Figure 2: Aerial View

2 Proposed Development

2.1 Land Use

The proposed development is a Solar farm and Battery storage system. The project will be split into two sites. The northern site will be located at the corner of Great Southern Highway and Wanerie Road. The southern site will be located south of Contine Road.

The preliminary site plan is shown in Figure 3.

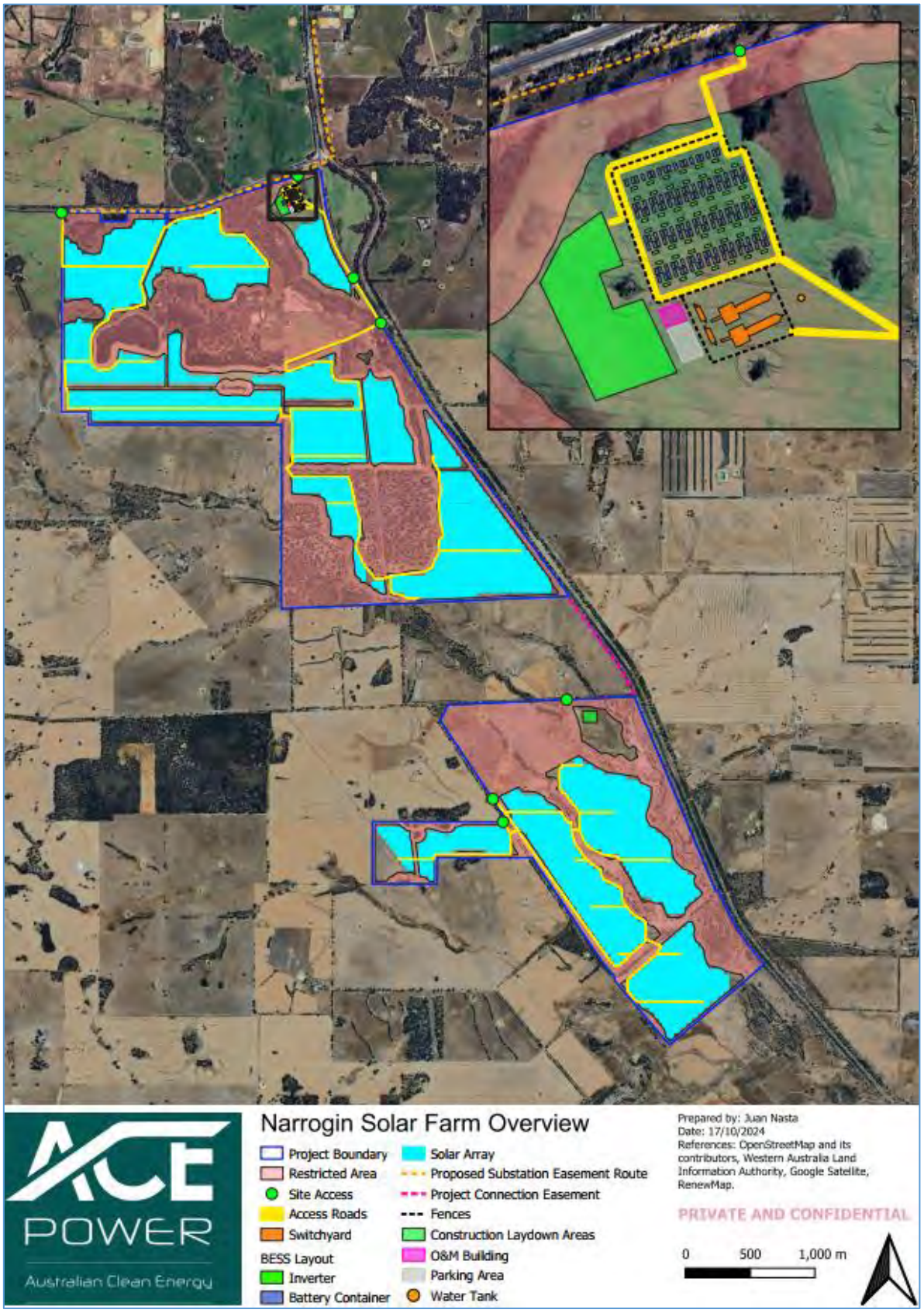


Figure 3: Site Layout

3 Traffic Management on Frontage Streets

3.1 Road Network

The layout and hierarchy of the existing local road network according to the Main Roads WA *Road Information Mapping System* is shown in Figure 4.

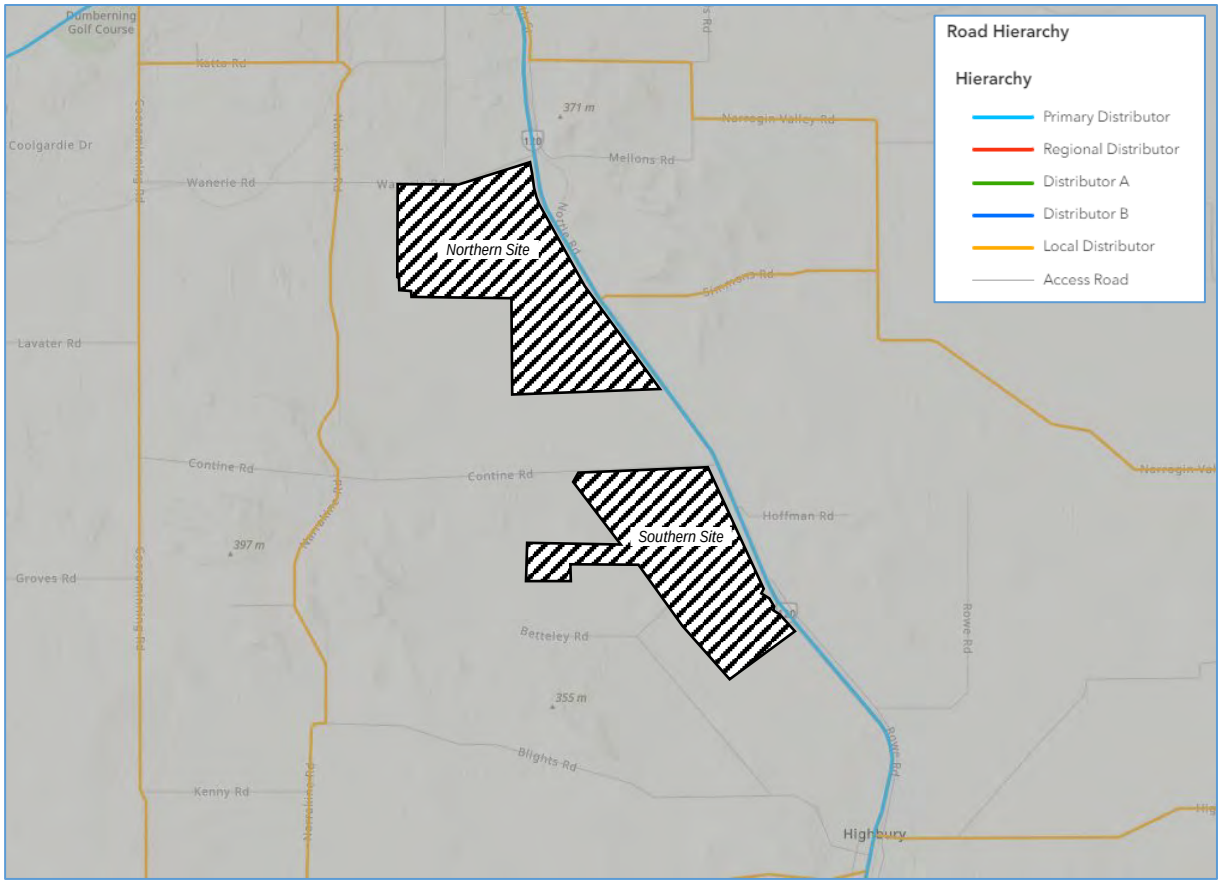


Figure 4: Existing Road Network Hierarchy

As shown, each site has frontages to Great Southern Highway which is a Primary Distributor Road controlled by Main Roads WA. The adjacent section of Great Southern Highway is currently constructed as a two-lane, single carriageway road.

The northern site has frontage to Wanerie Road which is an Access Road and is currently constructed as a two-lane, single carriageway road.

The southern site has frontage to Contine Road and Parks Road which is an Access Road and is currently constructed as an unsealed road.

Wanerie Road, Contine Road and Parks Road are under the jurisdiction of the Shire of Narrogin.

3.2 Speed Limits

The existing speed limits on the surrounding roads are shown in Figure 5.

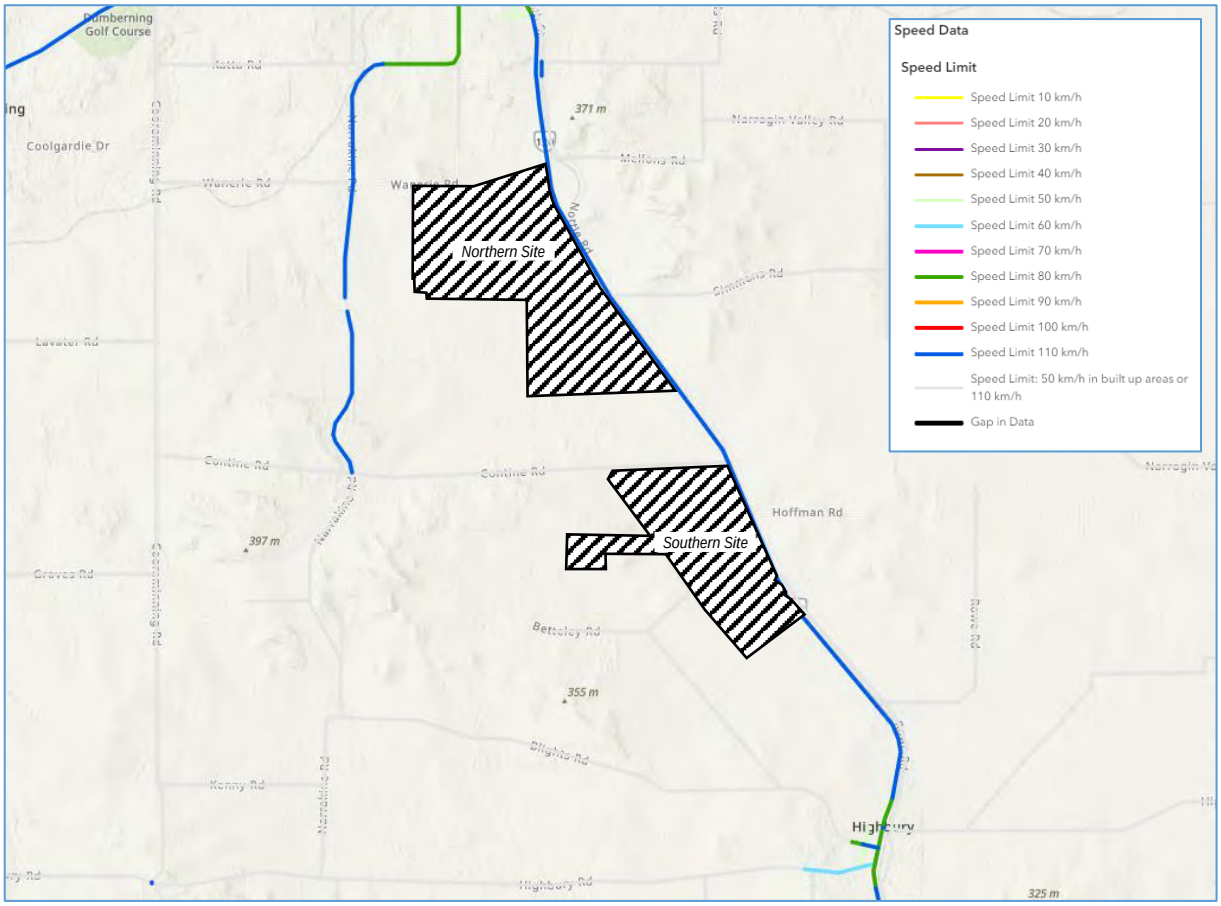


Figure 5: Existing Speed Limits

As shown, Great Southern Highway is operating at a 110km/h speed limit. Wanerie Road will also be operating on a 110km/h speed limit as it is located outside built up areas.

Contine Road and Park roads are currently unsealed roads. It is anticipated that drivers will be travelling at a reduced speed under the conditions of the roads.

3.3 Traffic Volumes

The available traffic volumes sourced from Main Roads WA's Traffic Map of the surrounding network are shown in Figure 6.

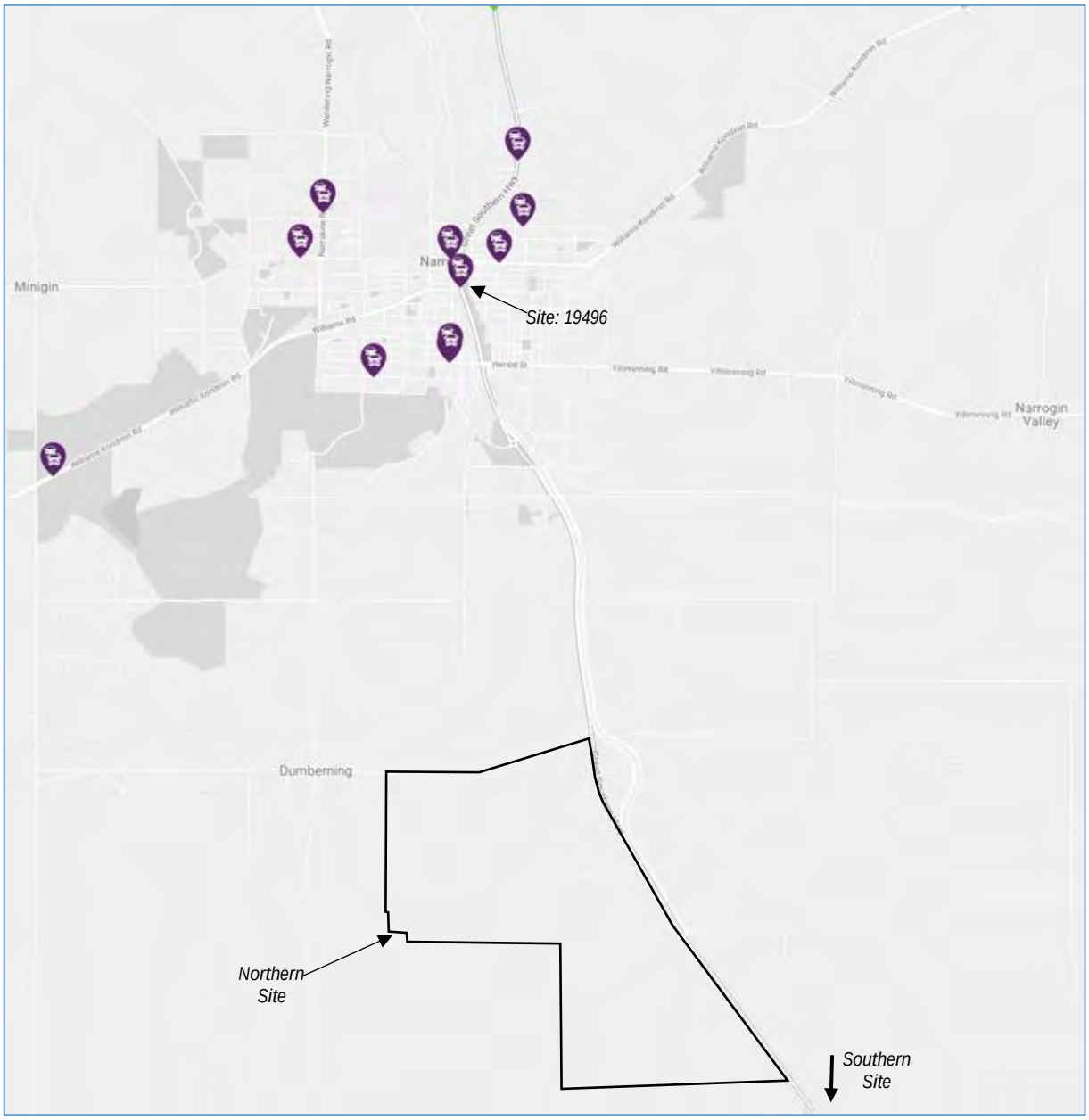
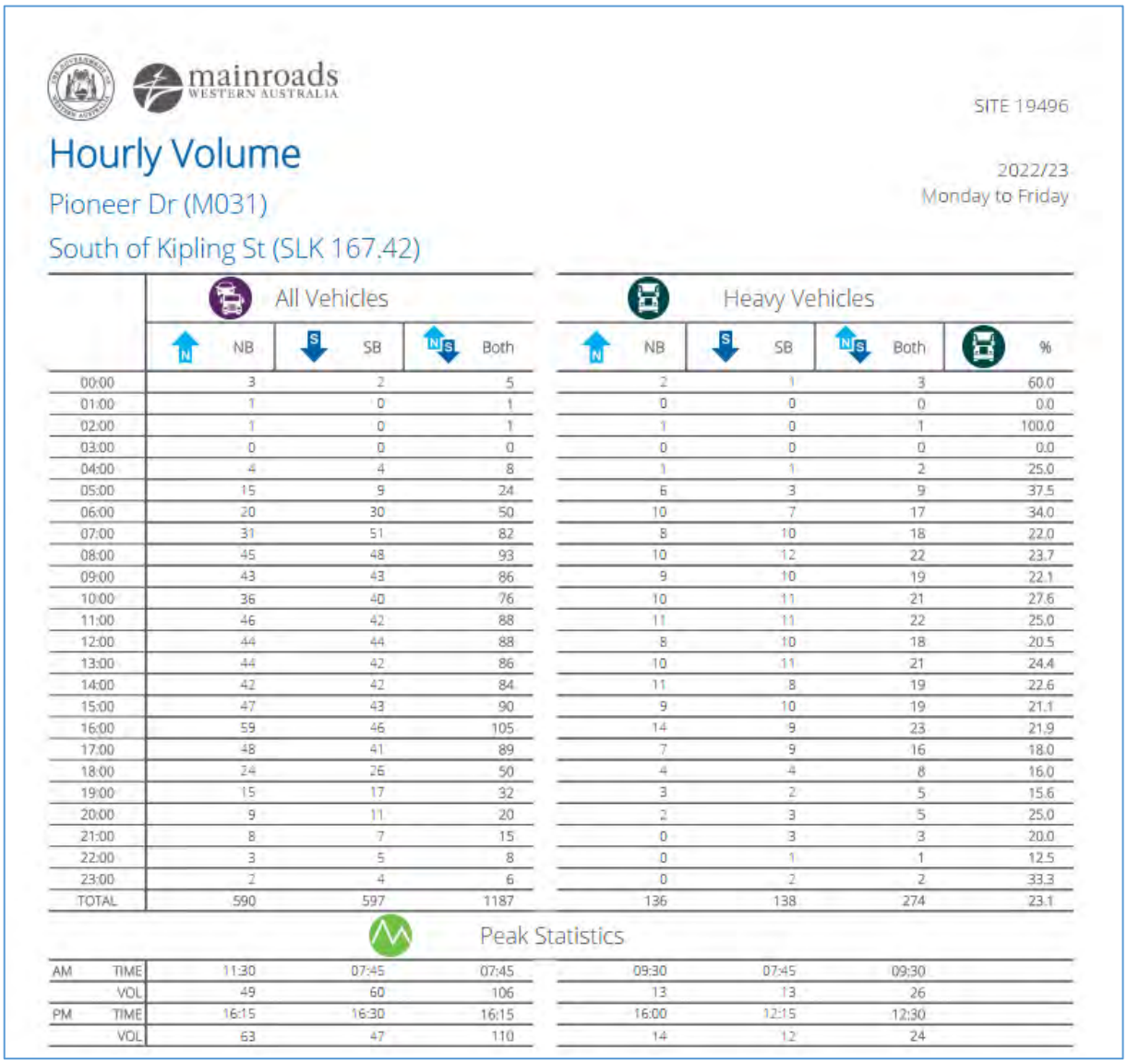


Figure 6: MRWA Trafficmap Available Traffic Volumes

In the absence of traffic volumes near the site, the traffic count on Great Southern Highway / Pioneer Road in Narrogin (Site ID:19496) has been used for assessment as shown in Figure 7. The actual volumes in the vicinity of the proposed project are likely to be lower.



mainroads WESTERN AUSTRALIA

SITE 19496

Hourly Volume

Pioneer Dr (M031)

South of Kipling St (SLK 167.42)

2022/23

Monday to Friday

	All Vehicles			Heavy Vehicles			
	NB	SB	Both	NB	SB	Both	%
00:00	3	2	5	2	1	3	60.0
01:00	1	0	1	0	0	0	0.0
02:00	1	0	1	1	0	1	100.0
03:00	0	0	0	0	0	0	0.0
04:00	4	4	8	1	1	2	25.0
05:00	15	9	24	6	3	9	37.5
06:00	20	30	50	10	7	17	34.0
07:00	31	51	82	8	10	18	22.0
08:00	45	48	93	10	12	22	23.7
09:00	43	43	86	9	10	19	22.1
10:00	36	40	76	10	11	21	27.6
11:00	46	42	88	11	11	22	25.0
12:00	44	44	88	8	10	18	20.5
13:00	44	42	86	10	11	21	24.4
14:00	42	42	84	11	8	19	22.6
15:00	47	43	90	9	10	19	21.1
16:00	59	46	105	14	9	23	21.9
17:00	48	41	89	7	9	16	18.0
18:00	24	26	50	4	4	8	16.0
19:00	15	17	32	3	2	5	15.6
20:00	9	11	20	2	3	5	25.0
21:00	8	7	15	0	3	3	20.0
22:00	3	5	8	0	1	1	12.5
23:00	2	4	6	0	2	2	33.3
TOTAL	590	597	1187	136	138	274	23.1

Peak Statistics

AM	TIME	11:30	07:45	07:45	09:30	07:45	09:30
	VOL	49	60	106	13	13	26
PM	TIME	16:15	16:30	16:15	16:00	12:15	12:30
	VOL	63	47	110	14	12	24

Figure 7: Great Southern Highway / Pioneer Drive (South of Kipling Street) Traffic Volumes – Average Weekend

According to Austroads *Guide to Traffic Management Part 3: Transport Study and Analysis Methods*, the capacity of a two-lane highway is 1,700 passenger cars per hour for each direction of travel. The above volumes are well within the capacity of Great Southern Highway.

3.4 RAV Network

The Tandem Drive Restricted Access Vehicle (RAV) network according to MRWA's Heavy Vehicle Services (HVS) network mapping tool is shown in Figure 8.

