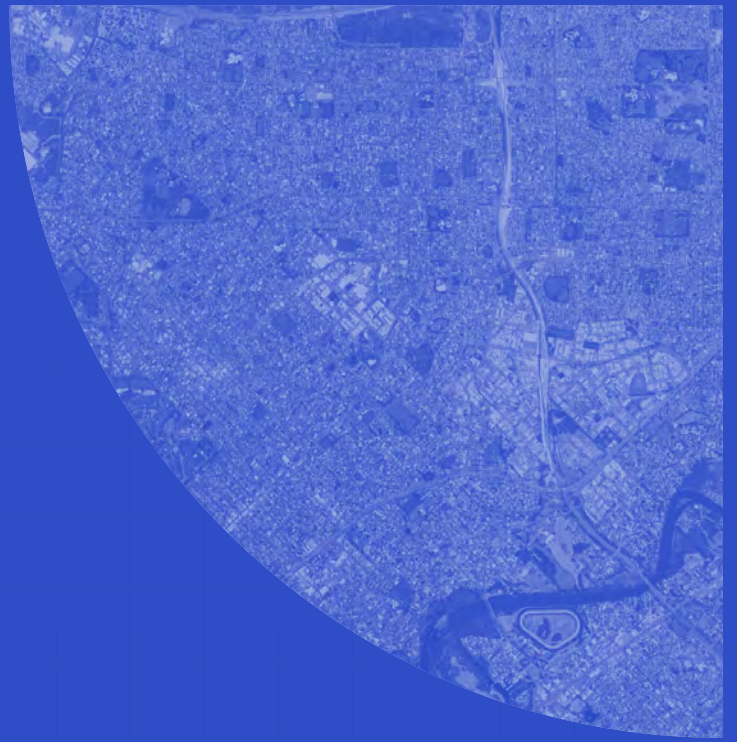


Rise Urban.



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Lot 31 Great Southern Highway, Dumberning
FutureEnergy Australia

Renewable Diesel Biorefinery – Application for Development Approval
Planning Report

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Appendices

1. Completed Shire of Narrogin *Application for Planning Consent* form and DAP Form 1
2. Current certificate of title Lot 31 Great Southern Highway
3. Copies of plans including site plans, floor plans and elevation plans
4. Artists impression perspectives of the proposed development
5. Civil Plans (Technip Energies, August 2022)
6. Site Survey (ST Spatial Consulting Surveyors, May 2022)
7. Transport Impact Statement (Transcore, August 2022)
8. Bushfire Management Plan (Bushfire Prone Planning, October 2022)
9. Bushfire Risk Assessment and Management Report (Bushfire Prone Planning, September 2022)
10. Approved Local Development Plan – Lot 31 Great Southern Highway, Narrogin (Shire of Narrogin, 2017)

Executive Summary

FutureEnergy Australia (FEA) is a joint venture between Carnarvon Energy Ltd and Frontier Impact Group. FEA was established with the aim of becoming a leader in the transition from energy-intensive fuels to innovative renewable carbon-neutral fuels to support the transition to a carbon net-zero future. FEA plans to build and operate renewable fuel biorefineries and is set to establish Australia's first large-scale renewable fuel business in Western Australia.

FEA's first project is a renewable diesel biorefinery, located a few kilometres south of the Narrogin township. The biorefinery, known as the Narrogin FutureEnergy Park, is a \$200 million AUD investment in the Shire of Narrogin, and will generate an estimated 35 direct jobs and up to 90 indirect jobs once operational, plus more during construction.

The biorefinery converts biomass (woodchips and agricultural crop residue pellets) sourced from the Wheatbelt into renewable diesel via a thermochemical process called 'pyrolysis' which applies heat to the biomass in the absence of oxygen to drive a chemical reaction. The renewable diesel is cleaner and more efficient than typical fossil fuel diesel, and is considered a 'drop in' substitute for mineral diesel. The diesel has a substantially reduced environmental footprint.

As well as renewable diesel, the biorefining process also produces a graphene-rich biochar and a wood vinegar, both of which have significant economic benefits complementing the primary renewable diesel production. The graphene-rich biochar also has potential industrial applications, and can be refined further into a graphene product for use in batteries, electronics, construction, fabrics and polymer coatings.

The proposal is consistent with the planning requirements of Local Planning Scheme No. 3, the applicable Local Development Plan and relevant State Planning Policies.

A Transport Impact Statement, Bushfire Management Plan and Bushfire Risk Assessment and Management Report provide further technical detail to this proposal. Together, these reports demonstrate that the traffic arising from the proposal will not adversely impact the adjoining properties or the locality, as well as demonstrating that the proposal complies with relevant bushfire planning requirements and ensures an acceptable and tolerable level of bushfire risk.

The proposal meets the definition of a "prescribed premises" under the *Environmental Protection Act 1986* and as such, requires separate approvals / licences from the Environmental Protection Authority prior to commencement. Separate applications are being prepared and will be issued to the EPA in November 2022 for assessment. Whilst environmental and amenity impacts are important planning considerations, the EPA approval process is entirely separate to the planning approval process. The EPA applications address important considerations such as emissions, noise, and impacts on the natural environment and adjoining properties. The key findings of the environmental assessments completed to date are summarised in this report, while the technical reports and assessments will be made available once submitted to the EPA.

The proposal has been designed and located to minimise amenity impacts on the surrounding locality while being situated a convenient distance from Narrogin to support the sustainability of the community. The biorefinery layout is modular and includes potential for expansion by up to 50% of its proposed capacity in the future.

This project is a critical step in FEA's mission to develop approximately 20 renewable diesel refineries across Western Australia. Its successful implementation will buoy investor confidence and enable the economic, environmental and community benefits of a biorefinery such as this to be replicated and multiplied across Western Australia. FEA is proud to be partnering with the Narrogin community on this important first project.

1.0 Introduction

Rise Urban has been engaged by FutureEnergy Australia (FEA) to seek development approval for a renewable diesel biorefinery at Lot 31 Great Southern Hwy, Dumberning.

FEA has chosen to develop Australia's first renewable diesel biorefinery in Narrogin due to its locational comparative advantage, being surrounded by agricultural uses that produce the biorefinery inputs (biomass and feedstock) while remaining within reasonable proximity to major freight routes and wholesalers of the diesel produced at the biorefinery.

The biorefinery will directly create 35 new jobs in addition to construction jobs and potential future indirect jobs elsewhere (estimated to be up to 90 indirect jobs). With those jobs will likely come families and discretionary spending, which will generate flow-on benefits for Narrogin.

The biorefinery is the first commercial scale project of its kind in Australia and has the potential to be a game-changer for the Western Australian fuel, energy, resources and logistics sectors (as well as the environment) by providing a cleaner, greener source of energy than what is currently available for use by Western Australian businesses and households. On a broader scale, this proposal will improve fuel security in Western Australia as a whole, which has broad regional and strategic consequences, as well as introducing a circular economy to the primary producers in the area.

The biorefinery will contribute to Western Australia's pathway towards net zero carbon emissions and will reduce its environmental footprint. The biorefinery is low carbon (or carbon negative subject to the outcomes of the life cycle assessment currently underway), produces diesel that is cleaner to burn than diesel produced using traditional methods, avoids emissions associated with burning of the biomass that will be converted to diesel, and is a net-positive producer of clean water.

FEA and its team have been progressively developing the project specifications and design throughout 2022. This process will continue until construction commences, with the design to become progressively further detailed and refined over time.

As this is the first commercial scale project of its kind in Australia, the forthcoming detailed design process may lead to amendments to the design being required. This is standard practice for projects of this scale and will be managed closely with the Shire of Narrogin throughout the project lifecycle. This development application is lodged on the basis that there is now sufficient certainty in the design and site layout of the project to provide the JDAP and Shire sufficient information to assess and determine the proposal.

This report sets out justification for the proposal and is supported by the following documentation:

- Appendix 1 – Completed Application for Planning Consent and DAP forms
- Appendix 2 – Current certificate of title
- Appendix 3 – Plans of the proposed development
- Appendix 4 – Artists impression perspectives of the proposed development
- Appendix 5 – Civil Plans (Technip Energies, Aug 2022)
- Appendix 6 – Site Survey (ST Spatial Consulting Surveyors, May 2022)
- Appendix 7 – Transport Impact Statement (Transcore, Aug 2022)
- Appendix 8 – Bushfire Management Plan (Bushfire Prone Planning, Oct 2022)
- Appendix 9 – Bushfire Risk Assessment and Management Report (Bushfire Prone Planning, Sept 2022)
- Appendix 10 – Approved Local Development Plan – Lot 31 Great Southern Highway, Narrogin (Shire of Narrogin, 2017)

2.0 Site Context

The features and physical context relevant to the subject site and to this proposal are detailed in the following section.

2.1 Site and Local Context

Lot 31 Great Southern Highway, Dumberning is located 4km south of the Narrogin town centre, and 1km south of the Narrogin general industrial area, and is on the north-west quadrant of the Great Southern Highway – Wanerie Road intersection.

Lot 31 is 64.624ha in size, and the portion of Lot 31 that is proposed to be used for the renewable diesel biorefinery ('the subject site') is 10.8ha in size. The subject site is located adjacent to the southern boundary of Lot 31, facing Wanerie Road.

Lot 31 is currently owned by Baringa Investment Pty Ltd, and is under contract to Carnarvon Energy Ltd subject to FEA's completion of the planning, environmental and due diligence processes. At settlement, the entirety of Lot 31 will be under the ownership of Carnarvon Energy Ltd and thence the biorefinery site would be leased to FEA.

A local context map and site context map depicting the subject site, Lot 31 and its immediate surrounds are shown at Figures 1 and 2 below.

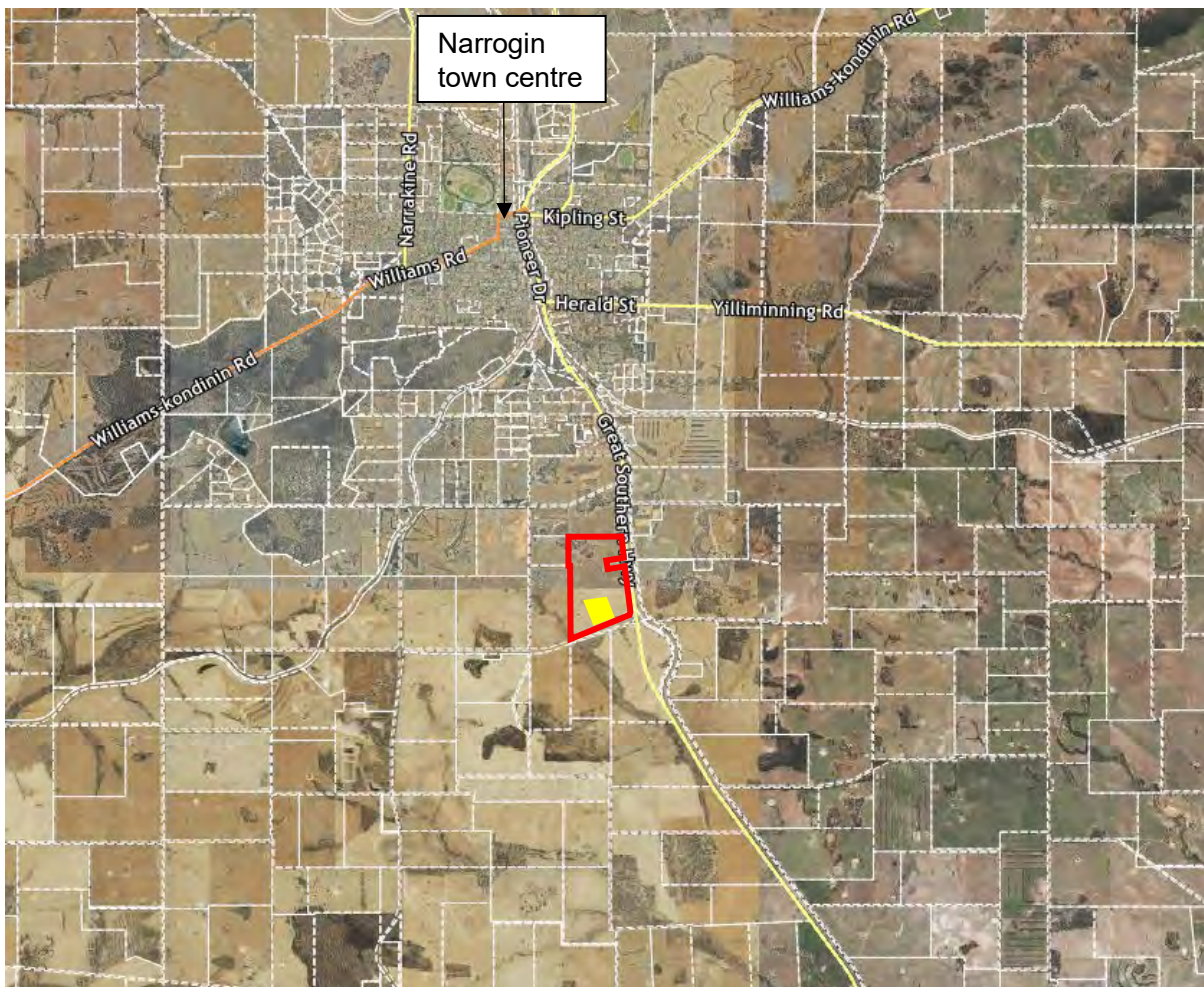


Figure 1 – Local Context Map – Lot 31 Great Southern Hwy, Dumberning (source: MNG Access 2022)

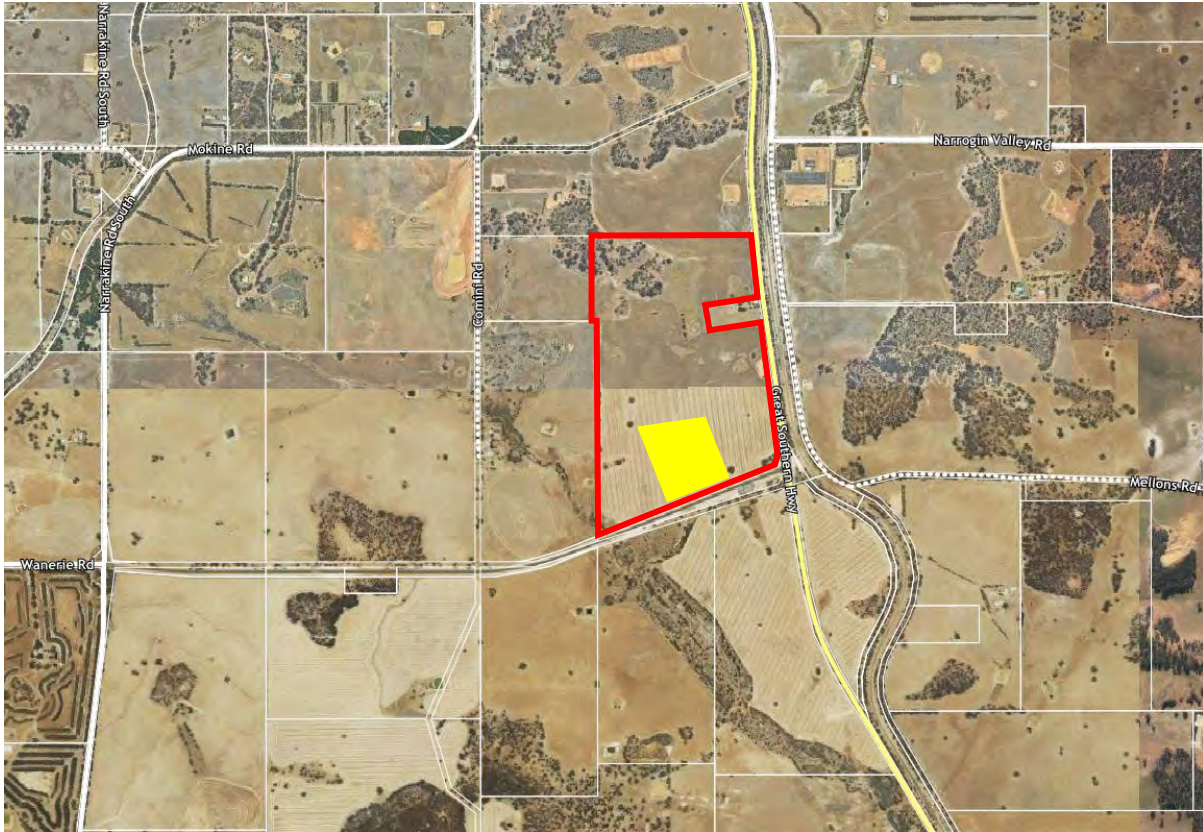


Figure 2 – Site Context Map – Lot 31 Great Southern Hwy, Dumberning (source: MNG Access 2022)

Lot 31 borders four rural lots to the west, north and east, Great Southern Highway to the east and Wanerie Road to the south.

The locality surrounding Lot 31 is zoned and used for rural purposes, however Wanerie Road separates the site from the rural uses to the south with a road reserve width ranging from 42m to 92m, and Great Southern Highway and the Narrogin-Wagin railway reserve separate the site from the rural uses to the east with a combined 120m reserve width.

The nearest dwellings are located 500m north-east of the subject site at Lot 21 Great Southern Highway and 700m to the west of the subject site at Lot 30 Comini Road.

2.2 Topography

The subject site is located on a gently sloping hill, with heights ranging from 338m AHD at the south-western corner to 345m AHD along the northern and eastern sides. The landscape rises further to hills at approximately 380m AHD to the north, east and west, while the Great Southern Highway - Wanerie Road intersection is located on a small ridge at 348-356m AHD. As such, the subject site is located in a small valley, ensuring that it will not have any undue impact on views in the area.

The subject site is not readily visible from Great Southern Highway south of the Wanerie Road intersection or any lots to the south or east of those roads, or any lots north of Lot 31.

2.3 Site Description and Suitability

The subject site is cleared and vacant, with no man-made structures or features other than agricultural boundary fencing. A 22kV power line runs north-south through Lot 31 approximately 100m east of the subject site.

The site has direct access to Wanerie Road – a two lane sealed rural road. Wanerie Road was recently upgraded by the Shire and Main Roads WA. It is of an appropriate standard to accommodate the proposed use, and does not require any further upgrades to accommodate the additional traffic.

An orthophoto of Lot 31 and its immediate surrounds is shown at Figure 3 below.



Figure 3 – Orthophoto – Lot 31 Great Southern Hwy, Dumberning (source: PlanWA 2022)

The site has previously been identified as suitable for industrial uses through its rezoning to Special Use zone in 2017 and subsequent development of the Lot 31 Great Southern Highway, Narrogin Local Development Plan. The site is suitable for the proposed diesel biorefinery due to its proximity to input sources (as described previously).

Images of the site are provided overleaf.



Figure 4 – Lot 31 Great Southern Highway viewed from the southern boundary, facing north through the biorefinery site (source: Rise Urban 2022)



Figure 5 – Lot 31 Great Southern Highway viewed from the northern boundary, facing south towards the biorefinery site (source: Rise Urban 2022)



Figure 6 - Lot 31 Great Southern Highway viewed from Wanerie Road facing east, approximately 500m west of the biorefinery site (source: Rise Urban 2022)

2.4 Vegetation

The only vegetation of note on the subject site is three mature paddock trees, none of which conflict with the proposed biorefinery location and layout. The site is otherwise cleared, with a 3-4m gravel firebreak and access track located on the inside of the Lot 31 boundary.

2.5 Wetlands and Waterways

A small creek runs through the south-western corner of Lot 31, approximately 150m west of the subject site. The lowest point of the biorefinery site is located approximately 4m above the level of the creek within Lot 31. The creek is not a constraint to development and any discharge to the creek from the subject site will be appropriately detained and treated such that the pre-development hydrology is respected.

The site topography creates a seasonal watercourse that drains stormwater from Lots 21 and 31 to the creek, connecting south of Wanerie Road. This watercourse runs north-south through the subject site. As earthworks are proposed to flatten the entire biorefinery site over two levels, a diversion channel is proposed along the rear and east sides of the site to redirect water running down this watercourse around the biorefinery to the existing drainage channel at the south side of the site along Wanerie Road. Management of flows through the watercourse will be discussed later in this report.

There are no other waterways or wetlands that affect the subject site.



Figure 7 - Lot 31 Great Southern Highway viewed from the culvert at the south-west corner, facing north-east (source: Technip Energies 2022)

3.0 Planning Context

This section details the key planning instruments relevant to the site and this proposal, and how the proposal responds to the requirements of those instruments.

3.1 Strategic Planning Context

The Wheatbelt Regional Planning and Infrastructure Framework provides an overview of planning issues that affect the broader Wheatbelt region, and establishes objectives to guide planning strategies and regional development initiatives under three categories: Liveable Communities, Vibrant Economy and Valued Natural Amenity.

The Framework identifies an opportunity to establish industries and services that support the Wheatbelt resources sector, particularly in areas with good access to major transport routes. This proposal seeks to take full advantage of that opportunity by providing a supplementary source of income for landowners and agricultural businesses that produce more biomass than they use, and to create a circular economy that supports the growth of the agricultural sector.

The Shire of Narrogin Local Planning Strategy was adopted in 2019, with the intention of providing a strategic plan for development in the Shire and guiding the development and adoption of a new Local Planning Scheme, to streamline implementation of the objectives identified in the Strategy.

The Strategy identifies a need for diversification of industrial uses in the Shire to support expansion of the local economy, and also aims to ensure that all industrial development is undertaken in appropriate locations. Many existing industrial uses support the agricultural and resources sectors as well as day-to-day functions, however this proposal represents significant diversification of the industrial uses in the Shire of Narrogin through its exposure to the fuel and energy sectors.

One of the actions included in the Strategy is to “*ensure that the permissibility of land usage in Local Planning Scheme No. 3 is sufficiently flexible and applied accordingly to facilitate diversification of the Shire’s economy*”, with a priority of “*Immediately & Ongoing*”.

In this regard, a new Local Planning Scheme for the Shire of Narrogin is currently sitting with the Minister for Planning for final review and approval (as of the date of lodgement of this application), and includes revised classifications of land uses by zone throughout the Shire.

3.2 Local Planning Scheme and Zoning

While LPS 2 is the current Scheme that applies to the development site, this application seeks that the Shire assesses the proposal against LPS 3 in lieu of LPS 2, as LPS 3 is currently sitting with the Minister for Planning for determination and is likely to become operative and supersede LPS 2 prior to the date of determination of this development application. In the interim, LPS 3 has been publicly advertised and formally adopted by the Shire since advertising closed, and is therefore seriously entertained.

For this reason, this submission includes an assessment of the proposal against the provisions of LPS 3 rather than LPS 2.

Lot 31 retains its current LPS 2 zoning as a Special Use zone under LPS 3. Descriptions of each Special Use Zone, along with any applicable conditions is set out in Schedule 7 of LPS 3. Lot 31 is identified as Special Use 5, and includes the following description in Schedule 7.

Table 1 – LPS 3 Schedule 7 – Special Use 5

Description of Land	Special Use	Conditions
<p>Lot 31 Great Southern Highway, Dumberning.</p>	<p>Composite uses comprising uses permissible in the 'Rural Residential', 'Rural Enterprise' and 'General Industry' zones as set out in the Zoning Table.</p>	<ol style="list-style-type: none"> 1. Notwithstanding any other provisions in this scheme, Development approval shall be required for all development including signage. 2. Development of the land shall generally be in accordance with an approved Structure Plan or Local Development Plan (LDP) approved by the local government. The LDP should provide sufficient information to address the requirements of the Scheme and the following: <ol style="list-style-type: none"> (i) The provision of potable reticulated water and onsite wastewater disposal; (ii) Revegetation and the introduction of separation distances and buffers from sensitive land uses; (iii) Bushfire Risk; (iv) The spatial extent of precincts that encompass the industrial, composite and residential uses; (v) The spatial extent and location of residential building envelopes; (vi) The staging of infrastructure; (vii) The transition between industrial uses and residential uses, including bulk and scale and separation distances; (viii) The size of lots in the industrial precinct having consideration to separation distances and land use buffers; (ix) Areas of low capability for on-site effluent disposal; (x) Access and traffic management; and (xi) Waste management including bin disposal areas in the where non-residential development is proposed. 3. Prior to subdivision or development, a Local Water Management Strategy (LWMS) shall be prepared and approved by the local government on the advice of the Department of Water and Environmental Regulation. Stormwater drainage shall be contained on -site to the satisfaction of the local government. 4. Prior to subdivision or development, a revegetation plan shall be prepared. The revegetation plan should include native species to the specification of the local government. 5. Prior to subdivision or development, a bushfire management plan is to be prepared and approved concurrently with any revegetation plan. 6. Development on the site being provided with an onsite effluent disposal system in accordance with the Government Sewerage Policy to the satisfaction of the local government and the Department of Health. 7. Development requirements set out in Part 4 of the Scheme shall be applied as appropriate to each precinct. 8. Applications for development approval for non-residential land uses shall take into account and address appropriate separation distances from sensitive land uses. 9. Residential building envelopes/exclusion zones on land where no non-residential development is proposed shall be limited to a maximum size of 1200m² and setback 10 metres from the primary street and side/rear boundaries. 10. Notwithstanding anything elsewhere appearing in the Scheme, the minimum building setback to Great Southern Highway in the residential precinct shall be 30 metres.

		<ol style="list-style-type: none"> 11. Enterprise envelopes within the 'Rural Enterprise' precinct shall be located behind the main residential building line, setback 10 metres from side boundaries and screened accordingly. 12. Development shall be confined to either a residential building envelope or enterprise envelope in the 'Rural Enterprise' precinct, as depicted on an approved LDP. 13. Buildings within a nominated enterprise envelope in the 'Rural Enterprise' precinct shall be limited to a maximum total floor space of 900m², unless otherwise approved by the local government. 14. At subdivision or development stage residential lots shall be subject to a notification on title to advise landowners of the potential impact from nearby agricultural and industrial land uses. 15. Lot sizes in the 'industrial' precinct should average 4 hectares and consider on-site separation distances. 16. All other lots shall be a minimum of 1 hectare. 17. No lot shall have direct access onto Great Southern Highway or Wanerie Road. Access shall be restricted to local access roads. 18. Access points shall be designed, approved and constructed to Main Roads Western Australia specifications. 19. Built form is to be consistent with a predominant theme for the site, in terms of scale, colour and use of materials. 20. Use of land or buildings for any form of human habitation is prohibited within nominated enterprise envelopes in the 'Rural Enterprise' precinct. 21. Stockings rates for rural pursuit/hobby farm apply to 'Rural Residential' uses, as guided by the local government.
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The proposed biorefinery falls within the land use class of 'industry' under the land use definitions set out in Schedule 1 of LPS 3.

“industry” means premises used for the manufacture, dismantling, processing, assembly, treating, testing, servicing, maintenance or repairing of goods, products, articles, materials or substances and includes facilities on the premises for any of the following purposes –

- (a) the storage of goods;*
- (b) the work of administration or accounting;*
- (c) the selling of goods by wholesale or retail;*
- (d) the provision of amenities for employees;*
- (e) incidental purposes;*

Schedule 7 prescribes that land use over the southern portion of lot 31 shall be in accordance with the 'General Industry' zone. The use class 'industry' is classified as a 'P' (permitted) use in the General Industry zone, and as such, is also a permitted use within Special Use 5.

3.3 Local Development Plan

The Lot 31 Great Southern Highway, Narrogin Local Development Plan (“LDP”) was approved in 2017 and establishes the site-specific development requirements for Lot 31, including zoning, access, landscaping and an indicative subdivision design. A copy of the LDP is included as Appendix 10.

The LDP effectively separates Lot 31 into 3 precincts of roughly equal size. The northernmost third of the site is identified for Special Rural uses, while the middle third is identified for Rural Enterprise, which is understood to facilitate low intensity residential uses with small scale industrial / workshop type uses located on the same site as the dwelling. These two precincts have not yet been subdivided or developed in accordance with the LDP, however the proposed biorefinery does not prevent their future development in a manner that is broadly consistent with the LDP.

The LDP identifies the southern third of Lot 31, which includes the subject site, as Industrial. It depicts a cap road to Wanerie Road to service the industrial uses and minimise crossovers. It also identifies a “wind break / nature strip” around the perimeter of the industrial precinct, and includes a “development exclusion zone” along the northern boundary of the industrial precinct – presumably to provide a suitable transition and interface to the Rural Enterprise precinct to the north.

The LDP was prepared prior to FEA’s interest in the site, and proposed a speculative form of industrial subdivision that was not based on a particular proposal. Given the large footprint of the proposed biorefinery, it will occupy the majority of the Industrial precinct, and will not require further subdivision in the form that is depicted on the LDP. Other than the industrial subdivision, the proposed development is consistent with the key provisions of the LDP as follows:

- Access to and from the site is proposed generally in accordance with the cap road layout shown on the LDP, with the entrance and exit driveways separated by sufficient distance to ensure that trucks entering or exiting the facility do not conflict on Wanerie Road, as confirmed by the Transport Impact Statement appended to this submission.
- There is sufficient land to provide a development exclusion zone to the north of the biorefinery as envisaged by the LDP.
- The wind break / nature strip will be installed at construction stage, and will be carefully managed and designed to ensure that additional bushfire hazards are not introduced to the precinct.

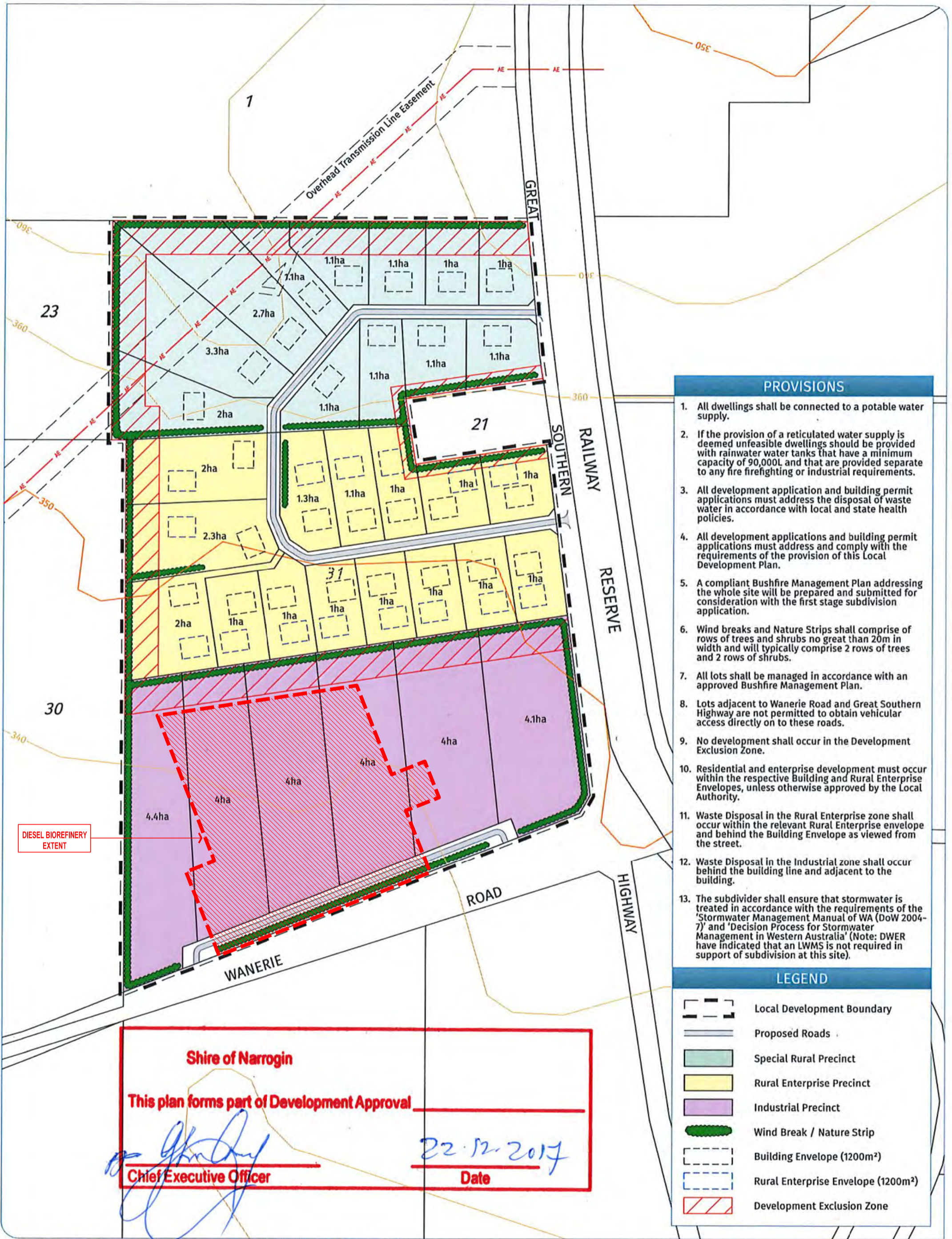
The LDP is not binding on a decision maker, and must be given due regard in the decision making process. LDPs are intended to be applied with a degree of flexibility on the understanding that future development applications will refine and confirm the precise built form and land footprints associated with the land uses shown on the LDP.

Whilst not necessary as part of this proposal, the Shire has requested that an amended LDP be lodged at a later stage to ensure that the LDP reflects the layout of the final approved facility and includes appropriate provisions to manage the interface between the facility and Rural Enterprise precinct to the north. As it is possible that some minor modifications might be made to the site layout and building design at detailed design stage, the most effective time to amend the LDP will be once the detailed design has been completed.

It should also be noted that upon conclusion of the due diligence period, the entirety of Lot 31 will be under the ownership of Carnarvon Energy Ltd, and as such, Carnarvon Energy Ltd will retain complete control over the future development of the Special Rural and Rural Enterprise precincts, ensuring that any future development or subdivision will recognise and respond to the biorefinery.

In the interim it is appropriate that the JDAP exercises discretion to approve the proposal in the absence of subdivision of the Industrial precinct as foreshadowed by the LDP.

An overlay of the proposed biorefinery over the LDP is shown overleaf.