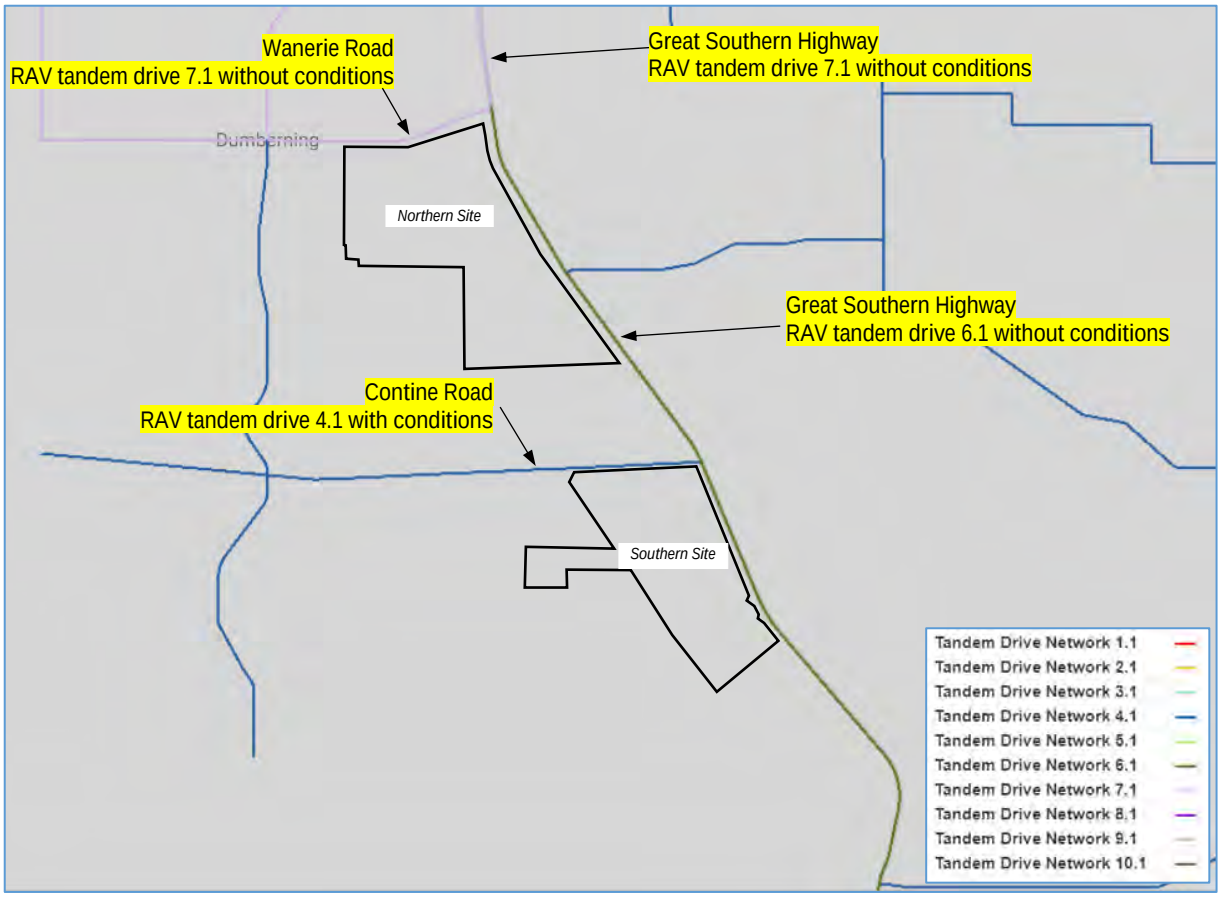


Figure 8: Existing Tandem Drive RAV Network

Contine Road permits RAVs up to Tandem Drive 4.1 with the following conditions:

- Headlights to be switched on at all times.
- No operation on unsealed road segment when visibly wet, without road owner's approval.
- Note: Low Volume (LV).
- Maximum speed 40km/h.
- When travelling at night, the RAV must travel at a maximum speed of 40km/h and display an amber flashing warning light on the prime mover.
- Direct radio contact must be maintained with other restricted access vehicles to establish their position on or near the road (Suggest UHF channel 40).
- For single lane road, the road must not be entered until driver has established via radio contact that there is no other RAV on the road travelling in the oncoming direction.

The Tri Drive RAV network according to MRWA's Heavy Vehicle Services (HVS) network mapping tool is shown in Figure 9.

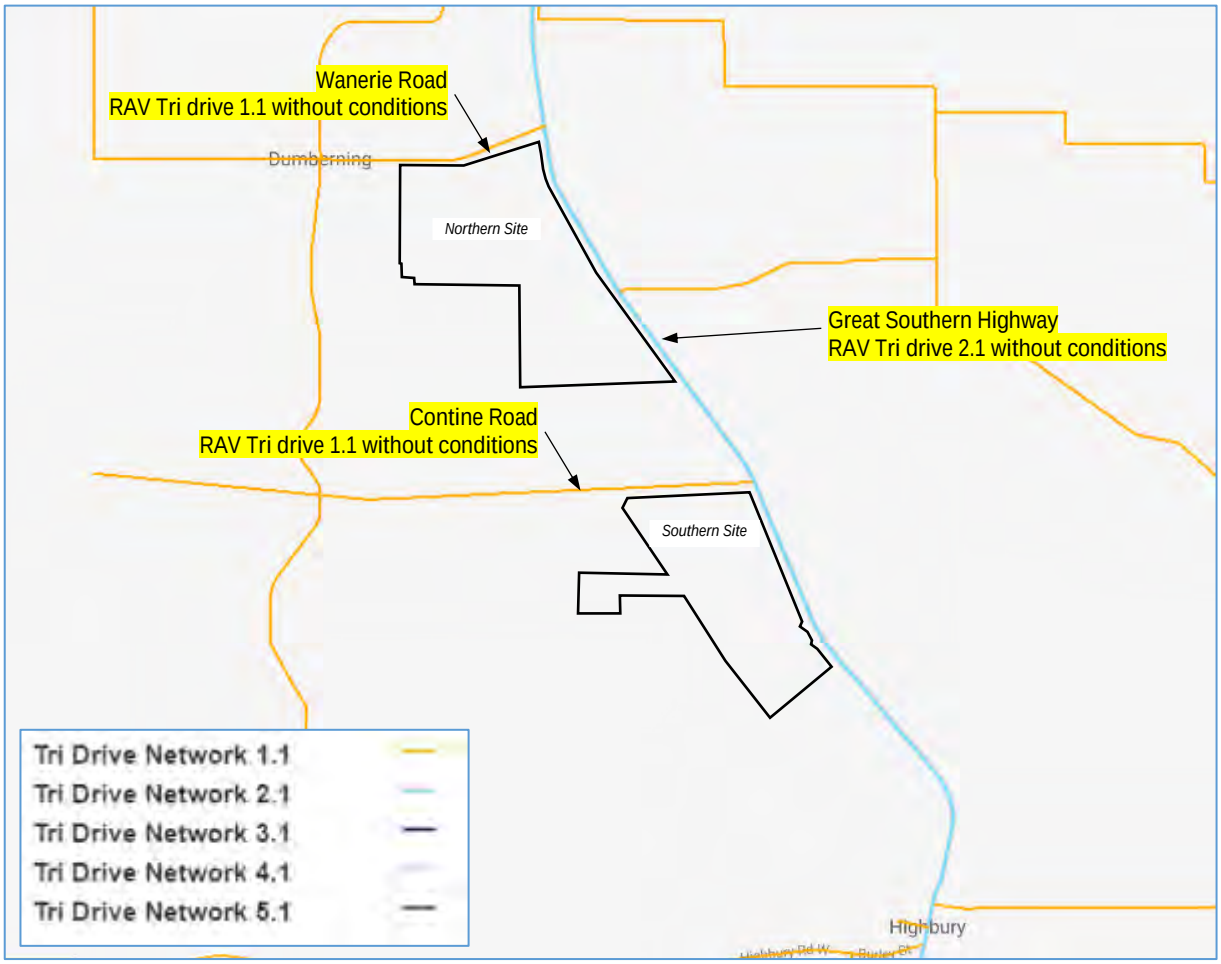


Figure 9: Existing Tri-Drive RAV Network

As shown in Figure 8 and Figure 9, the northern site can accommodate up to RAV 7 trucks whilst Contine Road for the southern site can accommodate up to RAV 4 trucks. Parks Road is currently not registered in the MRWA RAV network.

4 Traffic Impact

4.1 Assessment Period

The site will generate the most traffic during the construction phase which is estimated by the client to last approximately 24 months. The client has also confirmed that construction will occur 6 days per week.

In accordance with the Western Australia noise regulation, construction work must be carried out between 7am to 7pm on any day which is not a Sunday or public holiday Therefore the construction phase will be between 7am and 5pm which staff will be arriving before 7am and expected to leave the site shortly after 5pm. Therefore, the peak hours will be from 6 to 7am and from 5 to 6pm.

Once the site is constructed and operational, it is advised that approximately 9 staff will be on site during operation for maintenance. As a worst case scenario, approximately 9 vehicles trips will be arriving in the morning and leaving at the same time during the afternoon.

The peak hours for assessment are therefore:

- From 6 to 7am in the morning when construction staff arrive.
- From 5 to 6pm in the evening when construction staff leave.

Only the weekday scenarios have been tested as the background traffic is slightly lower on the weekends.

4.2 Traffic Generation

4.2.1 Trucks

During the construction phase, materials such as solar panels, containers, batteries and inverters will be delivered to the site using large articulated trucks. It has been advised the following equipment is being transported to the site from Perth is summarised in Table 1.

Table 1: Equipment Deliveries and Truck Movement

Description	Truck Movements	Transport
BESS Inverters	48	20ft Container
Solar Inverters	48	20ft Container
Battery Units (CSI Solbank)	144	20ft Container
Solar Panels	667^	40ft Container
OSOM	2	OSOM vehicle

^The site will require approximately 400,000 panels, and each 40ft container can transports 600 panels.

As shown, the site will generate approximately 909 truck movements during the 24 month construction period. The delivery schedule has not been confirmed and it is conservatively assessed that truck movements will be spread out evenly over the construction period and therefore the following movements are summarised below:

- 38 truck movements per month (over 24 months)
- 10 truck movements per week (over 4 weeks)
- 2 truck movements per day (over 7 days)

The client has also advised that majority of trucks will travel to and from Perth and are anticipated to enter/exit from the northwest access on Wanerie Road to access the BESS storage site.

4.2.2 Light Vehicles, Vans and Buses

It is advised that the construction site will have approximately 233 workers being transported to and from the site on buses. It is anticipated that 12 bus movements will enter the site and exit the site during the both peak hours.

It is proposed to provide a parking area located in the BESS storage site which will be able to accommodate up to 15 vehicles.

4.2.3 Oversize and Over Mass (OSOM)

It is advised that the Solar and Battery storage site will require two high voltage transformers which will be transported using OSOM vehicles. The OSOM vehicles will be travelling under escort and will require special permits to be accessed and approved by Main Roads WA. It is recommended that an OSOM route study to be undertaken by the operator to review the manoeuvrability of the OSOM vehicles along the transport route between the port and the site, particularly through the intersections.

4.2.4 Total Traffic Generation

The movements per day will include both the entering and exiting movements throughout the day.

Once the site is constructed and operational, it is advised that a maximum of 9 staff will be on site during operation for maintenance. As a worst case scenario, approximately 9 vehicles trips will be arriving in the morning and leaving at the same time during the afternoon.

The peak traffic generation during the construction period is estimated to be:

- During Construction
    - 4 truck movements and 24 light vehicle movements per day.
    - Total of 14 movements during the AM peak hour (6 to 7am).
    - Total of 14 movements during the PM peak hour (5 to 6pm).
- Constructed and operational
    - 18 vehicle trips per day
    - Total of 9 vehicle movements during the morning and afternoon peak hour.

4.3 Road Capacity

According to the WAPC TIA guidelines, an increase of between 10 to 100 peak hour vehicles is considered to have a low to moderate impact and is generally deemed acceptable without requiring detailed capacity analysis. The estimated 14 vehicles per hour during construction and 18 vehicles once operational is at the lower end of this range and so the development traffic is considered to have a low impact and can be accommodated within the existing capacity of the road network.

As mentioned previously, the current peak hour traffic volumes along Great Southern Highway are well within the mid-block capacity of the road. With the construction traffic added to the background traffic, the peak hour traffic volumes along the adjacent roads would still remain well within capacity.

It is also noted that the peak hour of construction traffic is unlikely to coincide with the peak hours of the road network. The current peak hours along Great Southern Highway are from 7:30 to 8:30am during the AM peak hour and 3 to 4pm during the PM peak hour during the weekdays. During the weekend, 11am to 12pm is the peak hour.

Construction is estimated to last 24 months and once operational, the site will generate minimal traffic.

5 Vehicle Access Assessment

5.1 Construction Access – Northern Site

5.1.1 Access Arrangement

Vehicle access to the northern site during construction is via three locations on Wanerie Road and Great Southern Highway. Access on Wanerie Road is shown in Figure 10.



Figure 10: Northern Site Access 1 (Wanerie Road)

As shown, access to the northern site along Wanerie Road is via an existing unsealed access road.

No Google Street View is available on Wanerie Road for the northern site access 1.

The site access location on Great Southern Highway is shown in Figure 11.



Figure 11: North Site Access 2 & 3 On Great Southern Highway

As shown, site access 2 on Great Southern Highway for northern site utilises the existing site driveway.

Extracts from Google Street View sourced are shown on Figure 12 and Figure 13.



Figure 12: Northern Site Access 3 on Great Southern Highway – Sourced from Google Street View



Figure 13: Northern Site Access 2 on Great Southern Highway – Sourced from Google Street View

5.1.2 Sight Distance

The proposed site access points on Wanerie Road are to achieve Stopping Sight Distance (SSD) in accordance with *Austroads Guide to Road Design Part 3*.

The required SSD is calculated in Table 2. The grades were estimated based on Landgate contours.

Table 2: Calculation of SSD Requirement – Northern Site

Vehicle	Operating Speed V	Reaction Time R_T	Deceleration Coefficient d	Direction	Grade a	Required SISD
North Site – Access 1 (Wanerie Road)						
Cars	110km/h	2s	0.36	West	0%	193m
				East	-2.5%	185m
Trucks	100km/h	2s	0.29	West	0%	191m
				East	-2.5%	181m

As shown, the northern site access 1 on Wanerie Road requires a minimum of 193m sight distance to the west and 185m to the east. The available sight distance for the site access on Wanerie Road is shown in Figure 14.



Figure 14: Northern Site Access 1 - Available Sight Distance

As shown, the northern site access 1 on Wanerie Road achieves the minimum SSD in both directions.

The site access on Great Southern Highway is to achieve Safe Intersection Sight Distance (SISD) in accordance with *Austroads Guide to Road Design Part 4a.* The required SISD is calculated in Table 3.

Table 3: Calculation of SISD Requirement – Northern Site

Vehicle	Operating Speed V	Reaction Time R_T	Deceleration Coefficient d	Direction	Grade a	Required SISD
North Site – Access 2 (Great Southern Highway)						
Cars	110km/h	5.5s	0.36	North	0%	300m
				South	0%	300m
Trucks	100km/h	5.5s	0.29	North	0%	289m
				South	0%	289m
North Site – Access 3 (Great Southern Highway)						
Cars	110km/h	5.5s	0.36	North	0%	300m
				South	0%	300m
Trucks	100km/h	5.5s	0.29	North	0%	289m
				South	0%	289m

As shown, the site access on Great Southern Highway requires a minimum SISD of 300m in both directions.

The available distance for the site access on Great Southern Highway is shown in Figure 15.

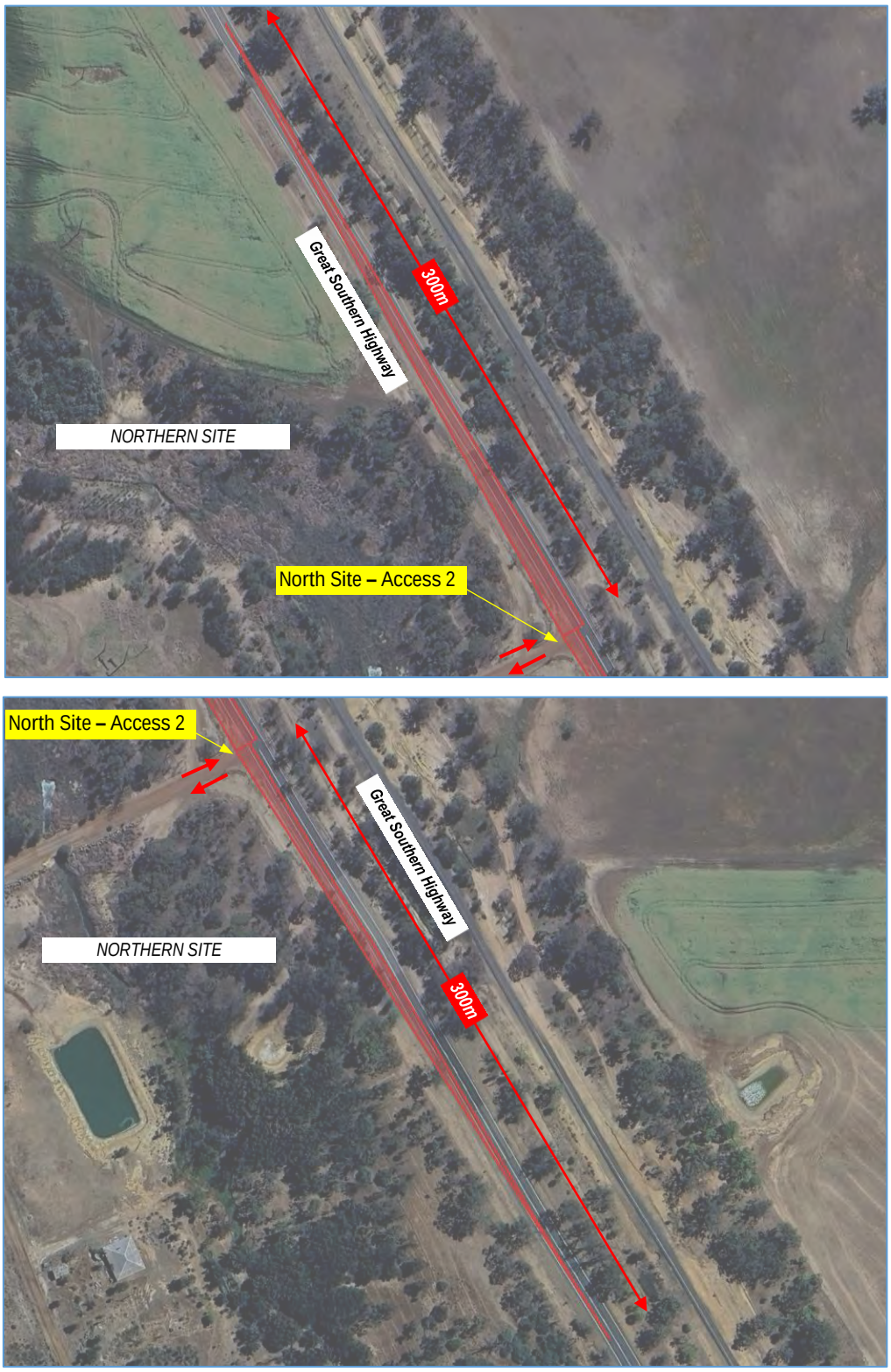


Figure 15: Northern Site Access 2 - Available Sight Distance



Figure 16: Northern Site Access 3 - Available Sight Distance

As shown, both site access on Great Southern Highway achieves the minimum SISD in all directions.

5.2 Construction Access – Southern Site

5.2.1 Access Arrangement

Vehicle access to the southern site during construction is via Contine Road and Parks Road. The southern site access 1 on Contine Road is shown in Figure 17.



Figure 17: Southern Site Access 1 (Contine Road)

As shown, the proposed site access on Contine Road is via an existing driveway and a site photo provided by the Client shows the existing gate opening as shown in Figure 18.



Figure 18: Southern Site Access 1 (Contine Road) - Site Photo

The proposed site access to the southern site is located on Park Roads as shown in Figure 19.



Figure 19: Southern Site Access 2, 3 and 4 (Parks Road)

The Client has provided site photos of the existing accesses on Parks Road as shown in Figure 20 and Figure 21.



Figure 20: Southern Site Access 2 (Parks Road) – Site Photo



Figure 21: Southern Site Access 4 (Parks Road) – Site Photo

5.2.2 Sight Distance

The proposed site access points on Contine Road and Parks Road are to achieve Stopping Sight Distance (SSD).

The required SSD is calculated in Table 4. The grades were estimated based on Landgate contours.

Contine Road and Parks Road is currently unsealed and so vehicles will likely be travelling at a reduced speed due to the conditions of the road. Conservatively, a 110km/h operating speed has been assessed in accordance with Main Roads WA speed limit.

It is noted that the southern site access 3 is located on an internal road off Park Roads and will not be assessed.

Table 4: Calculation of SSD Requirement – Southern Site

Vehicle	Operating Speed V	Reaction Time R_T	Deceleration Coefficient d	Direction	Grade a	Required SISD
Southern Site Access 1 (Contine Road)						
Cars	110km/h	2s	0.36	West	0%	193m
				East	0%	193m
Trucks	100km/h	2s	0.29	West	0%	191m
				East	0%	191m
Southern Site Access 2 (Parks Road)						
Cars	110km/h	2s	0.36	North	0%	193m
				South	0%	193m
Trucks	100km/h	2s	0.29	North	0%	191m
				South	0%	191m
Southern Site Access 4 (Parks Road)						
Cars	110km/h	2s	0.36	North	0%	193m
				South	0%	193m
Trucks	100km/h	2s	0.29	North	0%	191m
				South	0%	191m

As shown, the minimum required SSD for the site access for the southern site on Contine Road and Park Road is 193m in all directions.

The available sight distance on Contine Road is shown in Figure 22.



Figure 22: Southern Site Access 1 - Available Sight Distance

As shown, the available sight distance on the southern site access 1 on Contine road achieves the minimum SSD in both directions. However, there is existing vegetation to the west of the access which may restrict sight distance. It is recommended to monitor and trim back this vegetation to provide drivers clear sight lines in both directions.

The available sight distance on Parks Road is shown in Figure 23 and Figure 24.



Figure 23: Southern Site Access 2 - Available Sight Distance

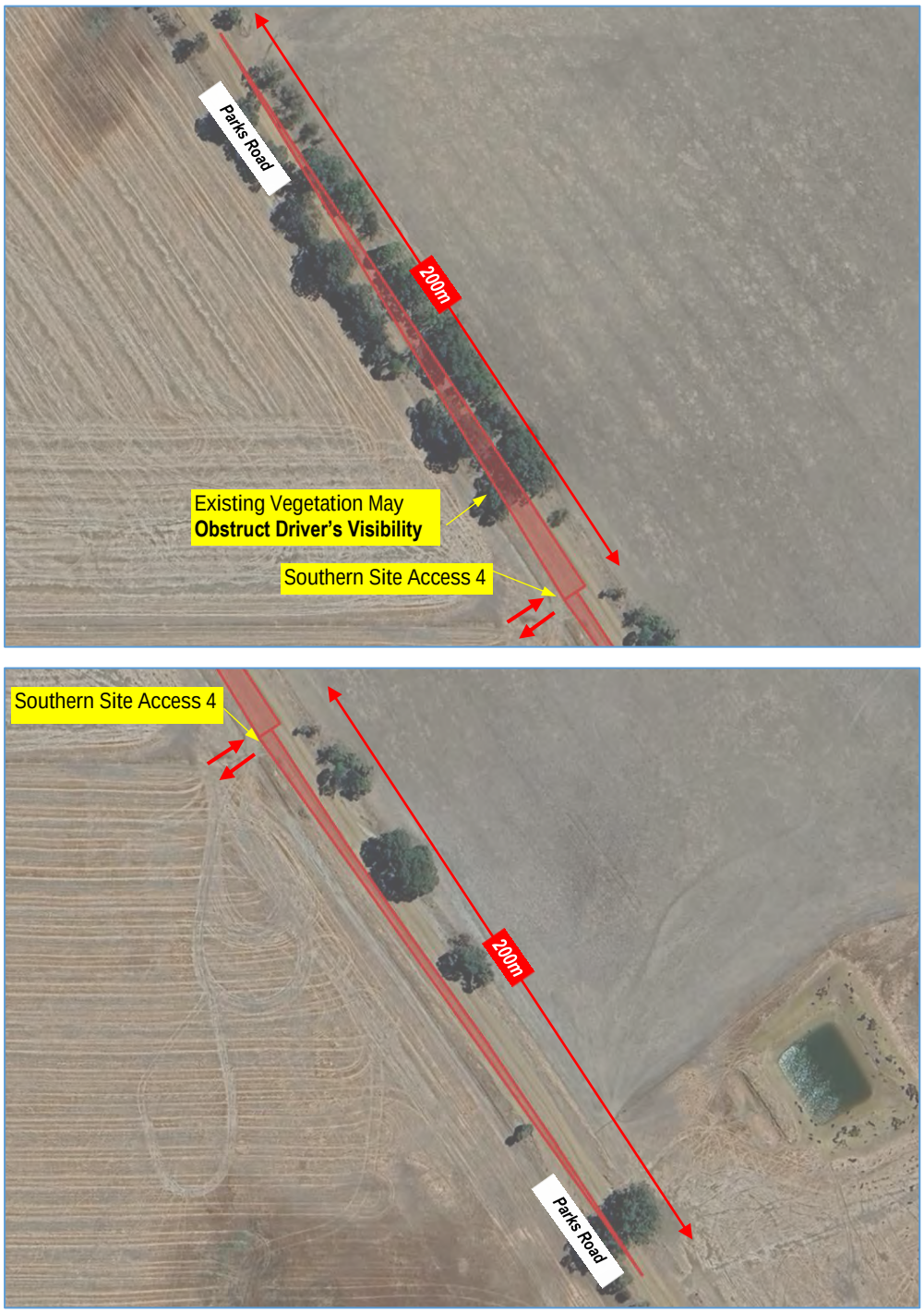


Figure 24: Southern Site Access 4 - Available Sight Distance

As shown, the available sight distance on the southern site access 2 and 4 on Parks Road achieves the minimum SSD in both directions. However, there is existing vegetation adjacent the access point that may restrict sight distance. It is recommended to monitor and trim back this vegetation to provide drivers clear sight lines in both directions.

5.3 BESS Storage Site - Permanent Access

5.3.1 Access Arrangement

Vehicle access to the BESS storage site is via Wanerie Road as shown in Figure 25.



Figure 25: BESS Site Access Location

As shown, the proposed BESS site access on Wanerie Road is via an existing gravel hardstand. There is an existing gate located during to the south of this located which will be retained and utilised to access the BESS storage facility. A site visit of the proposed BESS site access on Wanerie Road was undertaken by Ace Power as shown in Figure 26.





Figure 26: BESS Site Access On-Site Photos

5.3.2 Sight Distance

The proposed site access points on Wanerie Road are to achieve Stopping Sight Distance (SSD) in accordance with *Austroads Guide to Road Design Part 3*. The required SSD for the BESS storage site is calculated in Table 5. The grades were estimated based on Landgate contours.

Table 5: Calculation of SSD Requirement – BESS Storage Site

Vehicle	Operating Speed V	Reaction Time R_T	Deceleration Coefficient d	Direction	Grade a	Required SISD
BESS Storage Site on Wanerie Road						
Cars	110km/h	2s	0.36	West	-4%	180m
				East	3.5%	208m
Trucks	100km/h	2s	0.29	West	-4%	175m
				East	3.5%	210m

As shown, the northern site access 1 on Wanerie Road requires a minimum of 180m sight distance to the west and 210m to the east. The available sight distance for the BESS Storage site access on Wanerie Road is shown in Figure 27.



Figure 27: BESS Site Access - Available Sight Distance

As shown, the proposed BESS storage site access on Wanerie Road achieves the minimum SSD in all directions.

5.4 Access Geometry

The vehicle access is likely to require widening to accommodate the turning movement of the proposed construction trucks. An example rural driveway layout for double road trains is shown Figure 28. It is noted that the access will need to be designed, widened and upgraded generally in accordance with the MRWA guideline drawing. A swept path analysis using MRWA RAV vehicle templates will need to be undertaken when designing the access to determine the geometry.

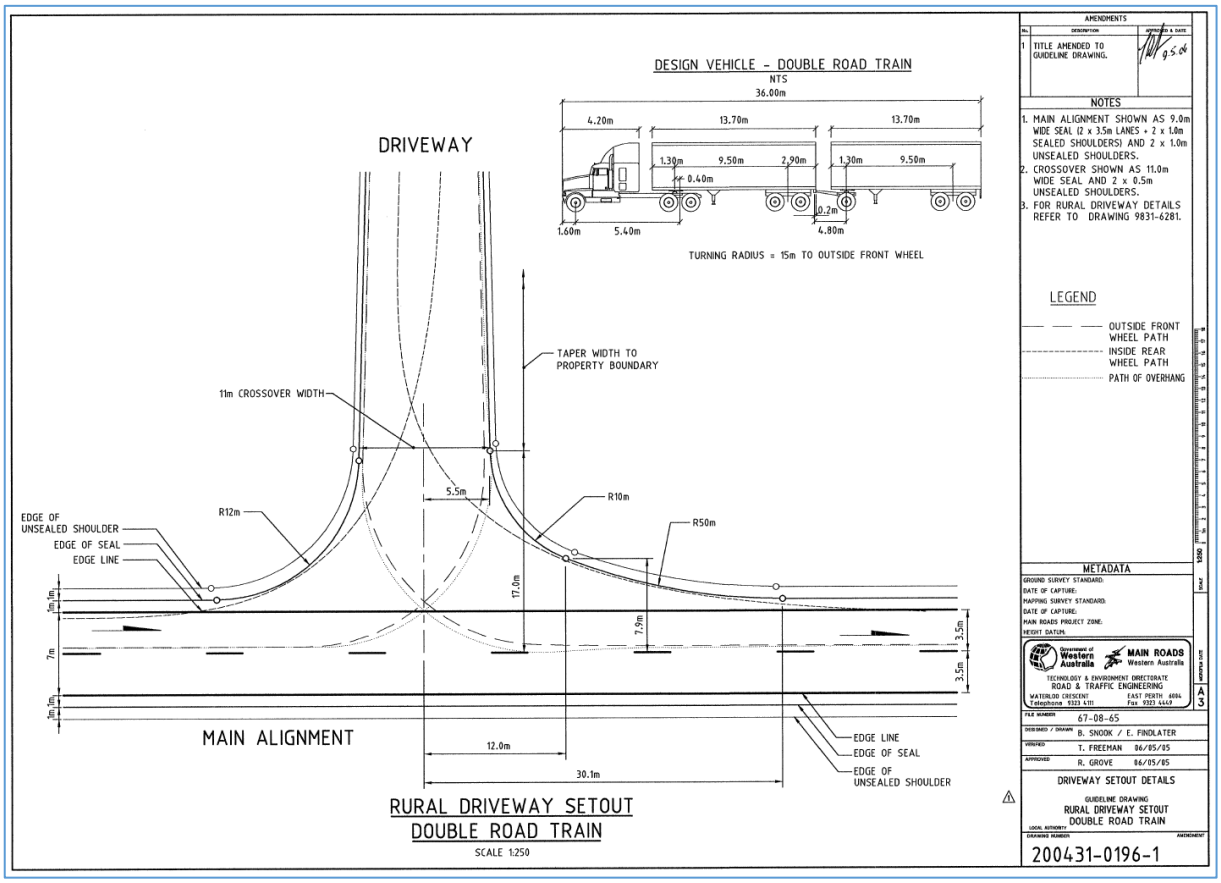


Figure 28: Example MRWA Rural Driveway Setout for Double Road Train Access

6 Site Specific Issues and Safety Issues

6.1 Crash History

The crash history of the adjacent road network was sourced from the MRWA Reporting Centre. The crashes recorded over the five-year period from January 2019 to December 2023 are shown in Figure 29.

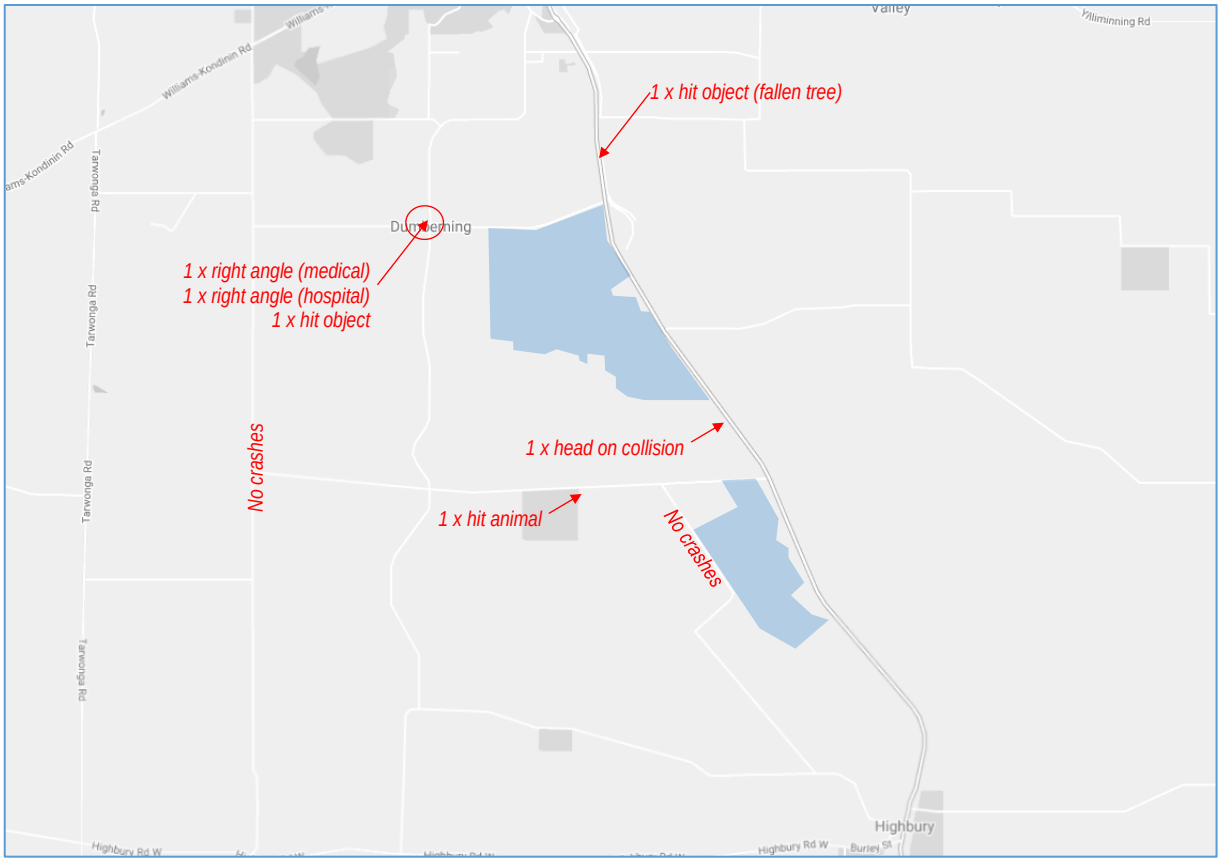


Figure 29: MRWA Crash Information - 2019 - 2023

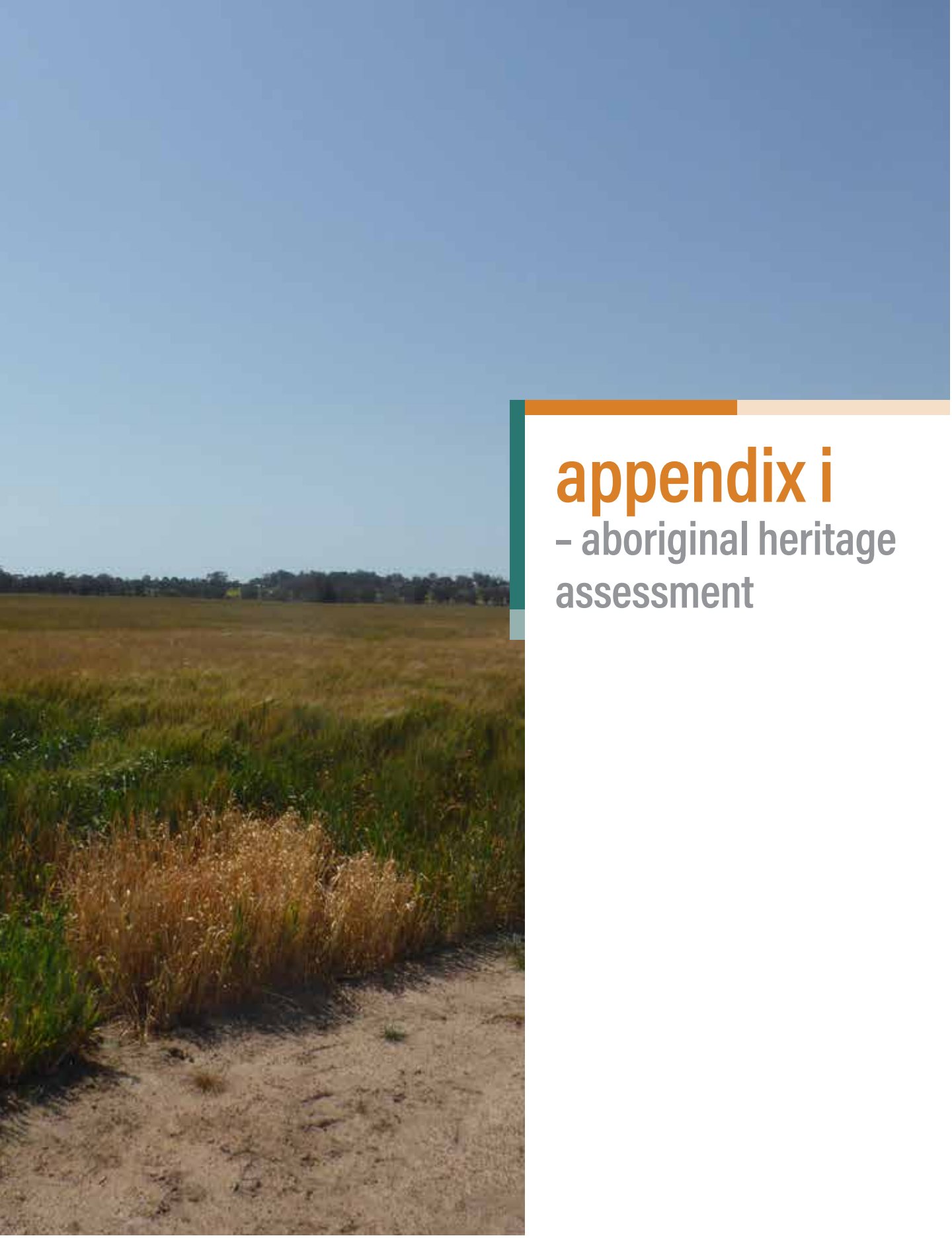
As shown, no major crash has been reported along the access location on Wanerie Road. The crash history does not appear to indicate any major safety issue.

The proposed project will generate a low volume of additional traffic over a limited period of time and is unlikely to increase the risk of crashes unacceptably.

7 Conclusion

This Transport Impact Statement for the proposed project in Narrogin concluded the following:

- The peak traffic generation during the construction period is estimated to be:
    - During Construction
        - 4 truck movements and 24 light vehicle movements per day.
        - Total of 14 movements during the AM peak hour (6 to 7am).
        - Total of 14 movements during the PM peak hour (5 to 6pm).
    - Constructed and operational
        - 18 vehicle trips per day
        - Total of 9 vehicle movements during the morning and afternoon peak hour.
- According to the WAPC TIA guidelines, an increase of between 10 to 100 peak hour vehicles is considered to have a low to moderate impact and is generally deemed acceptable without requiring detailed capacity analysis. The estimated 14 vehicles per hour during construction and 18 vehicles once operational is at the lower end of this range and so the development traffic is considered to have a low impact and can be accommodated within the existing capacity of the road network.
- The Solar and Battery storage site will require two high voltage transformers using a OSOM vehicle. The OSOM vehicles will be travelling under escort and will require special permits to be accessed and approved by Main Roads WA. It is recommended that an OSOM route study to be undertaken by the operator to review the manoeuvrability of the OSOM vehicles along the transport route between the port and the site, particularly through the intersections.
- The vehicle accesses are likely to require widening to accommodate the turning movement of the proposed construction trucks. The access will need to be designed, widened and upgraded generally in accordance with the MRWA guideline drawing. A swept path analysis using MRWA RAV vehicle templates will need to be undertaken when designing the access to determine the exact geometry.
- The minimum required Stopping Sight Distance for the site access located on Wanerie Road, Contine Road and Parks Road is achieved in both directions at the proposed construction access and BESS storage site access.
- The minimum required Safe Intersection Sight Distance for the site access located on Great Southern Highway is achieved in both directions at the proposed construction access.
- The crash history of the adjacent road network does not indicate any major safety issues.



appendix i

– aboriginal heritage assessment

An Aboriginal Heritage Desktop Assessment of the proposed Solar and Battery Project in Narrogin, Western Australia

Prepared for: Narrogin Solar Pty Ltd

Author: Aaron Rayner, BSc, MSc, Dip. Man

Aboriginal Heritage | Native Title

May 2024

Disclaimers

The analysis and recommendations contained within this report are based on information made available at the time of its preparation. The author takes no responsibility for omissions and/or inconsistencies that may result from information becoming available after the report's completion.

Any future compensation liabilities that may arise under the *Native Title Act 1993* do not form part of this advice. This report does not contain legal advice.

This advice is confidential and intended for use by Narrogin Solar Pty Ltd only. It is not for inclusion in the Aboriginal Cultural Heritage Inquiry System or sharing with third parties.

Author

Aaron Rayner conducted the research and analysis and prepared this report for Narrogin Solar Pty Ltd. Aaron is the former Chief Heritage Officer and Deputy Director General at the Department of Aboriginal Affairs in Western Australia. In these roles Aaron was responsible for managing the *Aboriginal Heritage Act 1972* and its regulations and for providing advice to executive government and industry proponents. For five years Aaron was a member of the Aboriginal Cultural Material Committee (ACMC) the statutory body that provides advice to the Minister for Aboriginal Affairs on all Aboriginal heritage matters. Aaron has significant experience and expert understanding of the Aboriginal Heritage regulatory framework in WA and is a practicing anthropologist.

Glossary of Terms

ACMC	Aboriginal Cultural Heritage Committee
AH Act	*Aboriginal Heritage Act 1972*
DPLH	Department of Planning, Lands and Heritage
GKBAC	Gnaala Karla Booja Aboriginal Corporation
Minister	Minister for Aboriginal Affairs
NSPL	Narrogin Solar Pty Ltd
NT Act	*Native Title Act 1993* (Cth.)
SWALSC	South West Aboriginal Land and Sea Council

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Executive Summary

Key finding: there are no Aboriginal sites within the area of land proposed for the Narrogin Solar and battery project. The potential for unrecorded Aboriginal heritage sites to be discovered in the project area is very low. Aboriginal sites if they exist, would be in the undisturbed areas of land adjacent to the project land, outside of the project boundary. There would be benefit in conducting an Aboriginal heritage survey with the Gnaala Karla Booja custodians if NSPL intend to use the undisturbed areas of land for the project.

The author was engaged by Narrogin Solar Pty Ltd (**NSPL**), who are the proponent proposing to construct a solar energy and battery storage facility near the Town of Narrogin in Western Australia. The facility will be located on the western side of the Great Southern Highway and will comprise a solar panel area, battery energy storage system, a project substation and an undergrounded cable route to the Narrogin South Substation (**Project Area**). The Project Area has historically been used for agricultural and farming purposes and as a result the land has been highly modified – see **Appendix 1**.

The *Aboriginal Heritage Act 1972* (**AH Act**) is the primary legislation for protecting Aboriginal sites of importance and significance in Western Australia. Section 5 of the AH Act defines the types of Aboriginal sites that are protected whether they are registered or unregistered on the Register of Aboriginal Sites. Section 17 makes it an offence to damage, alter, conceal, or destroy an Aboriginal site without explicit consent pursuant to section 16 and section 18 of the AH Act. Section 62 provides for a lack of knowledge defence. A person can rely on this defence where they can provide that they did not know or could be reasonably expected to know that they have caused a section 17 offence.

The entire Project Area is within the Gnaala Karla Booja region of the alternative Southwest Noongar Native Title Settlement Area. The Gnaala Karla Booja region is one of six Noongar regions in the southwest. In return for the settlement, the Gnaala Karla Booja People, along with other Noongar people from the other five regions, agreed to give up their native title rights in return for the benefits which are provided for in an Indigenous Land Use Agreement (**ILUA**) that is now registered with the National Native Title Tribunal (**NNTT**).

The purpose of this due diligence assessment is to assess whether there are recorded Aboriginal sites within the meaning of section 5 of the AH Act, and whether there is potential for unrecorded Aboriginal sites in or near the Project Area. There is no mandated process to undertake Aboriginal heritage due diligence assessments in WA. However, it is normal practice to carry out searches of the Aboriginal Cultural Heritage Inquiry System (**ACHIS**) for Aboriginal heritage site records and survey reports.

A search of the ACHIS was undertaken and found that there are no recorded Aboriginal sites in the Project Area. The nearest recorded site named Narrogin Scar Tree 1 ID 33260 is located approximately 2km northwest of the Project Area - see **Appendix 2**.

There are 16 recorded sites listed on the ACHIS for the Shire of Narrogin. Five of these Aboriginal sites feature modified or scarred trees, three fringe campsites, three sites contain stone artefacts and two of the sites are associated with water serpent mythologies including Narrogin Brook ID 38965 and Arthur River ID 37754.These sites are all recorded in areas of land that remain undisturbed by land uses – see **Figure 1**.

No Aboriginal heritage surveys are recorded on the ACHIS for the Project Area. However, several heritage surveys have been undertaken nearby and the reports of these surveys have been reviewed as part of this desktop assessment.

NSPL proposes to construct the project in areas of disturbed land – see **Appendix 1**. The adjacent wetlands and undisturbed bushland areas will not be impacted by the construction and operations of the solar energy facility. It is worth noting that in Noongar culture water sources such as creeks, brooks, rivers, and wetlands are of cultural significance to Aboriginal people because of the association with the rainbow serpent or *Waugal*.

Evidence of past Aboriginal use and occupation is more likely to be found in:

- elevated areas such as hills and mountains.
- areas with sandy and sand-sheet where access and ease of movement is more favorable.
- areas with permanent and semi-permanent water sources.
- areas where economically preferable lithic raw materials (e.g. fine-grained stone) can be sourced; and,
- areas where rock shelters and rock overhangs are located.

These conditions are not found in the Project Area.

This assessment concludes that the areas of land that NSPL intend to develop for the solar energy facility are extremely unlikely to contain any heritage sites that are important in Aboriginal tradition. If NSPL intends to use the undisturbed areas of land or cause any disturbance to the wetlands, then there would be benefit in conducting an Aboriginal heritage survey to elicit views from the traditional owners about the development and potential impacts on the wetlands.

Recommendations

It is recommended that Narrogin Solar Pty Ltd:

1. Note the contents of this report.
2. Note that under section 17 of the *Aboriginal Heritage Act 1972* it is a criminal offence 'to damage, destroy, alter or conceal an Aboriginal site'.
3. Note that there are no recorded Aboriginal heritage sites in the Project Area and consequently construction of the solar energy facility will be compliant with the AH Act.
4. Note that there is limited to no potential for unrecorded Aboriginal sites to be present in the areas of land proposed for the project development.
5. Note that there is potential for unrecorded Aboriginal cultural values to be present in the undisturbed areas of land and in the wetlands.