PROVISIONS

1. All dwellings shall be connected to a potable water supply.
2. If the provision of a reticulated water supply is deemed unfeasible dwellings should be provided with rainwater water tanks that have a minimum capacity of 90,000L and that are provided separate to any fire firefighting or industrial requirements.
3. All development application and building permit applications must address the disposal of waste water in accordance with local and state health policies.
4. All development applications and building permit applications must address and comply with the requirements of the provision of this Local Development Plan.
5. A compliant Bushfire Management Plan addressing the whole site will be prepared and submitted for consideration with the first stage subdivision application.
6. Wind breaks and Nature Strips shall comprise of rows of trees and shrubs no great than 20m in width and will typically comprise 2 rows of trees and 2 rows of shrubs.
7. All lots shall be managed in accordance with an approved Bushfire Management Plan.
8. Lots adjacent to Wanerie Road and Great Southern Highway are not permitted to obtain vehicular access directly on to these roads.
9. No development shall occur in the Development Exclusion Zone.
10. Residential and enterprise development must occur within the respective Building and Rural Enterprise Envelopes, unless otherwise approved by the Local Authority.
11. Waste Disposal in the Rural Enterprise zone shall occur within the relevant Rural Enterprise envelope and behind the Building Envelope as viewed from the street.
12. Waste Disposal in the Industrial zone shall occur behind the building line and adjacent to the building.
13. The subdivider shall ensure that stormwater is treated in accordance with the requirements of the 'Stormwater Management Manual of WA (DoW 2004-7)' and 'Decision Process for Stormwater Management in Western Australia' (Note: DWER have indicated that an LWMS is not required in support of subdivision at this site).

LEGEND

- Local Development Boundary
- Proposed Roads
- Special Rural Precinct
- Rural Enterprise Precinct
- Industrial Precinct
- Wind Break / Nature Strip
- Building Envelope (1200m²)
- Rural Enterprise Envelope (1200m²)
- Development Exclusion Zone

Shire of Narrogin

This plan forms part of Development Approval

Chief Executive Officer

Date

LOCAL DEVELOPMENT PLAN

Lot 31 Great Southern Highway,
NARROGIN
Shire of Narrogin

Plan No. | 20377-08E
Date | 30/11/17
Drawn | BDR
Checked | CP
Revision | E

Scale | 1:5000@A3

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Minutes Ordinary Council Meeting 20 December 2017



3.4 State Planning Policy 2.0 – Environment and Natural Resources

State Planning Policy 2.0 (SPP 2.0) requires the integration of environment management with broader land use planning and decision-making and the protection, conservation and enhancement of the natural environment. The specific policy measures are addressed in the table below.

No.	Section	Comment
5.1	General measures	<p>Complies. The selection of Lot 31 for the development of the biorefinery considered key issues that include:</p> <ul style="list-style-type: none"> • Industrial zoning, and location of the biorefinery within the industrial zone to improve environmental outcomes. • Minimisation of the need for supporting infrastructure which may entail environmental and social impacts. • Lack of impact on indigenous and cultural heritage. • Minimisation of impacts on waterways, vegetation and natural resources. • No need for land clearing. • Reduction of noise and air emission impacts. • Circular economy benefits delivered through the consumption of waste biomass streams.
5.2	Water resources	<p>Complies. A small creek runs through the south-western corner of Lot 31, approximately 150m west of the subject site. The lowest point of the biorefinery site is located approximately 4m above the level of the creek within Lot 31. The creek is not a constraint to development and any discharge to the creek from the subject site will be appropriately detained and treated such that the pre-development hydrology is respected and maintained.</p> <p>Groundwater abstraction will not be required during construction or operation of the proposal, avoiding impact to groundwater aquifer volumes.</p> <p>A stormwater management plan will be provided to the Shire at detailed design stage and implemented to separately manage stormwater flows outside and on the biorefinery site. Stormwater originating from outside the site will be directed around the site to an existing drainage channel along Wanerie Road. The stormwater management plan will include the construction of a holding pond and appropriate measures to ensure no impact on the water quality in the creek, including control and capture of any pollutants and nutrients.</p>
5.3	Air quality	<p>Complies. An air quality modelling assessment was undertaken to determine the potential air quality impacts on sensitive (human) receptors, including locations that are 'sensitive land uses' as defined under the Ambient Air Quality National Environmental Protection Measure (NEPC, 2021b) and other relevant regulatory guidance (EPA, 2015). The current draft Air Emissions Guideline (DWER, 2019) excludes onsite project related receptors as sensitive receptors. The nearest sensitive receptors to the biorefinery were identified as neighbouring rural residential properties.</p>

Additional discrete receptor locations have been included for assessment to represent the Narrogin townsite and surrounding areas. The results of the dispersion modelling study show that ground-level concentrations at all sensitive receptors are predicted to be well below the assessment criteria (limits), as follows:

- 1-hour ground-level NO₂ concentrations: less than 3%.
- Annual ground-level NO₂ concentrations: less than 1%.
- 1-hour ground-level SO₂ concentrations: less than 12% of the current assessment criteria and less than 15% of the future assessment criteria.
- 24-hour ground-level SO₂ concentrations: less than 7%.
- 1-hour ground-level CO concentrations: less than 1%.
- 8-hour ground-level CO concentrations: less than 1%.

Notwithstanding the above results, the following measures will be implemented to ensure the best possible air quality:

- All roads within the proposal area will be sealed to avoid dust lift off during dry conditions.
- Drying of feedstock will be undertaken at low temperatures to avoid charring or burning feedstock.
- Drying of feedstock will be undertaken within a semi enclosed warehouse to minimise particulate emissions.
- Tail gases will be effectively combusted through the thermal oxidiser to meet NEPM guideline limits at sensitive receptors.
- Dust extraction systems will be employed to minimise particulate emissions.
- The majority of gases will be effectively combusted through the thermal oxidiser to meet NEPM guideline limits at sensitive receptors.

As detailed above, a small percentage of gases from biomass drying and wood vinegar distillation will be vented externally and are not expected to result in a change to modelled ground level concentrations of contaminants or ambient air quality at sensitive receptors.

5.4	Soil and land quality	<p>Complies. The following measures will be implemented to minimise the potential for spills of hazardous materials to impact soil quality:</p> <ul style="list-style-type: none"> • Refuelling of diesel generators and earthmoving equipment within designated bunded and/or lined areas. • Sewage will be stored within temporary ablutions during construction that will be collected on a regular basis and include high level alarms and shut off features. • During site operation sewage will be directed to a septic tank system set back from the creek in accordance with Department of Health and Shire of Narrogin requirements. • Hazardous materials will be stored in designated, secured, weatherproof and appropriately bunded storage areas.
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- Handling of hazardous materials will be strictly in accordance with Safety Data Sheets and best practice standards.
- Training in the handling, storage and clean-up of Hazardous Materials and Dangerous Goods will be a mandatory requirement for all employees during construction and operation.

Where cutting and filling causes level differences at site boundaries, slopes will be provided at appropriate gradients to prevent erosion.

5.5	Biodiversity	Complies. The biorefinery site was chosen due to its distance from areas with identified environmental or conservation significance. Three isolated paddock trees occur adjacent to the site boundary. These trees occur within a highly disturbed and fragmented landscape and are unlikely to provide any significant habitat value for native fauna species.
5.6	Agricultural land and rangelands	The proposal will not cause any loss of agricultural land due to zoning of the site as Industrial via the Lot 31 Great Southern Highway, Narrogin Local Development Plan (“LDP”) in 2017 (prior to FEA’s interest in the site).
5.7	Minerals, petroleum and basic raw materials	The proposal will not impact any basic raw material resources, and will boost Western Australia’s capacity to produce diesel in an environmentally responsible manner.
5.8	Marine resources and aquaculture	Not applicable.
5.9	Landscape	Complies. The land has been previously cleared for agricultural use, prior to being rezoned for Industrial use. The biorefinery site has been located to minimise impacts on the creek and predominant rural land uses surrounding the site by taking advantage of the topography of the locality. The Development Envelope will be managed during the construction phase so as not impact on the creek and surrounding land.
5.10	Greenhouse gas emissions and energy efficiency	Complies. This proposal is for the first commercial scale renewable diesel biorefinery in Australia, which represents a significant step towards the SPP 2.0 objective to reduce greenhouse gas emissions by decreasing reliance on non-renewable fuels and increasing energy efficiency. FEA has engaged Thinkstep ANZ to prepare a Greenhouse Gas (GHG) inventory covering Scope 1, 2 and product related Scope 3 emissions for the proposal. The GHG inventory identified that:

- Scope 1 emissions will comprise 0.1% of the total annual carbon emission footprint for the biorefinery.
- Scope 2 emissions will comprise 80% of the total annual carbon emission footprint for the biorefinery, and are mostly attributable to electricity generated by Western Power.
- Scope 3 emissions will comprise 19% of the total annual carbon emission footprint for the biorefinery, and are attributable to products purchased, waste treatment, and disposal and transportation of products to and from the biorefinery.

The GHG assessment included a comparison of the carbon footprint of annual renewable diesel production and use and fossil-derived diesel production and use. The comparison determined the use of renewable diesel from biogenic sources in place of fossil-derived diesel could reduce emissions by up to 52%.

FEA is committed to continuous improvement in the ongoing reduction of GHG emissions and during the detailed design phase of the project will undertake the following additional investigations with the aim of further reducing GHG emissions for the proposal:

- Consult with Western Power on access to renewable energy generation sources for the biorefinery; and
- Investigate the potential to utilise the tail as a renewable fuel suit to generate renewable electricity on-site

3.5 State Planning Policy 2.5 – Rural Planning and State Planning Policy 4.1 – State Industrial Buffer

SPP 2.5 and SPP 4.1 require buffers to be applied for land uses that may generate off-site impacts and for industrial development with potential to impact local visual amenity. In this regard, a separation distance commensurate to the development exclusion zone required by the LDP is proposed between the biorefinery and the remainder of Lot 31 to the north, and setbacks of 50m-150m from the west lot boundary and 230m-330m from the east lot boundary with Great Southern Highway are proposed. These setbacks are sufficient to mitigate impacts of the facility on adjacent landholdings and the surplus portion of Lot 31, and will maintain visual amenity and rural character when viewed by drivers travelling on Great Southern Highway.

The need for, and extent of buffers is informed by extensive environmental investigations which form part of FEA's submission to the EPA. These investigations include noise, odour, air quality and water quality. Results from these studies indicate that the separation distances between the proposed biorefinery and surrounding sensitive uses are adequate to ensure the safety and amenity of nearby residents.

3.6 State Planning Policy 3.7 – Planning in Bushfire Prone Areas

State Planning Policy 3.7 (SPP 3.7) requires development applications for proposals located within designated bushfire prone areas to be supported by a Bushfire Management Plan. Where high-risk land uses are proposed that include flammable on-site hazards, a Risk Management Plan is also required. These two documents have been prepared by Bushfire Prone Planning in accordance with the requirements of SPP 3.7 and the associated Guidelines for Planning in Bushfire Prone Areas (the Guidelines), and are appended to this development application.

The Bushfire Management Plan confirms that the proposal is fully compliant with all relevant Bushfire Protection Criteria under the Guidelines, and therefore meets the requirements of SPP 3.7 subject to support by the Shire and Department of Fire and Emergency Services.

The Bushfire Risk Assessment and Management Report has been prepared in accordance with sections 4.7 and 5.6 of the Guidelines, and includes a comprehensive assessment of the risks associated with operation of the biorefinery and measures to mitigate those risks.

The conclusions and recommendations of these documents are detailed in section 6.7 of this report.

3.7 Development Control Policy 4.2 – Planning for Hazards and Safety

Development Control Policy 4.2 (DCP 4.2) includes refineries within the definition of ‘Hazardous Industry’, and diesel fuel is included within the definition of ‘Dangerous Goods’. Therefore, DCP 4.2 applies to the proposal. Most requirements of DCP 4.2 are captured by LPS 3 and the LDP, and the remaining relevant requirements are addressed below.

No.	Requirement	Comment
4.1.1	Development should be planned to minimise and otherwise control risks. Land use planning should contribute to safety by: <ul style="list-style-type: none"> • securing compatible land uses, • providing adequate buffers and providing for safe transport routes, • ensuring that infrastructure, such as fire and other emergency services, are considered and will have appropriate access. 	Complies. The location of the biorefinery in the centre of the Industrial zone increases its buffer to other uses and restricts incompatible land uses from being proposed adjacent to the site. Safe transport routes are provided for general and emergency access, as confirmed by the appended Bushfire Management Plan and Transport Impact Statement.
5.1.1	New hazardous development shall be located in industrial areas, separated from residential areas.	Complies.
6.1.1	Significant quantities of dangerous Goods should be stored in areas zoned Industrial or reserved for an appropriate special purpose.	Complies. Diesel is proposed to be stored in accordance with regulatory requirements and licences. It will be stored separately from all other built form and substances, and as far as possible from potential ignition sources.
6.1.2	In considering proposals for development of warehouses, open air storage and industries involving storage, a planning authority should establish whether dangerous goods, or materials that may cause a hazard in the event of a fire, are to be stored on site.	Complies. The Bushfire Management Plan and Risk Assessment and Management Report demonstrate that any risks associated with storage of diesel, woodchips and other flammable or explosive materials on site are appropriately mitigated.

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| 7.1.1 While this matter is not necessarily related to land use planning and is generally covered by other legislation, planners should take account of the resulting transport requirements when locating a hazardous facility. Consideration should be given to road reserve widths and routes to facilitate safe road or rail transport options. | Complies. The Transport Impact Statement appended to this application demonstrates that the development will generate a “moderately low” volume of traffic, and the proposed treatments to Wanerie Road are in excess of minimum requirements to handle anticipated demand from trucks and vehicles. Preliminary engagement with Main Roads WA confirms that the access to, and impacts upon the regional network are acceptable. |
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As demonstrated above, the proposal has been designed and located to minimise risks associated with operation of the biorefinery, and is therefore consistent with DCP 4.2.

3.8 Government Sewerage Policy

There is no sewerage or waste water infrastructure available to service the site. All sewage and waste water from ablutions will be directed to septic tanks on site, which will be emptied into a vacuum truck as needed and treated and disposed of offsite. Any waste water from the biorefinery that is untreatable will be collected and disposed of offsite at an industrial handling facility.

The biorefinery is proposed on a lot over the minimum 2,000m² size required for this arrangement, and is sufficiently separated from water resources, including the creek at the south-western corner of Lot 31.

Clause 4.11.2 of LPS 3 limits the volume of on-site effluent disposal to 540L per 2,000m² of lot size, resulting in a maximum storage size of 174,500L for Lot 31, which would be reduced to 29,160L for the biorefinery if it were to be subdivided in the future.

Final details of the onsite sewage system/septic tank, including the information required by section 4, Schedule 1 will be provided at building licence stage, and will be in accordance with Department of Health and Shire of Narrogin requirements.

All other types of liquid and industrial waste produced by the facility will be disposed of appropriately and responsibly by the biorefinery operator in accordance with the relevant licences and permits. Methods of disposal of waste generated by the facility are detailed in section 6.3 of this report.



Figure 8 – Current entrance to Lot 31 Great Southern Highway from Wanerie Road, facing north (source: Technip Energies 2022)

4.0 Description of the Proposal

The operations proposed to be undertaken at the renewable diesel biorefinery are unique to Australia, and are based on limited international precedents for this emerging technology. The broad details of the intended operations and process are provided in this section, however are subject to further design development due to the nature of the proposal as the first commercial scale project of its kind in Australia.

4.1 Overview of the Renewable Biorefinery Process

The process to convert biomass into renewable diesel comprises multiple stages that include complex physical actions and chemical reactions. In short, biomass is filtered, crushed and dried, and then pyrolysis and distillation processes are used to create renewable diesel and by-products. These by-products include water, wood vinegar and biochar with high levels of graphene (70% or more). These materials are environmentally friendly and have diverse use cases, for example biochar can be used as soil conditioner and wood vinegar can be used as an organic replacement for agricultural products.

It is important to maintain a distinction between renewable diesel and biodiesel. Whereas biodiesel must be blended with fossil fuels, unless significant vehicle/ equipment modifications are made, renewable diesel is 100% produced from organic sources, thereby significantly reducing its environmental footprint when it is burnt.

Woodchips and pellets to be used as feedstock for the biorefinery will be primarily sourced from timber stumps, oil mallee trees, agricultural crop residues, acacia chips and forestry residue.

The renewable biorefinery process is simplified in Figure 9 below.

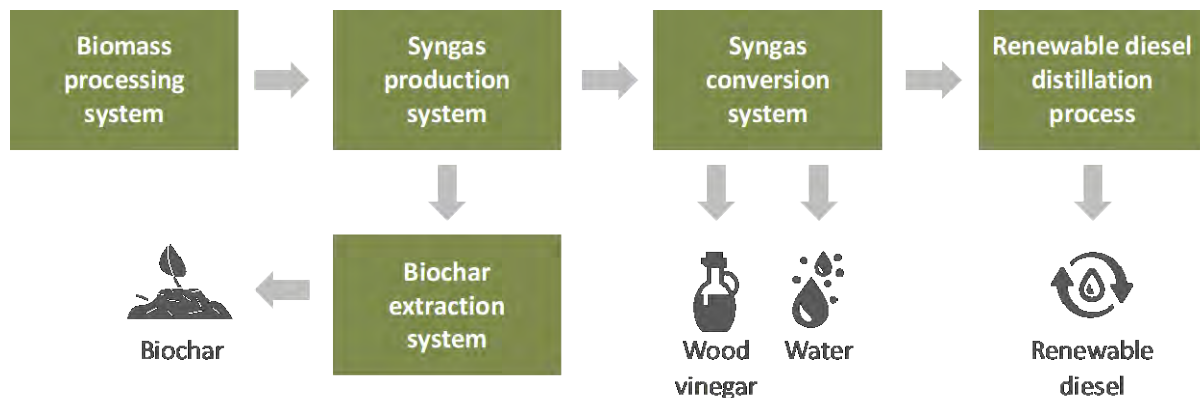


Figure 9 - Simplified Renewable Diesel Production Process (FutureEnergy Australia 2022)

The stages in the process are set out in further detail below.

1. Biomass and feedstock in woodchip and/or pelletised form are delivered to the receiving area at the rear of the facility and transferred to stockpiles adjacent where they are checked for quality and contaminants.
2. The accepted woodchips are fed into the crumbler, where any large objects are broken up to meet size requirements and fines (eg. dust) are rejected.
3. The crumbled woodchips and/or pellets are fed into the dryer, which removes moisture until a consistently low level (approximately 10%) remains.
4. The dried woodchips and/or pellets are pyrolysed (exposed to extreme heat) to create syngas.
5. Biochar (a pyrolysis by-product) is separated and bagged.
6. The syngas is run through multiple conversion reactions and distilled into diesel.

7. The renewable diesel is pumped to the storage tanks.
8. Waste process water from the fuel distillation process is pumped to the wood vinegar distillation unit to produce wood vinegar (a by-product), which is pumped to storage tanks.
9. The residual waste water from the wood vinegar distillation process is then treated and pumped to the storage tanks.
10. Waste tail gases from the pyrolysis and distillation processes are sent to the thermal oxidiser, which combusts the gas and pumps the heat to the woodchip dryer.
11. Renewable diesel, wood vinegar and biochar are loaded onto/into vehicles.

There is an emerging market for graphene and green hydrogen in Western Australia. The facility has been designed to be modular, providing adaptability and flexibility for certain machinery to be modified or replaced in the future to enable the facility to produce more of either of these resources (and less diesel) should the level of demand for these products rebalance in the future.

4.2 Proposed Site Layout and Site Works

The site layout has been designed specifically to accommodate the infrastructure and equipment required to operate the facility efficiently and effectively. As the equipment is modular, the site has been designed to include space to increase the capacity of the facility by 50% in the future (subject to separate approvals).

The proposed biorefinery occupies a land footprint of 10.8ha. As previously detailed, this area may be modified slightly through the detailed design process.

The biorefinery process generally occurs from the rear towards the front of the site. The biomass and feedstock are delivered at the rear of the site, woodchips and pellets are converted into a form suitable for pyrolysis and distillation, then pyrolysed and distilled at the front of the site. The various by-products and residuals are then collected and distilled, treated or oxidised at the front and east side of the site, and then stored in tanks at the west side of the site. Conveyor belts and pipelines travel east-west through the site linking the key process infrastructure.

The thermal oxidiser and diesel storage are separated from the remainder of the biorefinery to the east and west of the loop road respectively for risk management purposes in case of an accident or emergency. The biorefinery footprint includes protrusions to the east and west for this reason.

The site utility infrastructure (power and water) is located along the front portion of the loop road to improve maintenance efficiency, and the stormwater and retention ponds are located in the front setback at the lowest point of the site.

This process is represented by Figure 10 below.

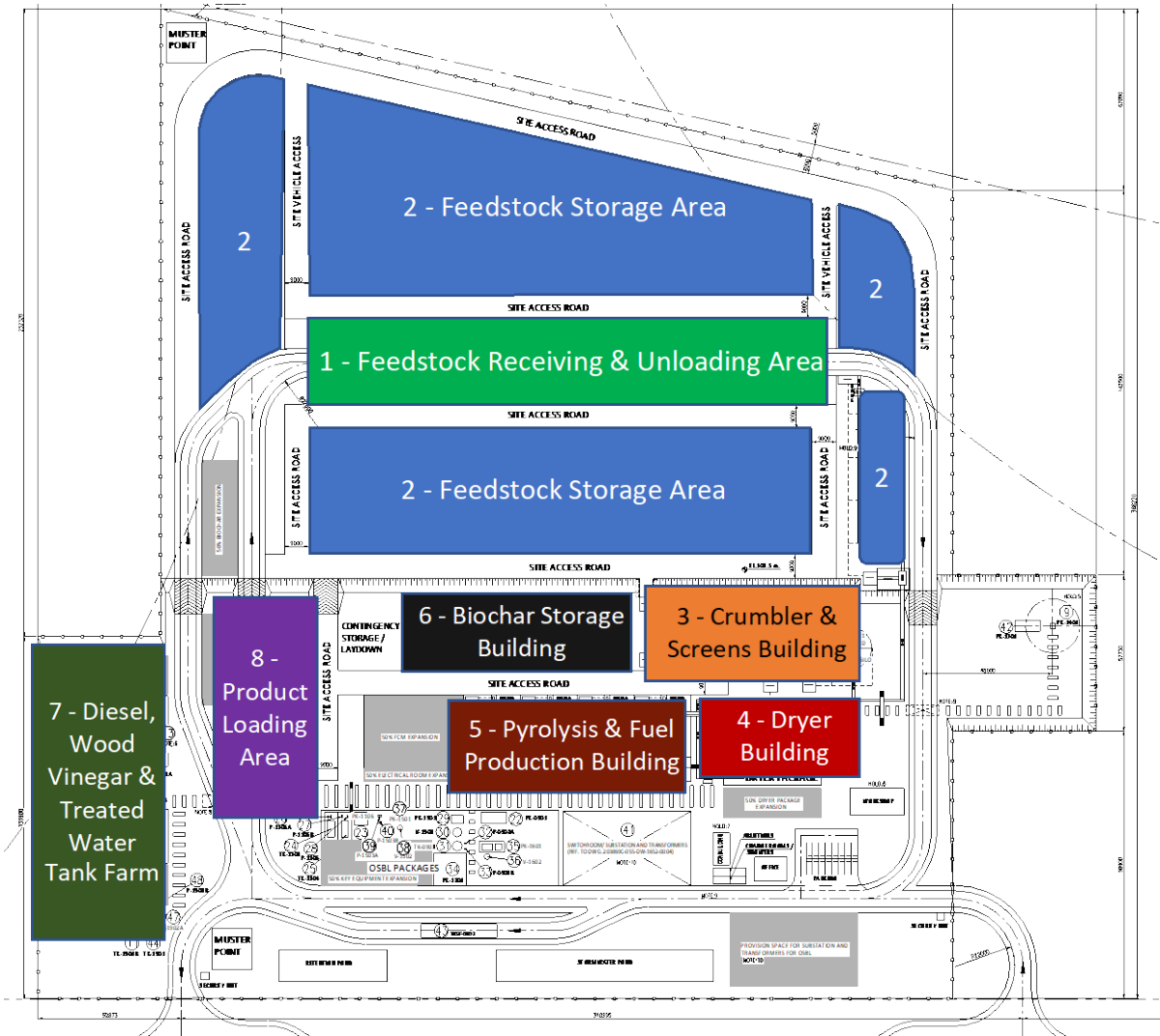


Figure 10 – Renewable Diesel Production Flow Process (FutureEnergy Australia 2022)

As the subject site is located on a hill, cut and fill is required for the primary production and storage areas at the front of the site. A retaining wall through the centre of the site is proposed to provide a 2.5m level difference between the feedstock storage area and the remainder of the site to reduce cutting and filling.

The setbacks between the biorefinery and key site boundaries are as follows:

- Wanerie Road: 42m from the main development line, with stormwater and retention ponds (6m), the weighbridge (20m) and fire water tanks (26m) located in this setback;
- Great Southern Highway: Approx. 230m from the front of the biorefinery and thermal oxidiser, and approx. 330m at the rear end of the biorefinery;
- West lot boundary: Approx. 150m at the front boundary, minimum 100m from the south-west tank cluster and approx. 50m at the rear of the biorefinery;
- Development exclusion zone: 7m from the development exclusion zone shown on the LDP, and 57m from the Industrial Enterprise zone boundary.

As previously discussed, amendments to the design may be required throughout the forthcoming detailed design process. These amendments will likely comprise building dimension changes and shifts to machinery locations/layouts or the size and capacity of the feedstock storage area at the rear of the site, with the aim of reducing the biorefinery footprint to increase setbacks.

It is not expected that the amendments will be so substantial that a new development application would be required, however to accommodate these design amendments it is requested that the Shire apply a condition of approval pursuant to clause 74 of Schedule 2 of the *Planning and Development (Local Planning Schemes) Regulations 2015* (Deemed Provisions) requiring further details of the proposal to be submitted to and approved by the Shire prior to commencement of development.

4.3 Built Form

The built form on the site can be broadly categorised as follows:

- Warehouses and sheds in which most heavy and bulky machinery are located;
- Modular transportable buildings for staff, amenities and utility services;
- Tanks and silos for liquids, crumbled wood and pellet storage; and
- Various open-air machinery such as pumps, pipes and conveyor belts.

The main built form visible from Wanerie Road will be the thermal oxidiser stack, liquid storage tanks and the site office, amenity and substation buildings. Parts of warehouses will be visible behind these buildings but will not be a prominent primary elevation feature. The woodchip piles and the pellet storage silos at the rear of the site will be shielded from view from Great Southern Highway and Wanerie Road.

Other than the production module building (15m), the maximum height of all structures on the site is anticipated to be 12m.

A comprehensive list of the proposed built form on the site is overleaf. As previously detailed, the final location and dimensions of the buildings and site features are subject to modification throughout the detailed design process, and the final plans and building specifications will be provided to the Shire for approval at building licence stage.

Structure	Type	Location in Biorefinery	Dimensions
Biochar storage shed (including eaves)	Unenclosed warehouse	Central	95m x 37m x 12m
Production module shed (including ISBL electrical room adjacent to south side and eaves)	Partially open warehouse	Central south	95m x 42m x 15m
Crumbler shed	Warehouse	Central east	35m x 13m x 8m
Dryer shed	Partially open warehouse	South-east	36m x 23m x 12m
Workshop	Warehouse	South-east corner	20m x 10m x 7m
Woodchip magnetic separator shed	Roof structure	Central east	3m x 3m x 2.5m
Pellet magnetic separator shed	Roof structure	North-east corner	3m x 3m x 2.5m
Pellet screening shed	Shed	Central east	8m x 7m x 3m
Fines storage shed	Roof structure	Central west	18m x 16m x 12m
Diesel generator shed	Roof structure	South	5m x 10m x 4m
Transformer yards (x3)	Unroofed walled yards	South	6.1m x 5m x 2.3m
Substation	Prefabricated	South	20m x 10m x 3.6m
HV switchroom	Prefabricated	South	10m x 5m x 3.6m
Site office	Prefabricated	South-east	12m x 9m x 5m
Central control room	Prefabricated	South-east	12m x 6m x 3m
Ablutions (x2)	Prefabricated	South-east	6m x 3m each
Change rooms / showers (x2)	Prefabricated	South-east	6m x 3m each
Security huts (x2)	Prefabricated	Inside entrance and exit gates	3m x 3m
Flue stack	Stack	East of loop road	4.5m x 4.5m x 25m
Thermal oxidiser and hot oil supply	Machinery	East of loop road	11m x 6m x 5m
Wood vinegar distillation module	Machinery	South-west	9m x 4m
Diesel clarification module, pumps and tanks (x2)	Machinery and tanks	South-west	16m x 10m
Waste water treatment module, pumps and tank	Machinery and tanks	South-west	12m x 12m
Chilled water module and pumps	Machinery	South-west	6m x 2.5m
Instrument air module and receiver	Machinery	South-west	9m x 4m
Pellet silos (x4)	Silo	North-east	15m x 15m x 22.5m
Crumbled wood storage silo	Silo	Central east	15m x 15m x 23m
Treated water tank	Above-ground tank	South-west (west of loop road)	8m x 8m x 15m
Wood vinegar tanks (x2)	Above-ground tank	South-west (west of loop road)	12m x 12m x 13m
Fire water tanks (x2)	Above-ground tank	South-west (west of loop road)	4.5m x 4.5m x 5.2m

The primary site features that do not comprise built form are below.

Feature	Location
Site access roads	Loop road around the site, with two diversions at the north, south and east to provide access for the biomass offloading area, weighbridge and biochar and fines loading areas respectively. Site access roads between and around structures to provide access.
Woodchip storage piles (hardstand or gravel under)	North half of the site.
Biomass delivery area (hardstand)	Bisecting the woodchip storage piles along the loop road.
Above-ground conveyor belts and pipelines	Between the dryer, crumbler, pellet silos, crumbled wood storage silo, production module, biochar storage shed, thermal oxidiser and various tanks.
Stormwater and retention ponds	South edge of the site, adjacent to the Wanerie Road boundary.
Bunded diesel containers (x10)	Western edge of the site, at the north end of the south-west tank cluster.

Signage is proposed adjacent to the vehicle entrance displaying “Narrogin FutureEnergy Park”, however the exact size, location and number of signs will be confirmed at building licence stage and provided as part of a separate application if required.

4.4 Vehicle Access, Parking and Circulation

The site access has been designed to function using a loop road for all large vehicles, with trucks weighed at the south end of the loop road after entering the site, biomass and feedstock is delivered at the rear of the site, and trucks are weighed again at the front of the site before leaving.

Various internal site access roads are located between biorefinery infrastructure and around biomass and feedstock storage piles to provide access for workers to conduct day-to-day activities and maintenance.

The site office, staff amenities, parking and workshop are located inside the vehicle entrance to the site.

Wanerie Road is proposed to be widened adjacent to the proposed crossovers to provide slip lanes to ensure that vehicles entering or exiting the facility do not do so directly from the main carriageway.

Four types of vehicle movements into and out of the site are anticipated to be generated through operation of the biorefinery:

- Delivery of biomass feedstock to the biorefinery;
- Shipment of renewable diesel, wood vinegar and biochar from the biorefinery;
- Staff accessing the biorefinery at the start and end of shifts; and
- Miscellaneous purposes such as deliveries and maintenance/servicing.

A maximum of 20 vehicles per day and between 80-100 vehicles per week are expected to deliver feedstock or ship products from the biorefinery. The Traffic Impact

Assessment prepared by Transcore (refer Appendix 7) confirms that there is sufficient capacity in the existing road network to support this additional traffic, and that the proposed crossovers can operate safely and efficiently.

4.5 Hours of Operation and Staffing

The facility is anticipated to operate 24/7 year round. The biorefinery will receive deliveries from semi trailers and B-double trucks between 7am-7pm Monday to Saturday, and the biorefinery will dispatch shipments using semi trailers and B-double trucks and tankers between 7am-7pm on weekdays and Saturdays. There will be continuous movement throughout the site internally during operating hours, with wheel loaders, radial stackers and forklifts used to shift and load biomass, feedstock and biochar.

The administration building will be occupied by 5 staff from 8am - 5pm on weekdays.

35 staff will work at the biorefinery, with three shifts daily to provide coverage across all hours, 7 days per week. The following breakdown is expected:

- 12 biorefinery workers during the day shift (7am - 3pm);
- 10 biorefinery workers during the evening shift (3pm - 11pm); and
- 8 biorefinery workers during the night shift (11pm - 7am).

4.6 Services and Utilities

The only proposed utility connection is to the existing 22kV power line traversing Lot 31, which will be used to power the facility. FEA has commenced discussions with Western Power regarding this connection, and at this stage it is anticipated that an isolator to the distribution line will be installed, as well as an underground cable between the isolator and biorefinery.

The remaining utilities will be managed as follows:

Utility	Management
Water	The biorefinery is a net water producer, and any wastewater will be treated as industrial waste as detailed in section 6.3 of this submission. Potable drinking water will be delivered to the biorefinery, but all other water used at the site will be produced by the biorefinery.
Sewage and waste water from ablutions and habitable buildings	Septic tanks will be provided on site to capture sewage and non-industrial waste water, and will be emptied periodically to be treated and disposed of off site.
Natural Gas	Where necessary the biorefinery will procure its own gas, to be supplied in loose cylinders and via bulk gas transported to the site and pumped into large storage tanks.
Telecommunications	This infrastructure will be confirmed at detailed design stage, and it is expected that high speed communication via telephone and internet will be provided.

4.7 Stormwater Management

As detailed previously, stormwater originating from outside the site will be directed around the site to an existing drainage channel along Wanerie Road.

A network of open channels, grated trenches and pipes are proposed to collect water from hardstand and building downpipes within the site and direct it to the stormwater pond at the front of the site. It is intended that stormwater will be managed so as not to impact the water quality in the stream. The managed stormwater will then be discharged into the creek running through the south-west corner of Lot 31 via a valve chamber connected to the retention pond, which provides capacity to limit the flow rate into the creek to pre-development rates.

Valves, sumps and oil separators are proposed to separate waste and contaminants from stormwater consistent with best practice water-management. In addition, a discharge water quality monitoring program including regular maintenance of stormwater drainage infrastructure will be developed and implemented as part of the operation of the facility. Further details of stormwater treatment methods and capacities of water to be held by the retention pond during rainfall events will be provided at detailed design stage to Shire of Narrogin requirements.

The site drainage layout and indicative stormwater infrastructure specifications are provided at Appendix 5.

4.8 Landscaping

Landscaping is not proposed within or in close proximity to the biorefinery site due to the need to reduce bushfire risk to the greatest extent possible. The landscaping configuration elsewhere in the Industrial zone (such as in the Development Exclusion Zone identified on the LDP and along Great Southern Highway) will be determined at detailed design stage and prior to commencement of construction. It is important to note that landscaping in industrial areas is typically required to reduce visual impacts from the public realm. In this instance, the site is not visible from Great Southern Highway due to the existing vegetation within the road reserve and is set back over 40m from Wanerie Road, and as such there is less need for landscaping to reduce visual impacts.

The vegetation associated with the creek in the south-western corner of Lot 31 is not proposed to be impacted.

4.9 Fencing

The biorefinery boundary is proposed to be fenced, with the fencing to have a uniform design, colour, material and height. Final fencing details will be determined at building licence stage.