1. Introduction & Methodology

NSPL is preparing to construct a solar farm and battery energy storage facility in the Shire of Narrogin to generate and store energy. The area of land proposed for the project has been used for agricultural purposes for decades and is a highly altered environment. The remnant bush land and wetland areas are excised from the proposed development.

NSPL has commissioned the author to complete an Aboriginal heritage due diligence assessment prior to finalizing its development design and plans.

The methodology for this assessment included:

- A search of the ACHIS and NNTT databases,
- Analysis of archival information relevant to the Project Area and surrounding areas; and
- Consideration of recent aerial imagery of the Project Area and the immediate surrounds.

2. Regulatory Framework

In July 2023, the *Aboriginal Cultural Heritage Act 2021* was fully enacted. However, in early August 2023 the State Government announced plans to repeal the legislation and revert to an amended version of the AH Act 1972. The repeal of the ACH Act and the reinstatement of the AH Act was completed on 17 November 2023.

The AH Act protects all Aboriginal heritage sites of significance whether the sites are registered or not, and whether they are known or unknown. Section 5 defines the places the Act protects. The legislative regime is expansive as it protects both cultural material places and sacred sites of importance and significance to Aboriginal people.

Part 2 – Application and traditional use

Section 5 of the AH Act applies to:

(a) Any place of importance and significance where persons of Aboriginal descent have, or appeared to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with traditional cultural life of the Aboriginal people, past or present;

(b) Any sacred, ritual, or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;

(c) Any place which, in the opinion of the Committee, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or

ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State; and

(d) Any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or remove.

Section 6 of the AH Act protects Aboriginal objects.

Part 4 – Protection of Aboriginal sites

Section 17 of the AH Act provides that it is a criminal offence to excavate, destroy, damage, conceal or in any way alter any Aboriginal site. Penalties include fines up to $100,000 and or 2 years imprisonment for a breach of section 17.

Section 18 of the AH Act provides the only means whereby a landowner can use land where an Aboriginal site might exist, and where a site can be altered or damaged in any way without the activity being an offence. Amendments to section 18 include providing appeal rights to Aboriginal parties aggrieved by a decision of the Minister.

Part 5 – Aboriginal Cultural Heritage Committee

Section 28 provides for the establishment of the Aboriginal Cultural Heritage Committee (ACHC).

Section 38 provides for a Register of Aboriginal Places and Objects.

Section 39 prescribes the functions of the Aboriginal Cultural Heritage Committee (ACHC) to evaluate on behalf of the community the importance of places and objects alleged to be associated with Aboriginal persons and to recommend to the Minister places and objects which, in the opinion of the ACHC, are, or have been, of special significance to persons of Aboriginal descent and should preserved. Associated sacred beliefs, and ritual or ceremonial usage, in so far as such matters can be ascertained, are regarded as the primary considerations in the evaluation of any place or objects for the purposes of this Act.

Part 6 – Enforcement

Section 62 provides that it is a defence if the charged person did not know and could not reasonably be expected to have known, that the place or object to which the charge relates was a place or object to which the Act applies.

3. Native Title

Gnaala Karla Booja Native Title Settlement Area that extends from Mandurah to Capel, and east to Narrogin, and includes Aboriginal people from the Binjareb/Pinjarup, Wilman and Ganeang language groups. This agreement settled the Gnaala Karla Booja native title claim (WC1998/058) by way of an Indigenous Land Use Agreement (**ILUA**). Five other native title claims were also settled. The six Noongar regions are shown in **Figure 2**.

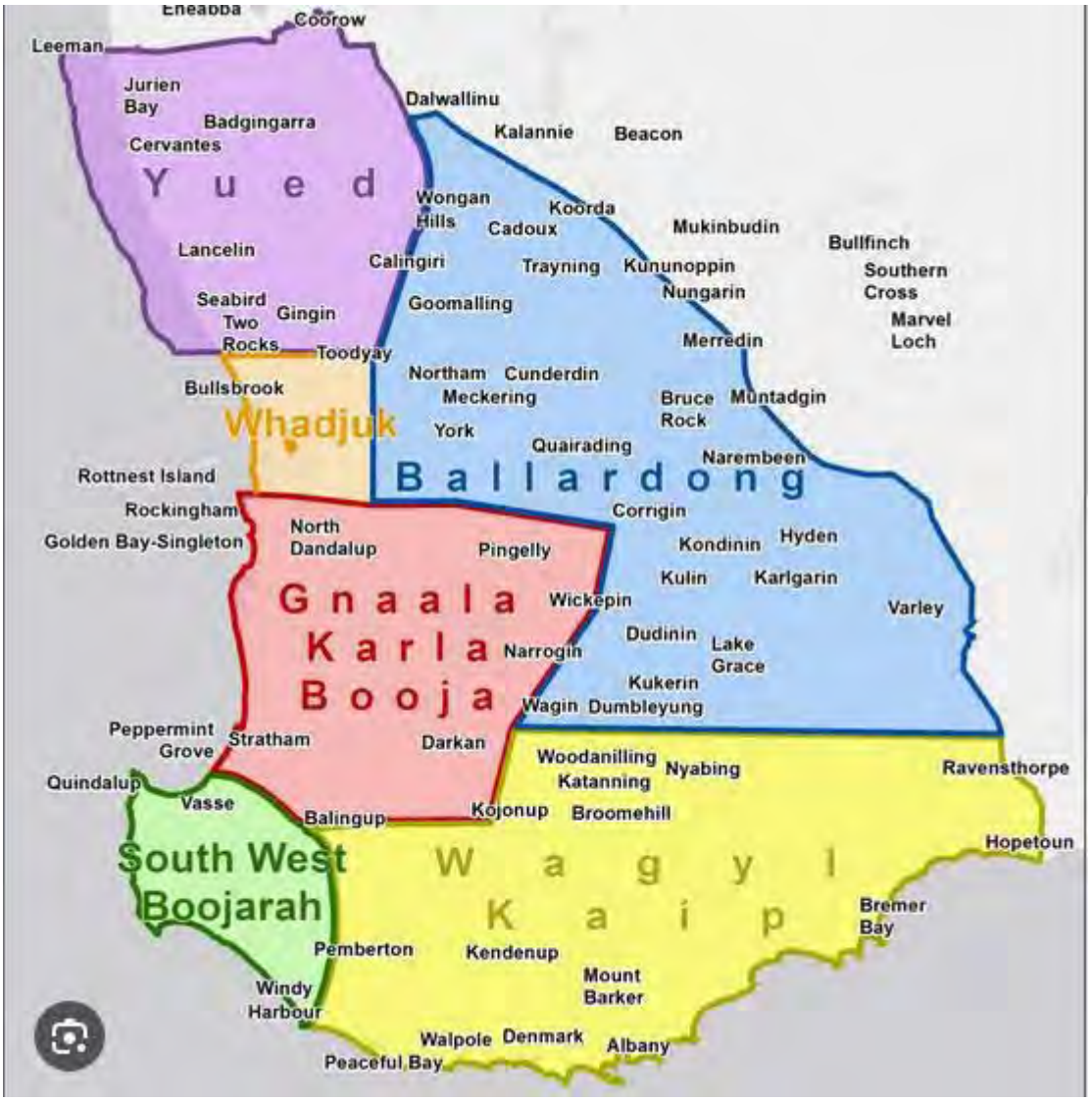


Figure 2. Six Noongar Regions in South West

Some aspects of ILUA are now being managed by the Gnaala Karla Booja Aboriginal Corporation, a newly formed body corporate. The Gnaala Karla Booja area is shown below in **Figure 3**. and covers an area approximately 38,488 km^2 in size and includes a range of different environment types from dry sclerophyll forest to mallee woodland and agricultural pastureland.

4. Ethnographic Background

Bates (1985, see also Tindale 1974) records that many Noongar groups, including the Gnaala Karla Booja, followed a matrilineal system of descent, consistent with the rest of the south west groups, but different to those groups north of Augusta which followed patrilineal descent. The Gnaala Karla Booja and neighbouring groups by all accounts kept a complex and very detailed cosmology revolving around obligations to care for land and maintain the ceremonies and rituals associated with the cosmology, which in turn supported complex social and kinship obligations and networks (see for example Machin 1996).

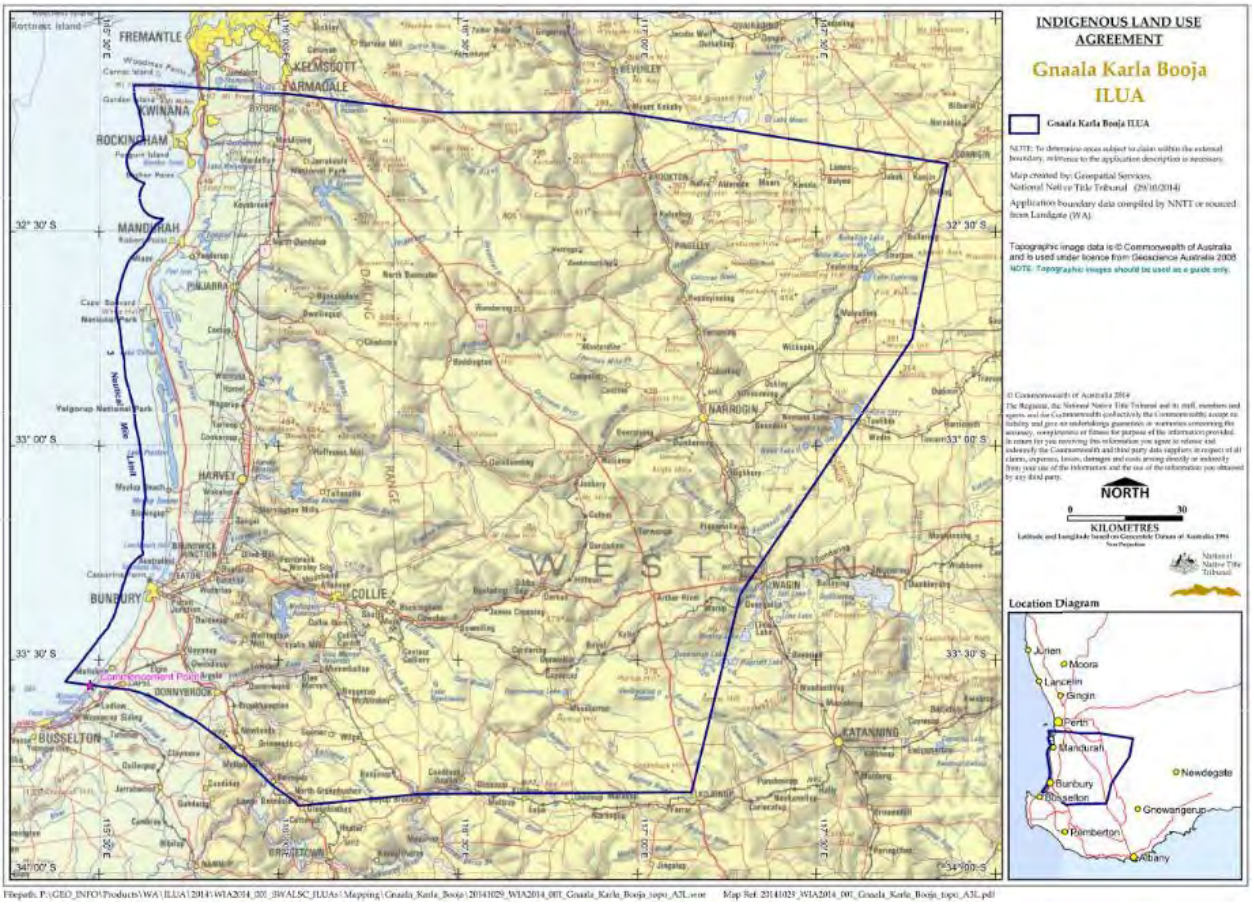


Figure 3. Gnaala Karla Booja Native Title Settlement Area

Aboriginal spirituality is inextricably linked to land and its creation. Everything in the landscape has meaning and purpose and was created in the Dreamtime by creation beings that roamed the earth. In Noongar mythology the *Waugal* is central to beliefs and customs. The *Waugal* is a snake or rainbow serpent recognised as the giver of life and maintains all freshwater sources. In Noongar beliefs it is the *Waugal* that made Noongar people the custodians of the land.

Noongar people believe that the *Waugal* resides in all waterways, pools, springs, wetlands, and rock holes. Customary rituals must be performed when approaching these types of water sources. These types of customary rituals are performed by Noongar Elders to keep people safe.

5. Aboriginal Site Types

The following are the main site types recorded on the DPLH Register of Aboriginal Sites.

Artefacts

An artefact site is a place where human activity is identifiable by the presence of a portable object(s) (e.g. stone, bone, shell) utilized or modified by Aboriginal people in relation to traditional cultural life past or present.

Artefact Scatters / Shell Scatter / Midden

These sites are concentrations of cultural material associated with a wide range of activities, such as food processing, tool manufacture and seasonal camping. These sites can be small, localized scatters around single stone reduction episodes, or larger, higher density scatters containing hundreds or perhaps thousands of artefacts or shells over a large area.

Ceremonial

A place set aside for a formal act or series of acts prescribed by ritual, belief in a mythological manifestation, religious belief or observance, protocol or convention that is connected with the traditional cultural life of Aboriginal people past or present.

Mythological

A place that is connected to the spirit ancestors in their various manifestations of the 'Dreamtime', and which continues to be important and of special significance to persons of Aboriginal descent.

Engraving

A motif (either figurative or non-figurative) on a rock surface produced by percussion or abrasion. Engravings are also often referred to as petroglyphs.

Grinding patches/Grooves

A place where grinding patches or grooves can be found. Grinding patches or grooves are smoothed areas or grooves on rock surfaces (non-portable) that have been created by

grinding activity associated with food production such as seed milling, preparation of pigments, tool manufacture and/or maintenance and ritual.

6. Landscape Assessment

The possibility of a landscape containing Aboriginal sites will differ between land which has had previous land use, for example intensive land clearing or development, such as the proposed project development area, and land which is largely in its natural state or is remote and undisturbed by previous land development.

Similarly, some landforms are more likely than others to serve as an indicator of Aboriginal traditional activity than others. Landscape features which may contain Aboriginal sites and should be approached with some caution include, but are not limited to: rock outcrops, rock shelters, caves, alluvial terraces, foreshores and coastal dunes, ranges and hills, natural wetlands, waterholes, springs, gnamma (rock) holes, rivers, creeks, streams, swamps, hills and mound formations, or areas with potential archaeological deposits.

7. Existing Aboriginal heritage information

The DPLH separates Aboriginal heritage sites into three categories: *Aboriginal Cultural Heritage (ACH), ACH Lodged Places, and ACH Historic Places.* ACH sites have been assessed by the ACMC as meeting the threshold tests for registration under sections 5 and 39 of the AH Act. ACH Lodged Places are awaiting a formal assessment and ACH Historic places have been assessed by the ACMC as not meeting the threshold test to be entered in the Register.

A search of the ACHIS maintained by the DPLH identifies no Aboriginal sites present in the Project Area – see **Appendix 2**. 16 Aboriginal sites have been recorded in the Shire of Narrogin. **Figure 1** shows that these sites are all situated in undisturbed areas of land. Search results from the ACHIS are shown in **Appendix 4**.

Research of the NNTT database was carried out by the author to assess whether any heritage sites had been reported during any of the native title processes for the Narrogin area. No heritage site records were identified during this research.



Figure 1. Recorded Aboriginal Sites in Narrogin

8. Heritage Survey Reports

The following survey reports were retrieved from the DPLH archive and reviewed.

Ethnographic Survey of Lot 501 Mokine Road, Narrogin. R. Williams, 2013

The survey was undertaken for LandCorp who were preparing to develop the land into residential freehold lots. Three sites of ethnographic importance were identified in and near to the surveyed land. All three are scarred trees and were subsequently lodged with the DPLH.

Aboriginal Survey for the Narrogin Link Road Realignment, Narrogin. B. Goode, 2003

This report discusses the information relating to the Noongar camping grounds such as the Loco Sheds, an area used as a camping ground at the railway workshops and, prior to this, traditionally. A peppermint tree or 'birthing site' along the Narrogin Brook is located as the birthplace of a named elder (now deceased). The report also discussed Narrogin Brook and campsites on either side of the brook extending north to the playing fields. It states that Narrogin Brook had known caping areas and was utilized extensively as a food resource for long necked turtles.

Report on an Ethnographic and Archaeological Survey of the Williams Kulin Road, Williams to Narrogin Section. B. Dobson, K. Macintyre, J. Harris, 1992

This report discusses various campsites in and around the Narrogin Townsite. Anecdotal remarks made by a settler called Grainger who arrived in Narrogin in 1894, recorded by Tonkinson (1962), stated that there were two groups of Aboriginals in Narrogin with two separate camps on either side of the town. Grainger also discussed with Tonkinson (1962) the trade by the Noongars of farm labour, possum fur and kangaroo skin for the much-desired flour, sugar, tea, and tobacco.

An Investigation into the Aboriginal Significance of Wetlands and Rivers in the Busselton-Walpole Region. R. O'Connor, 1995

This report provides an historical background for the early historical development of the area, referring to Governor Stirling's 1837 journal describing 'well-marked tracks from one watering hole to another…' and a '…well-known track that led from Perth to Pinjarra, Marrinup, Williams River, Kojounup and the Porongorups'. O'Connor makes the point that all freshwater sources, such as wetlands, rivers, and creeks, are important in Noongar tradition.

9. Discussion & Conclusion

The AH Act protects all Aboriginal sites whether they have been recorded or not. It is a criminal offence to damage, destroy, alter, or conceal any Aboriginal site in WA. Penalties for breaching section 17 of the AH Act include fines and imprisonment. It is therefore important that all land users consider the potential impacts to Aboriginal heritage before embarking upon their chosen land use.

For this assessment the existing Aboriginal cultural heritage information from the ACHIS was reviewed. Consideration was also given to up-to-date aerial imagery and of the previous land uses. No field inspections were conducted for this assessment.

The search of the ACHIS found that there are no recorded Aboriginal sites in the Project Area. However, no heritage surveys have been undertaken specially over the Project Area land. While the proposed project will be confined to already disturbed land, the adjacent undisturbed land, including the wetlands, has potential for Aboriginal cultural values to be present.

The risk of there being unidentified Aboriginal sites per section 5 of the AH Act in the Project Area is very low to zero. This is because the land has been used for agricultural purposes for many years and the environmental conditions for Aboriginal sites to be present does not exist. That is, there are no natural permanent or semi-permanent water sources or suitable lithic materials to manufacture stone tools present. The area of land is flat with no breakaways or rock-shelters.

This assessment concludes that there is no risk of the proposed project causing unauthorised impacts to unrecorded Aboriginal heritage sites in the Project Area. The adjacent wetland areas will likely be of some cultural significance to the Gnaala Karla Booja People because the *Waugal* creation story is associated with all water sources. These areas could be of general significance to the Gnaala Karla Booja People. It is unlikely that these areas are of special significance and hence would unlikely be considered an Aboriginal site per section 5(b) of the AH Act. Nevertheless, if NSPL decides to use or develop the undisturbed areas of land including the wetlands, there would be some benefit consulting the Gnaala Karla Booja People through an Aboriginal heritage survey prior to commencing the project development.

10. Recommendations

It is recommended that Narrogin Solar Pty Ltd:

1. Note the contents of this report.
2. Note that under section 17 of the *Aboriginal Heritage Act 1972* it is a criminal offence ‘to damage, destroy, alter or conceal an Aboriginal site’.

3. Note that there are no recorded Aboriginal heritage sites in the Project Area and consequently construction of the project will be compliant with the AH Act.
4. Note that there is limited to no potential for unrecorded Aboriginal sites to be present in the areas of land proposed for the project development.
5. Note that there is potential for unrecorded Aboriginal cultural values to be present in the undisturbed areas of land and in the wetlands.

References

Legislation

Aboriginal Heritage Act 1972 (WA)

Publications

Bates, D. 1985 *The Native Tribes of Western Australia*. Edited by I. White. National Library of Australia, Canberra.

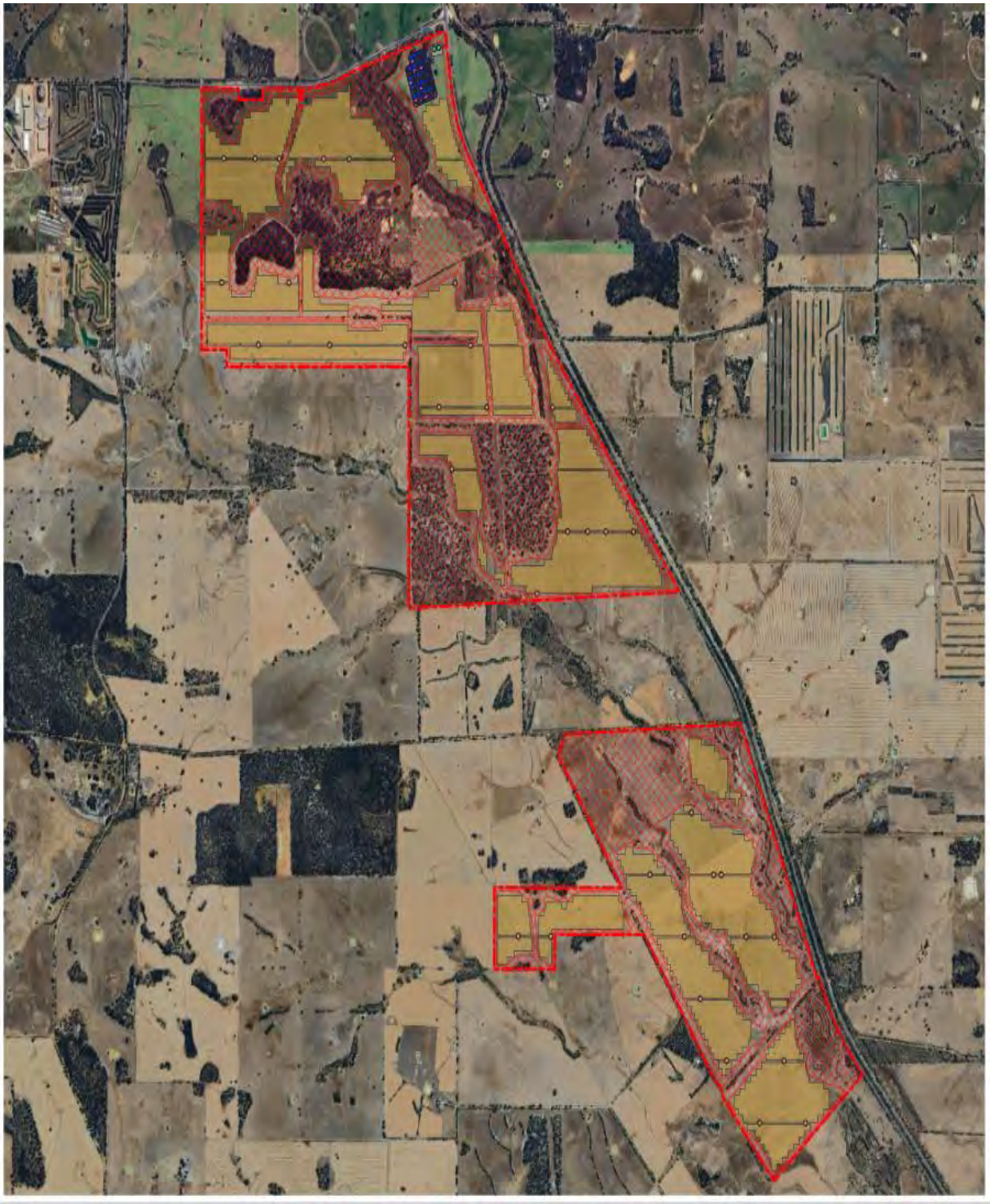
Berndt, R. M. 1992 *The World of the First Australians: Aboriginal traditional life, past and present*. Aboriginal Studies Press for the Australian Institute of Aboriginal and Torres Strait Islander Studies, Canberra.