Figure 11 – Lot 31 Great Southern Highway viewed from Wanerie Road, facing north through the biorefinery site (source: Technip Energies 2022)

5.0 Planning Considerations

The proposal has been designed and located to achieve an appropriate planning outcome for the site and the broader locality, as detailed in this section.

5.1 Land Use

The development is classified as 'industry' under the Shire's draft Local Planning Scheme No. 3 (LPS 3), and is zoned 'Special Use Zone 5' which provides a head of power for the applicable LDP. 'Industry' uses are permitted in the 'General Industry' zone under LPS 3.

5.2 Relationship to the Local Development Plan

The Local Development Plan includes provisions that apply to the development, consistent with those required for the site by Schedule 7 – Special use zones of LPS 3. The proposal meets the relevant LDP requirements as follows:

No.	Requirement	Comment
3.	All development application and building permit applications must address the disposal of waste water in accordance with local and state health policies.	Waste water disposal details are included in this application, specifically sections 4.7 and 6.3 of this submission.
4.	All development applications and building permit applications must address and comply with the requirements of the provision of this Local Development Plan.	This development application addresses and complies with the relevant requirements of the LDP, except as detailed below.
6.	Wind breaks and Nature Strips shall comprise of rows of trees and shrubs no greater than 20m in width and will typically comprise 2 rows of trees and 2 rows of shrubs.	Landscaping strips are not proposed to be provided along the south and west boundaries of Lot 31 adjacent to the biorefinery to minimise bushfire risk, as detailed in section 5.7 of this submission. Landscaping details will be provided at building licence stage once detailed design is completed.
7.	All lots shall be managed in accordance with an approved Bushfire Management Plan.	A Bushfire Management Plan has been appended to this application, and it is intended that the development will be undertaken and site managed in accordance with the actions required by the Bushfire Management Plan.
8.	Lots adjacent to Wanerie Road and Great Southern Highway are not permitted to obtain vehicular access directly on to these roads.	No subdivision is proposed over the industrial portion of the LDP. The internal circulation road for the proposal is in the same approximate location of the cap road on the LDP, which will separate traffic movements into and out of the site consistent with the intent of the LDP.
9.	No development shall occur in the Development Exclusion Zone.	No development is proposed in the Development Exclusion Zone.

11. Waste Disposal in the Industrial zone shall occur behind the building line and adjacent to the building. Waste disposal will occur inside buildings or behind structures and will not be visible from the street.

5.3 Development Controls

The proposal meets all site and built form development controls established by Table 2 of LPS 3 as demonstrated in the table below.

Requirement		Proposal
Minimum Lot Area	2,000m ²	64.624ha (10.8ha biorefinery site)
Minimum Effective Frontage	30m	370m
Minimum Front Setback	15m	26m (fire tanks)
Minimum Rear Setback	7.5m (may be reduced to zero subject to the local government's approval)	57m (industrial enterprise zone)
Minimum Side Setback	5m (may be reduced to zero subject to the local government's approval)	50m minimum
Maximum Plot Ratio	0.60	0.08 (biorefinery site)
Minimum Car Parking Spaces	1 per 100m ² Net Lettable Area or as determined by the local government	16

Clause 4.26.1 establishes a maximum building height of 10m above mean natural ground level. Due to the specific needs and nature of the biorefinery, multiple buildings on the site are proposed to exceed this height limit:

- Thermal oxidiser exhaust stack: 25m
- Pellet silos: 22.5m
- Biochar storage shed: 12m
- Production module shed: 15m
- Dryer shed: 12m
- Fines storage shed: 12m
- Crumbled wood storage silo: 22.5m
- Wood vinegar storage tanks: 13m

Clause 4.26.2 provides that buildings over the 10m height limit may be approved subject to meeting the above development standards and satisfying four further criteria. These buildings meet those criteria as follows:

Criteria	Compliance
Will not restrict light, sunshine and natural ventilation enjoyed by surrounding properties;	As the minimum setback between any building with a height over 10m and any adjacent property is 90m, there will be no impacts on light, sunshine and natural ventilation.
Will not intrude upon the privacy enjoyed by surrounding properties by virtue of overview;	All proposed buildings with heights in excess of 10m are single storey industrial warehouses with no mezzanines, or the stack or silos/tanks, none of which will enable overlooking of adjacent properties.

<p>Will not diminish views or outlook available from surrounding properties; and</p>	<p>Due to the Industrial zone being located approximately 20m lower than Lot 21 (18522) Great Southern Highway, any development would feature in the southward view from this property. The tallest proposed buildings (the stack and crumbled wood storage silo) are not bulky in the context of the scale and extent of development, and will thereby minimise impacts on views. The highest points of the remaining buildings will not impact views as they will be approximately 10m below the ground level of this property.</p>
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<p>Is sympathetic with the scale, townscape and character of the surrounding built environment.</p>	<p>N/A as there is no visible surrounding built environment or townscape. The biorefinery has been located at the lowest point of Lot 31 to minimise visual impacts on the adjacent rural uses. The scale and character of the proposal is consistent with the Industrial zone of the site.</p>
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5.4 Traffic, Access and Parking

In order to demonstrate that the proposal is satisfactory from a traffic and parking perspective, a Transport Impact Statement (prepared in accordance with WAPC Guidelines) has been prepared by traffic consultants Transcore. The TIS concludes:

- Traffic generation associated with the proposed development will be moderately low with an upper estimate of daily traffic flows being approximately 110 vehicles per day (20 trucks and 35 cars in / 20 trucks and 35 cars out). The trucks involved in deliveries to and from the proposed development will be 19m semi-trailers and 27.5m B-doubles.
- Wanerie Road is already included in Tandem Drive RAV Network 7, which permits vehicle combinations up to 36.5m long (such as double road trains), so 27.5m B-doubles are already permitted on this road.
- The only road upgrade considered to be warranted for this development is a basic right turn treatment on Wanerie Road for the eastern driveway crossover – effectively just a widening of the shoulder of the westbound traffic lane on Wanerie Road in the vicinity of that eastern driveway crossover.
- It is therefore concluded that traffic-related issues should not form an impediment to the approval of the proposed development.

Clause 4.28.1 and Table 2 of LPS 3 require 1 car parking bay to be provided per 100m² NLA or as determined by the local government. As most industrial buildings proposed do not have walls, they cannot be counted as NLA under the LPS 3 definition. For this reason, the crumbler shed, workshop, site office, central control room and two security huts are the only buildings that fall within the NLA definition. The combined area of these buildings is 853m², resulting in a requirement for 9 car bays. 16 car bays are proposed on the site, which is significantly more than the minimum requirement.

All car bays will be designed in accordance with Australian Standard AS2890.1, with plans demonstrating this to be provided at building licence stage.

The site access arrangement has been designed to meet the requirements of clauses 4.29, 4.30 and 4.31 of LPS 3 or as otherwise varied by the Local Development Plan.

5.5 Outdoor Storage Areas

All storage, laydown and other open areas to be used or trafficked are proposed to be sealed in accordance with clause 4.23.1 of LPS 3.

A significant proportion of the site area is proposed to be open and visible to enable efficient operation of the biorefinery and comply with risk mitigation requirements. However, as these areas are proposed to be significantly set back from Wanerie Road, Great Southern Highway and adjacent properties, they will not be prominently visible in the context of the overall biorefinery. The exception to this is the woodchip storage area and pellet silos at the rear of the site, which is likely to be visible from Great Southern Highway and adjacent properties. The woodchip storage area occupies half of the site and is a fundamental operational component of the proposal.

5.6 Fencing and Retaining

The proposed biorefinery boundary fencing will be of a uniform design, colour, material and height as required by clause 4.27.3 of LPS 3. Clause 4.27.4 of LPS 3 restricts fencing from being constructed along boundaries abutting road reserves, unless otherwise approved by the local government. Fencing is proposed along the Wanerie Road boundary for site security purposes given its proposed use as a biorefinery, and approval of this fencing by the Shire is therefore requested.

A 2.5m retaining wall is proposed to bisect the site, separating the woodchip storage area from the remainder of the biorefinery. This retaining wall is necessary to respond to the topography over the site and provide flat areas for the main built form and woodchip storage areas. Clause 4.27.1 of LPS 3 requires all retaining walls in excess of 0.5m height to “not adversely impact on the amenity of surrounding land and developments, occupants or the streetscape”. The retaining wall meets these requirements as its purpose is to accommodate existing site level differences, it will not be visible from the street and is not located in close proximity to any adjoining properties. Further details of the retaining wall will be provided to the Shire for approval at building licence stage.

5.7 Landscaping

Provision 6 of the Local Development Plan requires a nature strip to be provided around the boundary of the Industrial zone, including along the inside of the Lot 31 boundary. This development application proposes not to provide nature strips along the south and west boundaries of the Industrial zone, as inclusion of landscaping in these locations would likely create an unacceptable bushfire risk for the biorefinery, when the priority ought to be maximising the safety of the biorefinery and its employees. This is confirmed by the need to either remove or manage vegetation to a low threat level on the northern side of the Wanerie Road reserve adjacent to the biorefinery. For this reason, this application seeks discretion to be exercised by the Shire to issue approval for this element of the proposal.

5.8 Visual Amenity

The biorefinery is ideally located such that it is not readily visible from the majority of the surrounding lots and roads due to the existing vegetation and topography. The only location from which the biorefinery will be readily visible is along the Wanerie Road frontage. As the biorefinery is located on land that is effectively zoned ‘General Industry’, it is reasonable to expect industrial development to be visible from the road adjacent. Glimpses of the biorefinery will be possible from Great Southern Highway directly adjacent to the ‘Industry’ zone and from Wanerie Road at the crest of the hill approximately 1 kilometre west of Lot 31.

Only two dwellings are located within line of sight of Lot 31, and are set back from the biorefinery site by 500m (Lot 21 Great Southern Highway) and 700m (Lot 30 Comini Road). These distances will ensure that the rural amenity of these dwellings will not be unduly impacted by this proposal.

Given the scale of the proposal, the lack of suitably zoned industrial land in the broader region and bushfire risk constraints, the proposal has been designed and located to minimise visual amenity impacts to the greatest extent possible.



Figure 12 – Biorefinery site viewed from Great Southern Highway, facing west (source: Technip Energies 2022)

6.0 Environmental and Amenity Considerations

FutureEnergy Australia is dedicating significant time and resources to ensure targeted and effective management and mitigation of any impacts to enable the biorefinery to coexist with the surrounding rural land uses, and to ensure that the existing amenity is not unreasonably impacted. Design initiatives, management provisions and other measures to minimise any potential off-site impacts from the proposal are detailed in this section.

In addition to this development application, FutureEnergy Australia is currently finalising a referral submission to the EPA to obtain the appropriate licences and permits to operate the biorefinery. The various licence applications are supported by extensive technical studies and modelling into matters such as noise and odour emissions, and water / air quality. These studies will inform the EPA's assessment of the proposal and will ensure that all environmental considerations are adequately addressed prior to operation.

6.1 Approvals and Licenses under other Legislation

FEA is in the process of obtaining the following approvals to support this proposal:

- Approval under Part IV of the EP Act through the submission of the s.38 referral to the EPA and the issue of a Ministerial Statement by the Minister for Environment, if the EPA considers that approval under Part IV is necessary.
- Approval under Part V of the EP Act for the construction and operation of the proposal through the submission of an application for a Works Approval and Operating Licence to the Department of Water and Environmental Regulation.
- Building Licence approval under the Shire of Narrogin Local Planning Scheme.
- Approval under the *Dangerous Goods and Safety Act 2004* and regulations for volumes of Dangerous Goods that exceed the manifest threshold.

Should the EPA determine that this proposal is not required to be assessed under Part IV as the environmental impacts of the proposal can be adequately assessed and managed under the Part V Works Approval and Operating Licence provisions of the EP Act, it is understood that the EPA will refer this proposal to DWER for assessment under Part V of the EP Act.

State – Part IV EP Act

On 15 March 2022 FutureEnergy Australia submitted pre referral correspondence to the Department of Water and Environmental Regulation (EPA Services) outlining the nature and scale of the biorefinery proposal. On 17 March 2022 FEA met with EPA Services to discuss the proposal. The EPA recommended referring the proposal under s.38 of the *Environmental Protection Act 1986* (the EP Act), based on potential impacts to environmental factors of Air Quality and Social Surroundings.

The EPA recommended that the referral should address the requirements outlined in the EPA's Section 16e Advice to the Minister for Environment, published on 4 April 2013, "Environmental and health performance of waste to energy technologies (Report 1468) (EPA Section 16e advice).

FutureEnergy Australia has since engaged Aurora Environmental to prepare and submit a referral under s.38 of the EP Act to the EPA. FEA anticipates that the referral will be submitted to the EPA during November 2022.

Commonwealth

FEA has not referred the proposal to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) as the proposal will not impact on Matters of National Environmental Significance.

6.2 Noise

The biorefinery has been intentionally located at the southern (and lowest) end of Lot 31, with generous setbacks from the east and west site boundaries, to minimise the impacts of noise generated by the biorefinery on the rural amenity of surrounding properties.

There will not be any noise impacts on properties to the south and east of the site. There is no direct line of sight between the biorefinery and any uses to the south and east, due to the topography of the surrounding land and Great Southern Highway and Wanerie Road (and associated vegetation) acting as a shield for noise transmission. In addition, all dwellings to the south and east are located over 1.2km from the biorefinery.

Other landholdings are located closer to the north and west of the biorefinery than the south and east, but are still more than 500m away from the noise source. The following design and operational initiatives will minimise noise impacts on nearby uses and dwellings in these directions:

- The 2.5m retaining wall bisecting the site and surrounding the thermal oxidiser will reduce noise impacts from the machinery in the southern half of the site on the land to the north of the biorefinery.
- Where possible, noise-generating machinery is located within buildings, such as the crumbler shed, production module warehouse and workshop.
 - Buildings will be provided with noise insulation where necessary to further minimise external noise transmission.
 - Although the biorefinery will operate 24/7, the crumbler, being the largest noise generator, will be installed and managed to ensure noise levels at neighbouring properties are within limits designated by the EPA.
- The location of the biomass delivery area in the centre of the woodchip storage area will increase the distance of vehicle and mechanical noise generation from uses to the north of the biorefinery, and the woodchip piles themselves will also help to deflect noise transmission in all directions from this source.
- External noise-generating operations have been located inside warehouses or away from the west side of the facility where possible, in order to reduce noise emissions towards the neighbouring property (Lot 30 Comini Road). The only noise source with direct exposure to the west lot boundary is vehicular movement through the site, including trucks using the loop road and machinery moving woodchips at the rear of the site. This noise source is proposed to operate between 7am-7pm Monday to Saturday only and is typical for an Industrial zone, and will therefore not unduly impact the local amenity.

An acoustic assessment has been prepared by Herring Storer Acoustics, acoustic consultants working as subcontractors to Aurora Environmental. The activities carried out by Herring Storer Acoustics and the results of the assessment are detailed below.

Noise Monitoring

Continuous noise monitoring to establish the ambient noise levels was conducted in accordance with the Draft Guidelines on Environmental Noise for Prescribed Premises (DWER, May 2016). Monitoring was conducted on the eastern boundary of Lot 31, adjacent to the closest noise sensitive premises northeast of the proposed biorefinery site. Monitoring was conducted during the period 30th March to 4th April 2022 and the results (measured in decibels) are summarised in the table overleaf:

Date	Day (07:00 to 19:00)	Evening (19:00 to 22:00)	Night (22:00 to 07:00)
Wednesday, 30 March 2022	52	46	45
Thursday, 31 March 2022	53	46	44
Friday, 1 April 2022	52	47	40
Saturday, 2 April 2022	51	43	41
Sunday, 3 April 2022	50	47	51
Monday, 4 April 2022	56	46	48
Tuesday, 5 April 2022	53	44	43
Average	52	45	45

Noise Modelling

Noise modelling was undertaken involving the following operating scenarios detailed below. Noise levels from the biorefinery were modelled at the four nearest noise sensitive premises, being the residential premises 700m to the west (R1), 500m to the north (R2) and ~1.2km to the northeast and southeast (R3, R4) of the site as follows:

Scenario 1

- Day operations (Mon to Sat 7am to 7pm)
- Biorefinery Plant
- Transport in and out of site
- Loading and unloading

Scenario 2

- Night Operations (Most critical 10pm to 7am)
- Biorefinery Plant

It is noted, that for the scenarios considered, all equipment has been assumed to be operating at the same time. A summary of the calculated noise levels for scenarios 1 and 2 are presented in the table below:

Scenario and Applicable Times of Day	Receiver	Assessable Noise Level db(A)	Applicable L _{A01} Assigned Noise Level (dB)	Assigned Noise Level L _{A01} (dB) Compliance
1 – Day (Weekdays and Saturday 07:00 to 19:00)	R1	42	45	Complies
	R2	42		Complies
	R3	33		Complies
	R4	25		Complies
2 – Night (22:00 to 07:00)	R1	28	35	Complies
	R2	31		Complies
	R3	23		Complies
	R4	14		Complies

During the night-time period, the assigned noise level is 35 dB(A). The highest predicted noise emissions at the nearest noise sensitive premise (R2) during this period is 31 dB(A). This includes all biorefinery noise sources but excludes transport operations as there will be no deliveries to or from the biorefinery during the night-time period.

The operating scenarios consider all noise sources from the proposal operating at the same time with the calculated noise levels assessed under the highest night-time propagation weather conditions.

The noise modelling is therefore considered conservative as it is unlikely that all noise sources will be operating at the same time under the worst-case propagation conditions.

The acoustic assessment shows that in the worst-case scenario noise received at the nearest noise sensitive premise (R2) is below the assigned noise level. Therefore, noise emissions from the proposed biorefinery are expected to comply with EPA requirements and the *Environmental Protection (Noise) Regulations 1997*, and are unlikely to have a significant residual impact on the noise levels at the nearest noise sensitive premises.

6.3 Waste

Due to the number of processes occurring at the biorefinery, multiple types of waste will be generated. The types of waste, and how they will be handled, are detailed below.

Waste material	Waste source	Hazard Risk	Management Strategy
Decayed biomass	Stockpiles	Non-hazardous	Sent to a composting facility
Fines	Wood chip processing	Non-hazardous	Sent to a composting facility
Fines	Pellet processing	Non-hazardous	Sent to a composting facility
Metallic contaminants	Wood chip and pellet screening	Non-hazardous	Sent to a waste transfer station
Airborne fines dust	Crumbler (milling of wood chips)	Non-hazardous	Bagged and sent to a composting facility
Airborne fines dust	Dryer (drying of wood chips)	Non-hazardous	Bagged and sent to a composting facility
Airborne biochar dust	Biochar bagging units	Non-hazardous	Sent to a composting facility
Waste water residues	Waste water treatment unit	Hazardous	Managed in accordance with environmental approvals and licences and sent to an industrial waste handling facility
Fuel filtration residue	Fuel clarification unit	Hazardous	Managed in accordance with environmental approvals and licences and sent to an industrial waste handling facility

For the biorefinery to be a net positive water producer, most waste water will be treated on site and reused in chemical processes, cooling of infrastructure that generates heat and storage in fire water tanks. All contaminants removed as part of the treatment process, and excess contaminated water, will be handled as waste.

6.4 Dust Management

The proposal is likely to generate minimal amounts of dust and will not impact surrounding residences or other dust-sensitive uses. As the biorefinery uses woodchips as its primary input, dust is likely to be generated by activities involving movement or processing of woodchips. This includes unloading of woodchips from trucks to stockpiles, transport of woodchips from stockpiles to the magnetic separator, and transport to the crumbler. Dust generated in the crumbler and at all stages afterwards (such as by the woodchip dryer or separation of biochar) will be captured by a dust collection system, and will be directed to the dedicated fines storage and loading area.

A critical component of the biorefinery process is that high quality inputs are required to ensure the quality of the outputs. That is, high-quality woodchips and pellets are required to produce high-quality diesel, wood vinegar and biochar. For this reason, all woodchip deliveries to the biorefinery will be screened for quality, and part of this screening will be for excessive dust or fines. Deliveries with excessive dust or fines will likely be rejected. Therefore, any dust generated prior to entering the crumbler (ie. by unloading or transport of woodchips) is expected to be in a negligible quantity and density such that there will be no off-site impacts – particularly when considering the separation distance between the stockpiles and the nearest sensitive land uses.

6.5 Gaseous Emissions

The proposal includes a tall stack / chimney located in the north eastern corner of the biorefinery site. The stack forms part of the thermal oxidiser, which decomposes and destroys any hazardous gases generated by the facility into CO₂ and H₂O prior to release into the atmosphere. The emissions from the stack are non-harmful gases and are essentially water vapour, which will be visible as white steam. The environmental analysis undertaken as part of the EPA submission confirms that the emissions coming from the stack will not have any adverse impact on air quality.

Propane/natural gas will be used as a supplementary fuel for the thermal oxidiser to manage emissions during start-up and shutdown of the biorefinery (before and after maintenance). The composition of the emissions while propane/natural gas is used will differ in order to ensure smooth start-up and shutdown processes. For example, a small amount of fuel is required to start up the facility, and emissions will be generated by burning this fuel for a short period of time. It is important to note that maintenance of the biorefinery to the extent that shut down is required is only anticipated to occur a few times a year, so emissions resulting from this process will be negligible in the context of the overall operation of the biorefinery.

The stack and thermal oxidiser have been located as far as possible from nearby properties and at a lower elevation to reduce the perceived risk of air quality and visual impacts, while also maintaining a sufficient setback from the remainder of the biorefinery to mitigate against safety risks considering the high levels of heat that will be generated.

6.6 Other Emissions

As the facility will operate 24/7, external lighting will be required in operational areas and accessways around the site. A lighting strategy will be provided at building licence stage including lighting specifications and locations, and will aim to minimise impacts on surrounding properties, wildlife and the amenity of the locality. It is intended that lighting will be installed where needed and only directed towards areas that need to be lit. Sensor or timed lights will be installed where appropriate.

No processes undertaken at the facility or gaseous emissions will generate offensive odour.

6.7 Bushfire Risk and Mitigation

The Bushfire Risk Assessment and Management Report appended to this development application classifies all inherent risks associated with the proposal as ‘Low’, all residual risks as ‘Very Low’ and tolerability as ‘Acceptable’, except for only two risk sources as summarised in the following table:

Risk Source	Inherent Risk Level	Residual Risk Level	Tolerability
Physical infrastructure	Moderate	Very Low	Tolerable
People on access/egress routes	N/A	Low	Acceptable

The Report and the Bushfire Management Plan include 8 ‘required’ actions and 9 ‘recommended’ actions to address the two abovementioned risks and generally optimise protection of the biorefinery from bushfire risk. The ‘required’ actions will be undertaken, and the ‘recommended’ actions will be investigated at detailed design stage and confirmed at that point in time.

One of the required actions is removal or management of vegetation on the northern side of the Wanerie Road reserve to a low threat level in perpetuity. This is required to achieve a compliant APZ inside the southern boundary of the site.

Importantly, all high-risk activities are proposed to be undertaken, and flammable material/liquid stored, with sufficient separation from all bushfire hazards on adjoining land. This will be achieved by maintaining an extended Asset Protection Zone, comprising the remainder of Lot 31 outside the biorefinery site boundaries and south of the LDP Development Exclusion Zone, with no vegetation in perpetuity.



Figure 13 – Biorefinery site viewed from the south-east corner, facing west (source: FEA 2022)

7.0 Conclusion

As demonstrated by this report, the proposal satisfies the relevant planning requirements of LPS 3, the Local Development Plan, State Planning Policies and other relevant planning instruments, and is worthy of approval on planning grounds.

The location of the biorefinery within the Shire and broader Wheatbelt has been carefully selected due to its relative proximity to input sources (biomass) and buyers of the diesel to be produced at the biorefinery, such as Horizon Power. In addition, the chosen site is ideally located just outside of Narrogin to ensure that the flow-on economic benefits of the biorefinery are received by the town, and impacts on nearby properties are minimised to the greatest extent possible.

Due to the complexity of the project and uncertainty associated with the finer details owing to the biorefinery being the first commercial scale project of its kind in Australia, some of the more detailed information is not yet available. The project is now at a stage where enough detail is known to enable the JDAP and Shire to assess and determine the proposal subject to conditions requiring further and more detailed information to be provided at a later stage.

This proposal relies on the Shire conducting its assessment against draft Local Planning Scheme No. 3 instead of current Local Planning Scheme No. 2 to be capable of approval. This is a reasonable approach for this project as LPS 3 is seriously entertained and is highly likely to be approved by the Minister for Planning prior to determination of this development application.

The proposal is generally compliant with planning requirements, except for a small number of minor variations where discretion is requested to be exercised by the JDAP. In each of these cases, this report demonstrates that the proposal meets relevant principles that are required to be met to enable discretion to be exercised.

This proposal will substantially benefit the Shire of Narrogin and Western Australia's economy and environment, while minimising impacts on the immediate locality surrounding the biorefinery site. The Narrogin FutureEnergy Park is a once-in-a-lifetime opportunity to position Narrogin as a future-focused town with a front and centre role in Western Australia's transition to net zero carbon emissions.

Subject to a number of project milestones being met, broader economic conditions and the intensity of the construction materials and labour shortage reducing, the biorefinery is intended to be constructed from late 2023 to 2024, with operations to commence by the end of 2024.



Appendix 1

Shire of Narrogin Application for
Planning Consent and DAP Form 1

APPLICATION FOR PLANNING CONSENT



(FDRS005)

89 Earl Street
PO Box 1145
Narrogin WA 6312

(08) 9890 0900

www.narrogin.wa.gov.au
enquiries@narrogin.wa.gov.au

CASHIER HOURS:
8:30am – 4:30pm
MONDAY- FRIDAY

FORMER TOWN OF NARROGIN – TOWN PLANNING SCHEME NO.2
FORMER SHIRE OF NARROGIN – LOCAL PLANNING SCHEME NO.2

Name of Applicant	Nick Grindrod, Rise Urban
ABN (If Applicable)	87 845 140 667
Correspondence Address	3/448 Roberts Road, Subiaco WA 6008
Applicant Phone Number	0424 365 276
Applicant Email	nick@riseurban.com.au

If Applicant and Owner are different:

Name of Owner	Baringa Investment Pty Ltd
ABN (If Applicable)	84 113 687 746
Correspondence Address	PO Box 448, Maylands, WA 6931
Owner Phone Number	0433 141 105
Owner Email	workline108@hotmail.com

I hereby apply for planning consent to:

1. Use the land described hereunder for the purpose of Industry (Renewable Diesel Refinery)
and/or
2. Erect, alter or carry out development on land described hereunder in accordance with the accompanying plans.

Existing use of land	Vacant
Approximate cost of proposed development	\$200,000,000
Estimated time of completion	Mid 2024
No of persons to be housed / employed after completion	35-40 employees

TITLES OFFICE DESCRIPTION OF LAND

LOCALITY PLAN

Lot No	31	House No		Street Name	Great Southern Highway				
Suburb	Dumberning		Nearest Street Intersection	Wanerie Road					
Location No		Plan or Diagram	404104	Certificate of Title		Volume:	2882	Folio:	946
Title Encumbrances (e.g. Easements, Restrictive Covenants)	Water and electricity infrastructure easements								

LOT DIMENSIONS

Site area	646,242.00	Square metres
Frontage	762.00	Metres
Depth	1,152.00	Metres

ADVERTISING

The information and plans provided with this application may need to be made available by the local government for public viewing in connection with the application. Do you consent to this?

YES NO

AUTHORITY

Applicant's Signature 	Date 11 November 2022
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NOTE: ALL OWNERS OF THE PROPERTY MUST SIGN THIS APPLICATION FORM. WHERE PROPERTY IS OWNED BY A COMPANY, AT LEAST TWO DIRECTORS OF THE COMPANY MUST SIGN THE APPLICATION.

NOTE: WHERE THE APPLICANT IS NOT THE OWNER, THE OWNER'S SIGNATURE IS REQUIRED.

Owner's Signature 	Date 26/8/2022
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NOTE: THIS FORM IS TO BE SUBMITTED TOGETHER WITH COPIES OF PLANS, COMPRISING THE INFORMATION SPECIFIED IN THE PARTICULARS REQUIRED WITH THE APPLICATION OUTLINED BELOW. ADDITIONAL INFORMATION MAY BE REQUIRED AT A LATER STAGE.

NOTE: THE DEVELOPMENT APPLICATION MUST BE ACCOMPANIED WITH THE CORRECT PLANNING FEES (SEE CURRENT SCHEDULE OF FEES)

THIS IS NOT AN APPLICATION FOR A BUILDING LICENCE

PARTICULARS REQUIRED WITH APPLICATION FOR PLANNING CONSENT

Where an application involves the erection or alteration of a building or a change in levels of a site, the plans accompanying an application for planning consent shall, unless especially exempt by the Shire:

- a. Indicate the position and describe the existing buildings and improvements on the site and indicate those which are to be removed;
- b. Indicate the position (SITE PLAN, FLOOR PLAN AND ELEVATIONS) and describe the buildings and improvements proposed to be constructed, their appearance, height and proposed uses in relation to existing and proposed contours;
- c. Indicate the position, type and height of all the existing trees on the site and indicate those to be retained and those to be removed;
- d. Indicate the areas to be landscaped and the location and type of shrubs, trees and other treatment proposed;
- e. Indicate site contours and details of any proposed alteration to the natural contour of the area;
- f. Indicate car parking areas, their layout and dimensions and accessways and the position of existing and/or proposed crossovers; and
- g. Indicate site dimensions and be to metric scale.

OFFICE USE ONLY

File Reference		Application No	
Date Received		Date of Approval / Refusal	
Date of Notice of Decision		Officer's Signature	



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 Shire of Narrogin Local Planning Scheme No. 2 (to be assessed under draft LPS 3)	
Land	Lot number, street name, town/suburb Lot 31 Great Southern Hwy, Dumberning	
Certificate of Title (provide copy)	Volume Number 2882	Folio 946
	Location Number	Plan / Diagram Number 404104
Details of development application made to responsible authority	Summary of Proposal Renewable Diesel Refinery	
Development Use	Residential / Commercial / Industrial / Rural / Mixed Use / Other Industry	
Estimated cost of development (GST Exc)	\$ 200,000,000	

Part A – Acknowledgement by Applicant and Landowner

Mandatory Application	<input checked="" type="checkbox"/> I give notice that I understand that this is a mandatory Development Assessment Panel application (regulation 5)
Optional Application	<input type="checkbox"/> 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	<input type="checkbox"/> 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	Nick Grindrod	
Company	Rise Urban	
Address	Street Number/PO Box number, street name, suburb, state, postcode 3/448 Roberts Road, Subiaco WA 6008	
Contact Details	Email nick@riseurban.com.au	Phone 0424 365 276
Signature		Date 11 November 2022

Landowner Details (to be completed and signed if landowner is different from applicant)		
<ul style="list-style-type: none"> 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)	Baringa Investment Pty Ltd	
Contact Details	Email workline108@hotmail.com	Phone 0433141105
Address	Street Number/PO Box number, street name, suburb, state, postcode PO Box 448, Maylands, WA 6931	
Name/s	Desmond Lee	Alice Chai
Title/s	Landowner/Sole Director/Director (2 signatures required) Director/Secretary	Additional Landowner/ Director/Secretary (if applicable) Director
Signature/s		
Date	26/8/2022	26/8/2022

Part B – Local government acceptance for assessment

Responsible Authority	<input checked="" type="checkbox"/> Local Government (LG) <input type="checkbox"/> * Western Australian Planning Commission (WAPC) <input type="checkbox"/> * Dual – Local Government and Western Australian Planning Commission <input type="checkbox"/> Building Management and Works (Department of Finance) – <i>Public Primary School Applications</i>	
* 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)	<input type="checkbox"/> 60 days (advertising not required) <input type="checkbox"/> 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 accepted for assessment

Please refer to the [Guidance Note: Lodging a DAP Application](#) for further information.