Berndt, R. M. and C. H Berndt (eds) 1979 *Aborigines of the west: their past and their present*. University of Western Australia Press, Perth.

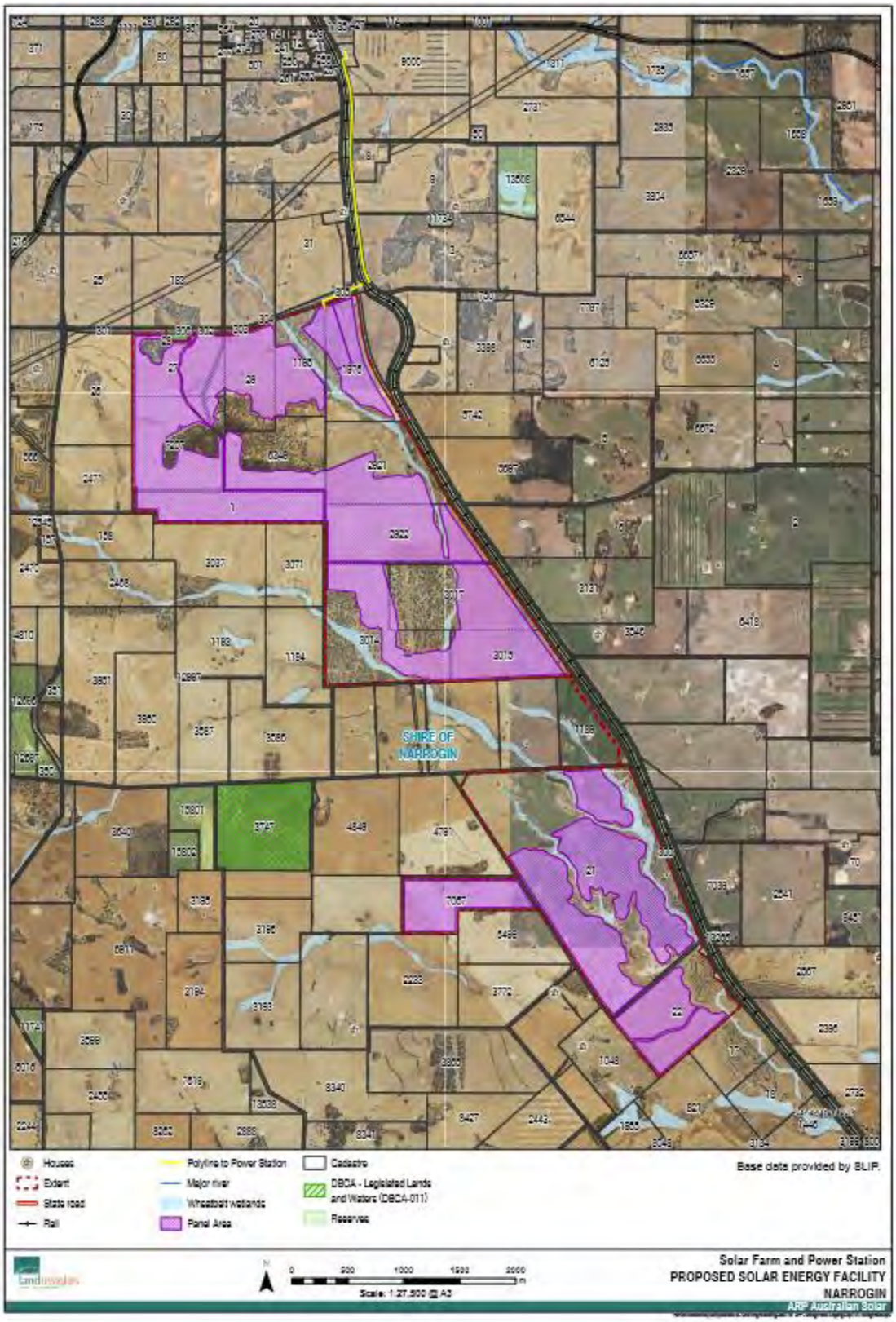
Tindale, N. 1974 *Aboriginal Tribes in Australia*. University of California Press, Berkley.

Tonkinson, R. 1962 Factors affecting movement and assimilation among part-Aborigines in the Narrogin District. University of WA, Dept. of Anthropology, Honours Thesis.

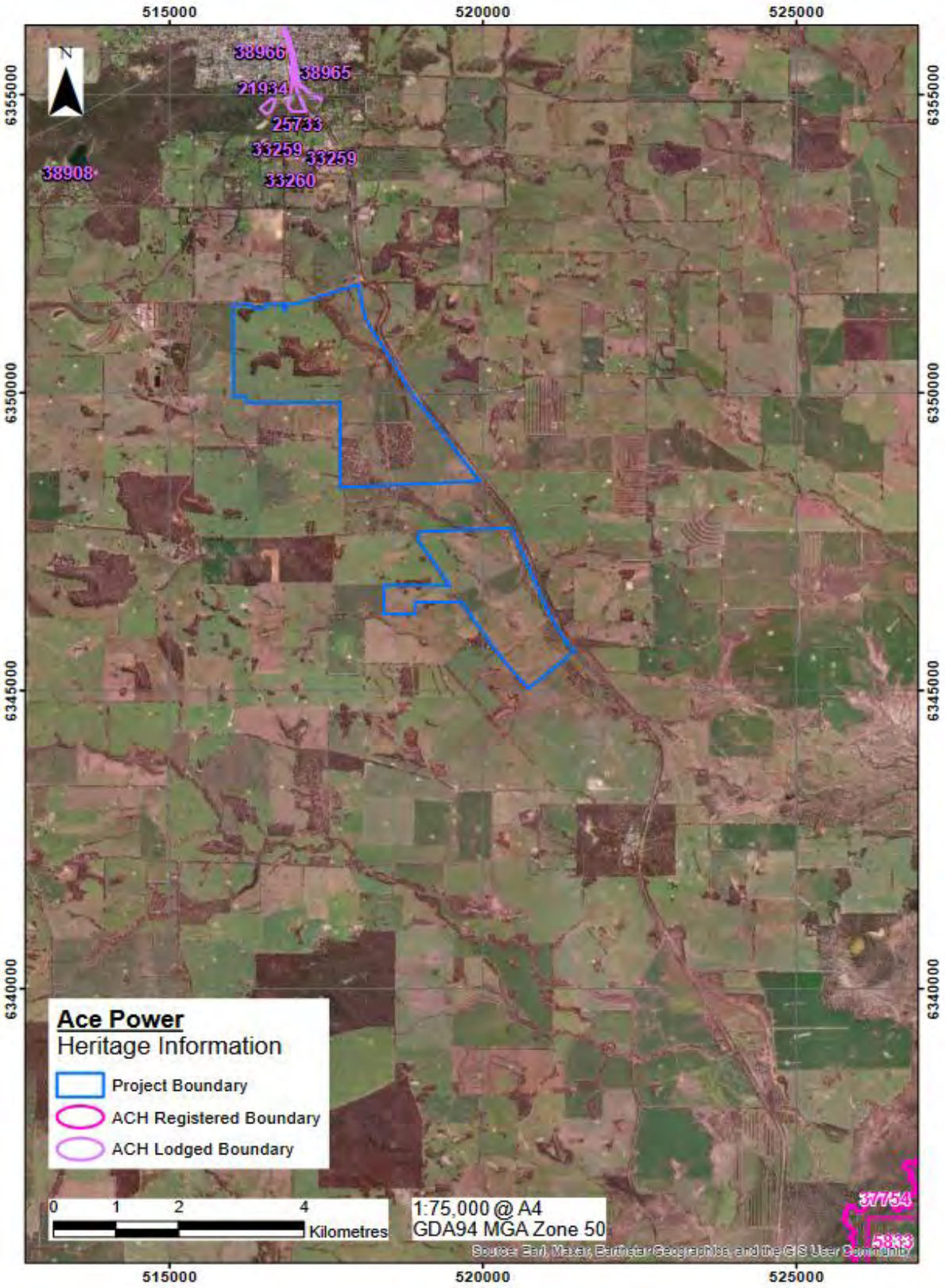
Appendix 1a. Project Land



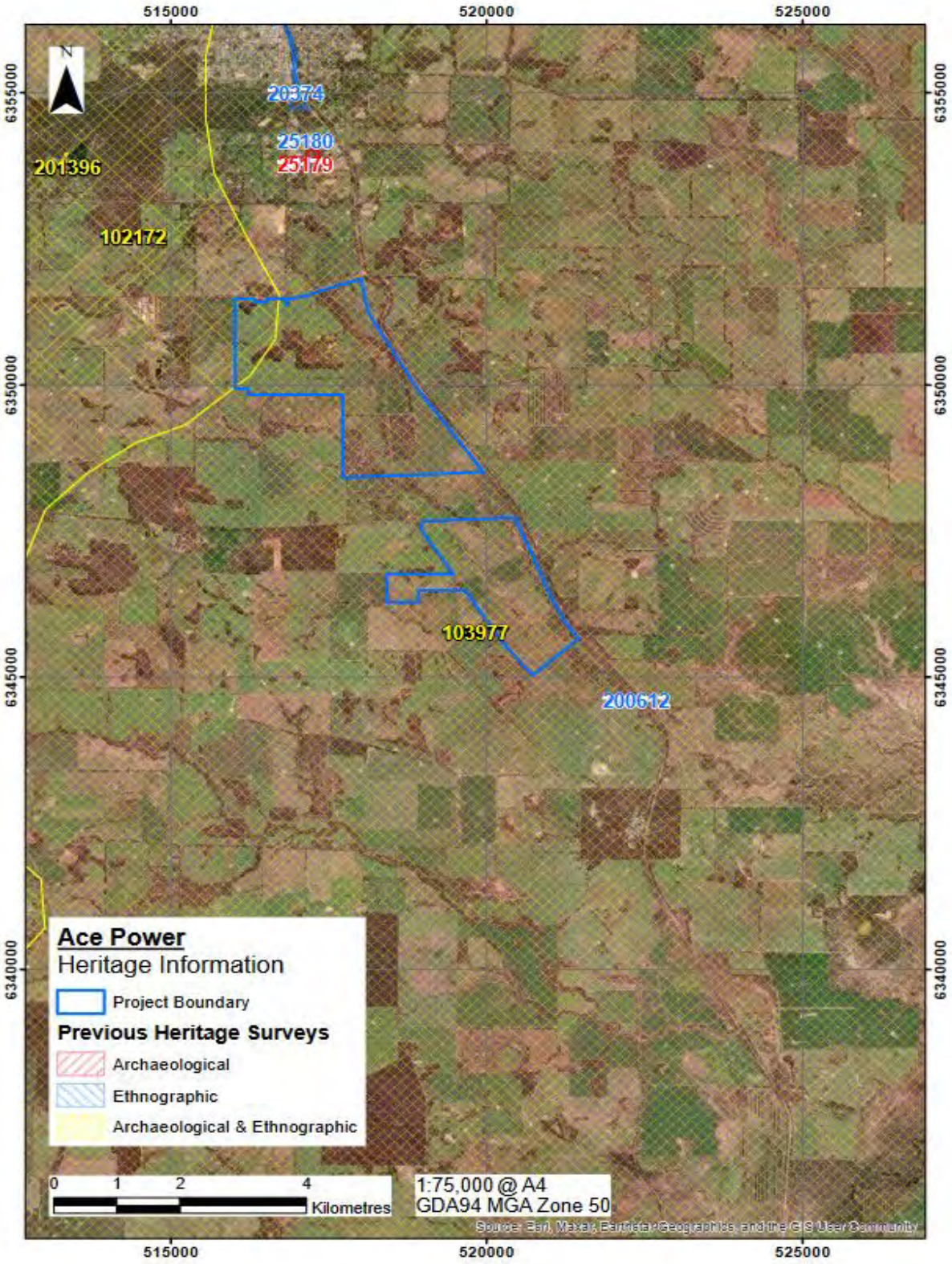
Appendix 1b. Project Land



Appendix 2. Aboriginal Sites Recorded near Project Land



Appendix 3. Aboriginal Surveys near Project Land



Appendix 4. ACHIS Search Results for Shire of Narrogin

Department of **Planning, Lands and Heritage**

Aboriginal Cultural Heritage Inquiry System

List of Aboriginal Cultural Heritage (ACH) Register

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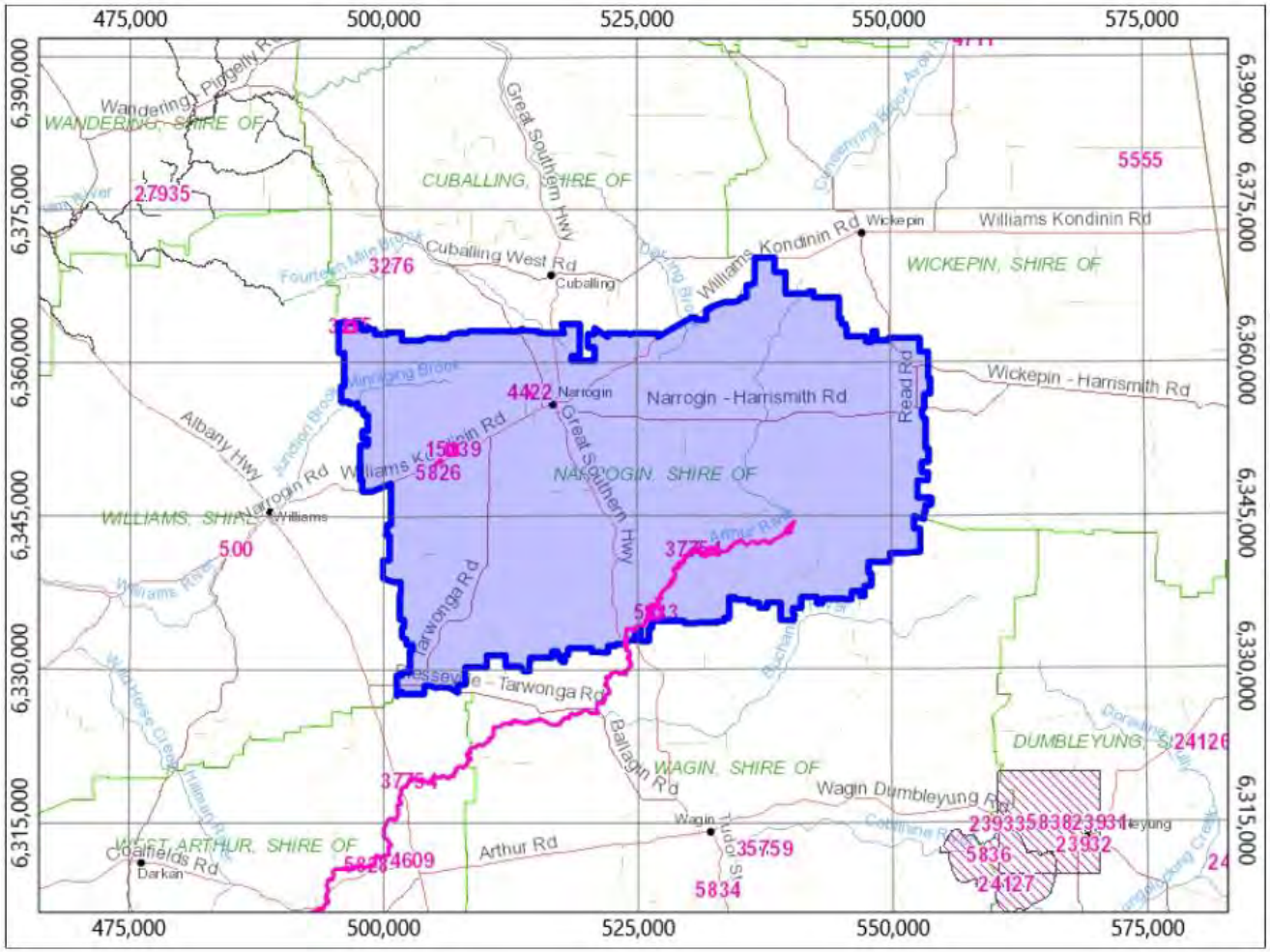
ID	Name	Boundary Restricted	Boundary Reliable	Culturally Sensitive	Culturally Sensitive Nature	Status	Place Type	Knowledge Holders	Legacy ID
3275	DRYANDRA, NARROGIN	No	No	No	No Gender / Initiation Restrictions	Register	Traditional Structure	*Registered Knowledge Holder names available from DPLH	S00223
4422	NARROGIN RESERVE 15566.	No	Yes	No	No Gender / Initiation Restrictions	Register	Camp; Other	*Registered Knowledge Holder names available from DPLH	S02797
5826	MANARING ROAD.	No	Yes	No	No Gender / Initiation Restrictions	Register	Modified Tree; Other	*Registered Knowledge Holder names available from DPLH	S00276
5833	WOLWOLLING POOL	No	No	No	No Gender / Initiation Restrictions	Register	Artefacts / Scatter	*Registered Knowledge Holder names available from DPLH	S00283
5888	GEERALYING, NARROGIN.	No	Yes	No	No Gender / Initiation Restrictions	Register	Burial; Artefacts / Scatter; Shell	*Registered Knowledge Holder names available from DPLH	S00226
15139	GEERALYING.	No	No	No	No Gender / Initiation Restrictions	Register	Camp; Modified Tree	*Registered Knowledge Holder names available from DPLH	S03027
37754	Arthur River	No	Yes	No		Register	Creation / Dreaming Narrative; Water Source	*Registered Knowledge Holder names available from DPLH	

Department of Planning, Lands and Heritage

Aboriginal Cultural Heritage Inquiry System

Map of Aboriginal Cultural Heritage (ACH) Register

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Legend

- Aboriginal Cultural Heritage (ACH) Register
- Search Area
- Aboriginal Community
  - *Permanent*
  - *Seasonal*
  - *Town Based*
- Town
- Road
- River
- Local Government Authority

22.30 kilometres

Map Scale 1 : 676,000

MGA Zone 50 (GDA94)

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Department of Planning, Lands and Heritage

Aboriginal Cultural Heritage Inquiry System

List of Aboriginal Cultural Heritage (ACH) Lodged

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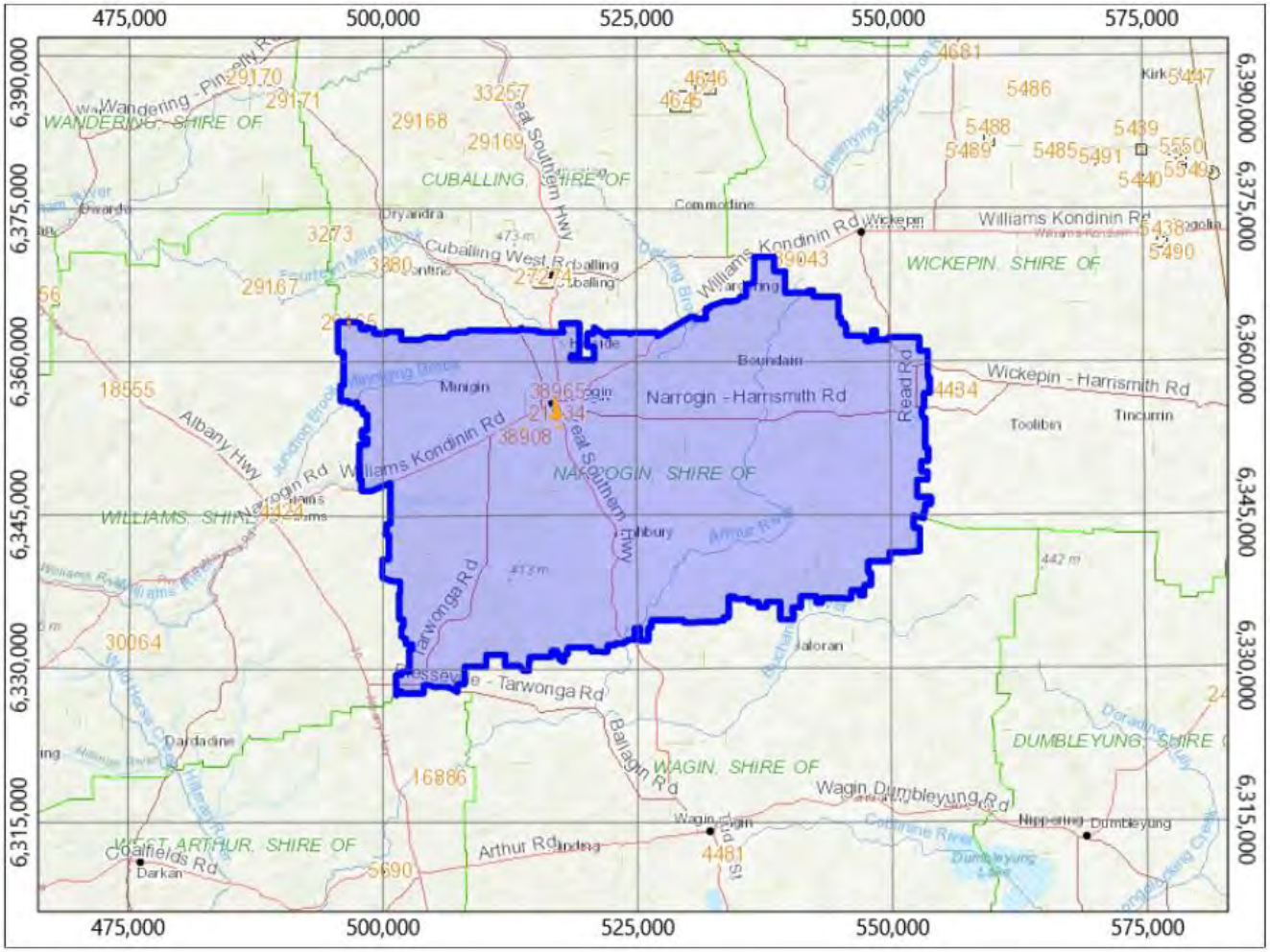
ID	Name	Boundary Restricted	Boundary Reliable	Culturally Sensitive	Culturally Sensitive Nature	Status	Place Type	Knowledge Holders	Legacy ID
21933	Peppermint Tree	No	Yes	No	No Gender / Initiation Restrictions	Lodged	Birthplace	*Registered Knowledge Holder names available from DPLH	
21934	Loco Shed Camps	No	Yes	No	No Gender / Initiation Restrictions	Lodged	Camp	*Registered Knowledge Holder names available from DPLH	
25733	Granite Road	No	Yes	No	No Gender / Initiation Restrictions	Lodged	Artefacts / Scatter; Camp; Historical; Traditional Structure; Other	*Registered Knowledge Holder names available from DPLH	
29165	Prison Massacre Site	No	Yes	No	No Gender / Initiation Restrictions	Lodged	Historical; Traditional Structure; Massacre	*Registered Knowledge Holder names available from DPLH	
33259	Narrogin Scarred Trees & Dam	No	Yes	No	No Gender / Initiation Restrictions	Lodged	Modified Tree; Water Source	*Registered Knowledge Holder names available from DPLH	
33260	Narrogin Scarred Tree1	No	Yes	No	No Gender / Initiation Restrictions	Lodged	Modified Tree	*Registered Knowledge Holder names available from DPLH	
38908	ALS21-01	No	Yes	No		Lodged	Modified Tree	*Registered Knowledge Holder names available from DPLH	
38965	Narrogin Brook	No	Yes	No		Lodged	Creation / Dreaming Narrative	*Refer to ACHKnowledge for list of registered Knowledge Holders	
38966	Gnarojin Park Corroboree Ground	No	Yes	No		Lodged	Ritual / Ceremonial	*Refer to ACHKnowledge for list of registered Knowledge Holders	

Department of **Planning, Lands and Heritage**

Aboriginal Cultural Heritage Inquiry System

Map of Aboriginal Cultural Heritage (ACH) Lodged

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Legend

- Aboriginal Cultural Heritage (ACH) Lodged
- Search Area
- Aboriginal Community
  - *Permanent*
  - *Seasonal*
  - *Town Based*
- Town
- Road
- River
- Local Government Authority

22.30 kilometres

Map Scale 1 : 676,000

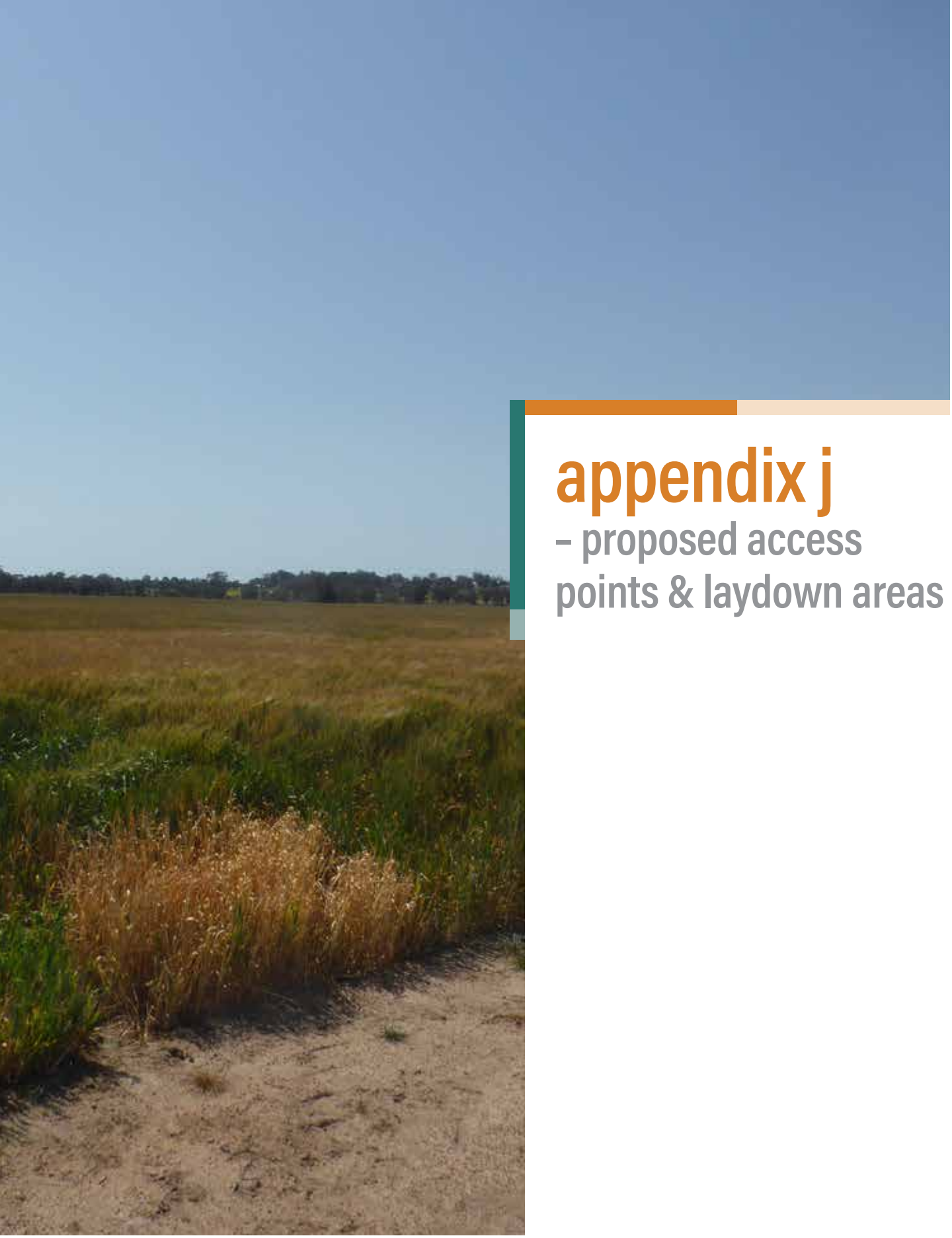
MGA Zone 50 (GDA94)

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appendix j

– proposed access points & laydown areas

Narrogin Solar Farm Overview

- Project Boundary
- Restricted Area
- Site Access
- Access Roads
- Switchyard

BESS Layout

- Inverter
- Battery Container
- Solar Array
- Proposed Substation Easement Route
- Project Connection Easement
- Fences
- Construction Laydown Areas
- O&M Building
- Parking Area
- Water Tank

Prepared by: Juan Nasta
Date: 17/10/2024
References: OpenStreetMap and its contributors, Western Australia Land Information Authority, Google Satellite, RenewMap.

PRIVATE AND CONFIDENTIAL

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appendix k

– landscape visualisation of project


NARROGIN SOLAR FARM OVERVIEW
VIEW POINT
ACCESS ROADS
SOLAR ARRAY
BATTERY STORAGE
SWITCHYARD
ACE
POWER
Australian Clean Energy

VIEWING POINT - ARP-01
WANERI ROAD - LOOKING SOUTH EAST



VIEWING POINT - ARP-08
CNR WANERI ROAD AND GREAT SOUTHERN HIGHWAY
INSIDE THE FIELD - LOOKING SOUTH WEST



VIEWING POINT - ARP-08-2
CNR WANERI ROAD AND GREAT SOUTHERN HIGHWAY
ROAD VIEW - SOUTHWARD



Google

VIEWING POINT - ARP-18
GREAT SOUTHERN HIGHWAY - LOOKING NORTH WEST



VIEWING POINT - ARP-20
GREAT SOUTHERN HIGHWAY - LOOKING WEST



VIEWING POINT - ARP-22
GREAT SOUTHERN HIGHWAY/SIMMONS - LOOKING SOUTH WEST



VIEWING POINT - ARP-24
GREAT SOUTHERN HIGHWAY SOUTH OF SIMMONS - WEST VIEW FROM SOUTH



PROPOSED BESS AND SWITCHYARD LAYOUT



landinsights
PLANNING DESIGN ENVIRONMENT

PO Box 289 Mt Lawley WA 6929
PHONE (08) 9271 8506 **EMAIL** admin@landinsights.com.au



Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
1. Water Corporation	<u>Water</u> A 58mm AC reticulation farmland main fronts some of the property boundary's; pending a capability assessment the landowner may be eligible for a Non-Standard Water Service. Such services are limited to a maximum flow of 2.1lpm	Noted.	No implication or change required.
	<u>Wastewater</u> No reticulated sewerage is available to the subject lots.	Noted – Habitable buildings once constructed will have to meet the health requirements of the Shire of Narrogin which will be addressed in the issue of a building approval for any required onsite facilities for the ongoing operations on the site.	No implication or change required.
	<u>Approval for works</u> Any works carried out in proximity to Water Corp assets must receive prior approval by applying for an Asset Protection Risk Assessment (APRA). To assess whether the proposed development will require an APRA, details of the Prescribed Proximities are available on our website: www.watercorporation.com.au/Developing-and-building/Working-near-assets/Approval-for-works.	Noted.	No implications or change required.
	<u>Building Approval Application</u> The Water Corporation has no objection for Development Application DAP418952	Noted.	No implication or change required.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	The information provided above is subject to review and may change. If the proposal has not proceeded within the next 6 months, please contact us to confirm that this information is still valid. Please provide the above comments to the landowner, developer and/or their representative.		
2. Public #1	As a resident of Narrogin I write to offer my support for the proposed facility. It is often the experience that any new project gets a nimby backlash. But we have to recognize that, since we all use electricity in our homes and businesses, we share a responsibility to produce and store that electricity.	Support Noted	No implication or change required.
	This area of the Wheatbelt is well placed with plenty of space to host solar generation and battery energy storage. Narrogin does experience, from time to time, power outages, in part reflecting that our electricity comes from a long distance. Having a local store of power would improve the reliability of the electricity structure in the Narrogin Shire. I see the proposal as a large positive for Narrogin which should be supported.	Support Noted	No change
	The Federal Coalition, under Peter Dutton, is proposing a nuclear power plant in Collie, which may take 10 to 20 years to put in place, even assuming it was approved. I think that, given the choice between a large nuclear facility upwind of Narrogin, or a greener solar system and battery storage system nearby, most residents would prefer the latter.	Noted	No change
3. Public #2	(a) By way of introduction, our home is located approximately 20 metres from the boundary of this proposed development and, as such, will be in what we would describe as very close proximity. We are, in fact, the closest residence to the whole proposed development area.	(a) The property is the closest house however it is 20 metres setback from their eastern lot boundary with a dedicated 20m road reserve along that boundary This provides at least 40 m separation which when	Updated mapping provided as part of submission showing location of house. Landscaping screening to be provided to mitigate visual impact

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	(b) This close proximity to the construction site and the potential build period of 18 months is of major concern to us, and we anticipate it will have a significant adverse impact on our lives. (c) Additionally, it is not unreasonable to expect that this project, particularly during the construction stage, will render our property unsaleable, should such a need arise.	combined with the Shire's development required setback of 20 metres for the installation within the lot boundary provides a minimum of 60 m horizontal separation between the house and the solar panel array. This intervening area can be landscape screened and therefore this separation is considered sufficient to mitigate visual impact. (b) Although the anticipated build time for the project is 18 months from commencement of works this does not mean construction works will continue for 18 months, and applies to the entire site not restricted to the boundary. The development will be staged across the site and as such development will only occur for a short period of time along this boundary.	

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
		The existing road reserve is not currently constructed and therefore is not planned to be used by heavy construction vehicles. The proponent Narrogin Solar Pty Ltd acknowledges the concern however reiterates that it is highly unlikely this boundary area will be traversed by heavy vehicles during the construction period. As a dedicated road however it is possible that this access will be used intermittently by workers during the 18 month construction period and when required for periodic maintenance access and to meet bushfire requirements during the life of the facility. (c) In regard to the saleability of the property this is a speculative and subjective opinion about a possible future impact,	

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
		however it is one which is not able to be considered as part of a development application and there is no indication the development would inhibit or prevent the property from being used as a rural enterprise.	
	Our decision to retire here in Highbury was carefully considered prior to purchase and the desire for a peaceful and tranquil rural setting was paramount in selecting this location. Whilst we understand that once completed, the solar farm should have a minimal impact on our lifestyle, the interim construction period will clearly be at odds with our current reality.	The respondent's lot adjoins an operating farm and so it is expected that during periods of seeding and cropping as well as other associated farming operations that there would be impacts on the property. These would have been foreseen. The solar array will not involve such activities and with this in mind offers a lower ongoing impact to neighbours. The construction of the solar array will take place in a staged manner across the entire the site and therefore it is highly unlikely that construction impacts are experienced for the entire	No change

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
		18 months. Whilst the expressed concern is noted, it is speculative and therefore open to conjecture and is therefore not reasonable to be considered as a matter for present planning consideration.	
	After carefully studying the DAP application, we would like to formally submit the following points of concern pertaining to the development, which in part is directly abutting the eastern boundary of our property located at 360 Parks Road, Highbury.		
	1. In reference to the DAP application prepared by Land Insights, the figure 1.3 map, page 7 (not fig 3.1 as incorrectly referenced on page 6) showing the location of houses surrounding the proposed development, fails to identify or highlight our home. This omission is continued over all subsequent included maps where house locations are indicated (see pages 9, 27, 29, 34 and 71.)	Mapping was prepared using shire and WALIS data. Due to the historical construction and location of buildings on farms without accurate mapping, it is sometimes possible that buildings located there may include houses or indicate the presence of houses within rural areas and can sometimes lead to properties being misidentified. An updated map showing the location of the property	Updated mapping provided to include buildings on this property. It is noted the building is located well away from the proposal.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
		is attached as part of these submissions. An introductory letter in relation to the project was sent to all adjoining landowners with an opportunity given for affected landowners to talk to the proponent Narrogin Solar Pty Ltd power and Land Insights directly. The proponents and Land Insights met directly with the nearest identified landowners whilst undertaking a site visit to discuss the project.	
	We are extremely disappointed that, as the nearest impacted residence to the proposed development, the physical location of our house is not shown in such a key mapping document. The only references to the proximity of our house are made in Section 6 Environmental Management, 6.4 Risk Management Table, page 60. (Refer subsection Landscape and Visual Impact, and Dust page 61.)	The opinion and expectation of impact is conjecture and has been addressed in the explanation above.	No proposed change necessary, address with standard approval conditions where necessary
	In each case, the reference to position is general by description and fails to specifically identify or locate our house. Our concern is that any assessment or conclusions drawn from the map(s) in regards to the proximity of housing to the project are flawed due to the failure of the DAP application to specifically identify the location of our residence.	An updated Map has been provided to the Shire and the RDAP as part of this response to submissions. During the site visit attended by Land Insights and the proponents a site	Condition to be included stipulating additional planting to be undertaken by the developer for additional screening to mitigate the visual impact.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
		visit was undertaken to the closest residence. It was noted during this site visit that given the topography of the site and adjoining road reserve and then on to the site where the solar array will be placed that from the garden of the property there will be limited view of the solar array and this can be mitigated through additional planting.	
	2. As detailed in the DAP application, currently in Western Australia there is no prescribed requirement concerning setback in relation to the development of facilities such as this. As such, we note that the setback on boundary sides other than those fronting the highway are 20m. Setback from the Gt Southern Highway is 50m. Given the size and scope of this proposed development we consider the 20m setback to be manifestly inadequate due to its proximity to our residence which is also located about 20m from the fence line.	Setbacks in relation to development in the Rural zone are prescribed under the Shire's Local Planning Scheme and relates to any form of development, for instance, if the farmer required a new large shed on that Lot then this would be able to be built at the 20m setback distance prescribed under the scheme. The start of the solar array will start approximately 60 metres from the side of the closest house. Visual	All setbacks are to comply .with the required minimum setbacks as stipulated in the Shire of Narrogin Local Planning Scheme No. 3 as follow: 50m – Primary Distributor Road; 20m – front , side and rear setbacks.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
		assessments have also been undertaken and due to the intervening topography of the land a significant amount of the solar array will be visually obscured from view due to the undulating landform, existing vegetation. This can be accentuated with screen planting at nominated places within the site and adjacent road reserve. The 60m separation is sufficient distance between the edge of the house and the start of the solar array.	
	We would respectfully request that special consideration be given to increasing the minimum setback requirement to at least 50m from the property line in the immediate area where it is in directly adjacent to a place of residence. Under this setback arrangement, when coupled with the existing easement width and our own building setback, overall separation from our house to the panels increases to 90m, which is far more acceptable than what is currently proposed.	Given that the house is located 20m inside their own boundary with and additional 20m for the dedicated road reserve and then an additional 20m before the solar array is started. The proponent believes that a 60m separation distance between the edge of the	Required buffers by additional landscaping to be undertaken to mitigate visual impact.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
		house and the start of the solar array is sufficient. During consultation there was agreement between the landowner and the proponent that some tree planting could take place within the lot boundary to screen the solar farm.	
	3. With reference to the Transport Impact Assessment prepared by Shawmac, page 22 Proposed Southern Site 3 access. This document indicates that the southern site 3 will be accessed by an internal roadway located on the easement directly adjoining our eastern property boundary. Whilst this internal roadway currently exists, it is not a serviced track and is infrequently utilised by a farmer to access his stock for feeding. The track is definitely not intended or suitable for regular vehicle traffic and, as it borders our property, we object to its proposed usage for site access. The track is 20m from our residence and as such its usage would subject us to unacceptable noise, dust and invasion of privacy. This easement and the native vegetation contained within it currently provides us with a natural wind break and shade for our property which is crucial during the summer months. It is also mentioned in the DAP application that the natural vegetation within the easement will assist with screening the proposed development from our property so any disturbance or usage of this easement roadway for site access is at odds with the screening objective.	This comment is noted and the unconstructed dedicated road reserve is not intended to be used for heavy traffic. The access may be used intermittently for access and for ongoing maintenance purposes.	The dedicated road reserve would only be used intermittently for farm access purposes as is the case presently. It will not be used by heavy vehicles. Main access to the site for deliveries and distribution will not be from this road reserve.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	Additionally, as shown in the photo below, access to this internal roadway will require all vehicles to enter and exit using our crossover driveway. This is unacceptable and would potentially impede our own property access.	This is not correct. If access is required, then Narrogin Solar Pty Ltd can make suitable arrangements with the Shire so that suitable access can be obtained.	Approved plans will address site access and will require further negotiations between Narrogin Solar Pty Ltd and the Shire will be undertaken if access along the road reserve is required for other reasons.
	It is appropriate to draw reference to the Overview Plan of the project, see page 4 of the Shawmac Traffic Assessment, which clearly indicates a constructed access roadway within the proposed development boundary that connects the southern sites 2 and 3. This roadway should be the sole means of access the southern site 3 and not via the easement track outside of the development area.	As noted above the area is a dedicated road reserve and will be used intermittently throughout the construction phase and for maintenance purposes during the operations phase.	Recommended that Contine and Parks Road as the main access point to the proposed development be upgraded and sealed at the applicants cost to the satisfaction of the Shire.
	4. With reference to the Glint and Glare Assessment prepared by SLR Consulting Australia. It is noted in this assessment, section 5.3.2 page 21 and 24, several areas of potential glare have been identified along Parks Road and mitigating vegetation proposed to reduce the effect. We would like to draw to your attention that since this report was prepared an area of the road verge has recently been cleared in parts to construct a replacement boundary fence to one of the lots associated with this proposed development. The removal of the native vegetation from the verge has created additional areas where the panels will not be	The proponent has taken the advice of the glint and glare specialists and panels can be programmed to reduce the amount of glint and glare that affects surrounding properties. The proponent will comply with all recommendations contained within the report.	Applicant to Implement the report by SLR Consulting Australia on Glint and Glare Assessment.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	screened from the road and as such, we consider that a further analysis of Parks Road will be required to confirm if additional areas of mitigating vegetation will be needed to prevent glare. Refer to the photo below.	As outlined in the Visual Assessment that forms part of the report that the landform of the site is not flat and undulates over the site with existing remnant vegetation remaining and the potential to enhance planting for screening where necessary this will screen views of the solar array throughout the site and its immediate surroundings. It is noted that with advances in technology the effects of glint and glare from solar panels is likely to be reduced over time.	
	5. Given that both Contine Road and Parks Road will be subject to a considerable increase in traffic movements during the construction period, we would also like to express our concerns that no mention is made in the DAP application as to who will be responsible for road maintenance/repair as and when required. Currently the Shire of Narrogin is responsible and generally the roads are graded once or twice per year. With the expectation of	Road maintenance can be conditioned as part of the approval and will be a matter between the proponent and the Shire.	To be conditioned or negotiated by the Shire with the proponent.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	increased traffic flow and more heavy vehicle usage, both roads will require more frequent attention.		
4. Public #3	I refer to the above proposals and pleased to be supportive of both. May I take opportunity to commend the Shire for this innovative concept and entrepreneurial approach and also the very comprehensive nature of the detail provided (in four booklets), the details of which were very clear in the presentation booklets as inspected at the library. I am most proud of the Shire and way it is managed. "Well Done."	Support for the proposal is noted	No change
5. Public Transport Authority	The Public Transport Authority (PTA) has no objections to this proposal. Due to the nature of the proposal, we do wish to remain involved in the following stages of development and kept up to date with how the proposal develops. This should be referred to WAPCreferrals@PTA.wa.gov.au	Noted – not clear as to how the PTA may affect or be affected by the project.	The proponent will provide updates in relation to the project to the PTA.
6. Aboriginal Heritage (DPLH)	Thank you for the letter dated 16 January 2025 seeking comment from the Department of Planning, Lands and Heritage (DPLH), Aboriginal Heritage Conservation team, regarding the Development Assessment Panel (DAP) Application for a proposed Solar Power Generation Facility and Battery Energy Storage System (BESS), located at the corner of Contine Road, Wanerie Road, and Great Southern Highway in the Shire of Narrogin, as described in the letter and maps provided in the development application (November 2024) prepared for proponent Narrogin Solar Pty Ltd.		
	I note that Aboriginal heritage is considered in the development application at Table 4.1, Section 5.7 and Table 6.1, concluding that no Aboriginal heritage sites were identified. A desktop Aboriginal Heritage Assessment is also provided at Appendix I.	Noted and accepted.	No change

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	A review of the Register of Places and Objects, as well as the DPLH Aboriginal Heritage Database, concludes that the subject area does not intersect with any known Aboriginal heritage Places or Registered Sites.	Noted	No change
	Therefore, based on the current information held by DPLH, no approvals under the *Aboriginal Heritage Act 1972* (AHA) are required in this instance. Please note that the subject area does not appear to have been surveyed in its entirety and, as such, it is unknown if there is Aboriginal heritage present. The AHA protects all Aboriginal sites in Western Australia, regardless of whether they have been recorded and registered. The development application indicates the proponent's awareness of the obligations under the AHA should any Aboriginal heritage be discovered during the works. DPLH advises Narrogin Solar Pty Ltd to remain aware of these obligations and encourages that the Gnaala Karla Boodja Aboriginal Corporation is consulted with regarding the proposal.	Noted – This advice forms part of the Heritage Assessment that was undertaken over the site and forms part of the development application.	Confirmation that adequate Aboriginal Heritage checking has been completed. No change
	DPLH also advises Narrogin Solar Pty Ltd regularly checks ACHIS should new Aboriginal Heritage be reported within the subject area. You can search ACHIS by using the following link: https://espatial.dplh.wa.gov.au/ACHIS/index.html?viewer=ACHIS.	Noted – this is a standard protocol and Narrogin Solar Pty Ltd will adhere to this.	No change
7. Public #4	In commenting on the proposed Battery Solar Power Generation Facility and BESS we would like to begin by expressing our dissatisfaction/abhorrence at the way the energy renewal projects seem to be proliferating.	Noted this opinion does not elaborate or address the proposal or the site in detail.	No change
	We are incensed at the blatant broadscale use of productive agricultural land for such projects. A standard line used by renewal energy companies when promoting the establishment of such projects is that 'productive agricultural land will not be used'. In the case of the Narrogin Solar Farm this is not so and belies the honesty/integrity of such companies in their rush for capital profit.	An assessment of the agricultural productivity undertaken by the applicant of this site indicates low value agricultural land and for this proposal indicates	No change

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
		that the site is a small percentage of regional productive agricultural land.	
	With the proliferation of renewable energy projects throughout areas such as the Shires of Narrogin, Williams, Wagin, Arthur River and Kojonup, to name some, we fear differences of opinion between landowners, and community members in general, will lead to, and apparently already has led to, disharmony within town and farming communities. While economic benefit to communities from such projects is taken into account, albeit with possible logistical issues such as housing for workers, if there is underlying discontent within a community then this would run counter to any economic benefit.	This statement is a matter of opinion. The proposal is consistent with WA and Federal Government objectives to advance renewable energy projects to meet international climate change protocols. As to local impacts consultation has been undertaken directly with surrounding landowners and through 2 community consultation days undertaken prior to the development application being lodged. There has been no indication of social disharmony with regard to the project. Further community benefits will follow post the start of construction.	No change

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	We have a farming operation in the Shire of Narrogin, part of which is immediately adjacent to the north-west section of the proposed Narrogin Solar Farm and other parts of the farm being in close proximity to the proposed Solar Farm (see attached map). Our major objections/areas of concern are listed and explained below: 1. Drainage (please refer to map) The proposed Narrogin Solar Farm's Locations 27, 7207 and 1* comprise an ironstone ridge and are immediately above and adjacent to Jenolan Nominees Locations 26, 2471, 158, 3037, 3071. Current broadacre livestock and crop farming in the Narrogin Solar Farm locations allays the water runoff from the ironstone ridges. The installation of solar arrays will result in soil compaction and vastly greater runoff onto the Jenolan Nominees locations in an average to wet rainfall year. From years of experience/observation such inundation of water would make those Jenolan Nominees locations very difficult to farm. In view of this it would be beholden upon Narrogin Solar Farms to install mitigation measures (earthworks). * In the letter of notification and invitation to comment from the Shire of Narrogin dated 16 January 2025, Location 1 was not included, indicating to us that this Location would not have panels. This however is contrary to the information provided by Narrogin Solar Pty Ltd as per the map	1. Matters raised are speculative and subject to conjecture. Evidence to support the claim has not been provided and therefore cannot be checked. Should the Shire decide it can be addressed via a drainage/stormwater management plan to the satisfaction of the Shire if this is considered necessary as a condition of the application and required prior to any initial earthworks being undertaken. Location 1 is included in all mapping contained within the report provided in support of the proposal. Plans provided as part of the Shire's advertising do not form part of this application. Location 1 was also included as part of the mapping contained within	The applicant to submit a stormwater and drainage management plan prior to the commencement of the development.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
		the consultation letter that was distributed to adjoining landowners. As an adjoining landowner Jenolan Nominees was sent this letter and offered the opportunity to liaise with the proponent. Only 1 landowner took up this opportunity to meet and this was the closest landowner. The mapping at the community consultation also included this area showing panels on Location 1.	
	2. Land maintenance by Narrogin Solar Farm: A major aspect of NSF's management of their land is that of fire prevention. While it may seem like a straightforward procedure to keep the ground free of combustible material we can only draw on the knowledge of another solar farm where that was very slipshod. Control of any fire hazard would involve the use of chemicals. This would need to be done according to responsible chemical usage pertaining to correct chemicals used, accurate calibration of equipment and accurate application. This would be crucial to prevent unwanted runoff/leaching of chemical residue over NSF's boundaries and into neighbouring/Jenolan	A detailed has been developed as part of this application. The Department of Fire and Emergency Services has made several recommendations for improvements and updates to the documents can be conditional of this development approval.	The Bush Fire Management Plan and Bushfire Risk Assessment are required to be amended incorporating the recommendations provided by the Department of Fire and Emergency Services.