Appendix 2

**Certificate of Title
Lot 31 Great Southern Highway,
Dumberning**

WESTERN



AUSTRALIA

REGISTER NUMBER 31/DP404104	
DUPLICATE EDITION N/A	DATE DUPLICATE ISSUED N/A

RECORD OF CERTIFICATE OF TITLE
UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2882** FOLIO **946**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES



LAND DESCRIPTION:

LOT 31 ON DEPOSITED PLAN 404104

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

BARINGA INVESTMENT PTY LTD OF PO BOX 448, MAYLANDS

(AF N295822) REGISTERED 7/4/2016

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. *EASEMENT BURDEN CREATED UNDER SECTION 136C T.L.A. FOR WATER SUPPLY PURPOSES - SEE DEPOSITED PLAN 404104
2. *C763537 EASEMENT TO THE STATE ENERGY COMMISSION OF WESTERN AUSTRALIA FOR ELECTRICAL. SEE DEPOSITED PLAN 404104 REGISTERED 4/5/1984.
3. *K941752 NOTIFICATION CONTAINS FACTORS AFFECTING THE WITHIN LAND. LODGED 15/5/2009.
4. *P208895 CAVEAT BY CARNARVON ENERGY LIMITED LODGED 7/7/2022.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

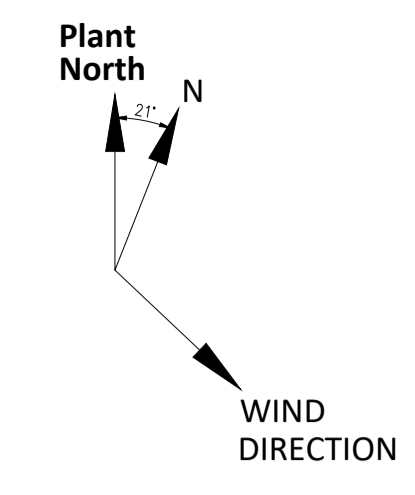
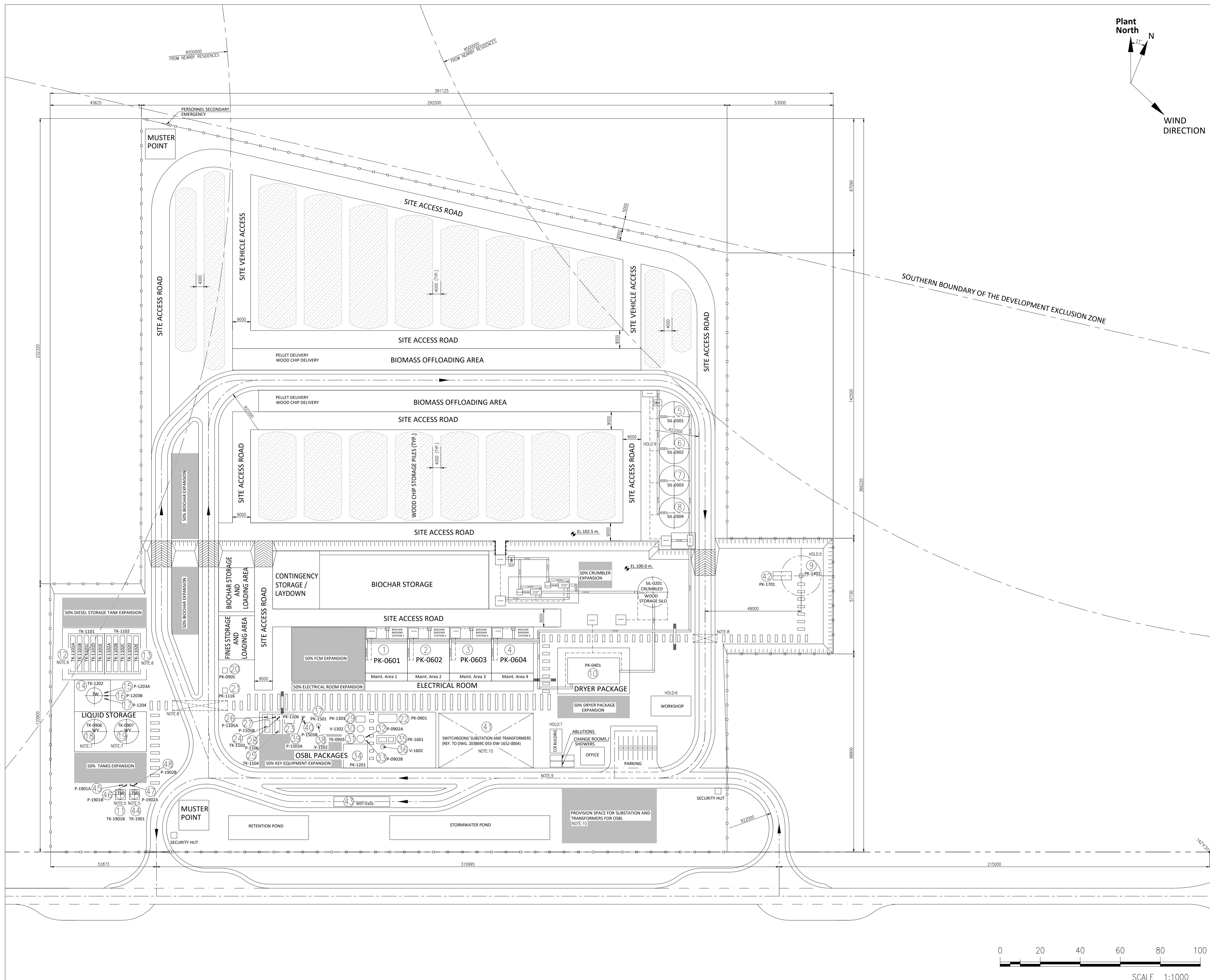
SKETCH OF LAND: DP404104
PREVIOUS TITLE: 2735-805
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AUTHORITY: SHIRE OF NARROGIN

NOTE 1: N295822 THIS LOT/TITLE CREATED AFTER PORTION OF THE LAND TAKEN FROM THE FORMER LOT WITHOUT PRODUCTION OF THE DUPLICATE TITLE BY TAKING ORDER N295822. CURRENT DUPLICATE FOR THE WITHIN LAND IS STILL VOL.2735 FOL.805 EDITION 2



Appendix 3

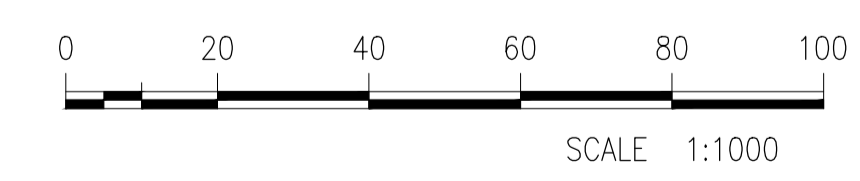
Proposed Development Plans



FACILITY LIST		
NO.	TAG NO.	DESCRIPTION
1	PK-0601	PRODUCTION MODULE 1 (PROVIDED BY ISBL (PPI) VENDOR)
2	PK-0602	PRODUCTION MODULE 2 (PROVIDED BY ISBL (PPI) VENDOR)
3	PK-0603	PRODUCTION MODULE 3 (PROVIDED BY ISBL (PPI) VENDOR)
4	PK-0604	PRODUCTION MODULE 4 (PROVIDED BY ISBL (PPI) VENDOR)
5	SIL-0301	PELLET STORAGE SILO 1
6	SIL-0302	PELLET STORAGE SILO 2
7	SIL-0303	PELLET STORAGE SILO 3
8	SIL-0304	PELLET STORAGE SILO 4
9	PK-1401	THERMAL OXIDIZER INCLUDING WASTE HEAT RECOVERY
10	PK-0401	DRYER PACKAGE 1
11	TK-1901B	FIRE WATER STORAGE TANK B
12	TK-1101	DIESEL STORAGE TANK 1 (NOTE:8)
13	TK-1102	DIESEL STORAGE TANK 2 (NOTE:8)
14	TK-1202	TREATED WATER TANK
15	P-1203A	TREATED WATER PUMP A
16	P-1203B	TREATED WATER PUMP B
17	P-1204	UTILITY WATER PUMP
18	TK-0906	WOOD VINEGAR STORAGE TANK 1 (NOTE:9)
19	TK-0907	WOOD VINEGAR STORAGE TANK 2 (NOTE:9)
20	PK-0905	WOOD VINEGAR LOADING SKID
21	PK-1116	DIESEL LOADING SKID
22	PK-0901	WOOD VINEGAR DISTILLATION MODULE
23	PK-1106	DIESEL CLARIFICATION PACKAGE (PROVIDED BY ISBL (PPI) VENDOR)
24	TK-1103	DIESEL INTERMEDIATE HOLDING TANK 1
25	TK-1104	DIESEL INTERMEDIATE HOLDING TANK 2
26	P-1105A	DIESEL TRANSFER PUMP A
27	P-1105B	DIESEL TRANSFER PUMP B
28	P-1106	OFF-SPEC DIESEL TRANSFER PUMP
29	PK-1301	NITROGEN GENERATION PACKAGE
30	V-1302	NITROGEN RECEIVER
31	TK-0903	WASTE WATER TANK
32	P-0902A	WASTE WATER TRANSFER PUMP A
33	P-0902B	WASTE WATER TRANSFER PUMP B
34	PK-1201	WASTE WATER TREATMENT PACKAGE
35	PK-1601	INSTRUMENT AIR PACKAGE
36	V-1602	INSTRUMENT AIR RECEIVER
37	PK-1501	CHILLED WATER PACKAGE
38	V-1502	CHILLED WATER EXPANSION VESSEL
39	P-1503A	CHILLED WATER PUMP A
40	P-1503B	CHILLED WATER PUMP B
41	-	SWITCH ROOM/SUBSTATION, POWER TRANSFORMER AND DIESEL ENGINE GENERATOR PACKAGE
42	PK-1701	HOT OIL PACKAGE (PROVIDED BY THERMAL OXIDIZER PACKAGE VENDOR)
43	WST-0101	WEIGH STATION
44	TK-1901	FIRE WATER STORAGE TANK
45	P-1901A	FIRE WATER PUMP(DIESEL ENGINE DRIVEN)
46	P-1901B	FIRE WATER PUMP(MOTOR DRIVEN)
47	P-1902A	JOCKEY PUMP(MOTOR DRIVEN) A
48	P-1902B	JOCKEY PUMP(MOTOR DRIVEN) B

- LEGEND:**
- FENCING
 - BIN LINE
 - UNDERGROUND TRENCH
 - SLOPE ROAD
 - SLEEPERS
 - SLOPE GROUND

- HOLDS:**
1. PLANT BOUNDARY, DATUM, COORDINATES & ELEVATION.
 2. SECURITY FENCE AREA.
 3. PIPE SLEEPER, WIDTH & ELEVATION.
 4. SIZING OF SIL-0301/0302, PK-1401, PK-1701, SIL-0201/0301/0302/0303/0304, PK-1401.
 5. THE LOCATION SHALL BE CONFIRMED BY FLARE/VENT THERMAL RADIATION AND DISPERSION STUDY REPORT 203869C-025-RT-1900-0001.
 6. THE LOCATION SHALL BE CONFIRMED BY FIRE AND EXPLOSION CONSEQUENCE MODELLING (2D) STUDY REPORT 203869C-025-RT-1900-0002.
 7. THE SAFETY MITIGATION SHALL BE CONFIRMED BY FIRE AND EXPLOSION CONSEQUENCE MODELLING (2D) STUDY REPORT 203869C-025-RT-1900-0002.
 8. THE DIMENSION OF SUBSTATION, TRANSFORMERS AND EMERGENCY DIESEL GENERATOR SHALL BE VERIFIED DURING DETAILED DESIGN.
 9. MATERIALS HANDLING LAYOUT AS SUBJECT TO CHANGE PENDING VENDOR DESIGN INPUTS.
 10. THE SHELTER/ENCLOSURE DIMENSION AND LAYOUT OF BIOCHAR STORAGE, BIOCHAR STORAGE / LOADING, FINES STORAGE/LOADING, FINE STORAGE, CRUMBLER, PRODUCTION MODULE, DRYER PACKAGE.



- NOTE:**
1. ALL DIMENSIONS ARE IN MILLIMETERS, ALL ELEVATIONS AND ALL COORDINATES ARE IN METERS UNLESS NOTED OTHERWISE.
 2. PLANT. EL.+100.000 IS EQUIVALENT TO MSL. EL. (HOLD 1).
 3. THE COORDINATES AT PLANT DATUM ARE N (HOLD 1) AND E (HOLD 1).
 4. EQUIPMENT SIZING BASE ON MECHANICAL EQUIPMENT LIST(ISBL & OSBL) DOC. NO. 203869C-035-EL-0001 REV. A.
 5. FW TANK / PUMP STATION SHALL BE AWAY FROM TK-1101, TK-1102, PK-0905 AND FUTURE PROCESS AREA >30 M.
 6. -

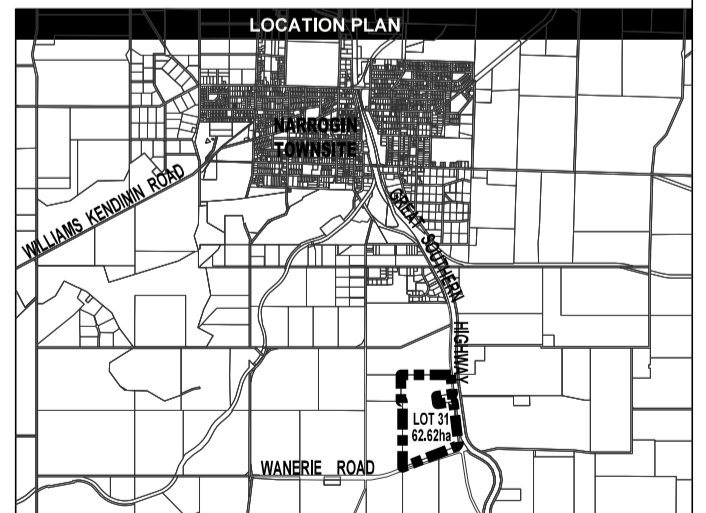
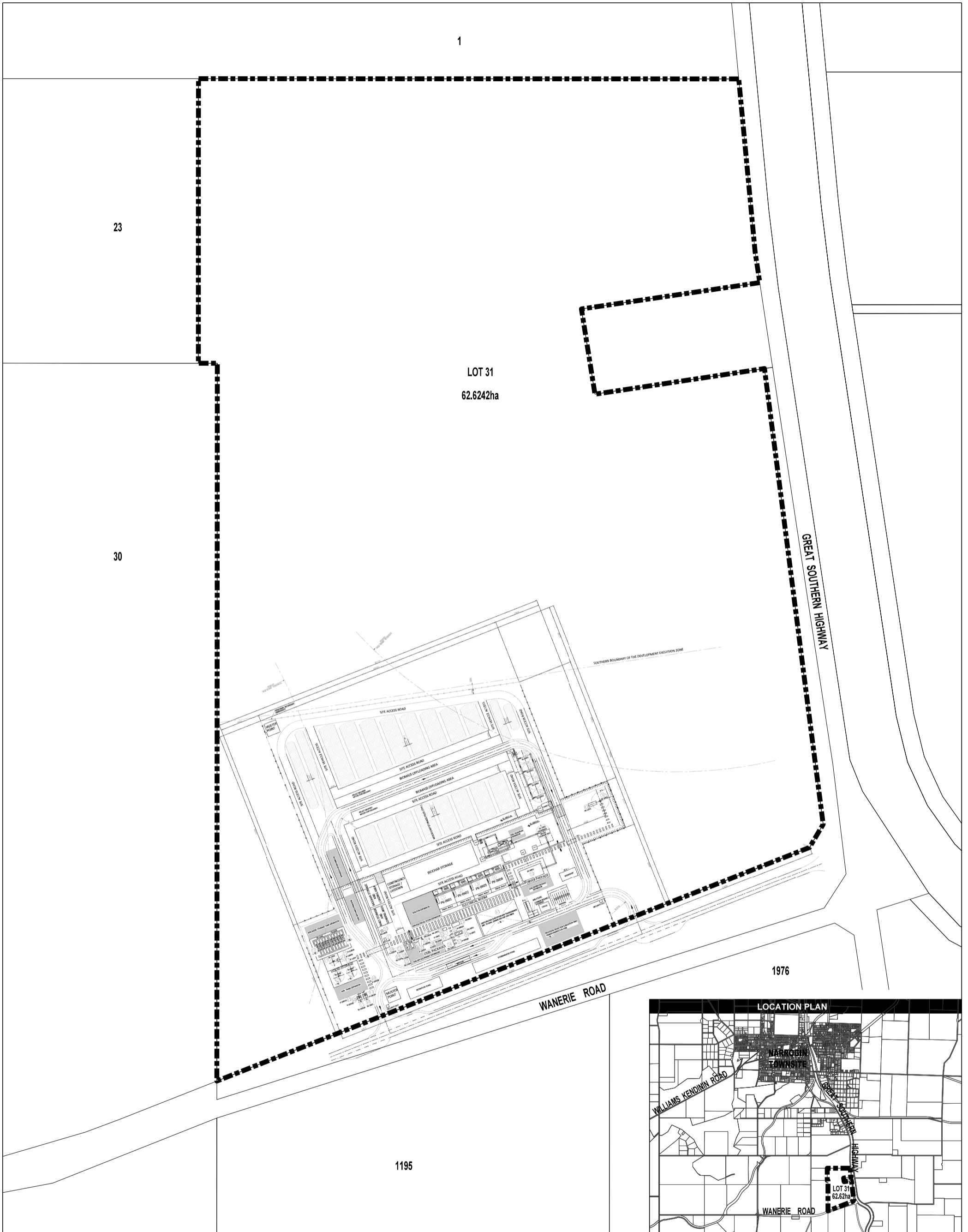
7. -
8. ALL PIPE SLEEPERS WHEN CROSSING THE ROAD WILL BE RUN UNDERGROUND.
9. ALL PLANT ROADS TO BE 6 METERS WIDTH MINIMUM AND ARE ONE WAY DIRECTIONAL (NOT INCLUDING SITE VEHICLE ACCESS ROADS WITHIN PROCESS AREAS).
10. THE LOCATION OF SWITCHROOM AND TRANSFORMERS SHALL BE VERIFIED AS PER THE MINIMUM SAFETY CLEARANCE BETWEEN TRANSFORMERS AND PROCESS AREA DURING DETAILED DESIGN, SAFETY DISTANCE BETWEEN PROCESS EQUIPMENT / PIPING SYSTEM & UNMANNED ELECTRICAL UTILITIES SUCH AS SUBSTATIONS, TRANSFORMER THESE SHALL BE LOCATED BY 30 METERS SEPARATION AWAY REFER TO SAFETY CONCEPT PHILOSOPHY NO. 203869C-020-JSD-1900-0001_REV. A. THE VERIFICATION ON THE POTENTIAL HAZARD ON FLAMMABLE GAS REACHING OR FIRE & EXPLOSION RISK SHALL BE PERFORMED IN CONSEQUENT PHASE.

CHANGE NO.	REV	REASON FOR ISSUE	DATE	PREPARED BY	DISCIPLINE CHECK	TECHNICAL INTEGRITY	PROJECT APPROVAL
	B	RE-ISSUED FOR FEED	15-07-22	PKH	TUP	AST	
	A	ISSUED FOR FEED	08-07-22	PKH	TUP	AST	
DOCUMENT CONFIDENTIALITY CLASSIFICATION		MATERIAL	TREATMENT	COATING			
CONFIDENTIAL-NOT TO DISCLOSE WITHOUT AUTHORISATION.		N/A	N/A	N/A			
TECHNIP ENERGIES DOCUMENT No.		TITLE		WEIGHT			
		REFERENCE DOCUMENTS		N/A			

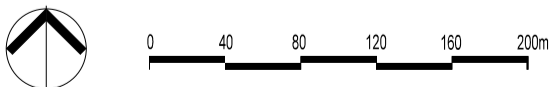
RENEWABLE DIESEL BIOREFINERY PROJECT

GENERAL OVERALL PLOT PLAN-NEW

SCALE	DRAWING SIZE	DRAWING NUMBER	SHEET No.	REV.
1:1000	A1	203869C-045-DW-0051-0001	1 OF 1	B



RENEWABLE DIESEL BIOREFINERY PROJECT - SITE PLAN
LOT 31 WANERIE ROAD, NARROGIN



NOTE:
 Base Data supplied by Landgate.

Areas and dimensions shown are subject to final survey calculations.

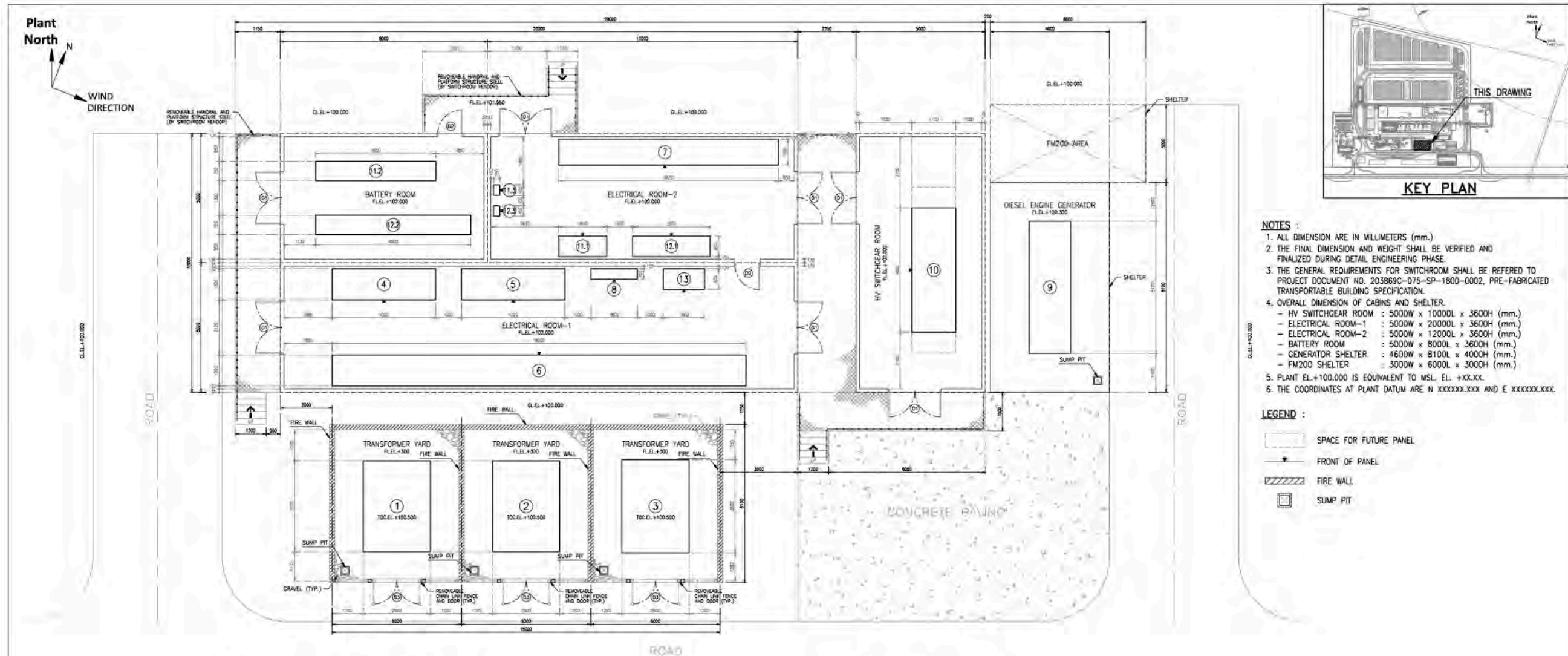
Revision	Date	Item
A	27/9/22	Initial issue

LEGEND

--- SUBJECT LOT BOUNDARY

- : CLIENT
 A3@1:4,000 : SCALE
 27 SEPTEMBER 2022 : DATE
 1000-SP-001 : PLAN No
 A : REVISION
 N.G. : PLANNER
 B.L. : DRAWN

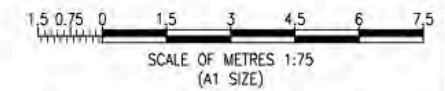
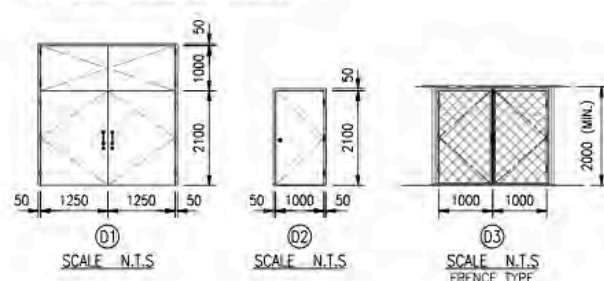




ELECTRICAL EQUIPMENT LIST

ELECTRICAL EQUIPMENT LIST						
NO.	TAG NO.	DESCRIPTION	DIMENSION (mm)		WEIGHT (kg)	REMARK
			WIDTH	DEPTH	HEIGHT	
1	TR-01	22/0.415kV ISBL TRANSFORMER-01, 2500kVA	2600	3500	2200	7400 OIL = 1600 LITERS
2	TR-02	22/0.415kV ISBL TRANSFORMER-02, 2500kVA	2600	3500	2200	7400 OIL = 1600 LITERS
3	TR-03	22/0.415kV OSBL TRANSFORMER, 3000kVA	2600	3600	2300	8500 OIL = 1750 LITERS
4	LV SWGR-01	400V ISBL SWITCHGEAR-01	4000	1200	2200	3800
5	LV SWGR-02	400V ISBL SWITCHGEAR-02	4000	1200	2200	3800
8	LV SWGR-03	400V OSBL SWITCHGEAR	18000	1200	2200	7600
7	EMCC-01	400V EMERGENCY MCC	8500	1000	2200	4000
8	MDB-01	400V MAIN DISTRIBUTION BOARD	1800	400	2100	700
9	DEG-01	400V DIESEL ENGINE GENERATOR, 256kW/320kVA	5100	1600	2500	5000
10	HV SWGR-01	22kV SWITCHGEAR	4800	1700	2900	6200
11.1	DCUPS-01	110VDC UPS C/W DISTRIBUTION BOARD	1850	800	2000	750
11.2	BATT-01	BATTERY BANK FOR 110VDC UPS	4650	750	1600	3900
11.3	MCCB-01	BATTERY MCCB BOX FOR 110VDC UPS	400	250	600	200
12.1	ACUPS-01	230VAC UPS C/W DISTRIBUTION BOARD	3000	800	2000	1700
12.2	BATT-02	BATTERY BANK FOR 230VAC UPS	6000	750	1600	8200
12.3	MCCB-02	BATTERY MCCB BOX FOR 230VAC UPS	400	250	600	200
13	IRP-01	INTERPOSING RELAY PANEL	1600	800	2200	200

TYPICAL SIZE OF DOOR



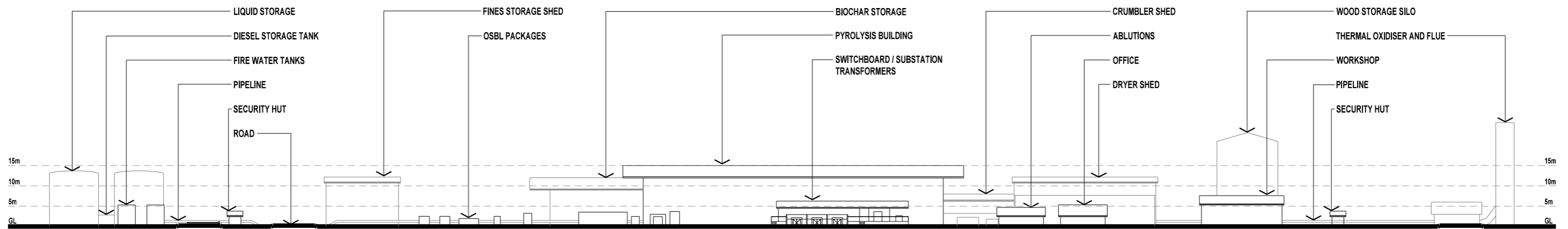
ISSUED FOR FEED	20-07-22	SSS	ASS	AST
CHANGE NOTE NO.	REASON FOR ISSUE	DATE	PREPARED BY	DISCIPLINE
203869C-055-DW-1652-0001	ELECTRICAL OVERALL KEY SINGLE LINE DIAGRAM			
203869C-045-DW-0051-0001	GENERAL OVERALL PLOT PLAN			
TECHNIP ENERGIES DOCUMENT No.	TITLE	WEIGHT	PROJECT APPROVAL	
		N/A		

Note:

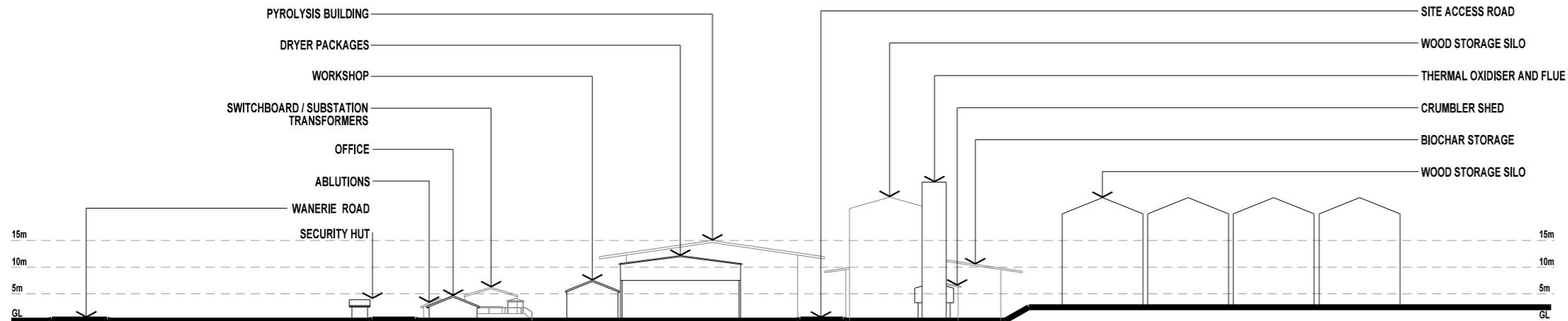
1. Substation - Electrical Switchgear Room Layout Drawing No 203869C-055-FDW-1652-00004A



Project Name:		Narrogen Renewable Diesel Biorefinery		
Title:		Electrical Switchgear Room - Outline		
Date Prepared:	Scale	Dwg Size:	Drawing No:	Sheet No:
27-Sept-2022	N/A	N/A	FEA-NAR-DWG-0012	3 of 3
Rev:	A			



SOUTHERN ELEVATION
SCALE 1:1,000@A3



EASTERN ELEVATION
SCALE 1:1,000@A3



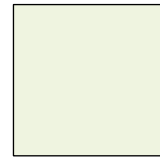
RENEWABLE DIESEL BIOREFINERY PROJECT - ELEVATIONS
LOT 31 WANERIE ROAD, NARROGIN

NOTE:
Areas and dimensions shown are subject to final survey calculations.

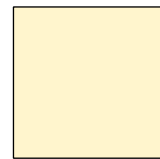
Revision	Date	Item
A	27/9/22	Initial Issue

- : CLIENT
A3@1:1,000 : SCALE
28 SEPTEMBER 2022 : DATE
1000-E-001 : PLAN No
A : REVISION
N.G. : PLANNER
B.L. : DRAWN





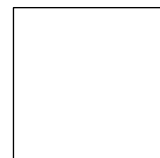
PALE GREEN - EXTERNAL WALLS



PALE YELLOW - INTERNAL WALLS



LIGHT GREY - ROOF



WHITE - NO EXTERNAL WALLS AND WALL OPENINGS

Note:



Project Name:

Narrogin Renewable Diesel Biorefinery

Title:

Outline Drawing Colour Legend

Date Prepared:

26-Sept-2022

Scale

N/A

Dwg Size:

A3

Drawing No:

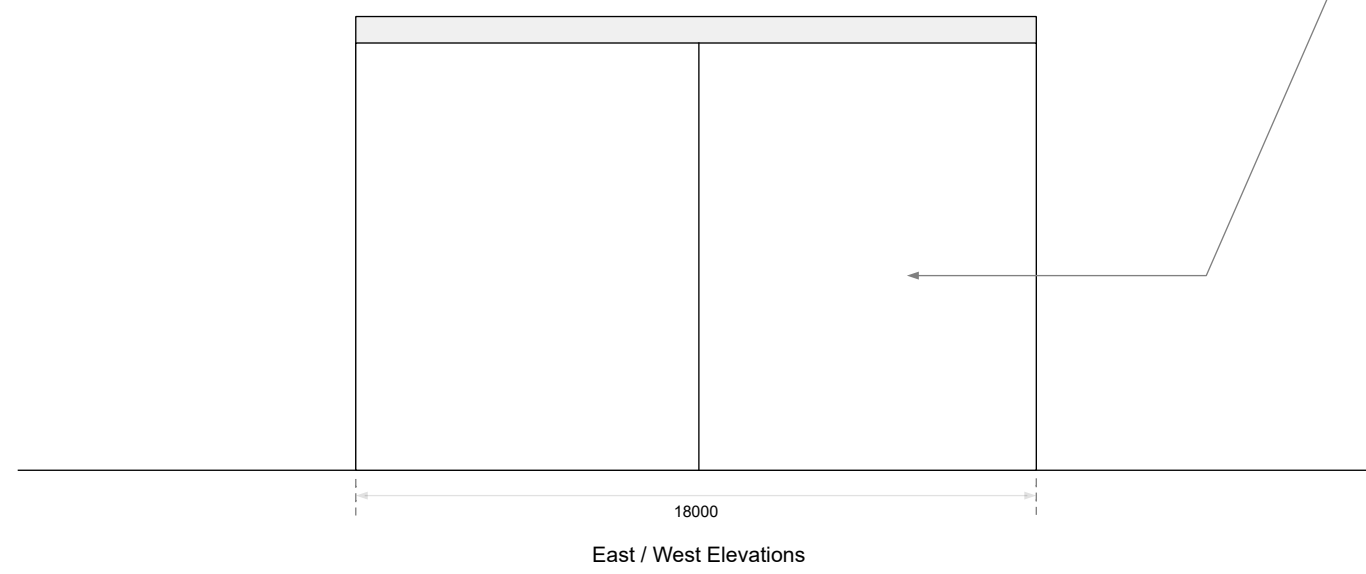
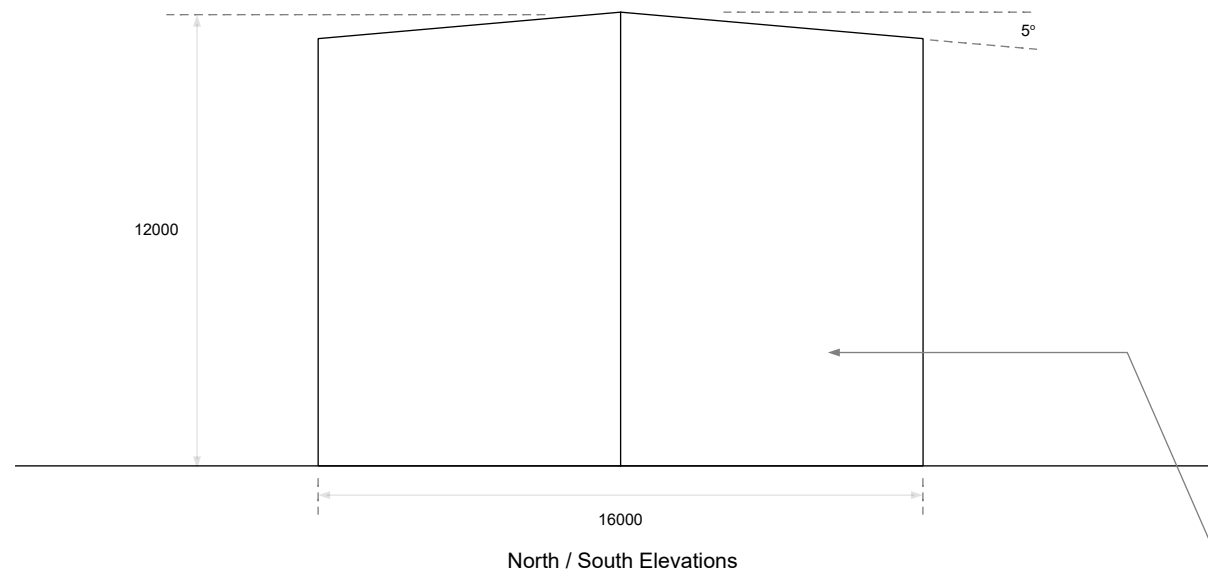
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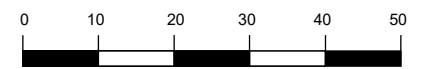
1 of 1

Rev:

A



See Note 1 - Open all 4 sides



SCALE 1:200

ALL DIMENSIONS IN MILLIMETRES

Note:

1. No enclosed sides
2. No insulation
3. Structural design to be determined during detailed design
4. Roof pitch angle to be determined during detailed design
5. Natural ventilation

6. Material specifications to be determined during detailed design
7. Exterior roof finish colour to conform with local planning requirements



Project Name:

Narrogin Renewable Diesel Biorefinery

Title:

Fines Storage Shed - Outline

Date Prepared:
22-Sept-2022

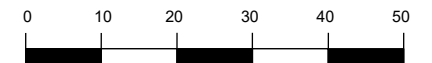
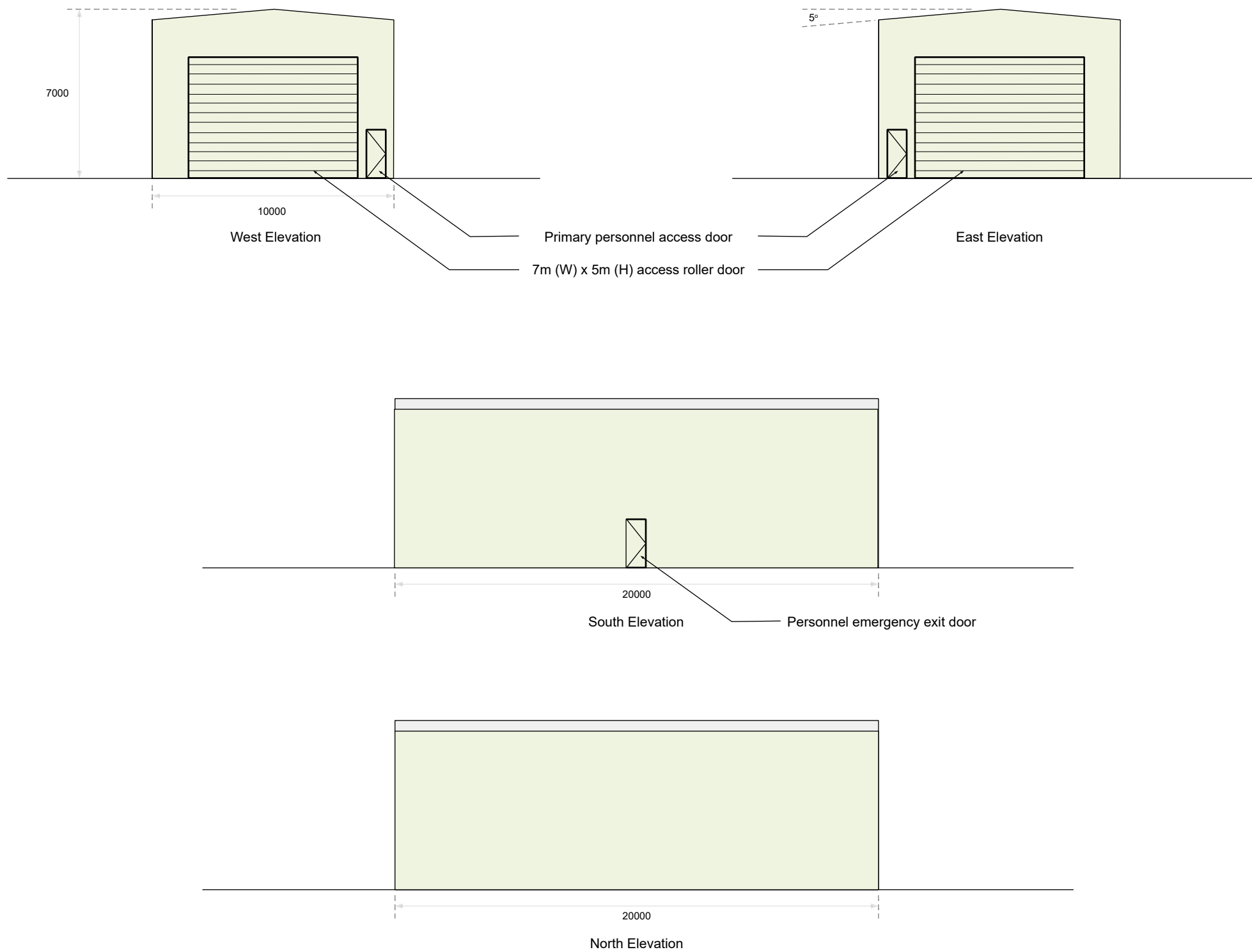
Scale
1:200

Dwg Size:
A3

Drawing No:
FEA-NAR-DWG-0001

Sheet No:
2 of 2

Rev:
A



SCALE 1:200

ALL DIMENSIONS IN MILLIMETRES

Note:

1. Fully enclosed sides
2. Thermal insulation - details to be determined during detailed design
3. Structural design to be determined during detailed design
4. Roof pitch angle to be determined during detailed design
5. Natural ventilation

6. Material details to be determined during detailed design
7. Exterior finish colour to conform with local planning requirements
8. All door details and locations to be finalised during detailed design



Project Name:

Narrogin Renewable Diesel Biorefinery

Title:

Workshop Shed - Outline

Date Prepared:
19-Sept-2022

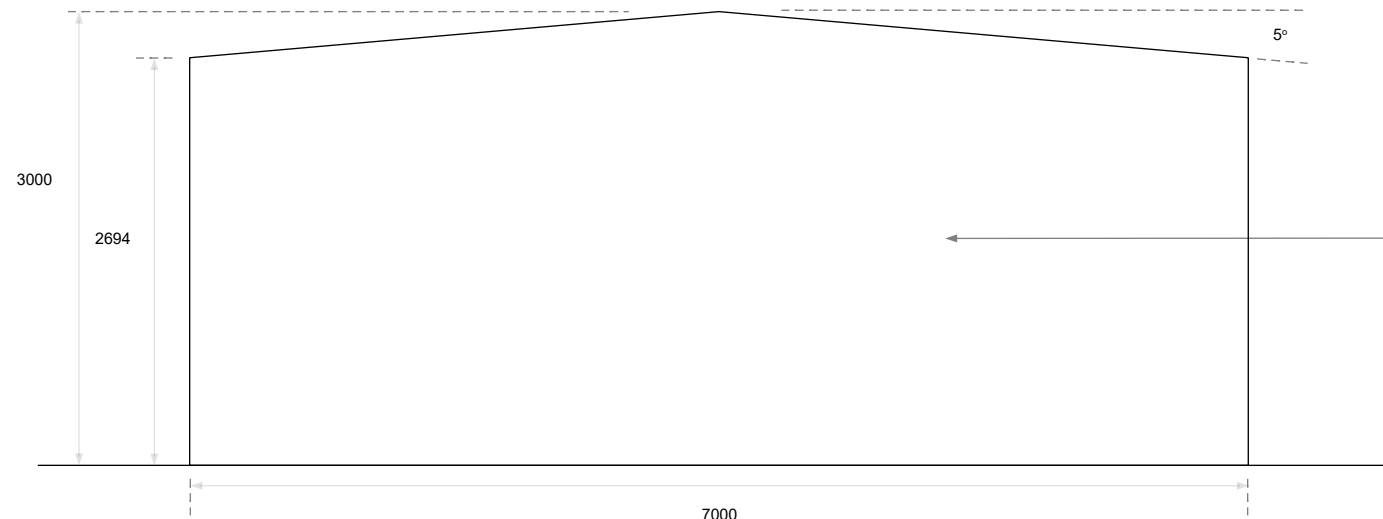
Scale
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Dwg Size:
A3

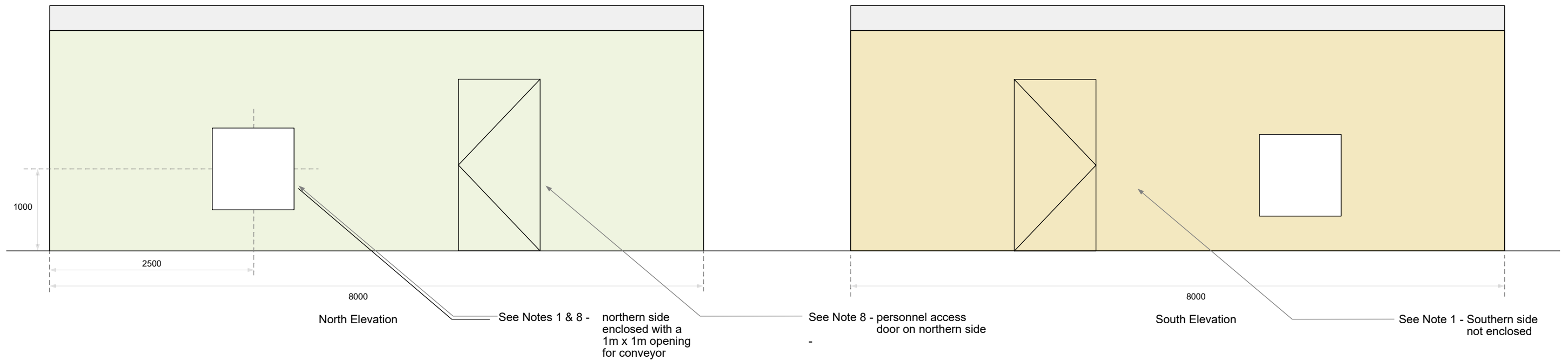
Drawing No:
FEA-NAR-DWG-0002

Sheet No:
2 of 2

Rev:
A




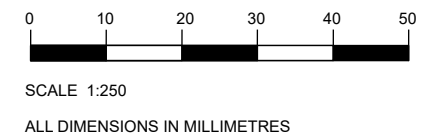
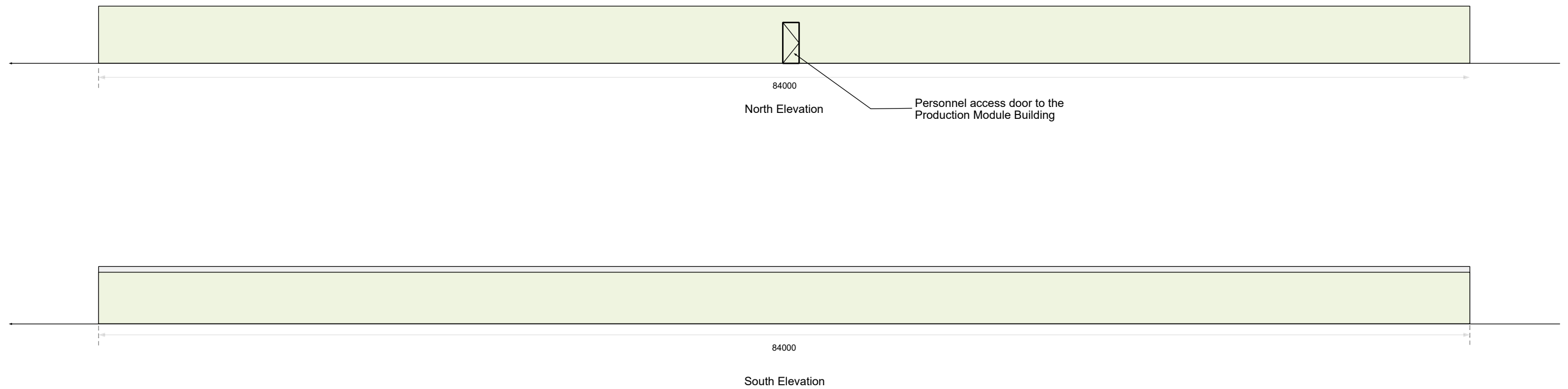
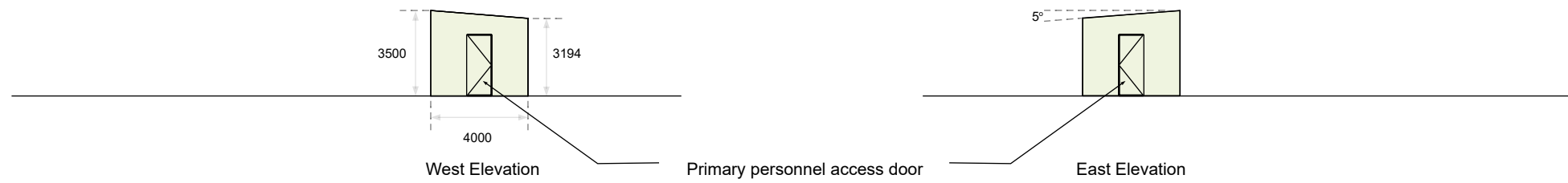
East / West Elevations



- Note:**
1. North side enclosed only
 2. Acoustic insulation - walls and roof
 3. Structural design to be determined during detailed design
 4. Roof pitch angle to be determined during detailed design
 5. Natural ventilation

6. Material specifications to be determined during detailed design
7. Exterior roof finish colour to conform with local planning requirements
8. Door location and conveyor opening, on the northern side to be determined during detailed design

		Project Name: Narrogin Renewable Diesel Biorefinery			
		Title: Pellet Screening Shed - Outline			
Date Prepared: 26-Sept-2022	Scale: 1:50	Dwg Size: A3	Drawing No: FEA-NAR-DWG-0003	Sheet No: 2 of 2	Rev: A



Note:

1. Fully enclosed sides
2. Thermal insulation - details to be determined during detailed design
3. Structural design to be determined during detailed design
4. Roof pitch angle to be determined during detailed design
5. HVAC system to provide cooling to dissipate approx. 149kW heat

6. Material details to be determined during detailed design
7. Exterior finish colour to conform with local planning requirements
8. The northern wall of the ISBL Electrical Room will abut to the southern wall of the Production Module Building
9. The location of the door connecting the ISBL Electrical Room to the Production Module Building to be finalised during detailed design



Project Name:

Narrogin Renewable Diesel Biorefinery

Title:

ISBL Electrical Room - Outline

Date Prepared:
19-Sept-2022

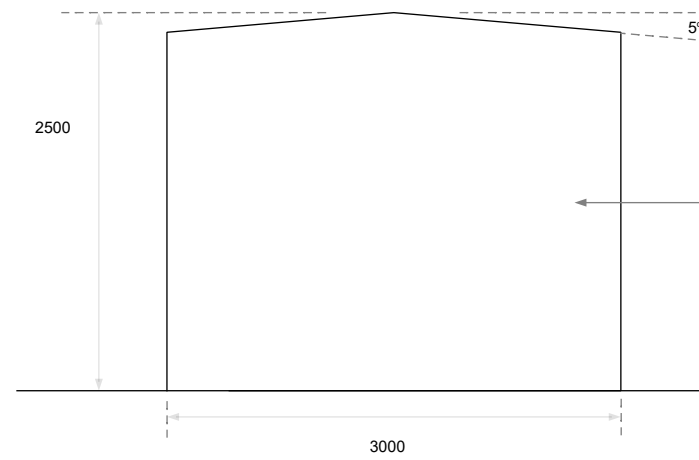
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1:250

Dwg Size:
A3

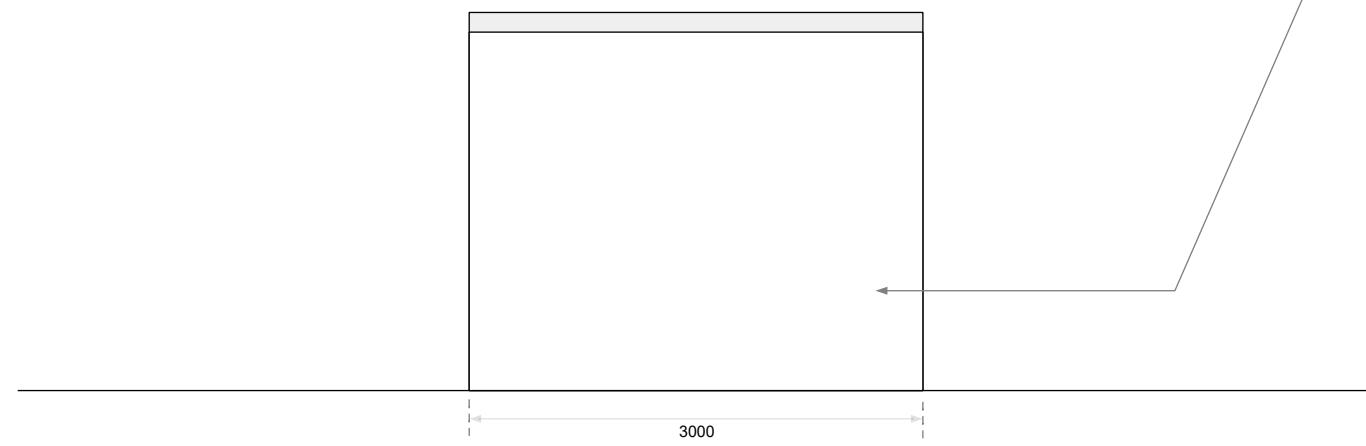
Drawing No:
FEA-NAR-DWG-0004

Sheet No:
2 of 2

Rev:
A



East / West Elevations



North / South Elevations

See Note 1 - Open all 4 sides



SCALE 1:50

ALL DIMENSIONS IN MILLIMETRES

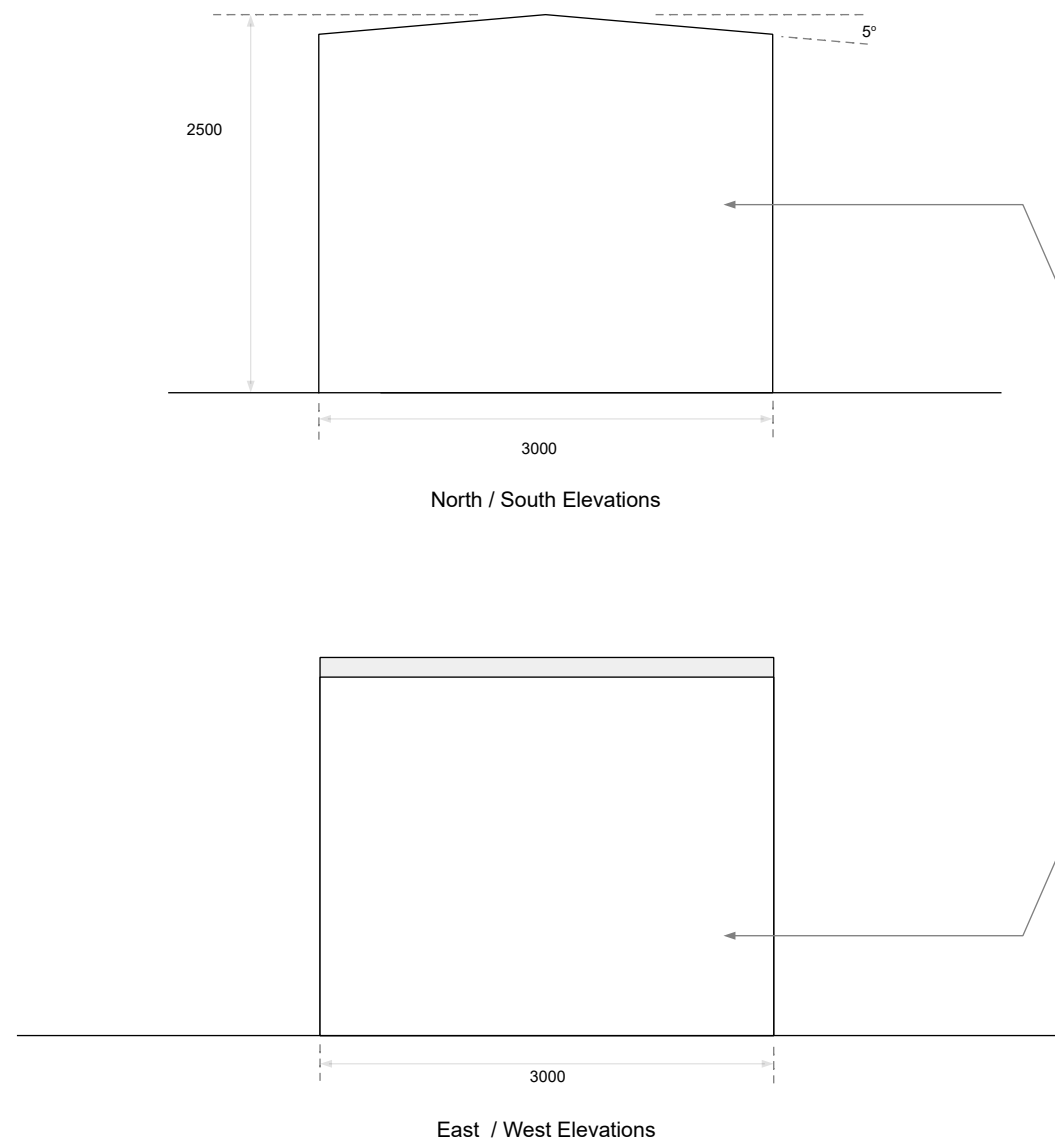
Note:

1. Not enclosed - open on all 4 sides
2. No insulation
3. Structural design to be determined during detailed design
4. Roof pitch angle to be determined during detailed design
5. Natural ventilation

6. Material specifications to be determined during detailed design
7. Exterior roof finish colour to conform with local planning requirements



Project Name:					Narrogin Renewable Diesel Biorefinery				
Title:					Wood Chip Magnetic Separator Shed - Outline				
Date Prepared:	Scale	Dwg Size:	Drawing No:	Sheet No:	Rev:				
22-Sept-2022	1:50	A3	FEA-NAR-DWG-0005	2 of 2	A				



SCALE 1:50
ALL DIMENSIONS IN MILLIMETRES

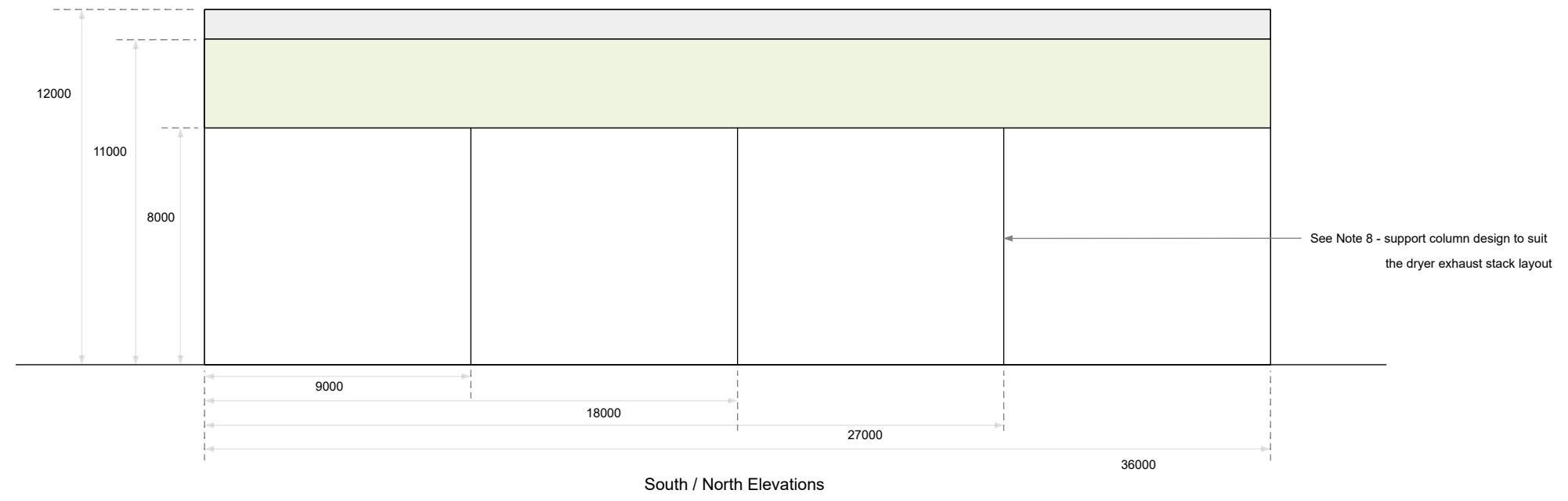
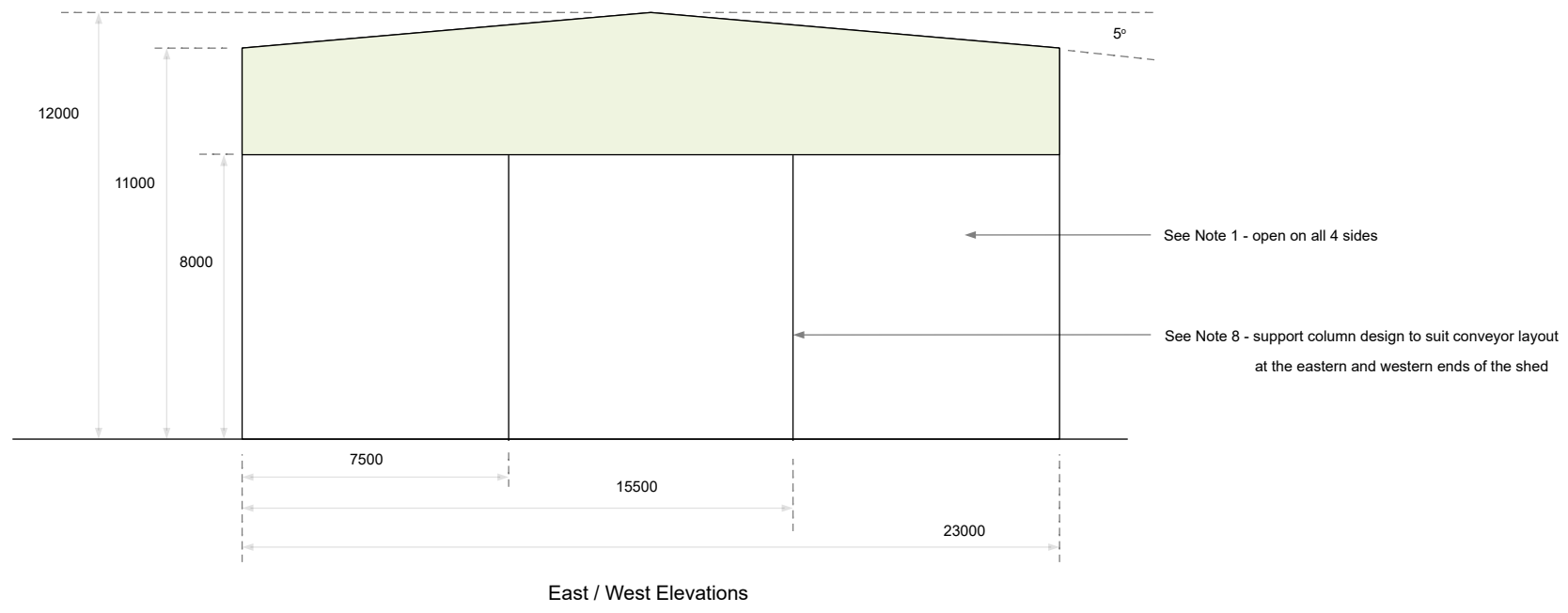
- Note:**
1. Not enclosed - open on all 4 sides
 2. No insulation
 3. Structural design to be determined during detailed design
 4. Roof pitch angle to be determined during detailed design
 5. Natural ventilation

6. Material specifications to be determined during detailed design
7. Exterior roof finish colour to conform with local planning requirements



Date Prepared:
22-Sept-2022

Project Name: Narrogin Renewable Diesel Biorefinery				
Title: Pellet Magnetic Separator Shed - Outline				
Scale 1:50	Dwg Size: A3	Drawing No: FEA-NAR-DWG-0006	Sheet No: 2 of 2	Rev: A



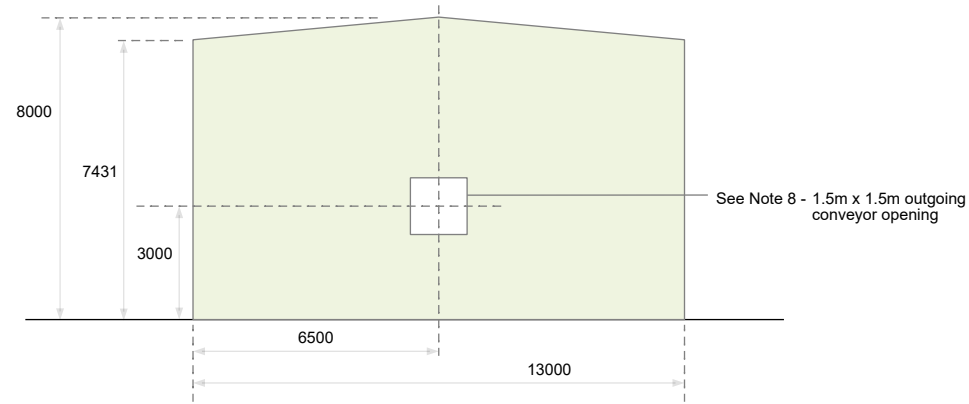
SCALE 1:200
ALL DIMENSIONS IN MILLIMETRES

- Note:**
1. Not fully enclosed - open on all 4 sides, with a partial height wall from the roof to 3m below the roof around the outside of the building
 2. No insulation
 3. Structural design to be determined during detailed design
 4. Roof pitch angle to be determined during detailed design

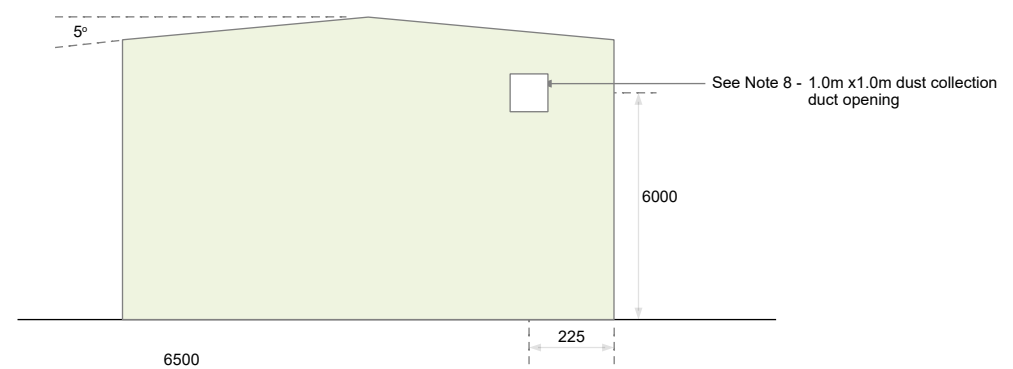
5. Natural ventilation
6. Material specification to be determined during detailed design
7. Exterior roof finish colour to conform with local planning requirements
8. Additional conveyor access, dryer operational and maintenance access requirements to be incorporated during details design

Date Prepared: 22-Sept-2022

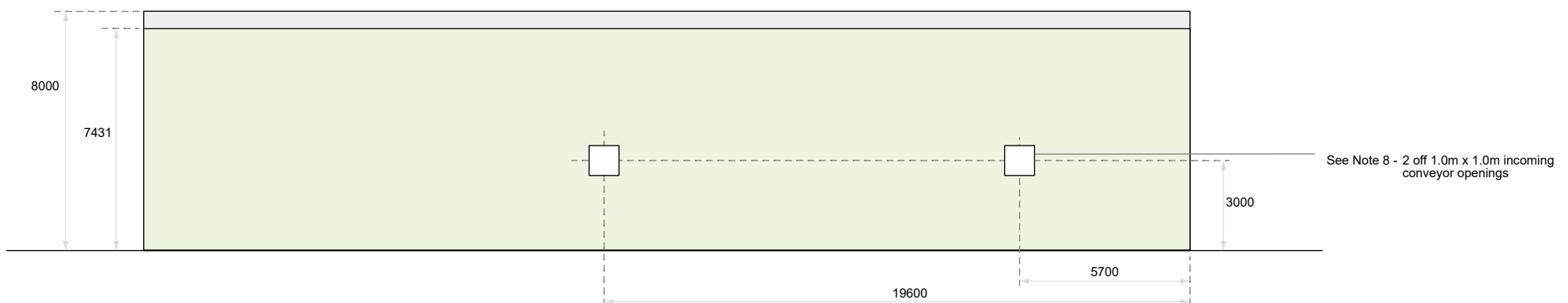
Project Name: Narrogin Renewable Diesel Biorefinery				
Title: Dryer Shed - Outline				
Scale: 1:200	Dwg Size: A3	Drawing No: FEA-NAR-DWG-0007	Sheet No: 2 of 2	Rev: A



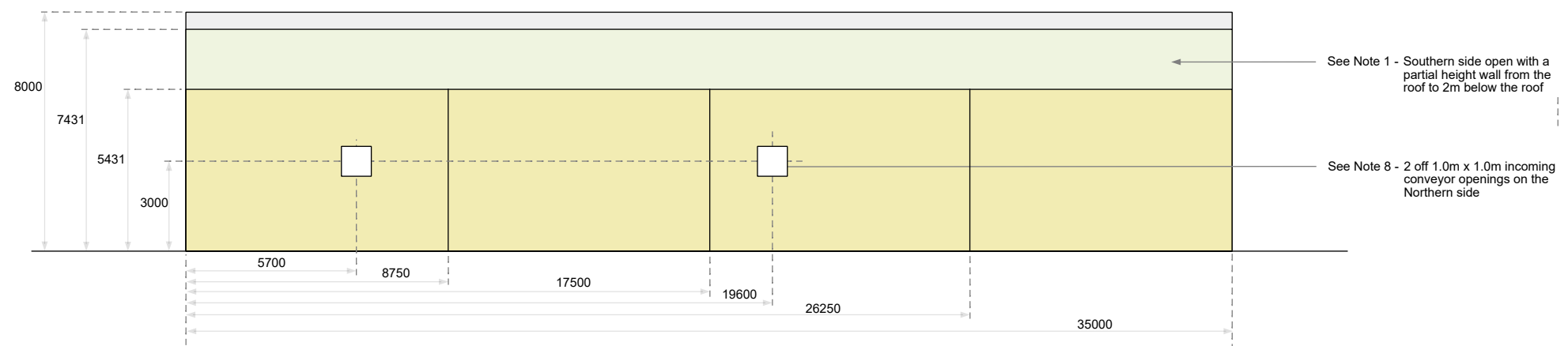
East Elevation



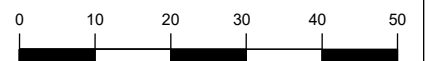
West Elevation



North Elevation



South Elevation



SCALE 1:200
ALL DIMENSIONS IN MILLIMETRES

Note:

1. Northern, eastern and western sides fully enclosed. Southern side open with a partial height wall from the roof to 2m below the roof
2. Acoustic insulation on walls and roof
3. Structural design to be determined during detailed design
4. Roof pitch angle to be determined during detailed design

5. Natural ventilation
6. Material specification to be determined during detailed design
7. Exterior roof finish colour to conform with local planning requirements
8. Conveyor access, dust collection duct access, operational and maintenance access requirements to be finalised in detailed design



Project Name:

Narrogin Renewable Diesel Biorefinery

Title:

Crumbler Shed - Outline

Date Prepared:
22-Sept-2022

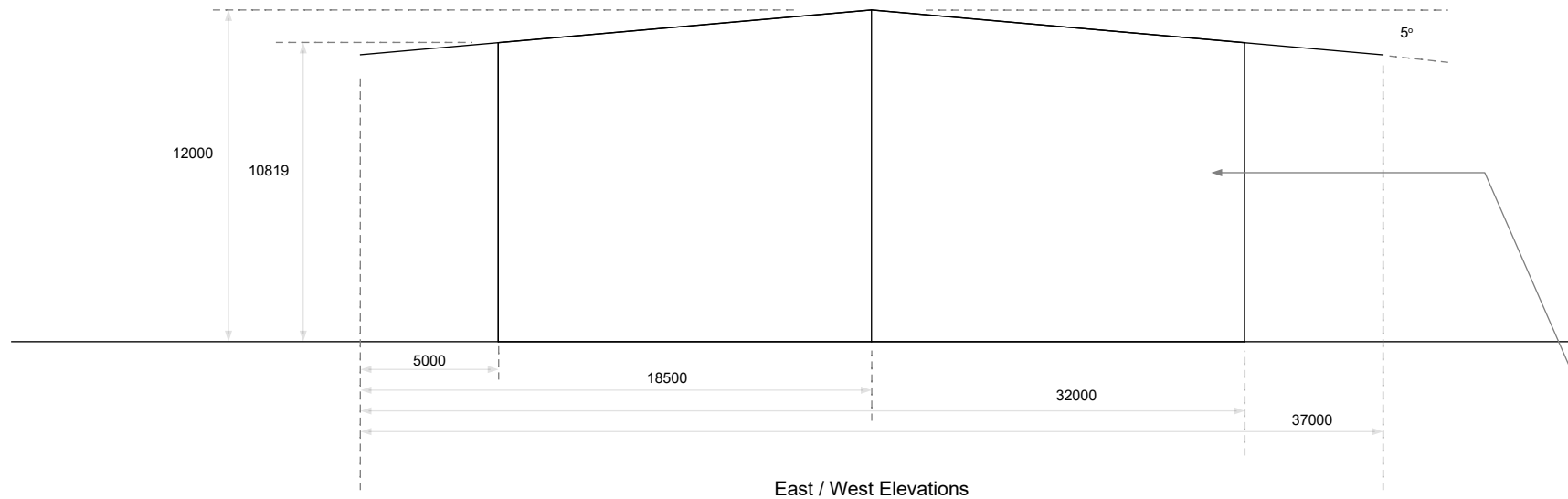
Scale
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Dwg Size:
A3

Drawing No:
FEA-NAR-DWG-0008

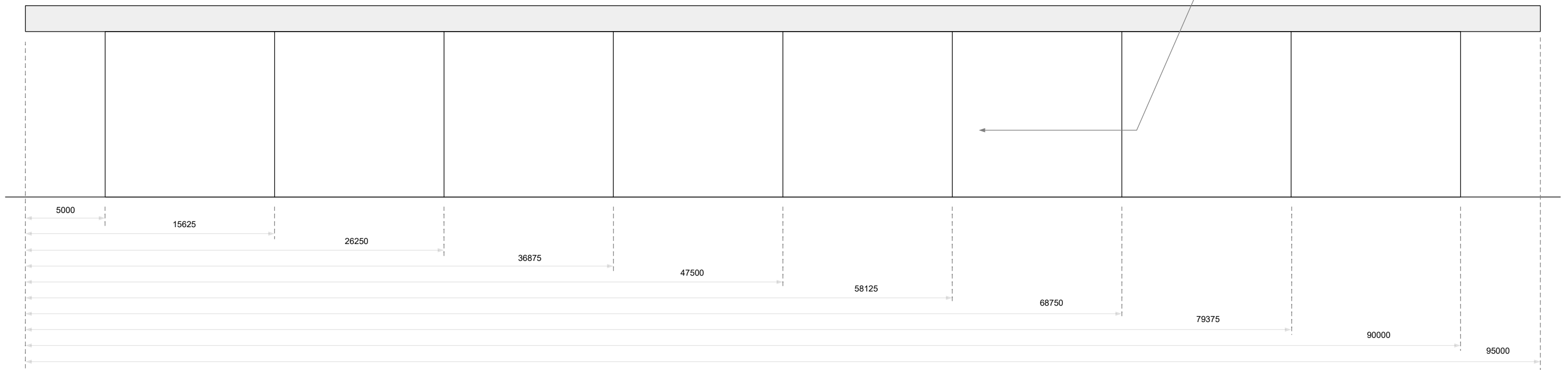
Sheet No:
2 of 2

Rev:
A

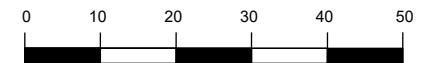


East / West Elevations

See Note 1 - Open all 4 sides



South / North Elevations



SCALE 1:250

ALL DIMENSIONS IN MILLIMETRES

Note:

1. Not enclosed - fully open on all four sides
2. No insulation
3. Structural design to be determined during detailed design
4. Roof pitch angle to be determined during detailed design

5. 5m roof overhang around outside of the shed
6. Natural ventilation
7. Material specification to be determined during detailed design
8. Exterior roof finish colour to conform with local planning requirements



Project Name:

Narrogin Renewable Diesel Biorefinery

Title:

Biochar Storage Shed - Outline

Date Prepared:
21-Sept-2022

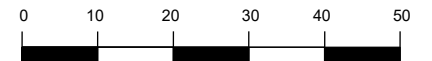
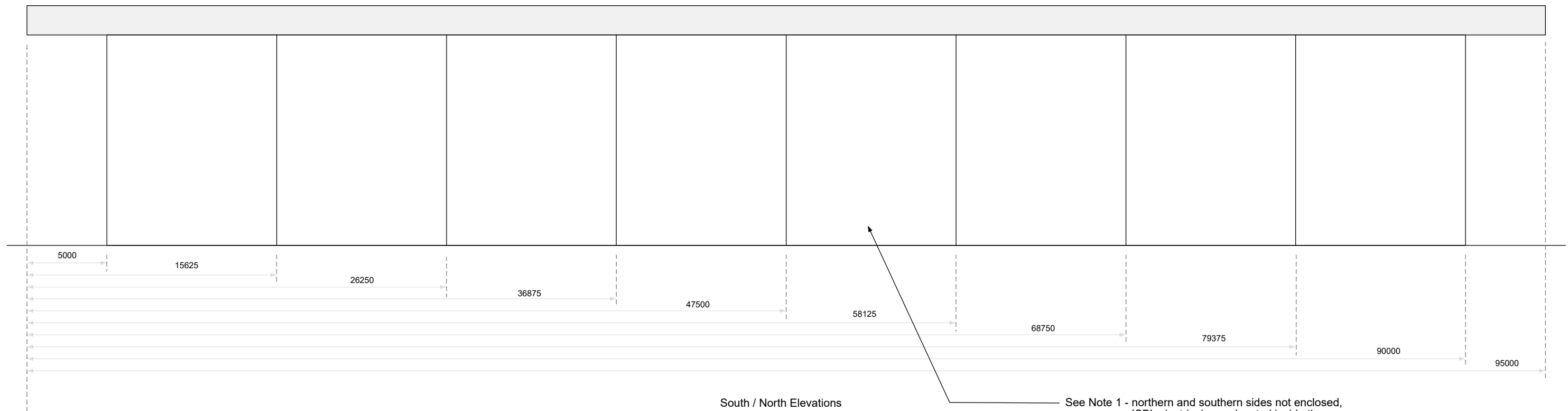
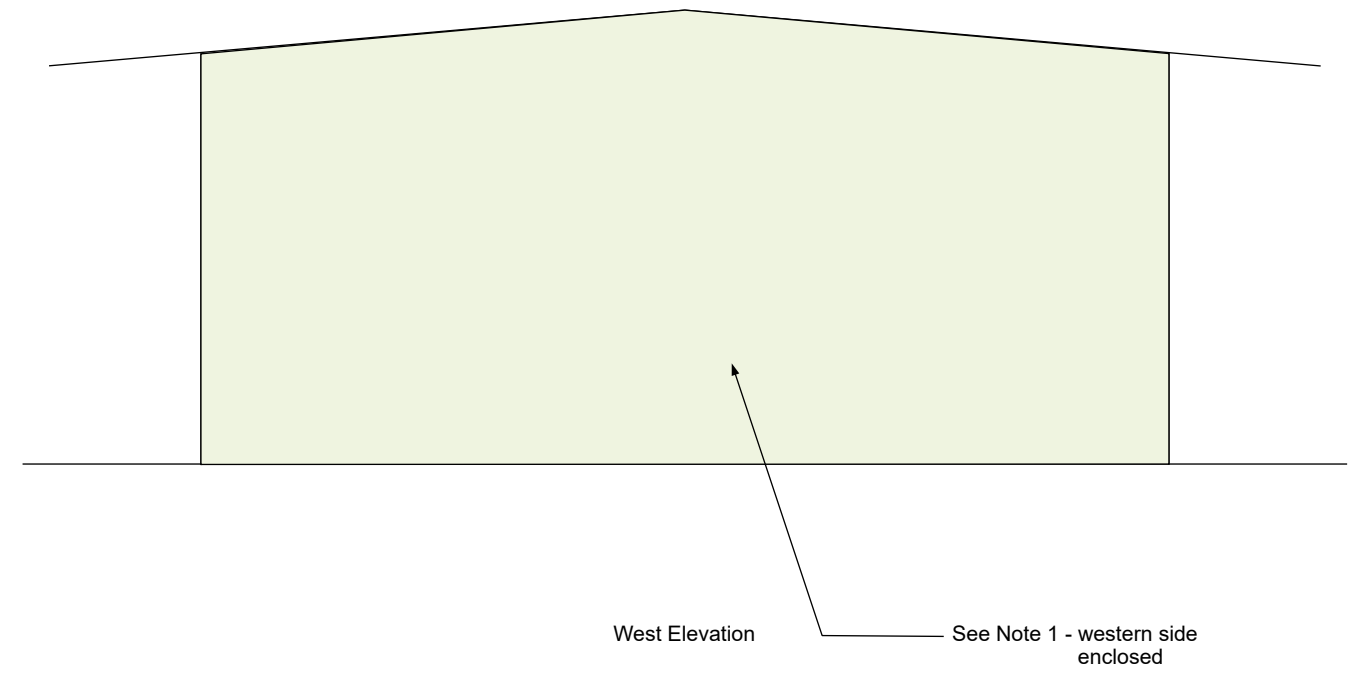
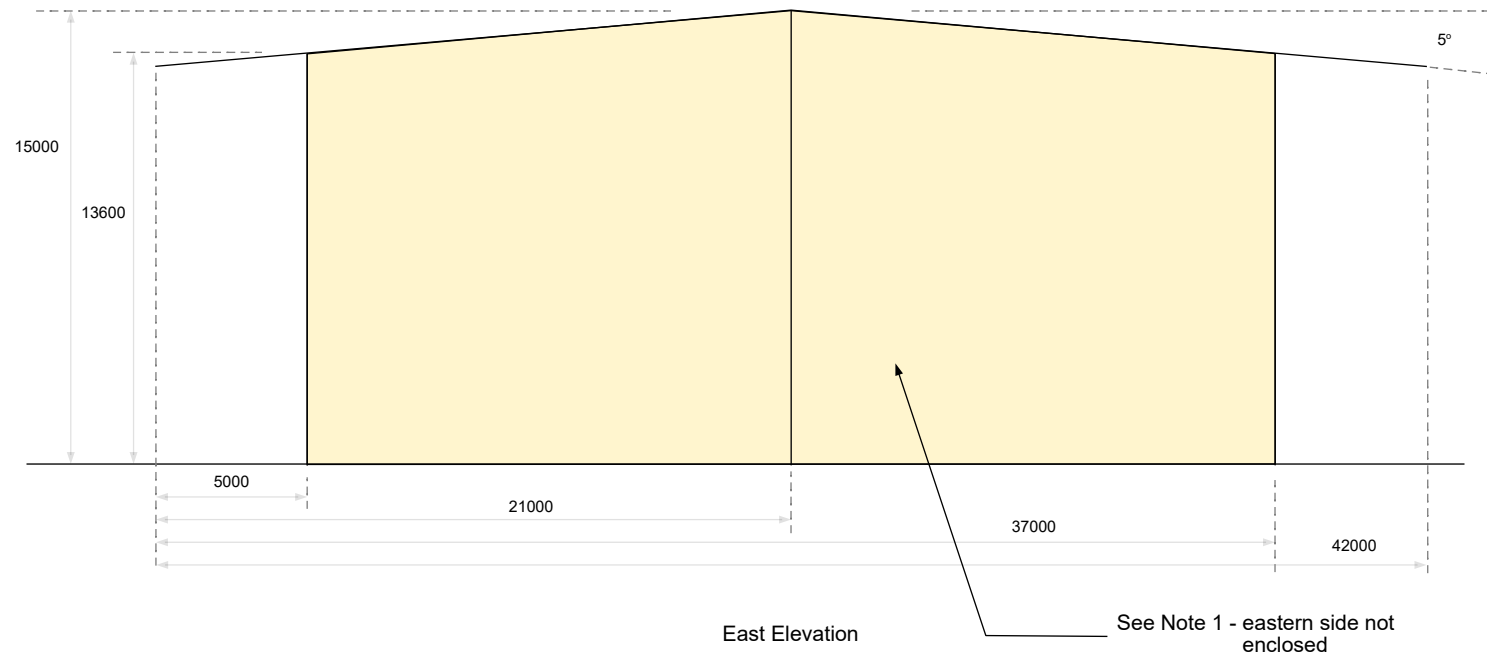
Scale
1:250

Dwg Size:
A3

Drawing No:
FEA-NAR-DWG-0009

Sheet No:
2 of 2

Rev:
A



SCALE 1:250

ALL DIMENSIONS IN MILLIMETRES

Note:

1. Western side enclosed, southern side "walled ISBL electrical room", open on the northern and eastern sides
2. Thermal insulation under the roof
3. Structural design to be determined during detailed design
4. Roof pitch angle to be determined during detailed design

5. Additional maintenance and operational requirements to be considered during detailed design
6. 5m roof overhang around outside of the shed
7. Natural ventilation
8. Material specification to be determined during detailed design
9. Exterior roof finish colour to conform with local planning requirements



Project Name:

Narrogin Renewable Diesel Biorefinery

Title:

Production Module Shed - Outline

Date Prepared:

24-Sept-2022

Scale

1:250

Dwg Size:

A3

Drawing No:

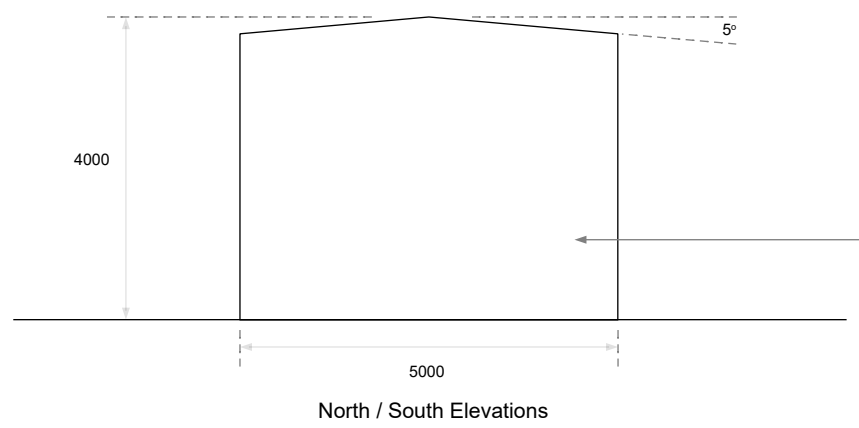
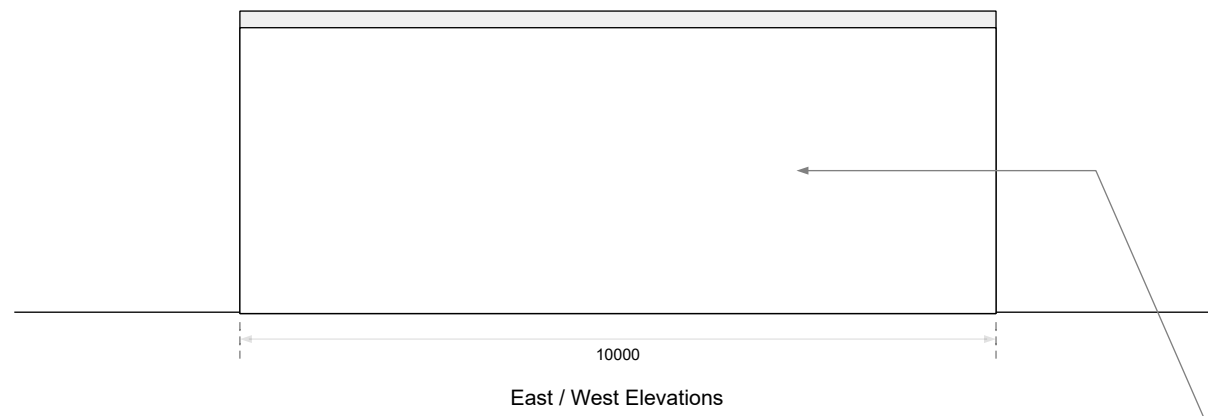
FEA-NAR-DWG-0010

Sheet No:

2 of 2

Rev:

A



See Note 1 - Open all 4 sides



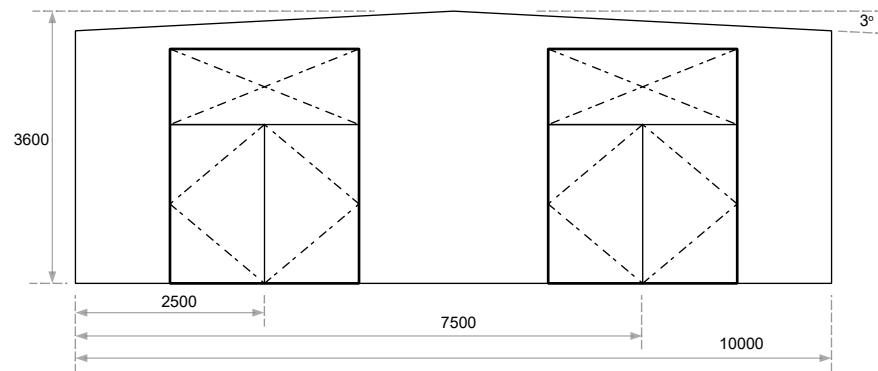
- Note:**
1. Not enclosed - open on all 4 sides
 2. No insulation
 3. Structural design to be determined during detailed design
 4. Roof pitch angle to be determined during detailed design
 5. Natural ventilation

6. Material details to be determined during detailed design
7. Exterior roof finish colour to conform with local planning requirements
8. A 3m x 8m section of roof (or whole roof) to be removable to facilitate diesel generator package removal

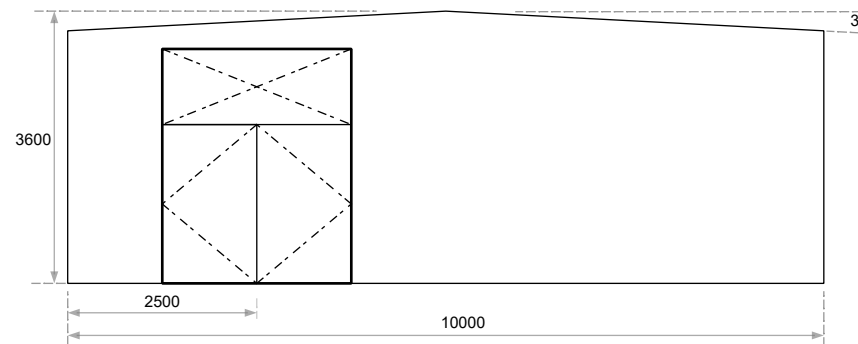


Date Prepared:
19-Sept-2022

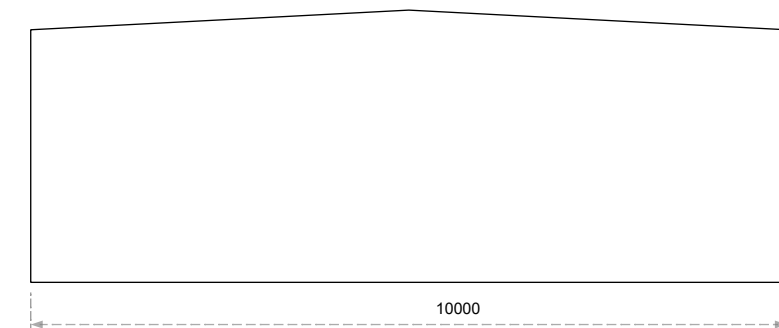
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Title: Diesel Generator Shed - Outline				
Scale: 1:100	Dwg Size: A3	Drawing No: FEA-NAR-DWG-0011	Sheet No: 2 of 2	Rev: A



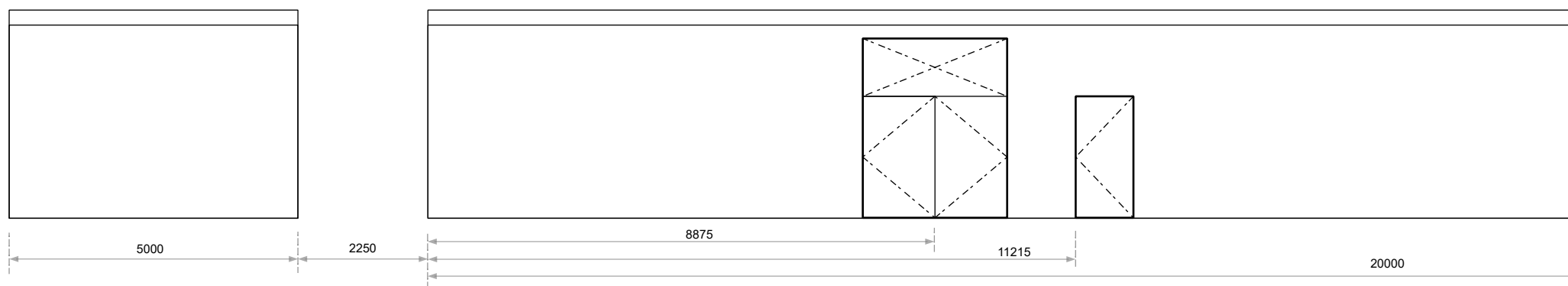
Switchgear Electrical Room - East / West Elevation



HV Switchgear Room - West Elevation



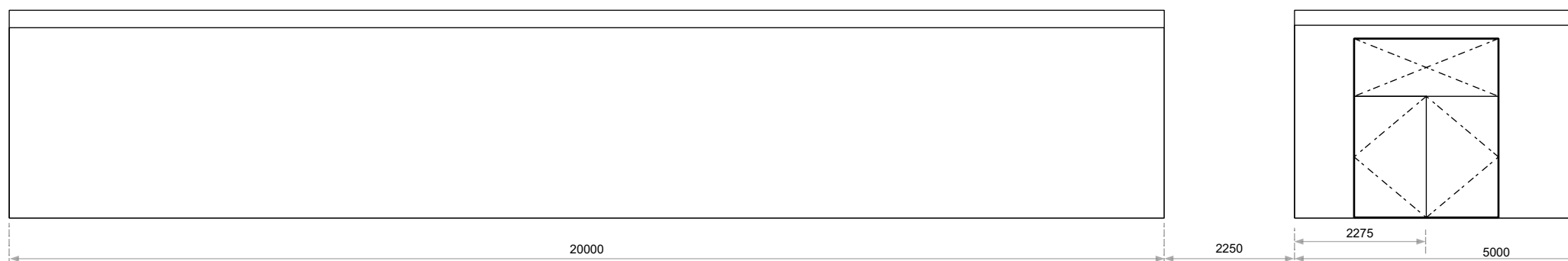
HV Switchgear Room - East Elevation



HV Switchgear Room

Switchgear Electrical Room

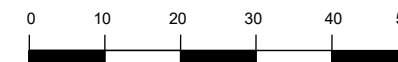
North Elevation



Switchgear Electrical Room

HV Switchgear Room

South Elevation



SCALE 1:100

ALL DIMENSIONS IN MILLIMETRES

Note:

1. Fully enclosed and insulated per Prefabricated Transportable Building Specification No. 203869C-075-SP-1800-0002 and Substation - Electrical Switchgear Room Layout Drawing No 203869C-055-FDW-1652-00004A
2. Structural design to be determined during detailed design

3. Roof pitch angle to be determined during detailed design
4. Door locations to be finalised during detailed design
5. Material details to be determined during detailed design
6. Exterior roof finish colour to conform with local planning requirements
7. Access stairs and platforms to be determined during detailed design



Project Name:

Narrogin Renewable Diesel Biorefinery

Title:

Electrical Switchgear Room - Outline

Date Prepared:

27-Sept-2022

Scale

1:100

Dwg Size:

A3

Drawing No:

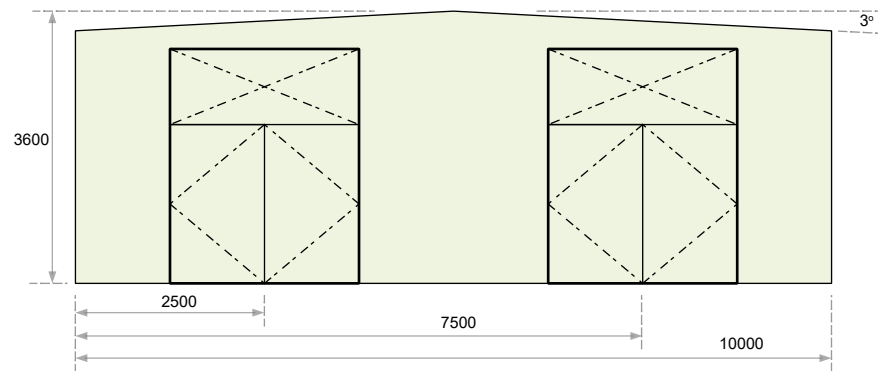
FEA-NAR-DWG-0012

Sheet No:

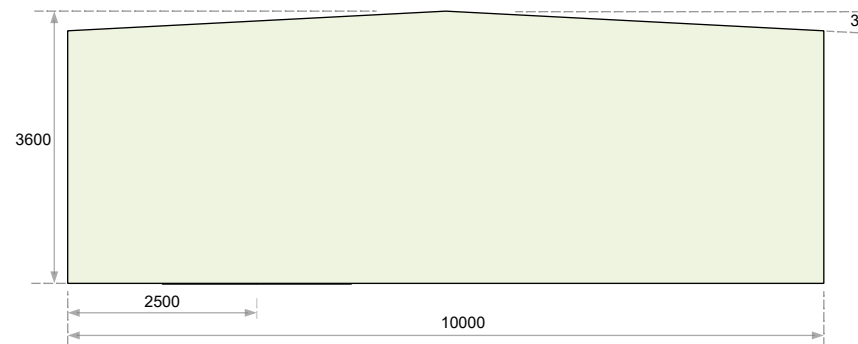
1 of 3

Rev:

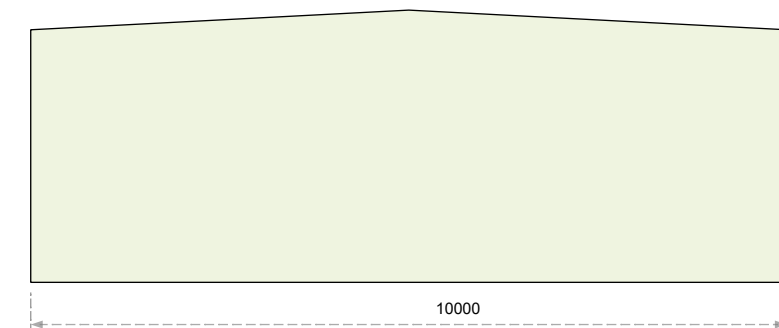
A



Switchgear Electrical Room - East / West Elevation



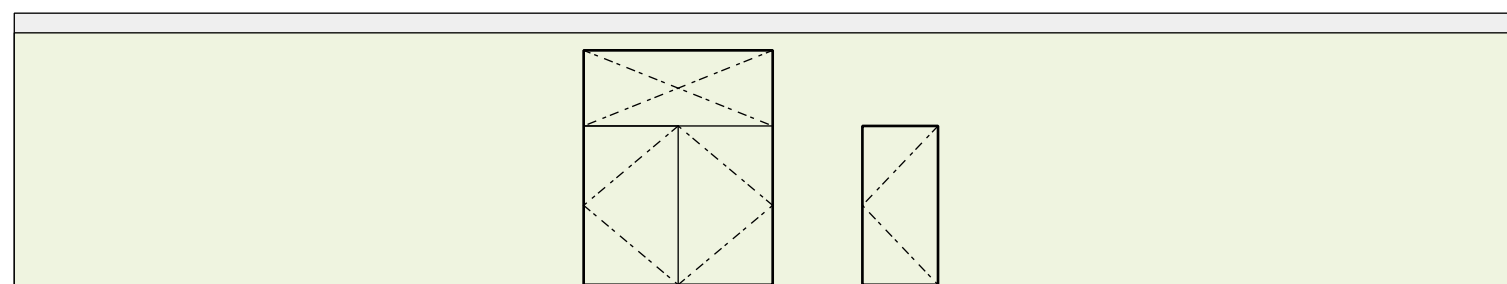
HV Switchgear Room - West Elevation



HV Switchgear Room - East Elevation

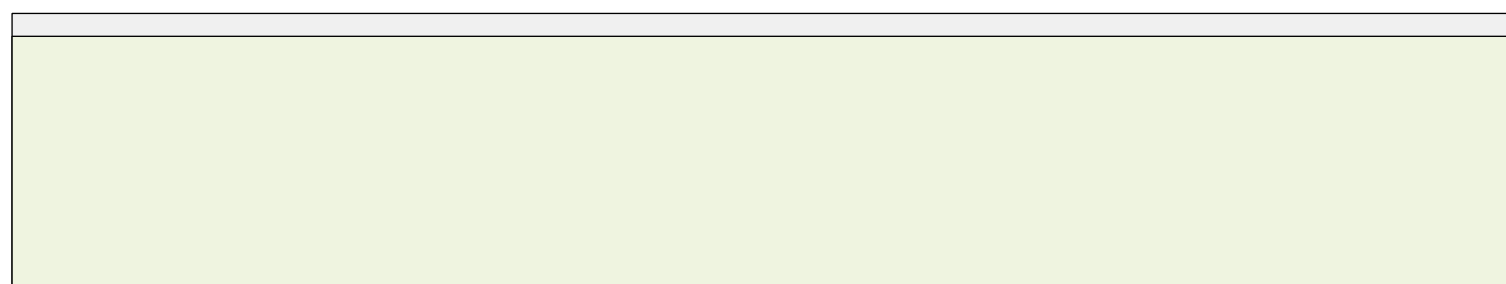


HV Switchgear Room



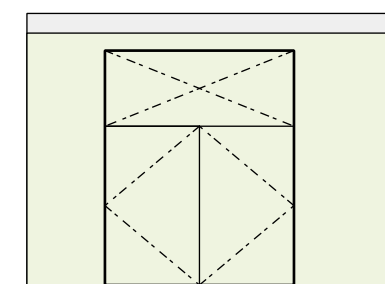
Switchgear Electrical Room

North Elevation

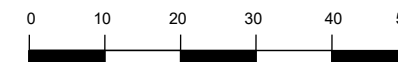


Switchgear Electrical Room

South Elevation



HV Switchgear Room



SCALE 1:100

ALL DIMENSIONS IN MILLIMETRES

Note:

1. Fully enclosed and insulated per Prefabricated Transportable Building Specification No. 203869C-075-SP-1800-0002 and Substation - Electrical Switchgear Room Layout Drawing No 203869C-055-FDW-1652-00004A
2. Structural design to be determined during detailed design

3. Roof pitch angle to be determined during detailed design
4. Door locations to be finalised during detailed design
5. Material details to be determined during detailed design
6. Exterior roof finish colour to conform with local planning requirements
7. Access stairs and platforms to be determined during detailed design



Project Name:

Narrogin Renewable Diesel Biorefinery

Title:

Electrical Switchgear Room - Outline

Date Prepared:
27-Sept-2022

Scale
1:100

Dwg Size:
A3

Drawing No:
FEA-NAR-DWG-0012

Sheet No:
2 of 3

Rev:
A



Appendix 4

Artists impression perspectives



LUMION

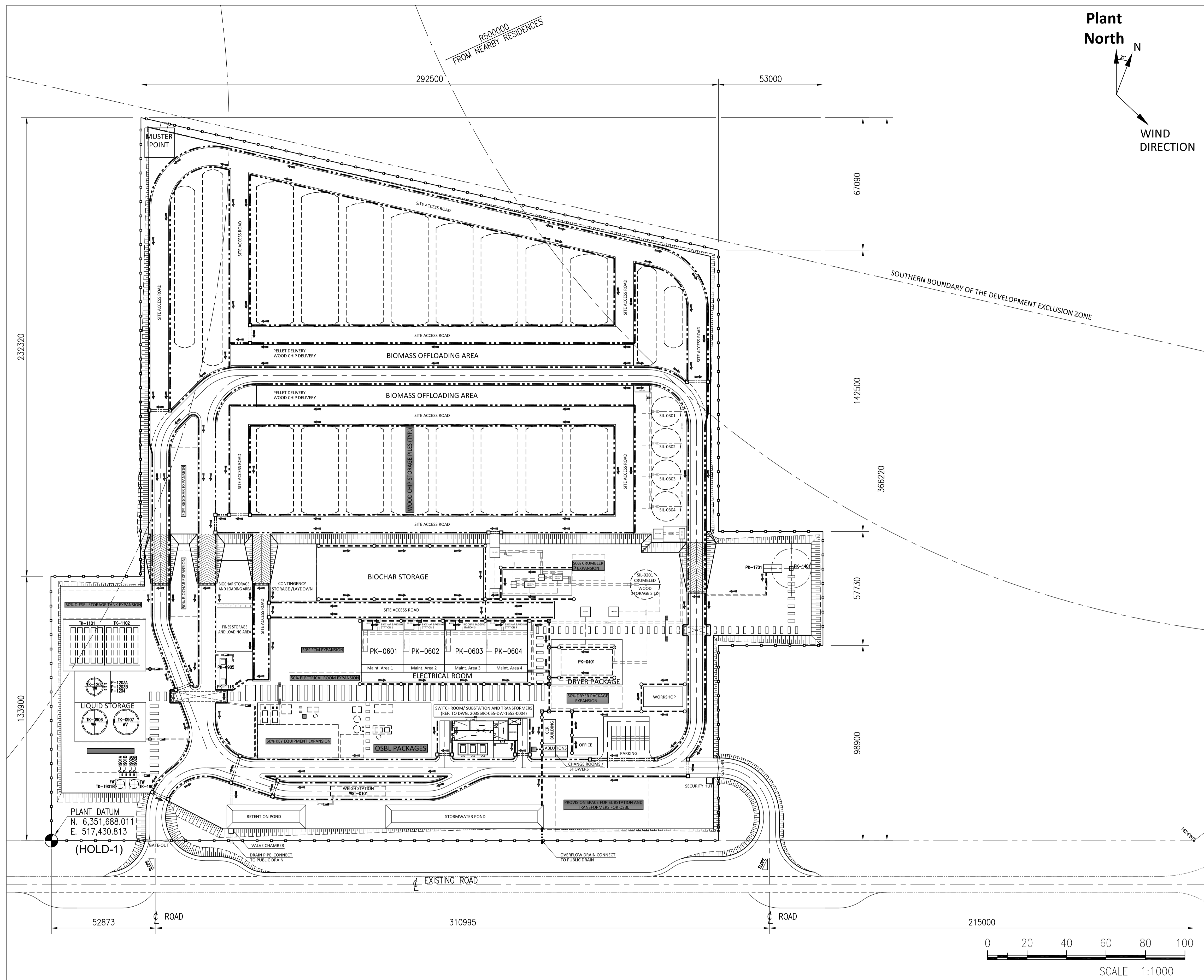






Appendix 5

Civil Plans



- LEGENDS:**
- STORMWATER CHANNEL
 - ==== RC. PIPE
 - - - - STORMWATER PIPE
 - - - - ACCIDENTAL OILY CONTAMINATED DRAIN PIPE
 - SANITARY SEWAGE PIPE
 - JUNCTION PIT
 - ⊠ MANHOLE
 - CATCH BASIN FOR DOWN PIPES
 - ▨ LOCAL SUMP
 - ▤ LOCAL OIL SEPARATOR
 - ↑ DRAIN DIRECTION
 - ▬ GRATED TRENCH
 - ⊙ VALVE BOX