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	Nominees land. The previous section on drainage is pertinent to this	The proponent Narrogin Solar Pty Ltd will comply with all the recommendations required within these reports. In relation to the suppression of fires within a BESS facility the current best practice used within Australia is to simply let the Battery burn whilst making sure the fire is monitored and does not spread to other high-risk areas.	
	3. Liability: While we do not know the full value of the Narrogin Solar Farm it would be vastly more than $20 million which is the usual Public Liability in farm insurance policies. This then is a cause for concern SHOULD a fire ever emanate from Jenolan Nominees and cause damage to Narrogin Solar Farm. What costs may be imposed by insurance companies to account for this?	Noted – At this stage no information in relation to these matters is available.	No change
	4. Electromagnetic Fields (EMF): Probably a lesser known/researched aspect of solar farms is the EMF produced by the large concentration of panels. What effects on animal health – both human and otherwise (livestock and native fauna) – might they have? Currently, to gain Livestock Production Assurance Accreditation it is relevant if livestock have access to solar panels. If this	Noted –These claims are unsubstantiated and appear unreliable due to the lack of supporting evidence. Solar farms have been operating in Australia in rural areas for many years now and without	No change required.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	parameter is broadened it could make running of livestock in the vicinity of solar panels a problem. Another concern is the possible effect of EMF on the use of GPS equipment which is used extensively in agriculture.	documented reports of any of these claimed detrimental effects.	
	5. Setback distance: 3 of the aforementioned points of concern namely Drainage, Land Management by NSF and Liability are impacted by the 20 metre setback from Lot boundaries. It would be beholden upon NSF to implement mitigation measures pertaining to those 3 points and would require more than a 20 metre setback. It is unjust for internal Lot Boundaries not to have the same consideration as the Great Southern Highway and for the setback for internal Lot boundaries to be 50 metres.	The setback distance in relation to Rural lots is set under the Shire's Local Planning Scheme and relates to all forms of development. The greater setback to Great Southern Highway relates to the fact that this is a Major Highway (Red Road) and the setback is required as much for mitigating highway noise and visual impacts to adjoining property. The solar array would suffer no impacts from highway noise.	All setbacks are to comply .with the required minimum setbacks as stipulated in the Shire of Narrogin Local Planning Scheme No. 3 as follow: 50m – Primary Distributor Road; 20m – front , side and rear setbacks.
	6. Land value: Devaluation of our farmland is a major concern. While one bank's opinion is neutral at the moment, they are not prepared to forecast the retention of land values given that this – renewable energy projects – is unchartered territory. A downside of lower land values is the impact on future finance application.	Whilst this may be of concern to the respondent it is unproven, and evidence suggests that the opposite may be proved given the economic benefits of renewable energy for regional communities. This	No change

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		development application needs to be assessed based on its actual likely physical impacts. Perceptions of future land values can be affected by many matters and therefore it is not reasonable to be considered as part of the application.	
	7. Glare aspect: Jenolan Nominees purchased 300 Parks Road in July 2025 unaware/uninformed of the Narrogin Solar Farm proposal. This property includes a residential house which is situated close to where banks of solar arrays are to be located along Parks Road. According to the report this house will be subject to high levels of glint/glare. This would need to be mitigated.	Due steps were undertaken to inform landowners. As part of the community consultation process a letter was sent in March 2025 to landowners by the proponent to inform them of the project. Jenolan may elect take this matter up with the vendor. A further 2 day community consultation was also undertaken at the Shire's community facilities prior to the lodgement of the development application. The house located on Lot 300 is behind the vegetation that has been planted on	The Applicant is to Implement the recommendation in the report by SLR Consulting Australia on Glint and Glare Assessment.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
		Lot 360 Parks Road. Whilst some glint and glare may affect the residence it can be effectively mitigated by the proponent once evident, and should it be required once panels are installed. It should also be noted that the house located on Lot 300 is approximately some 310m to the start of the solar array to the east of the property and over 1km to the start of the solar array to the North.	
	In conclusion we oppose the development of the proposed Narrogin Solar Farm in its current form. It was disappointing to learn of this proposal well after the inception of planning and not to have been approached – as an interested party (NEIGHBOUR) – by Narrogin Solar Pty Ltd. Renewable energy is an important consideration for our future needs. However the current headlong rush into renewable energy projects for political appeasement and to claim the mighty dollar is, we feel, unsustainable.	Noted as opposed. However, the reasons provided are general in nature and not directly relevant to the proposal or the manner in which it has been researched and documented.	No change
8. Main Roads WA	Main Roads Western Australia has considered the application and requests the following conditions:	Noted as support with condition–Main Roads will as a matter or process be consulted to ensure that	Include as conditions of approval: Prior to the commencement of the

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	Suitable arrangements being made with Main Roads Western Australia for the upgrading of vehicular crossovers to service the two lots directly accessing the Great Southern Highway (Northam Cranbrook Road).	crossovers and access are suitable.	development, suitable arrangements shall be made to the satisfaction of Main Roads Western Australia for the upgrading of vehicular crossovers servicing the two lots with direct access to the Great Southern Highway (Northam Cranbrook Road).
	Prior to the commencement of the development the applicant shall undertake an operational assessment, to the satisfaction of Main Roads Western Australia, of the Great Southern Highway (Northam Cranbrook Road)/Contine Road Intersection.	As above	Include as condition of approval
	Prior to the commencement of the development the applicant shall make satisfactory arrangements with Main Roads Western Australia for the upgrading of Great Southern Highway (Northam Cranbrook Road)/Contine Road Intersection in line with the intersection operational assessment.	As above	Include as condition of approval
	The developer is required to liaise with Main Roads Heavy Vehicles Services Department for all Over Size Over Mass (OSOM) vehicle movements.	As above	Include as Advice Note: The applicant is advised that all Over Size Over Mass (OSOM) vehicle movements must be coordinated with Main

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
			Roads WA's Heavy Vehicle Services.
9. DFES	It is the responsibility of the proponent to ensure the proposal complies with relevant planning and building requirements. This advice does not exempt the applicant/proponent from obtaining approvals that apply to the proposal including planning, building, health or any other approvals required by a relevant authority under written laws.	Noted	No change
	It is noted that the term 'high risk land use' was removed from the current version of SPP 3.7. This proposal was referred to DFES as a discretionary referral from the decision maker. DFES considers that the current SPP 3.7 does not adequately consider high risk land use or renewable energy facilities that do not have a habitable building. Should a habitable building be proposed SPP 3.7 focusses only on the building and does not consider the land use.	Noted – Proposal is not involved with SPP3.7. DFES needs to take matter up with WAPC.	No change
	DFES has assessed the proposal against the CFA Design Guidelines and Model Requirements – Renewable Energy Facilities (REF) v4 (August 2023) (REF Guidelines) which is considered best practice for the assessment of renewable energy facilities.	Noted	No change
	DFES notes the submission of a Bushfire Risk Report (BRR). Additional comments regarding the BRR are provided below.		
	Further clarification is required within the BMP of the requirements of SPP 3.7 and associated Guidelines and the REF Guidelines as outlined in our assessment below. The assessment comments against the REF Guidelines have been incorporated into the overall compliance comments against the Bushfire Protection	Noted – can be conditional	As per recommendation below..
	1. Policy Measure 7.1 ii. c. Preparation of a BAL contour map Vegetation Classification:	Noted – Updates to the BMP can be undertaken as a condition. It should also	Applicant is required to submit a revised Bushfire Management

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	• There is no photographic evidence to support the vegetation exclusion within Plot 6. • The BMP should provide evidence to support the exclusion of Plot 6 as managed to low threat in accordance with AS3959. • The BMP should address an enforceable mechanism to provide certainty that the proposed management measures can be achieved in perpetuity and that they are enforceable. • If unsubstantiated, the vegetation should be classified as per AS3959, or the resultant BAL ratings may be inaccurate. • Vegetation within Area 2 cannot be substantiated as Class B Woodland in its entirety with the limited information and photographic evidence provided. • DFES considers the boundaries between each area are unclear as the aerial image shows continual canopy coverage in some areas. • Specifically, some parts of Area 2 appear to be a continuation of Area 1. The potential for revegetation has not been considered. • The BMP should detail specifically how the Class B Woodland classification was derived as opposed to Class A Forest. • If unsubstantiated, the vegetation classification should be revised to consider the vegetation at maturity as per AS3959, or the resultant BAL ratings may be inaccurate. Action:	be noted that the co-consultant undertook a detailed site assessment prior to producing the Bushfire Management Plan and Risk Assessment.	Plan incorporating the recommended modifications provided by the Department of Fire and Emergency Services prior to commencement of any on site works.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	Modification to the BMP is required.		
	Vegetation Management There are areas classified as Class G Grassland, which may require active management to be maintained accordingly. The decision maker should be satisfied that there is an enforceable mechanism to ensure the current vegetation classifications, and/or exclusions, are maintained as such to achieve the radiant heat levels relied upon for the areas calculated as either an APZ or 10kw/m2. Action: The decision maker to be satisfied with the vegetation management proposed.	Noted – The proponent will undertake measures to ensure that the site is bushfire compliant at all times	As per above recommendation.
	Vegetation Classification DFES considers the vegetation classification maps within the BMP (Figure 3.1.1 and 3.1.2) are not at a scale that is legible for assessment and validation of the BAL ratings. The 10KW/m2 boundary is not considered visible to enable validation of the Method 2 or location of the BESS or solar energy facility infrastructure. Additionally, DFES considers there are a number of administrative inaccuracies, including: • Photo 27 is located within Figure 3.1.2, however Area 3 is not shown within Figure 3.1.2. • The labels for the areas are not connected to any area. • Table 3.2 references Area 3 as Class D (Scrub) Action: Modification to the BMP is required.	Noted - Condition	As per above recommendation.

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	Method 2 No land contours have been provided to demonstrate the slope on the Classified Vegetation and Topography maps within the BMP. DFES considers the Method 2 cannot be validated due to the inaccurate slope inputs. Action: Modification to the BMP is required.	Noted - Condition	As per above recommendation.
	2. Policy Measure 7.1 ii. d. Identification of any bushfire hazard issues arising from the assessment Consultation In the event that an approval is granted, the DFES District Officer responsible for this region and the local fire and emergency services should be consulted during the development, construction, and leading up to the commissioning of the facility. It is considered critical for the local fire and emergency services to understand the hazards present in the facility and the measures required to ensure the safety of firefighting personnel when working in or around different parts of the facility. This may impact on how crews respond to a fire within the facility, which may in turn have ramification regarding the optimal number and location of water supplies. Action: Comment Only	Noted – During the site visit and community consultation members of the Local Fire Service when briefed about the project advised about firefighting mitigation measures for the site.	The applicant is to ensure that they have they appropriate Fire Management plan and system in place to address fire incident within the facility.
	Bushfire Risk Report (BRR)	Noted	Include in condition of approval as per

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	DFES supports the inclusion of the BRR as a tool to identify hazards and detail the proposed responses. DFES considers that the document does not appear to address several risks relevant to the proposed use as required by the REF Guidelines including (but not limited to) over charge of the batteries, battery failure, lightning strike, adequacy of internal lot layout for response etc. DFES considers that a risk assessment should comply with ISO 31000:2018 and should include the following as a minimum: • A vulnerability assessment to determine the current risk level using impact, likelihood, consequence etc. • Mitigation measures to either reduce or mitigate the risk. • Tolerable Residual Risk (agreed in consultation with the decision maker and proponent). DFES recommends that a modified BRR or alternative Risk Assessment is provided to address the above concerns, with new response measures included in both the BRR and BMP. Action: Modification to the BRR and BMP required.	The final specification and design of the facility in relation to equipment that will be placed on site is still going through refinement and detailed design. Once finalised reports can be updated. It should also be noted that the required internal boundary setbacks of 50m to Great Southern Highway and 20m to lot boundaries makes allowance for fire control vehicles to access the site easily. The transformer contains equipment to mitigate lighting strikes.	recommended modifications.
	3. Policy Measure 7.1 e) Compliance with Bushfire Protection Criteria 7 Siting and Design A2.1b and A2.2 – not demonstrated The BAL ratings cannot be validated for the reason(s) outlined in the above table.	The BESS facility is located within a cleared area with only small pockets of remnant vegetation on the remainder of the site.	Include in condition of approval as per recommended modifications.

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	Additionally, the REF Guidelines require that a proposed BESS be located outside of a bushfire prone area, or that they be located within a moderate hazard level i.e. open paddock. The Fire Risk Management Principles of the REF also states that renewable energy infrastructure should be sited so as to eliminate or reduce hazards to emergency responders. Furthermore, evidence is required that the proposal meets the separation distance requirements (whichever is greater) to ensure: a) that radiant heat from a nearby bushfire will not trigger a failure in the infrastructure (whatever the most susceptible component is); and b) that radiant heat emitted from a failure in infrastructure should be used to inform the minimum separation distance required (i.e. radiant heat level that the weakest component can withstand) and provided to demonstrate compliance. Sufficient evidence in the form of technical specification and/or standards should be provided. Action: Modification to the BMP required.	As outlined above final detailed design will be undertaken with the final selection of components undertaken to enable updates to the BMP and Risk assessment can be undertaken.	
	Vehicular Access A3.1 – not demonstrated The BMP states that a compliant internal driveway will be provided, however the internal driveway is not detailed on the submitted plans. It is recommended that the internal driveway is clearly detailed on plans to ensure that all standards (e.g. clearances and widths) can be met. Action:	There are a number of entrances to the site that will be maintained and the setbacks required under the Shire's scheme will provide sufficient access around the site for bushfire and maintenance purposes.	Include in condition of approval as per recommended modifications.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	Modification to the BMP is required.		
	Water Supply A4.1 – not demonstrated The BMP should clarify how many tanks are proposed at this stage of development. Additionally, DFES considers that water tanks and adjacent hard standings should be provided in areas of BAL-29. It is recommended that the water tanks and adjacent hard standing areas are clearly detailed on plans (including the BAL Contour Map) to ensure that all standards can be met. Action: Modification to the BMP is required.	Noted – Requirements in relation to the number and size of water tanks to be placed throughout the site are included in the BMP. They will all be installed to the required specifications.	Include in condition of approval as per recommended modifications.
	DFES Internal Consultation The proposal was referred internally to other branches of DFES, however due to the impact of the high-threat period on resources, no responses could be provided within the referral timeframe. If any responses are received, they will be forwarded to the decision maker.	Noted	
	Recommendation – compliance with acceptable solutions not demonstrated – modifications required It is considered critical the bushfire management measures within the BMP are modified to ensure they are accurate and can be implemented to reduce the vulnerability of the development to bushfire. The proposed development has not demonstrated compliance with the following: 1. Element 2: Siting and Design, 2. Element 3: Vehicular Access, and 3. Element 4: Water.	The proposed solar array and associated BESS facility along with the switchyard and transformer meet all the elements in that: 1.The solar array and BESS facility are located on cleared land surrounded by sparse areas of remnant vegetation. 2.There are several points of access around the site	Include in condition of approval as per recommended modifications.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	Further information should also be provided to demonstrate compliance with the Victorian Country Fire Authority REF Guidelines, taken to be best practice.	with the setbacks prescribed under the Shires Scheme allowing for movement throughout the site as well as already existing internal tracks. 3.Requirements for the size of water tanks throughout the site and alongside the BESS facility are outlined in the BMP.	
	As this planning decision is to be made by the Development Assessment Panel please forward notification of the decision to DFES for our records.		
10. Development WA	DevelopmentWA has no comments to make on the DAP application for a proposed Solar Power Generation Facility and Battery Energy Storage System (BESS) at the corner of Contine Road, Wanerie Road, and Great Southern Highway. DevelopmentWA staff will arrange to meet with staff from the Shire of Narrogin in the near future to discuss whether there is any potential flow-on demand (should the application be approved and constructed) for supporting residential or industrial land development within the townsite of Narrogin.	Noted	No change
11. DPLH Department of Planning Lands and Heritage	Thank you for the letter dated 16 January 2025 seeking comment from the Department of Planning, Lands and Heritage (DPLH), Aboriginal Heritage Conservation team, regarding the Development Assessment Panel (DAP) Application for a proposed Solar Power Generation Facility and Battery Energy Storage System (BESS), located at the corner of Contine Road, Wanerie Road, and Great Southern Highway in the Shire of Narrogin, as described in the letter and maps provided	Noted understanding of the proposal and its location confirmed	No change

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	in the development application (November 2024) prepared for proponent Narrogin Solar Pty Ltd.		
	I note that Aboriginal heritage is considered in the development application at Table 4.1, Section 5.7 and Table 6.1, concluding that no Aboriginal heritage heritage sites were identified. A desktop Aboriginal Heritage Assessment is also provided at Appendix I.	Noted and confirmed	No change
	A review of the Register of Places and Objects, as well as the DPLH Aboriginal Heritage Database, concludes that the subject area does not intersect with any known Aboriginal heritage Places or Registered Sites.	Noted and check confirmed	No change
	Therefore, based on the current information held by DPLH, no approvals under the *Aboriginal Heritage Act 1972* (AHA) are required in this instance. Please note that the subject area does not appear to have been surveyed in its entirety and, as such, it is unknown if there is Aboriginal heritage present. The AHA protects all Aboriginal sites in Western Australia, regardless of whether they have been recorded and registered. The development application indicates the proponent's awareness of the obligations under the AHA should any Aboriginal heritage be discovered during the works. DPLH advises Narrogin Solar Pty Ltd to remain aware of these obligations, and encourages that the Gnaala Karla Boodja Aboriginal Corporation is consulted with regarding the proposal.	Noted -	No change
	DPLH also advises Narrogin Solar Pty Ltd regularly checks ACHIS should new Aboriginal Heritage be reported within the subject area. You can search ACHIS by using the following link: https://espatial.dplh.wa.gov.au/ACHIS/index.html?viewer=ACHIS.	Noted	Include as a condition of approval.
12. DWER Department of Water and	Thank you for providing the above referenced proposal for the Department of Water and Environmental Regulation (Department) to consider. The following comments are provided below, for which more detail is provided in the table:	Noted – support conditional. General comments may not apply to the proposed works.	Include as a condition of approval.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
Environmental Regulations	1. Issue: Workforce accommodation Advice: On-site domestic wastewater is to consider the requirements of the Government Sewerage Policy (WAPC 2019) for the protection of water resources. The subject site has several watercourses running through it, therefore the requirements of the *Government Sewerage Policy (WAPC 2019)* for the protection of water resources. This includes vertical and horizontal buffers, with horizontal buffers being measured from the outer edge of the riparian vegetation of the watercourses.		
	2. Issue: Water supply Advice: The proposed water source for construction, workforce accommodation, and on-going requirements (e.g. firefighting should be proven to the satisfaction of the local government. The subject property is located within a 'non-proclaimed' area for surface water under the *Rights in Water and Irrigation Act 1914*, where the taking of surface water for purposes other than domestic and non-intensive stock watering purposes cannot, in the department's determination, sensibly diminish stream flows or impact on the riparian rights of downstream users. The subject property is located within a 'non-proclaimed' area for ground water under the *Rights in Water and Irrigation Act 1914*. The presence and yield of groundwater in these areas is not guaranteed and as such, test holes should be drilled to locate a suitable supply. Abstraction of groundwater from artesian aquifers (from which water naturally flows, or has flowed, to the surface without the need for	Noted	No change

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	pumping) is subject to licensing from the department. A license is not required for abstraction from non-artesian groundwater resources. If it is intended to take groundwater and further advice is required, please contact our Water Licensing staff in Bunbury at bunbury.admin@dwer.wa.gov.au or 9726 4111.		
	3. Issue: Watercourse crossings Advice: A permit to undertake works on the bed or banks of a watercourse may be required for the construction of the internal road network or for any work related to ancillary infrastructure such as cables The subject property is located within a 'non-proclaimed' area for surface water under the *Rights in Water and Irrigation Act 1914*, however interference of the watercourse (such as the construction of a dam or crossing, or excavation of the watercourse) may require a *permit to interfere with the bed or banks* from the department. To determine if a permit is required the following guide may be used do-I-need-a-permit-to-interfere-with-bed-and-banks-of-a-watercourse.pdf. Further advice can be sought from our Water Licensing staff in Bunbury at bunbury.admin@dwer.wa.gov.au or 9726 4111.	Noted – No works are proposed to take place in any beds or banks of watercourses on the site.	No change

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	4. Issue: Native vegetation Advice: No clearing of native vegetation is indicated to occur, if clearing is required a clearing permit may be required It is stated that no clearing of native vegetation is proposed, however many of the references reference the retention of trees and ground cover is also considered native vegetation. Furthermore, there are references that state 'minimise cut and fill, earthwork, clearing of vegetation' and 'with little to no clearing of vegetation proposed'. If clearing is proposed then under section 51C of the *Environmental Protection Act 1986* (EP Act), clearing of native vegetation is an offence unless: • it is undertaken under the authority of a clearing permit, • it is done after the person has received notice under Section 51DA(5) that a clearing permit is not required, and/or • the clearing is subject to an exemption. Exemptions for clearing that are a requirement of written law, or authorised under certain statutory processes, are contained in Schedule 6 of the EP Act. Exemptions for low impact routine land management practices outside of environmentally sensitive areas (ESAs) are contained in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (the Clearing Regulations). The exemption under Regulation 5, Item 1 of the Clearing Regulations for clearing required as a result of the implementation of a development approval may apply in this situation. Note that this exemption does not apply prior to development approval being issued.	No clearing of native vegetation is proposed on the site. There is sufficient areas of cleared land over the site for the solar array to be placed on the site without the need for clearing.	Advice note to include that any vegetation clearing will require the prior approval from the Department of Water and Environmental Regulation.