HOLDS:

1. PLANT BOUNDARY, DATUM, COORDINATES & ELEVATION, WHICH SHALL BE VERIFIED AND CONFIRMED IN THE NEXT PHASE.

NOTES:

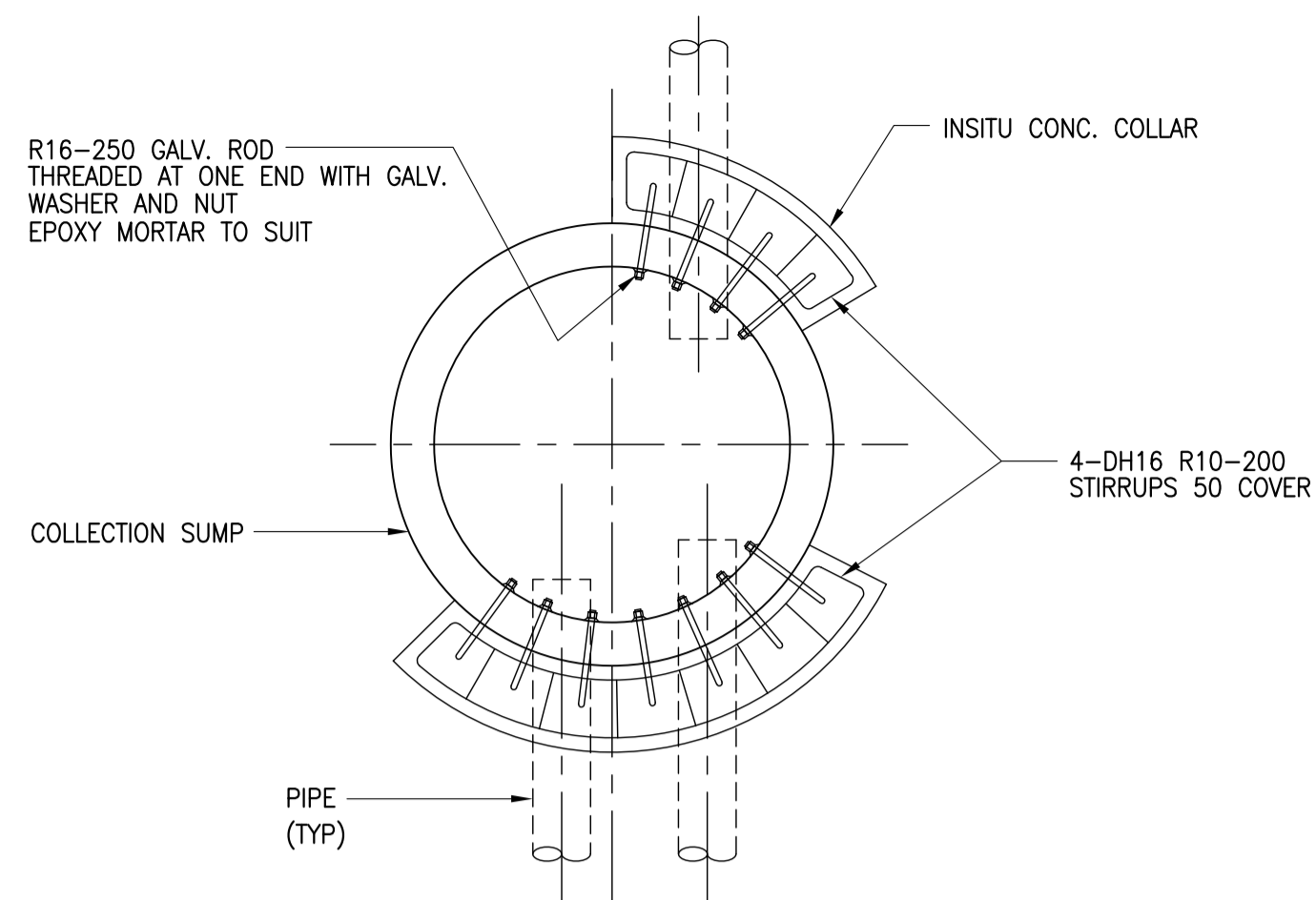
1. ALL DIMENSIONS ARE IN MILLIMETERS, ALL ELEVATIONS AND ALL COORDINATES ARE IN METERS UNLESS NOTED OT
2. PLANT. EL. +100.000 IS EQUIVALENT TO AHD. EL. +XX.XX. (HOLD-1)
3. THE COORDINATES AR PLANT DATUM ARE N XXXX.XXX AND E XXXX.XXX. (HOLD-1)
4. DRAINAGE ROUTES AND SYSTEM SHOWN ON THIS DRAWING ARE FOR INFORMATION ONLY. THE ACTUAL SIZING & ROUTING SHALL BE CONSIDERED/CALCULATED DURING THE DETAILED DESIGN STAGE.

DOCUMENT CONFIDENTIALITY CLASSIFICATION	MATERIAL	TREATMENT	COATING	WEIGHT
203869C-045-DW-0051-0001	N/A	N/A	N/A	N/A
TECHNIP ENERGIES DOCUMENT No.	GENERAL OVERALL PLOT PLAN-NEW		REFERENCE DOCUMENTS	
CHANGE NOTE No.	REV	REASON FOR ISSUE	DATE	PREPARED BY
-	A	ISSUED FOR FEED	04-08-22	CTJ
				NRK
				AST
<p>CONFIDENTIAL—NOT TO DISCLOSE WITHOUT AUTHORISATION.</p> <p>ALL DIMENSIONS ARE IN METRES U.N.O. DRAWN IN ACCORDANCE WITH AS 1100 U.N.O.</p> <p>THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION. ALL RIGHTS (INCLUDING COPYRIGHT, CONFIDENTIAL INFORMATION, TRADE SECRETS AND DESIGN RIGHTS) ARE OWNED BY T.EN AUSTRALIA AND NEW ZEALAND PTY LTD. NO USE OR DISCLOSURE IS TO BE MADE WITHOUT THE WRITTEN PERMISSION. COPYRIGHT T.EN AUSTRALIA AND NEW ZEALAND PTY LTD. ALL RIGHTS RESERVED.</p>				

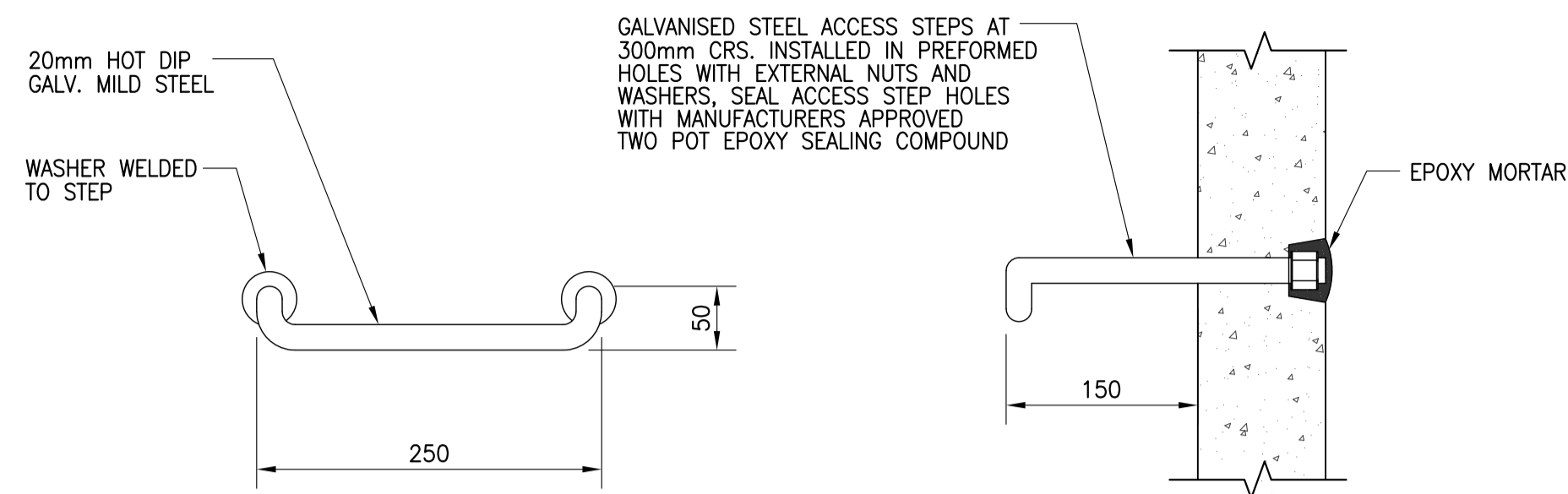
TECHNIP ENERGIES

RENEWABLE DIESEL BIOREFINERY PROJECT
DRAINAGE LAYOUT

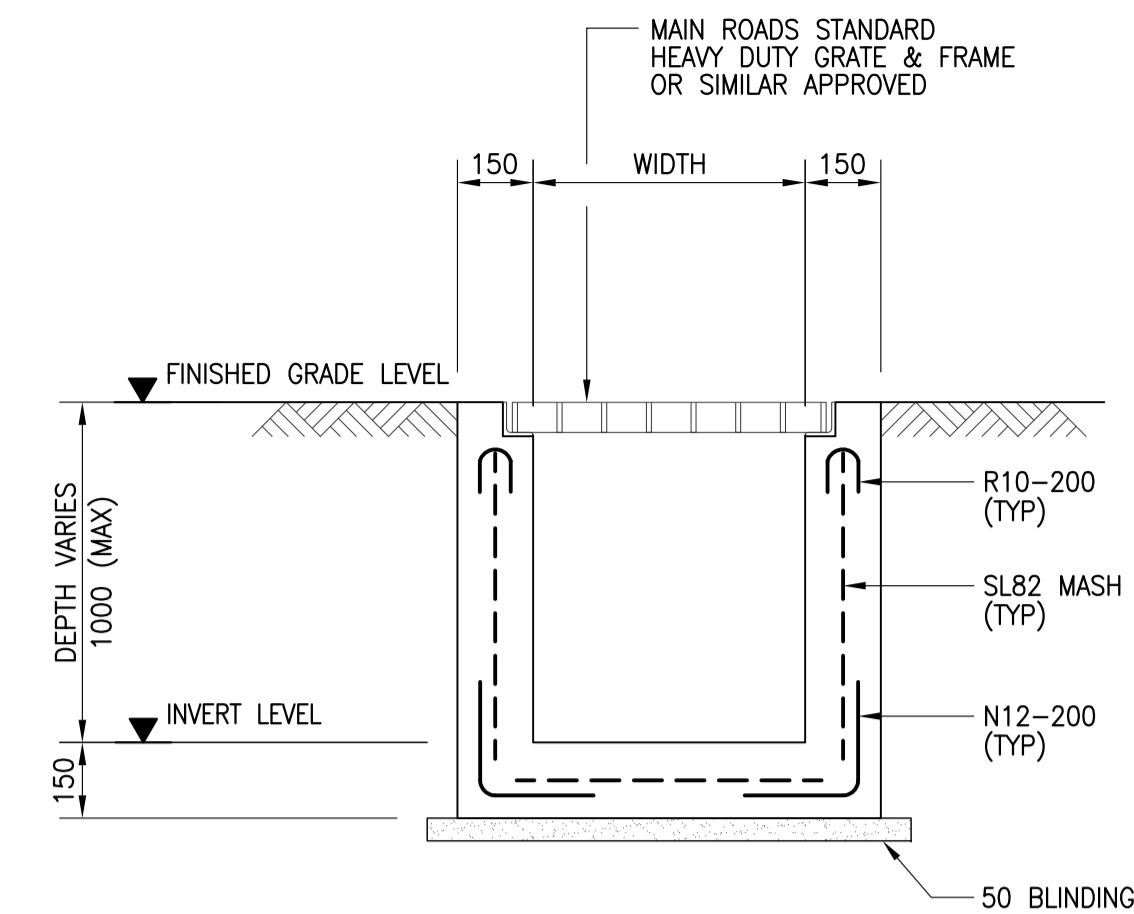
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1:1000	A1	203869C-085-DW-1452-0001	1 OF 1	A



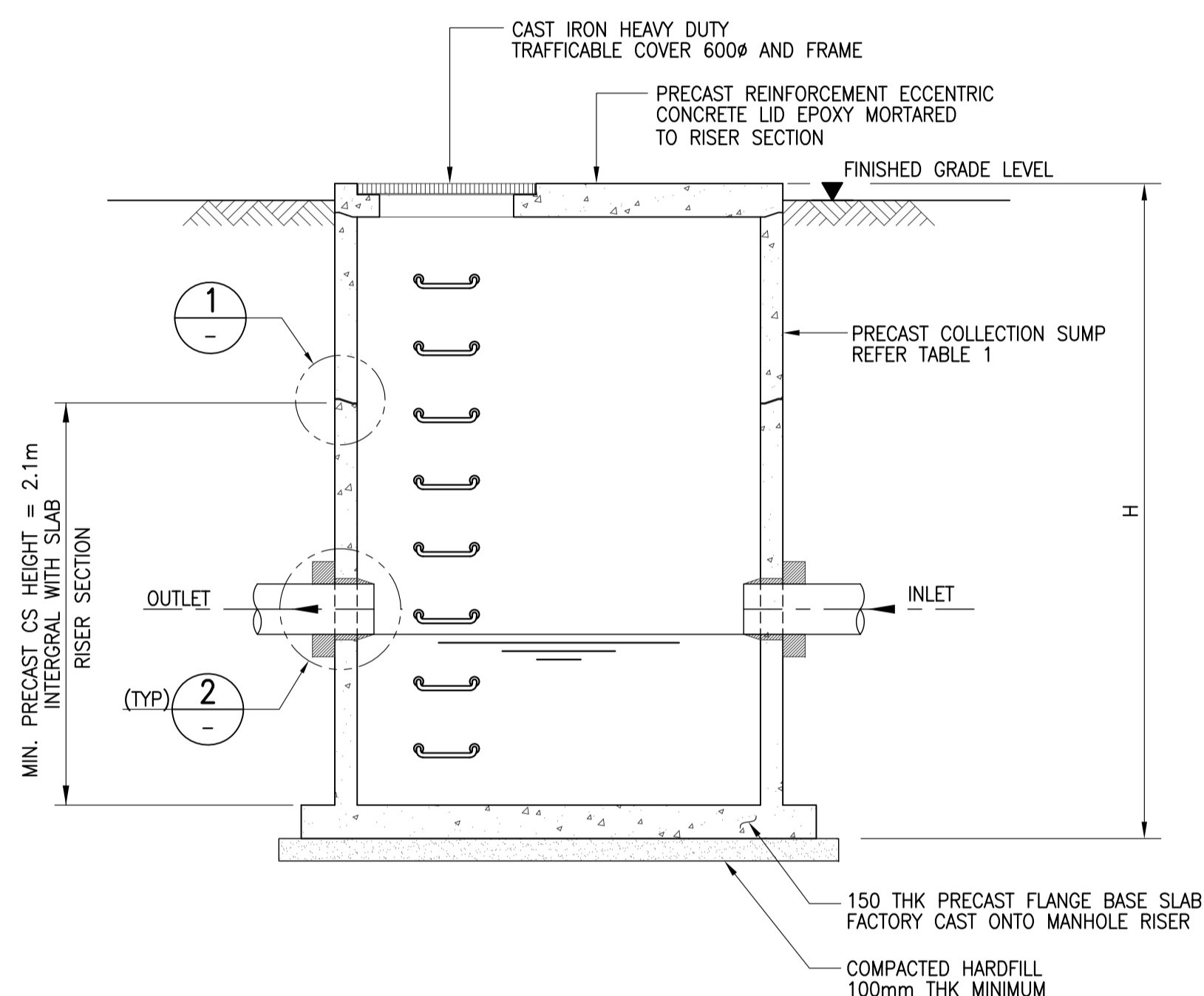
PLAN OF MANHOLE/CATCH BASIN



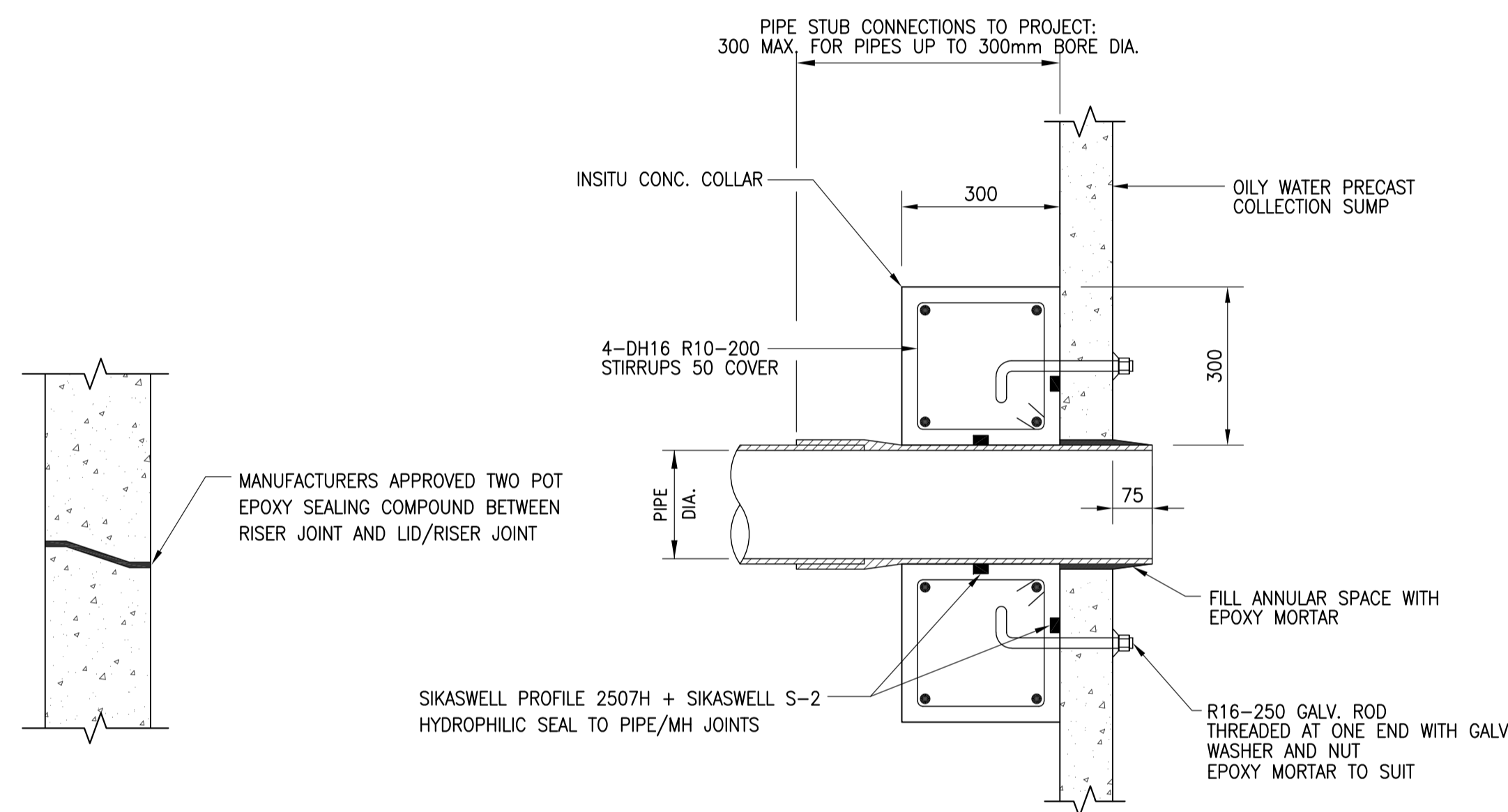
LADDER RUNGS DETAIL



GRATED TRENCH DETAIL

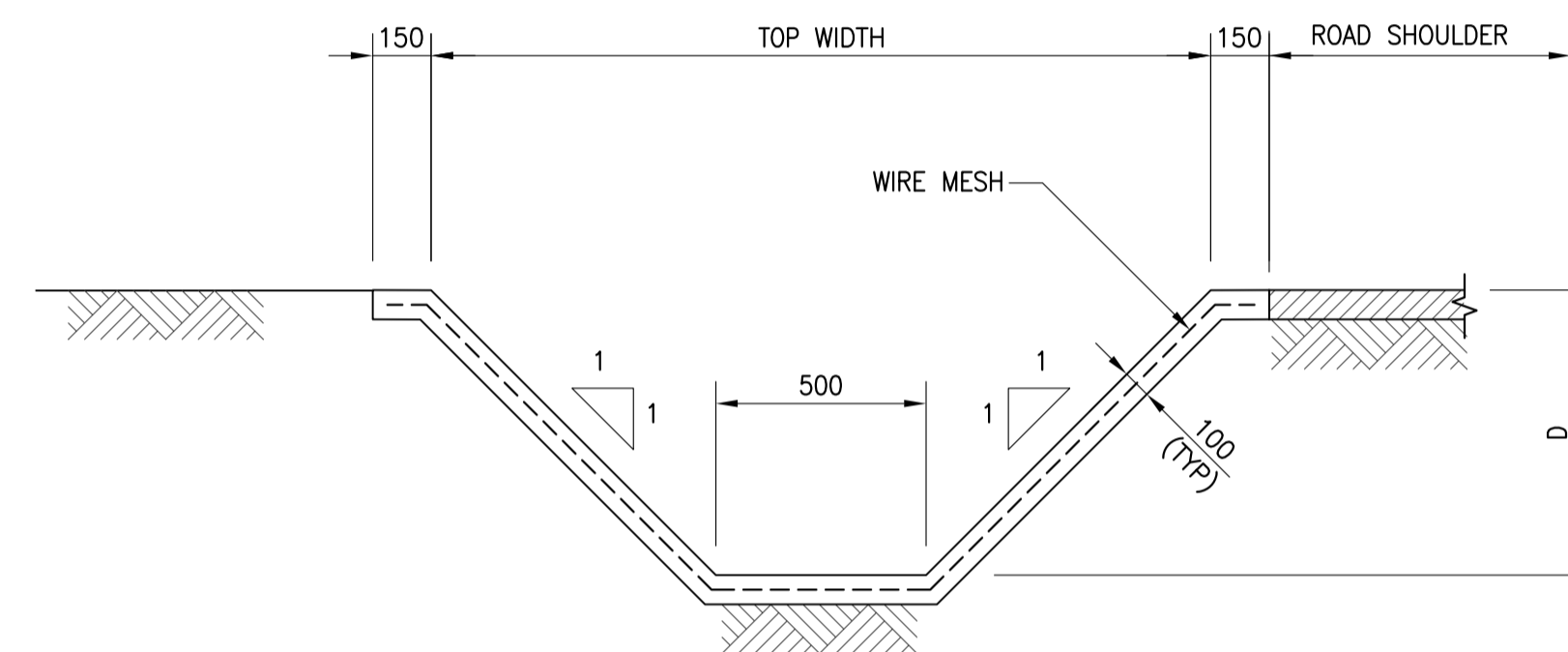


MANHOLE ELEVATION



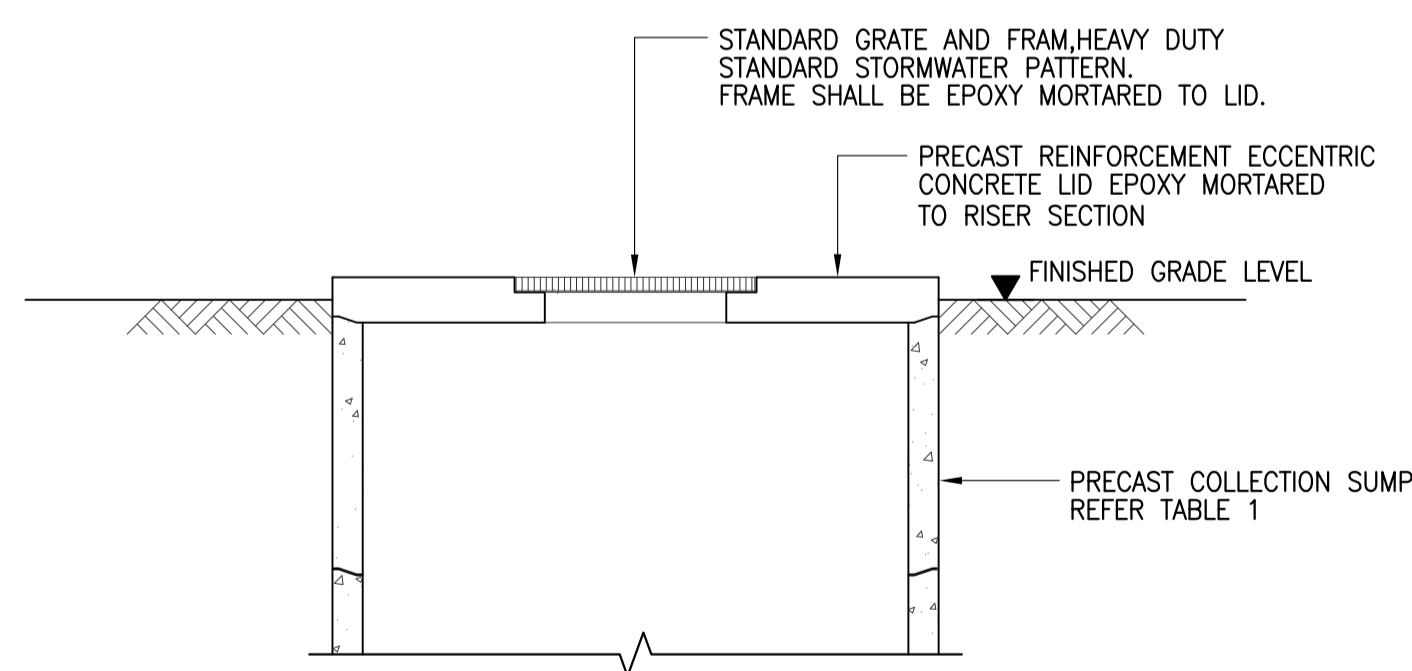
DETAIL 1

DETAIL 2



STORMWATER CHANNEL

TABLE 1	
LINER Ø	MAX. Ø PIPE CONNECTING TO LINER
NOM. Ø1050	NOM. Ø525
NOM. Ø1245	NOM. Ø625
NOM. Ø1500	NOM. Ø750
NOM. Ø1800	NOM. Ø900
NOM. Ø2100	NOM. Ø1050



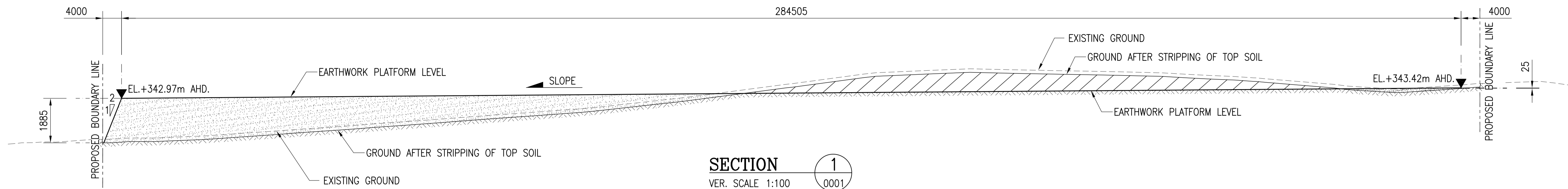
ELEVATION OF CATCH BASIN LID

NOTES:

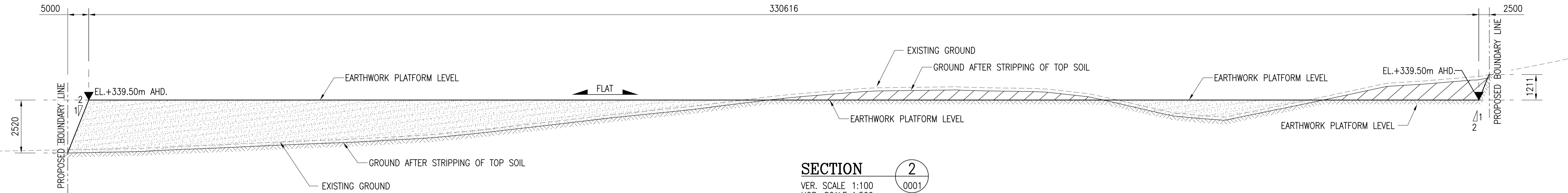
- DRAWING NOT TO SCALE.
- ALL DIMENSIONS ARE IN MILLIMETERS, ALL ELEVATIONS ARE IN METERS UNLESS NOTED OTHERWISE.
- LIFTING AND INSTALLATION OF COLLECTION SUMP REFER TO MANUFACTURER GUIDELINE.
- EPOXY MORTAR TO BE HIGH STRENGTH EPOXY RESIN PATCHING MORTAR OR TO MANUFACTURER'S SPECIFICATIONS NON SLUMP EPOXY RESIN REPAIR MORTAR/PUTTY.
- MATERIAL FOR ALL RUBBER RINGS FOR JOINTS FOR PIPE TO BE VITON ALL RUBBER RINGS TO BE MANUFACTURED IN ACCORDANCE WITH BS 2494/AS 1646 REQUIREMENTS.
- LINER : A) THE LINER SHALL BE REINFORCED CONCRETE SPUN TO AS4058.
 B) THE MAXIMUM INLET/OUTLET PIPE OUTSIDE DIAMETER MUST BE LESS THAN 60% OF THE LINER INTERNAL DIAMETER. SEE TABLE 1.
 C) MINIMUM OF 40% OF LINER SHALL REMAIN IN ANY HORIZONTAL PLANE.
 D) HOLES TO BE PUNCHED/CUT IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATION OR PREFORMED.
 E) THE LINER SHALL EQUIVALENT PROPERTIES AND REINFORCEMENT OF CLASS 2 RCP.

CHANGE NOTE No.	REV	REASON FOR ISSUE	DATE	PREPARED BY	DISCIPLINE CHECK	TECHNICAL INTEGRITY	PROJECT APPROVAL
-	A	ISSUED FOR FEED	04-08-22	JNT	NRK		AST
DOCUMENT CONFIDENTIALITY CLASSIFICATION		MATERIAL	TREATMENT	COATING		WEIGHT	
203869C-085-DW-1452-0001		N/A	N/A	N/A		N/A	
TECHNIP ENERGIES DOCUMENT No.		TITLE		DISCLOSE WITHOUT AUTHORIZATION.		ALL DIMENSIONS ARE IN METRES U.N.O. DRAWN IN ACCORDANCE WITH AS 1100 U.N.O.	
203869C-085-DW-1452-0001		DRAINAGE LAYOUT		THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION. ALL RIGHTS (INCLUDING COPYRIGHT, CONFIDENTIAL INFORMATION, TRADE SECRETS AND DESIGN RIGHTS) ARE OWNED BY T.EN AUSTRALIA AND NEW ZEALAND PTY LTD. NO USE OR DISCLOSURE IS TO BE MADE WITHOUT THE WRITTEN PERMISSION. COPYRIGHT T.EN AUSTRALIA AND NEW ZEALAND PTY LTD. ALL RIGHTS RESERVED.		N/A	

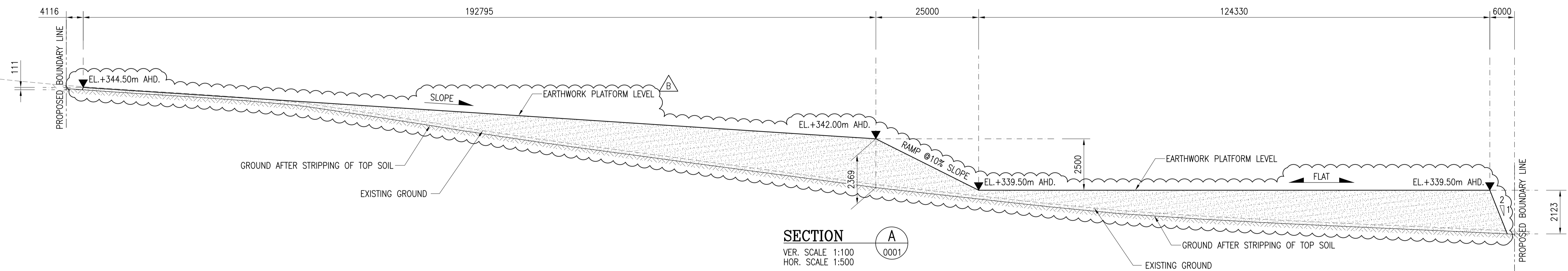
MANUAL CAD				
	RENEWABLE DIESEL BIOREFINERY PROJECT DRAINAGE DETAILS			
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NTS	A1	203869C-085-DW-1452-0002	1 OF 1	A



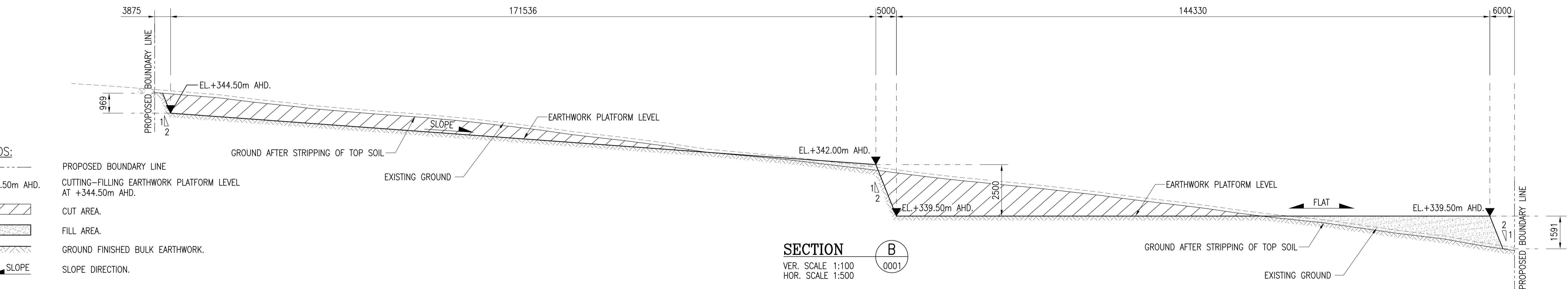
SECTION 1
 VER. SCALE 1:100
 HOR. SCALE 1:500



SECTION 2
 VER. SCALE 1:100
 HOR. SCALE 1:500



SECTION A
 VER. SCALE 1:100
 HOR. SCALE 1:500



SECTION B
 VER. SCALE 1:100
 HOR. SCALE 1:500

LEGENDS:

- PROPOSED BOUNDARY LINE
- +344.50m AHD. CUTTING-FILLING EARTHWORK PLATFORM LEVEL AT +344.50m AHD.
- [Hatched Area] CUT AREA.
- [Stippled Area] FILL AREA.
- [Dashed Line] GROUND FINISHED BULK EARTHWORK.
- [Arrow] SLOPE DIRECTION.