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	Please also note that that clearing for a building / structure, combined with other exempt clearing activities on the property, must not exceed five hectares in a financial year. If further clarification is required, please contact the Department's Native Vegetation Regulation section at admin.nvp@dwer.wa.gov.au or 6364 7098.		
	5. Issue: Sediment management Advice: This should be considered in the Stormwater Management Plan and Constriction and Environmental Management Plan It is stated that a detailed Stormwater Management Plan is to be prepared. This should consider impacts from temporary and long term maintenance access road construction, and the risk of sediment mobilisation especially at interfaces with watercourses. It is also recommended that a Construction and Environmental Management Plan is prepared to identify risks and mitigation strategies.	The provision of a drainage/stormwater management plan can be a condition of approval.	Include in Condition of approval.
	6. Issue: Acoustic report Advice: The *Environmental Noise Assessment - Narrogin Solar and Battery Project (Lloyd George Acoustics, 24/10/24)* has not been assessed The department assesses technical reports upon specific request. No response was received to the Department request to	Noted	No change

Submissions	Comments	Officer's/Applicant's Comment	RECOMMENDATION
	whether this was required, as attached, and therefore a technical assessment of *Environmental Noise Assessment - Narrogin Solar and Battery Project (Lloyd George Acoustics, 24/10/24)* has not been undertaken.		
13. (JTSE) Department of Jobs, Tourism, Science and Innovation	JTSI ins reviewing the referral, advises no comment required on the Solar Power Generation Facility and Battery Energy Storage System proposal.	Noted JTSE has no comment.	No change

LG Ref: DA9-24/25 IPA2436211
DAP Ref: DAP/25/02861

Enquiries: (08) 6551 9919

Rebekah Hampson
Land Insights
Level 12/197 St Georges Tce
Perth WA 6000

Dear Rebekah

REGIONAL DAP - SHIRE OF NARROGIN - DAP APPLICATION - DA9-24/25 IPA2436211 - DETERMINATION

Property Location:	Lots 21, 22, 7067, 1189 Contine and Parks Road, Lots 3014, 3015, 3017, 2922, 2921, 1976 Great Southern Highway and Lots 1195, 29, 27, 7207, 6349 Wanerie Road, Narrogin
Application Details:	Proposed Solar and Battery Hybrid Project

Thank you for your Form 1 Development Assessment Panel (DAP) application and plans submitted to the Shire of Narrogin on 11 February 2025 for the above-mentioned development.

This application was considered by the Regional DAP at its meeting held on 12 June 2025, where in accordance with the provisions of the Shire of Narrogin Local Planning Scheme No.3, it was resolved to **approve** the application as per the attached notice of determination.

Should the applicant not be satisfied by this decision, an application may be made to amend or cancel this planning approval in accordance with regulation 17 and 17A of the *Planning and Development (Development Assessment Panels) Regulations 2011*.

Please also be advised that there is a right of review by the State Administrative Tribunal in accordance with Part 14 of the *Planning and Development Act 2005*. Such an application must be made within 28 days of the determination, in accordance with the *State Administrative Tribunal Act 2004*.

Should you have any queries with respect to the conditions of approval, please contact Azhar Awang on behalf of the Shire of Narrogin on 08 9890 0907.

Yours sincerely,

DAP executive director

17 June 2025

Encl. DAP Determination Notice
Approved Plans

Cc: Azhar Awang
Shire of Narrogin

Planning and Development Act 2005

Shire of Narrogin Local Planning Scheme No.3

Regional Development Assessment Panel

Determination on Development Assessment Panel Application for Planning Approval

Property Location: Lots 21, 22, 7067, 1189 Contine and Parks Road, Lots 3014, 3015, 3017, 2922, 2921, 1976 Great Southern Highway and Lots 1195, 29, 27, 7207, 6349 Wanerie Road, Narrogin
Application Details: Proposed Solar and Battery Hybrid Project

In accordance with regulation 8 of the *Planning and Development (Development Assessment Panels) Regulations 2011*, the above application for planning approval was **granted** on 12 June 2025, subject to the following:

1. **Accept** that the DAP Application reference DAP/25/02861 is appropriate for consideration as a "Renewable Energy Facility" (Solar and Battery Hybrid facility) land use and compatible with the objectives of the zoning table in accordance with Clause 3 of the Shire of Narrogin Local Planning Scheme No. 3;

2. **Approve** DAP Application reference DAP/25/02861 and accompanying plans (as contained in Attachment 1 - Application Report Dated November 2024) in accordance with Clause 68 of Schedule 2 (Deemed Provisions) of the *Planning and Development (Local Planning Schemes) Regulations 2015*, and the provisions of Clause 3.3.2 of the Shire of Narrogin Local Planning Scheme No. 3, subject to the following conditions:

Conditions

1. This decision constitutes planning approval only and is valid for a period of four (4) years from the date of approval. If the subject development is not substantially commenced within the four (4) year's period, the approval shall lapse and be of no further effect.

2. The approved development shall be in accordance with the approved development plans and documentation which form part of this development approval, subject to modifications required as a consequence of any condition(s) of this approval.

3. Prior to the commencement of works on the development site associated with the approved development, a Construction Management Plan shall be submitted to and approved by the Shire of Narrogin. The Construction Management Plan shall detail how the following matters will be managed during the construction phase:
   a) Hours of construction noting construction work which emits noise can only be performed during the hours of 7:00am and 7:00pm Monday to Saturday. Noise before or after these times as well as Sundays and public holidays is not permitted, unless otherwise approved in writing by the local government;
   b) How materials and equipment will be delivered and removed from the site;

c) Details of measures to be put in place for the removal of any hazardous materials;
d) How materials and equipment will be stored on the site;
e) Parking arrangements for employees and contractors and no parking occurs on the public road network in the vicinity of the site;
f) Construction waste disposal strategy and location of waste disposal bins;
g) Details of cranes, large trucks or similar equipment which may block public thoroughfares during construction;
h) Development related vehicles (including private vehicles of employees, contractors and subcontractors associated with the construction, operation, upgrading and decommissioning of the development), leaving the site area are in a clean condition to minimise dirt being tracked onto the public road network;
i) Details of how the construction process will be managed to minimise the impact on pedestrian and vehicle movement;
j) Measures to be put in place to control, prevent and mitigate any environmental impacts on adjoining landowners and the surrounding road network. The matters to be addressed shall include noise, light spill, vibration, dust, sand, vehicle washdown, waste management and the movement of soil, sediment and stormwater;
k) Measures to be put in place to protect Shire infrastructure, particularly roads, during the construction period and to ensure these are reinstated to a satisfactory condition at the end of the construction and commissioning process. Where required by the Shire, a dilapidation report prepared by a suitably qualified person shall be submitted detailing the current condition of relevant Shire road infrastructure adjacent to the site;
l) establish a complaints handling system to address community concerns relating to construction and operation of the development for a period of three years post-commissioning. This system shall include:
    i) Dedicated contact details for the builder or contractor during construction and for the operator post-construction, made publicly available (e.g., signage, website, local notice).
    ii) A log of complaints received and actions taken in response, including timeframes and resolution outcomes.
    iii) Provision of an annual summary report of complaints and responses to the Shire of Narrogin for the duration of construction and for a minimum of three (3) years post-commissioning; and
m) Construction Traffic management measures for the local road network. The approved Construction Management Plan shall be implemented for the duration of the construction process to the satisfaction of the Shire of Narrogin.

4. Prior to the completion of construction, the applicant shall submit to, and have approved by, the Shire of Narrogin a Landscape Screening Plan that demonstrates how visual screening will be achieved through a combination of retained vegetation and new planting along visually sensitive boundaries of the site, particularly where the development is visible from public roads or sensitive receptors. The plan shall:
    a) Clearly identify the locations and extent of proposed screening, including areas of retained vegetation and new planting;
    b) Detail the species to be planted, plant densities, and expected mature heights;
    c) Be designed to enhance the visual amenity of the development without impacting solar generation efficiency; and

d) Be implemented within six (6) months of completion of construction and maintained for the life of the development to the satisfaction of the Shire.
e) Including the potential for additional planting to be implemented along Great Southern Highway subject to approval of the Shire of Narrogin in consultation with MRWA

5. Prior to the commencement of development, the applicant shall submit a Stormwater Management Plan to the satisfaction of the Shire of Narrogin. The approved Stormwater Management Plan shall be implemented prior to the commencement of use and maintained for the life of the development to the satisfaction of the Shire.

6. Prior to the commencement of the use, any new vehicle access points onto the local road network, as well as any new internal accessways and car parking areas proposed to be constructed as part of the development, shall be designed and constructed to the satisfaction of the Shire of Narrogin.

   Where the development proposes to use existing constructed access points and internal access tracks, these may continue to be used without modification, unless otherwise required by the Shire.
   All accessways and car parking areas shall be maintained in good condition for the life of the development.

7. In the event the operation of the Solar and Battery Hybrid Facility is to cease, no later than one (1) year prior to the anticipated cessation of operations, the proponent shall submit a Detailed Decommissioning and Rehabilitation Plan (DDRP) to the satisfaction of the Shire. The DDRP shall provide a methodology for decommissioning and site rehabilitation; outline waste management and recycling approaches; and identify timeframes for rehabilitation works. All infrastructure shall be removed, and the site rehabilitated in accordance with the approved DDRP within two (2) years of cessation, or within an alternative timeframe agreed by the Shire.

8. Prior to the commencement of any on site works, the applicant is to submit a revised Bushfire Management Plan (BMP), incorporating the recommended modifications by the Department of Fire and Emergency Services including:
   a) Vegetation classification- (rational for each vegetation classification using AS3959 definitions; Vegetation management (Responsible parties and frequency for fuel load reduction, incorporate an enforceable mechanism and ongoing monitoring and reporting regime in the Bushfire Management Plan);
   b) Mapping (scalable mapping with visible BAL contours, topographical data/contour maps);
   c) Bushfire Risk Report (address risks related to infrastructure failure (e.g., overcharge, thermal runaway and update BMP to reflect new mitigation measures);
   d) Siting and Design (Include tech specs or standards for infrastructure components to justify radiant heat thresholds, Re-assess siting in context of hazard level and responder safety as per Renewable Energy Facility and update BAL Contour Maps accordingly;
   e) Vehicular Access (provide plan showing width, turning radius, clearance, and hardstand details of internal access tracks); and

f) Water Supply (show tank and hardstand locations on BMP and BAL Contour Map, confirm compliance with water supply standards under the Guidelines).

9. The approved BMP shall be implemented in full and maintained for the life of the development to the satisfaction of the Shire of Narrogin.

   The applicant shall also:

   - Notify the Shire of Narrogin's Local Emergency Management Committee (LEMC) of project completion and operational commencement; and
   - Make reasonable efforts to assist local emergency services and bushfire brigades in the event of a bushfire in the vicinity of the site, where safe and practicable to do so.

10. The installation of any directional/traffic/warning/safety signage in the vicinity of the development's access point onto the road network, and relating to the development, as appropriate, shall be to the satisfaction of the local government in consultation with Main Roads.

11. The development shall be implemented and operated in accordance with the recommendations of the Glint and Glare Assessment and Visual Impact Assessment prepared by SLR Consulting Australia, forming part of the approved documentation, including (but not limited to):
    a) Minimising off-site visual impacts of solar infrastructure through appropriate layout and screening;
    b) Ensuring the visual integration of ancillary infrastructure (including buildings, fencing, and inverters) with the rural landscape through appropriate materials, finishes, and colour treatments; and
    c) Prohibiting the display of advertising signage or logos on-site, except as required for identification or safety.

12. The applicant shall be responsible for the repair, reinstatement, or replacement of any public road infrastructure that is damaged or degraded during the construction phase of the development as a direct result of development-related traffic, to the satisfaction of the Shire of Narrogin.

    Where agreed by the Shire, the applicant may instead make a financial contribution equal to the cost of the necessary repair works.

13. Prior to the commencement of construction, the applicant shall upgrade and seal the following road sections to a standard suitable for accommodating construction traffic, or alternate measures to ensure dust suppression on the roads, to the satisfaction of the Shire of Narrogin:
    - Contine Road from Great Southern Highway intersection to Parks Road.
    - Parks Road, from its intersection with Contine Road to southern boundary of Lot 6499.

    The scope, standard, and specification of the upgrade works shall be determined in consultation with the Shire of Narrogin and may be implemented in stages or secured through a bond or other form of financial guarantee, as agreed in writing by the Shire.

14. Any lighting device is to be positioned and shielded as not to cause any direct, reflected, or incidental light to encroach beyond the property boundaries.

Advice Notes

1. The applicant is advised that granting of development approval does not constitute a building permit and that an application for relevant building permits must be submitted to the local government and be approved before any work requiring a building permit can commence on site.

2. The applicant is advised that this planning approval does not negate the requirement for any additional approvals, and adherence to due diligence, which may be required under separate legislation. This including, but not limited to, the obtaining of any required approvals from the Department of Health, the Department of Energy, Mines, Industry Regulation & Safety, the Department of Water & Environment Regulation and Main Roads WA and consulting of Before You Dig Australia. It is the applicant's responsibility to obtain any additional approvals, and undertaking of due diligence, required before the development/use lawfully commences.

3. The applicant is advised that the proposed works are near an area of high risk. It is recommended that persons planning to build or undertake works in high risk areas near transmission or communication assets act in a safe manner at all times and in accordance with all applicable legal and safety requirements (including the 'duty of care' under the laws of negligence, WorkSafe requirements and guidelines, Australian Standards and Western Power policies and procedures).

4. Onsite sewerage treatment systems require approval from the Local Government's Environmental Health Services and the Department of Health. The system must comply with the Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974 and any other applicable legislation, regulations, or standards. It is recommended that the applicant engages with the Local Government early in the planning process to ensure that all design, installation, and operational requirements are met prior to commencing works.

5. The applicant is required to comply with the Environmental Protection Act 1986 and any Works Approval required for the proposed development prior to any site works.

6. Any clearing required as part of construction or bushfire prevention may require an application to be made to the Department of Water and Environmental Regulation.

7. The applicant will need to consult with the Main Roads WA Heavy Vehicle Services branch to ascertain any approval requirements that may be required for their proposed heavy vehicle combinations, transport routes and operations.

8. All mechanical equipment is to be designed and installed to prevent emitted noise levels from exceeding the relevant decibel levels as set out in the Environmental Protection (Noise) Regulations 1997.

9. The applicant is advised that there are no accommodation vacancies in the Shire of Narrogin that would sustain any form of construction activity as envisaged for the development and therefore it is strongly recommended to submit a Development Application to be considered and approved by the Shire of Narrogin with an accompanying detailed proposal for any associated temporary/transient workforce accommodation, in accordance with the Shire's adopted Local Planning Policy – Temporary/Transient Workforce Accommodation.

10. Pursuant to Advice Note 10, any workforce accommodation shall therefore:
    a) Be established only for the duration of the construction phase of the Solar and Battery Energy Hybrid Facility and shall be limited to a period of three (3) years from the date of occupancy.
    b) Include a Management Plan, Needs Assessment, Infrastructure Servicing Plan, and Decommissioning Plan to the satisfaction of the Shire.
    c) Be used solely for the accommodation of workers directly involved in the construction of the approved renewable energy facility with the approval of the Shire.
    d) Be removed, and the site rehabilitated to the satisfaction of the Shire, within 6 months of the conclusion of the construction works, unless an alternative legacy use has been approved by the Shire.

11. In the event that any Aboriginal Heritage site is discovered during the works, the applicant must consult with the Gnaala Karla Boodja Aboriginal Corporation. The applicant is also encouraged to regularly monitor the Aboriginal Cultural Heritage Inquiry System (ACHIS) for any newly reported Aboriginal Heritage sites within the subject area.

12. The applicant is advised that agreements with affected landowners for any required easements associated with the powerline are to be maintained and implemented in accordance with relevant legislation and separate legal mechanisms.

13. The proponent is strongly encouraged to develop a Regional Participation Plan, clearly demonstrating their strategic commitment to maximising local labour, trade, and industry involvement. This Regional Participation Plan should explicitly detail practical measures for engaging local businesses, tradespeople, apprentices, and trainees. Where feasible, this should include active collaboration with local business networks, local workforce providers, technical and further education institutions, the establishment of an accessible information portal, and the hosting of targeted information sessions to promote and facilitate local participation in available work packages and procurement opportunities.

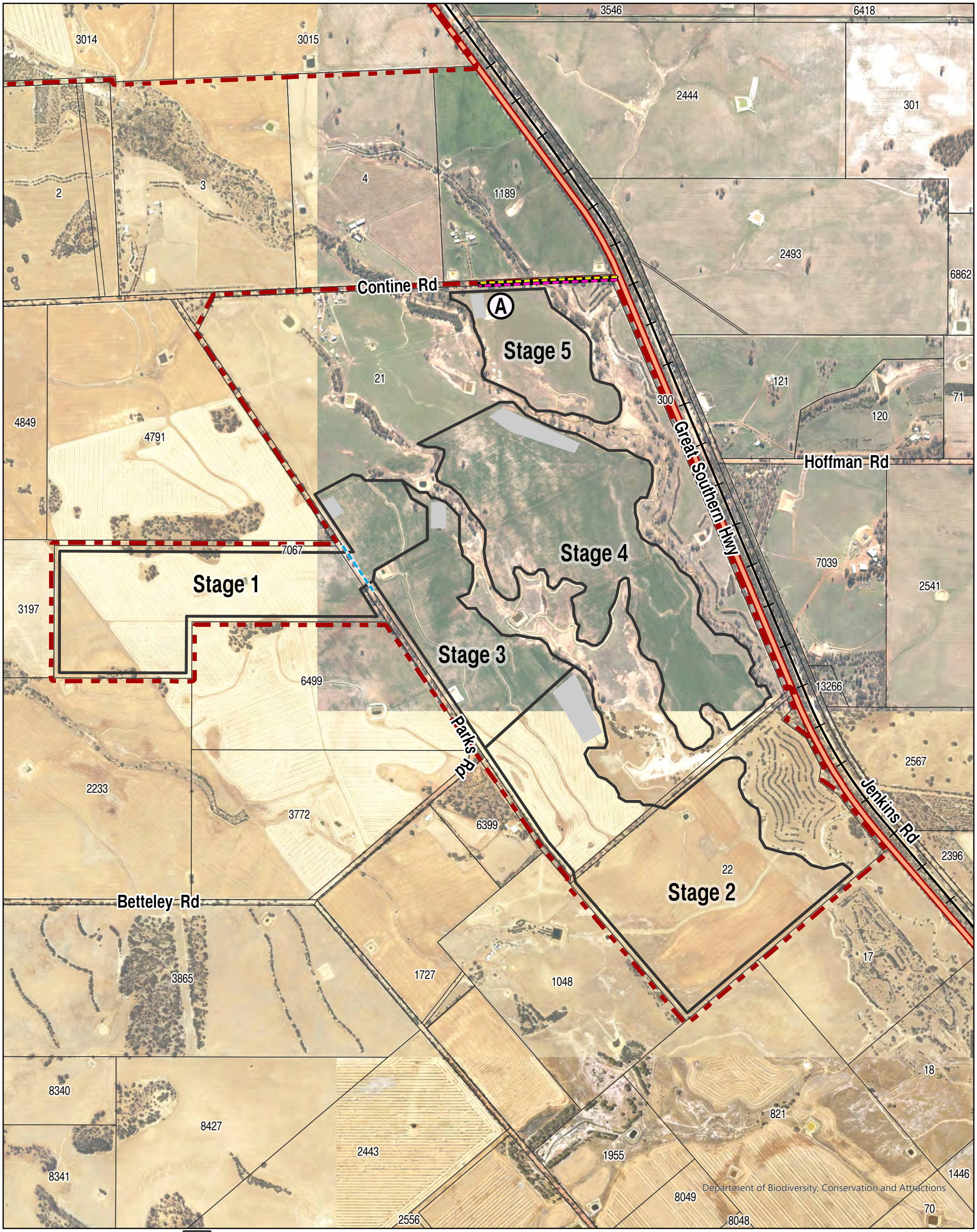
14. The proponent is advised to carefully identify, acknowledge, and implement measures to mitigate predicted significant impacts on scarce local natural resources, such as gravel, sand, and water supplies, essential for the construction phase. Effective strategies must be put in place to prevent significant depletion or inflation of resource prices, thereby ensuring the sustained availability of these resources for ongoing community needs, domestic purposes, road construction, and general infrastructure projects.

15. The applicant is encouraged to voluntarily engage with the Shire of Narrogin to implement public art contributions consistent with the Shire's Adopted Public Art Strategy & Masterplan 2019. Contributions can be through direct implementation or cash-in lieu, supporting community cultural enrichment and visual integration of renewable energy infrastructure.

16. The applicant is strongly encouraged to voluntarily establish and implement a Community Enhancement Fund (CEF) with the Shire of Narrogin, consistent with the Shire's Adopted Community Enhancements Fund Policy.

17. Should the applicant be aggrieved by this determination there is a right (pursuant to the Planning and Development Act 2005) to have the decision reviewed by the State Administrative Tribunal. Such application must be lodged within 28 days from the date of determination.

Where an approval has so lapsed, no development shall be carried out without further approval having first been sought and obtained, unless the applicant has applied and obtained Development Assessment Panel approval to extend the approval term under regulation 17(1)(a) or local government approval under regulation 17A of the *Planning and Development (Development Assessment Panels) Regulations 2011*.



State road
Cadastre
Project Extent
A Site access point

Construction Staging
Laydown area for each stage

GS Hwy to A sealed
Parks Rd between Lot 21 and 7067 sealed
Proposed road section (access to construction site) (504m)

Base data provided by SLIP.

landinsights
PLANNING DESIGN ENVIRONMENT

Projection: GDA2020 MGA Zone 50; Date Exported: 29/08/2025 1:32 PM
Project: 1121; Layout Name: ARP 1121-012-04-02 Narrogin Staging Access Ver2

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0 150 300 450 600 750 m

Scale: 1:12,500 @ A3

STAGING - CONSTRUCTION ACCESS
Narrogin Solar and Battery Hybrid Project
NARROGIN
Narrogin Solar Pty Ltd

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PART D – OTHER BUSINESS

1. State Administrative Tribunal Applications and Supreme Court Appeals

2. Meeting Closure