ABBREVIATION:

AHD. AUSTRALIAN HEIGHT DATUM

NOTES:

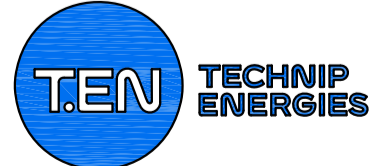

1. ALL DIMENSIONS ARE IN MILLIMETERS, ALL ELEVATIONS AND ALL COORDINATES ARE IN METERS UNLESS NOTED OTHERWISE.
 2. PLANT. EL.+100.000 IS EQUIVALENT TO AHD EL. +XX.XX.
 3. THE COORDINATES AT PLANT DATUM ARE N XXXXXX.XXX AND E XXXXXX.XXX.
- (HOLD-1)

HOLDS:

1. PLANT BOUNDARY, DATUM, COORDINATES & ELEVATION, WHICH SHALL BE VERIFIED AND CONFIRMED IN THE NEXT PHASE.

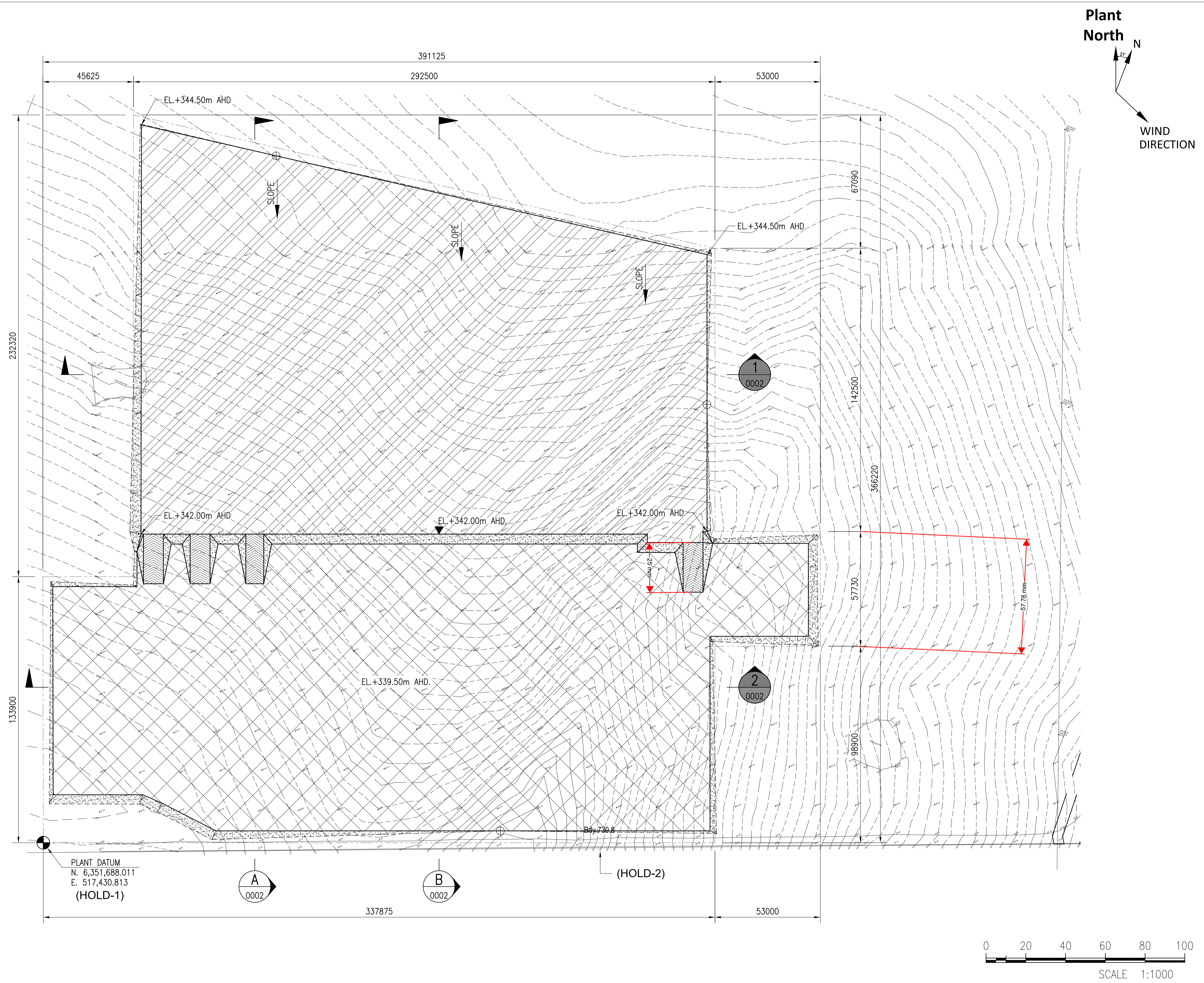
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-	B	RE-ISSUED FOR FEED	15-08-22	SPW	NRK		AST
-	A	ISSUED FOR FEED	04-08-22	CTJ	NRK		AST

DOCUMENT CONFIDENTIALITY CLASSIFICATION	MATERIAL	TREATMENT	COATING	WEIGHT
CONFIDENTIAL - NOT TO DISCLOSE WITHOUT AUTHORISATION.	N/A	N/A	N/A	N/A

RENEWABLE DIESEL BIOREFINERY PROJECT
PRELIM EARTHWORK DETAILS

SCALE AS SHOWN	DRAWING SIZE A1	DRAWING NUMBER 203869C-085-DW-1423-0002	SHEET No. 1 OF 1	REV. B
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- LEGENDS:**
- PROPOSED BOUNDARY LINE
 - ▨ EARTHWORK PLATFORM LEVEL FROM EL.+342.00m AHD TO EL.+344.50m AHD.
 - ▩ EARTHWORK PLATFORM LEVEL AT EL.+339.50m AHD.
 - ▧ SLOPE AREA
 - ▦ SLOPE RAMP
 - 349.0 CONTOUR LINE OF EXISTING GROUND (BEFORE STIPPIING)
 - +348.41 EXISTING SPOT HEIGHT AT +348.41m AHD.
 - ↘ SLOPE SLOPE DIRECTION.
 - ⊕ CONVERT POINT

ABBREVIATION:

AHD. AUSTRALIAN HEIGHT DATUM

- HOLDS:**
1. PLANT BOUNDARY, DATUM, COORDINATES & ELEVATION, WHICH SHALL BE VERIFIED AND CONFIRMED IN THE NEXT PHASE.
 2. TOPOGRAPHICAL SURVEY FROM PLANT BOUNDARY (SOUTH SIDE) TO PUBLIC ROAD.

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS, ALL ELEVATIONS AND ALL COORDINATES ARE IN METERS UNLESS NOTED OTHERWISE.
2. PLANT, EL.+100,000 IS EQUIVALENT TO AHD, EL. +XX.XX.
3. THE COORDINATES AT PLANT DATUM ARE N XXXXX.XXX AND E XXXXX.XXX.
(HOLD-1)

CHANGE NOTE No.	REV	REASON FOR ISSUE	DATE	PREPARED BY	DISCIPLINE CHECK	TECHNICAL INTEGRITY	PROJECT APPROVAL
-	A	ISSUED FOR FEED	04-08-22	CTJ	NRK		AST
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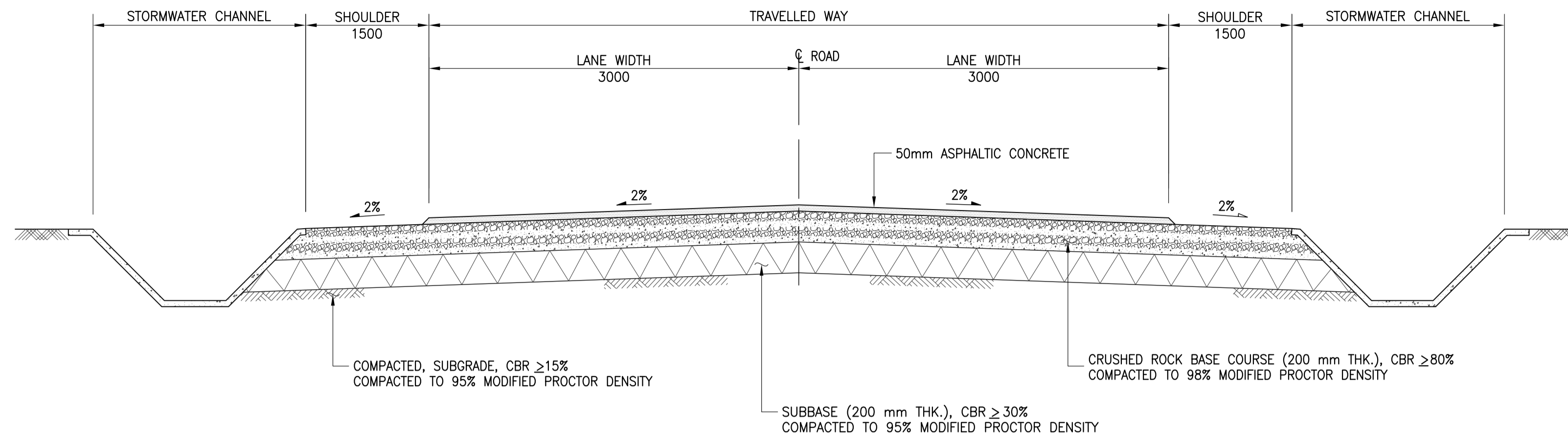
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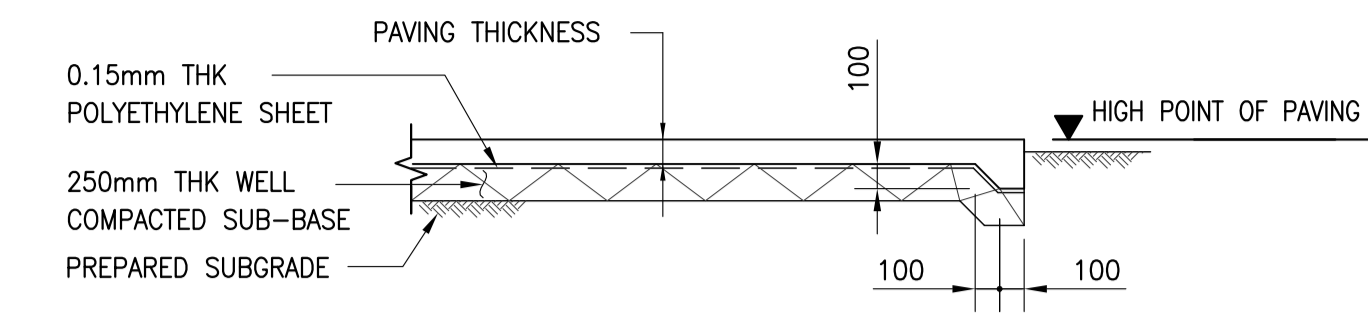
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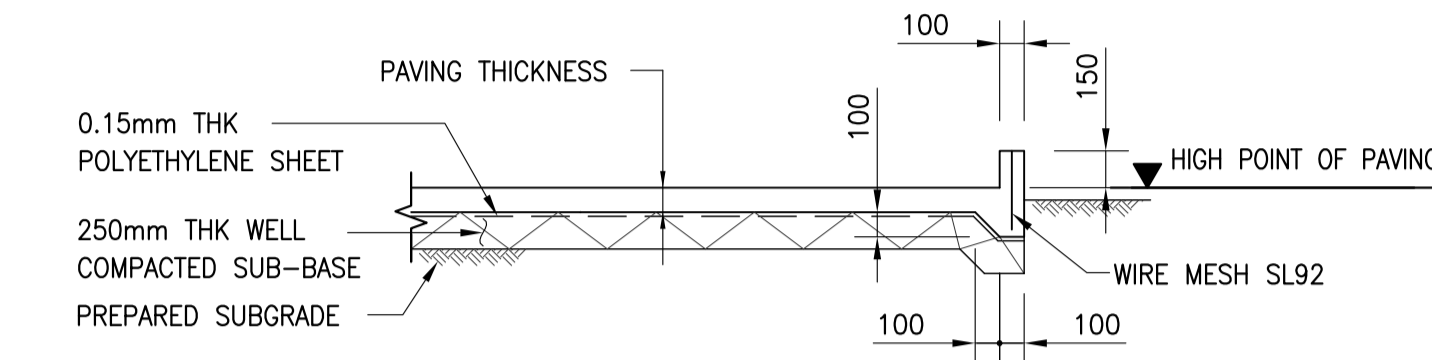


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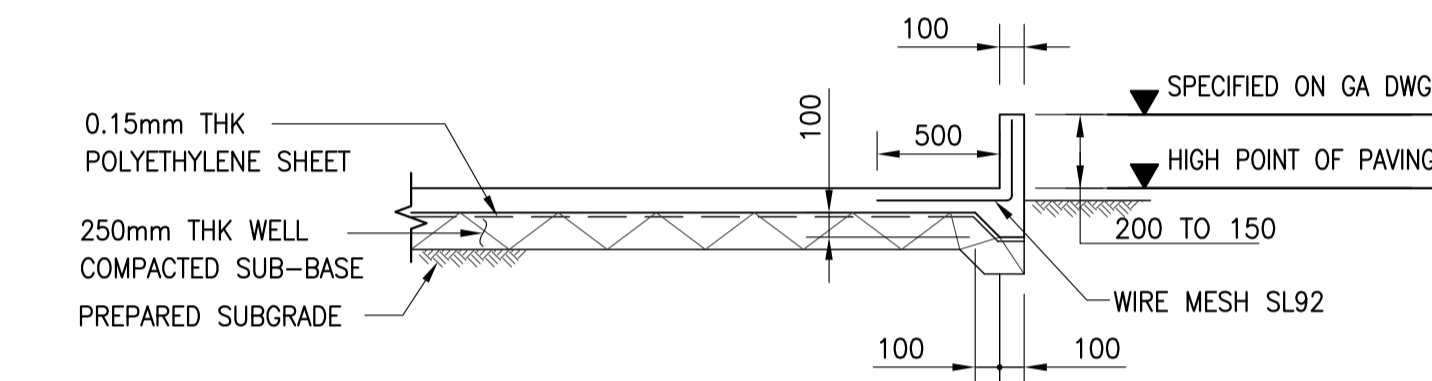
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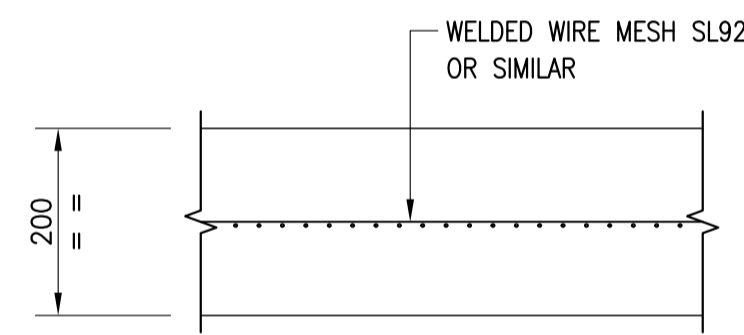


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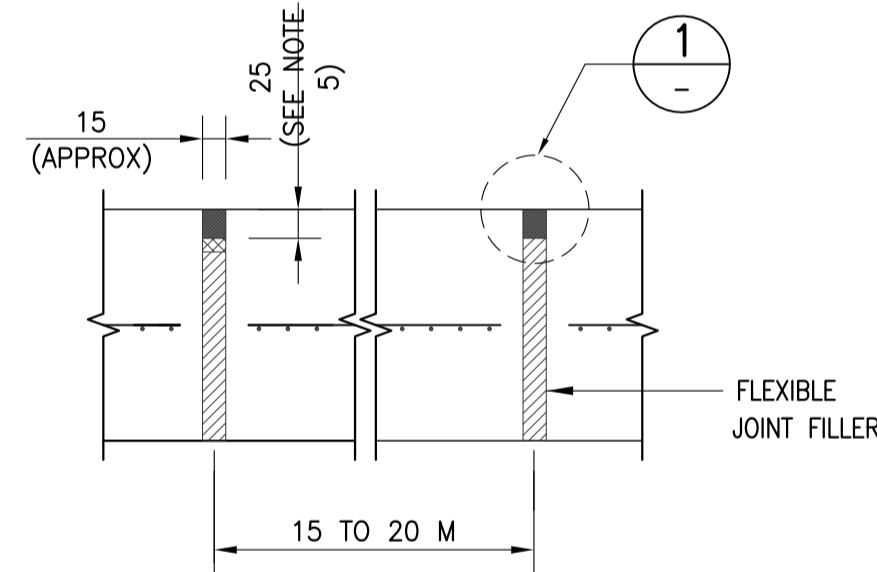


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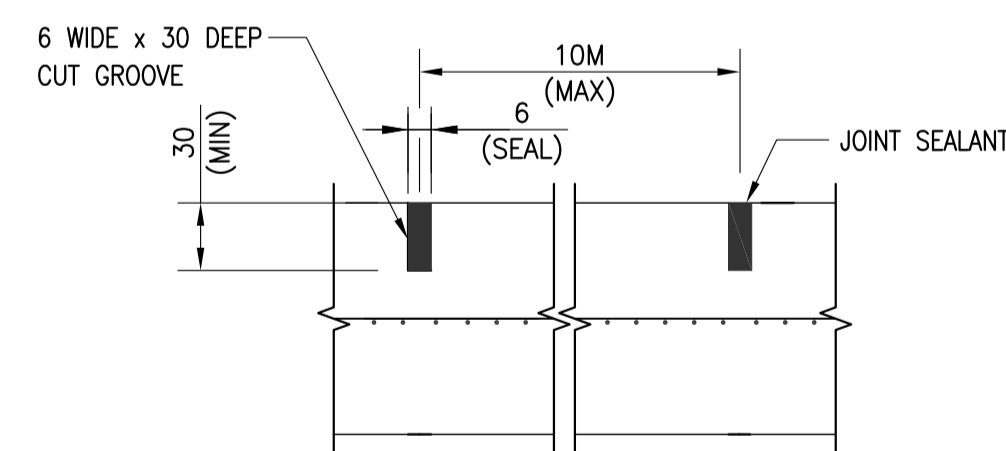
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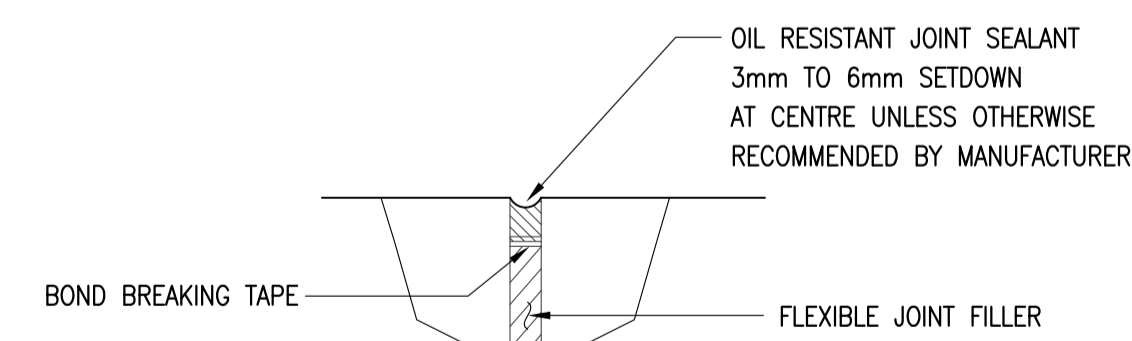
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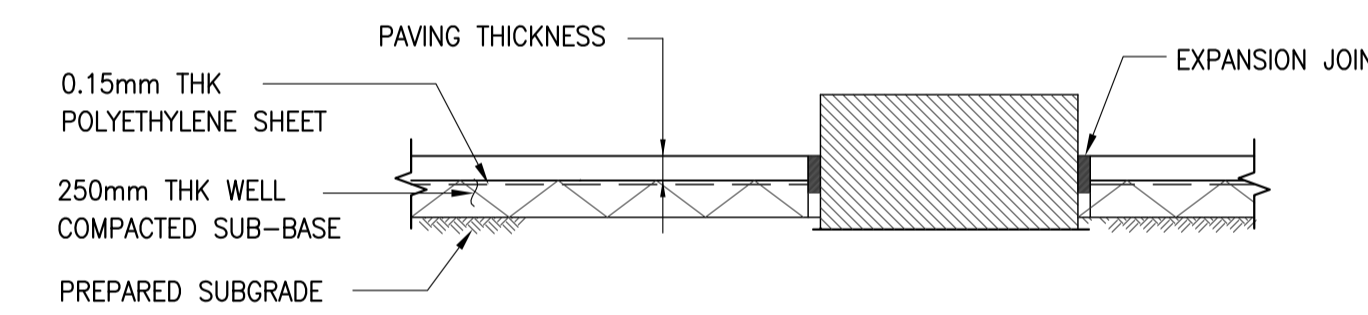
EXPANSION JOINTS



CONTRACTION JOINTS



DETAIL 1



JOINT AROUND FOUNDATION

NOTES:

- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
- MINIMUM SEALANT DEPTH SHALL BE 25mm UNLESS OTHERWISE RECOMMENDED BY SEALANT MANUFACTURER.

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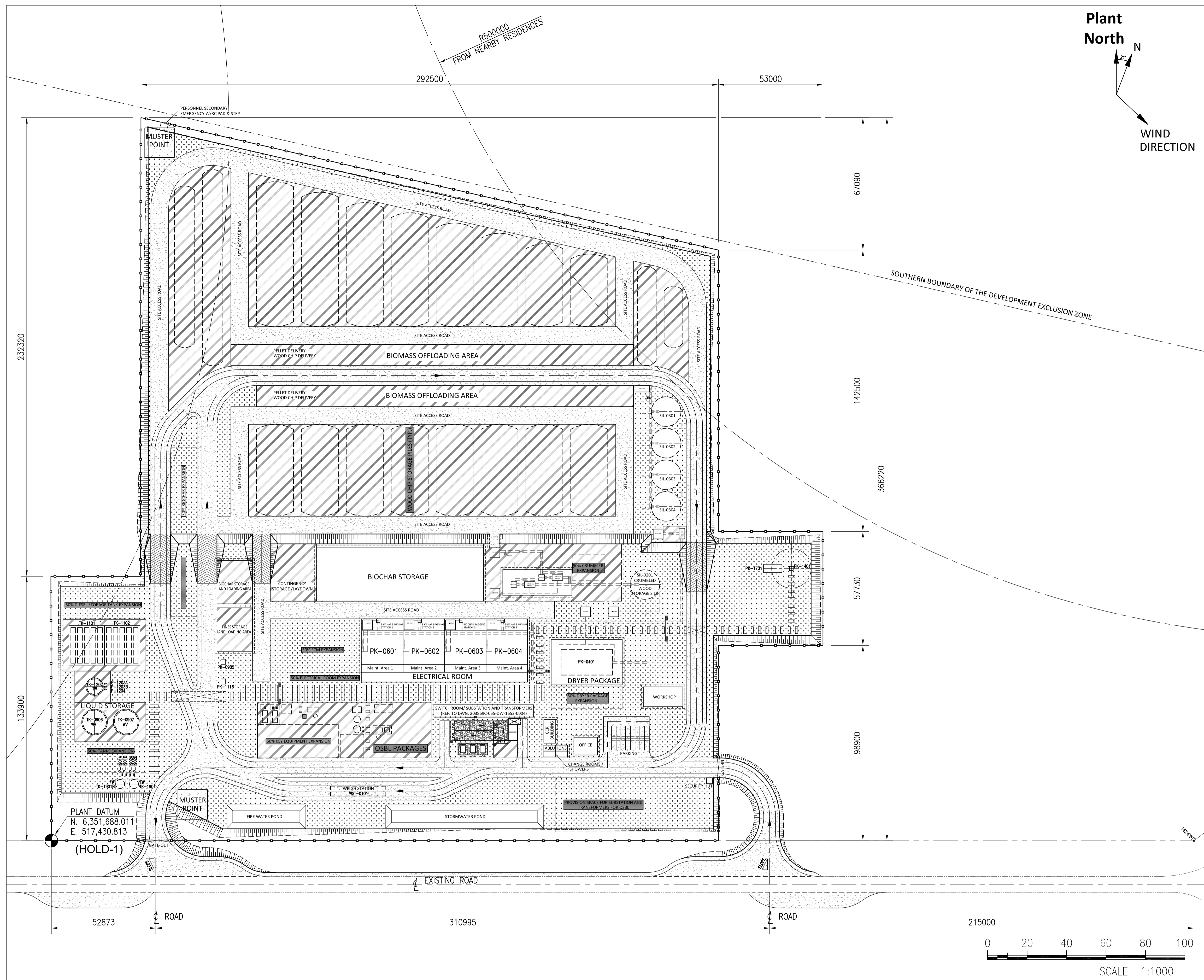
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- LEGENDS:**
- SECURITY FENCE
 - EXISTING OBJECT, ETC.
 - EQUIPMENT OUTLINE
 - GRAVEL 150mm THK.
 - CONCRETE PAVING
 - ASPHALT PAVING
 - CRUSHED ROCK (SIZE 15-25mm)
 - SHELTER/SHEDED/ENCLOSURE
 - BUILDING
 - PROPOSED SLOPE
 - TRAFFIC DIRECTION

- HOLDS:**
1. PLANT BOUNDARY, DATUM, COORDINATES & ELEVATION.

NOTES:

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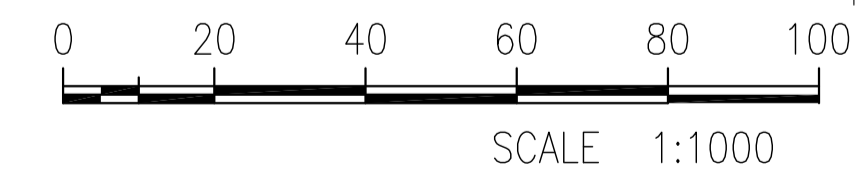
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TECHNIP ENERGIES DOCUMENT No.	REFERENCE DOCUMENTS			

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**RENEWABLE DIESEL BIOREFINERY PROJECT
ROADWORKS LAYOUT**

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Appendix 6

Site Survey

NOTES:

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THIS SURVEY DOES NOT INCLUDE A TITLE SEARCH AND AS SUCH MAY NOT SHOW EASEMENTS OR OTHER INTERESTS. THE TITLE SHOULD BE CHECKED TO VERIFY ALL LOT DETAILS AND FOR ANY EASEMENTS OR OTHER INTERESTS WHICH MAY AFFECT BUILDING ON THE PROPERTY.

THIS SURVEY DOES NOT INCLUDE VERIFICATION OF CADASTRAL BOUNDARIES. THE BOUNDARY HAS BEEN POSITIONED BASED UPON THE ORIENTATION TO EXISTING PEGS, WALLS AND FENCES ONLY WHICH MAY NOT BE ON THE CORRECT BOUNDARY ALIGNMENT. ANY DESIGNS BASED OR DEPENDANT ON THE TRUE LOCATION OF EXISTING FEATURES SHOULD HAVE THOSE FEATURES LOCATION VERIFIED IN RELATION TO THE TRUE BOUNDARY.

THIS SURVEY SHOWS ONLY THE RELEVANT VISIBLE FEATURES THAT ARE LOCATED IN THE FIELD AND WILL NOT SHOW LOCATIONS OF UNDERGROUND PIPES OR CONDUITS FOR INTERNAL AND MAINS SERVICES. VERIFICATION OF THE LOCATION OF ALL INTERNAL AND MAINS SERVICES SHOULD BE CONFIRMED PRIOR TO FINALISATION OF ANY DESIGN WORK AND/OR DEMOLITION, EXCAVATION OR CONSTRUCTION.

SEWER DATA SHOWN ON THIS PLAN IS DERIVED FROM SUPPLIED WATER CORPORATION INFORMATION SHEETS AND IS COMPILED AS A BEST-FIT MODEL. ST SPATIAL CANNOT GUARANTEE THE ACCURACY OF THIS DATA.

ST SPATIAL ACCEPT NO RESPONSIBILITY FOR ANY FEATURES NOT LOCATED NOR ANY PHYSICAL ON SITE CHANGES THAT HAVE OCCURRED AFTER THE DATE OF THIS SURVEY.

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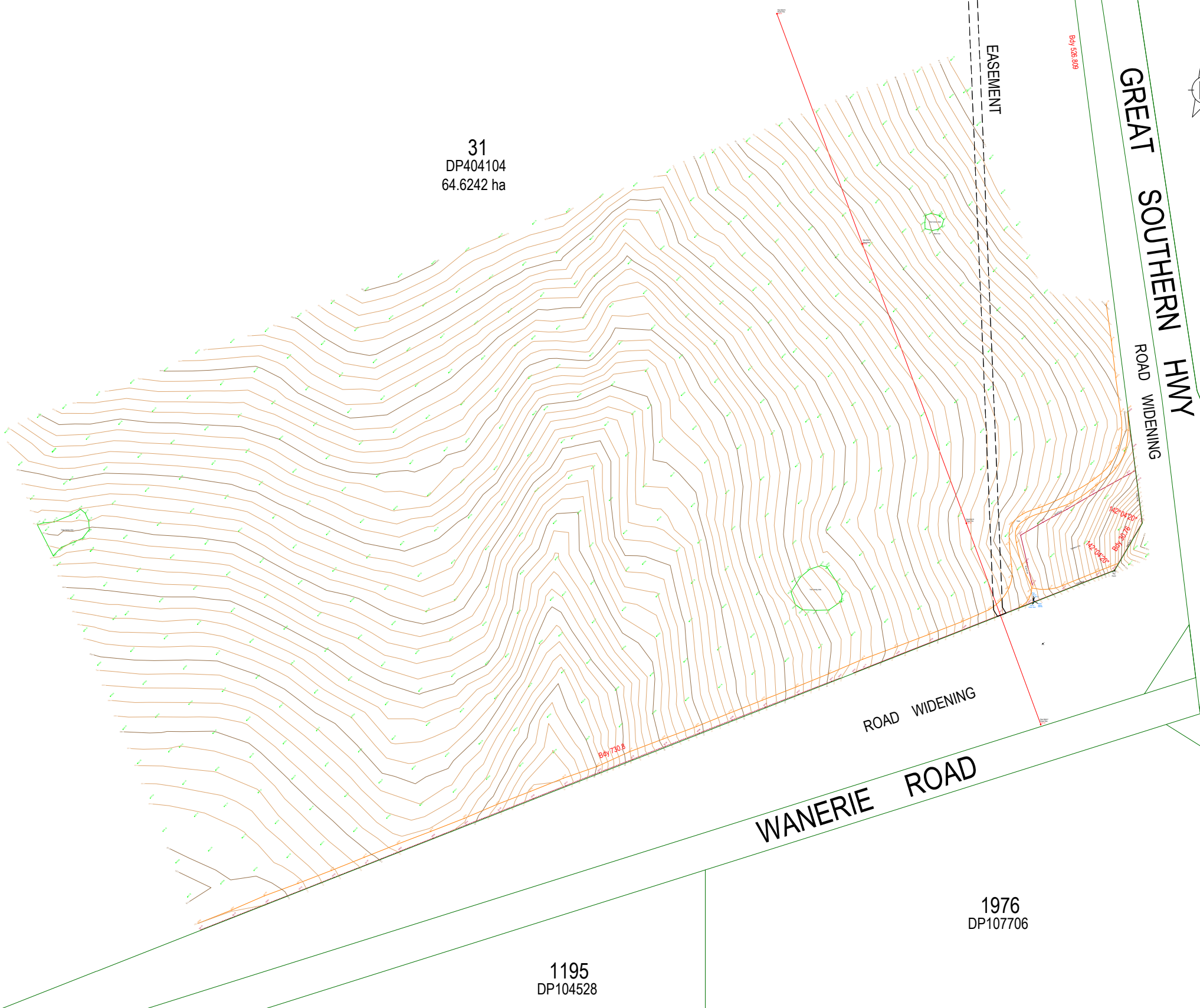
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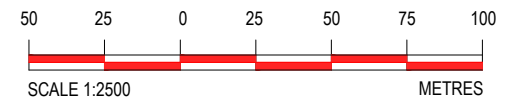
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FEATURE SURVEY

LOT 31 GREAT SOUTHERN HIGHWAY
DUMBERNING WA 6312
LOT 31 ON DEPOSITED PLAN 404104



DRAWN	F.BHATT	24/05/2022
SURVEYOR	S.KOHLSCHEIN	18/05/2022
CHECKED	P.SAID	24/05/2022

HORIZONTAL DATUM: MGA94Z50
VERTICAL DATUM: AHD

0	24/05/2022	APPROVED AND ISSUED TO CLIENT	FB	SK	PS	FRONTIER IMPACT GROUP	DRAWING NUMBER 22103-01	REV 0	SIZE A3
No.	DATE	REVISION	DRAWN	SURVEYOR	CHECKED	CLIENT			



Appendix 7

Transport Impact Statement



transport planning
traffic engineering
modelling

Renewable Diesel Biorefinery - Lot 31 Great Southern Hwy, Dumberning

Transport Impact Statement

PREPARED FOR:
Future Energy Australia

August 2022

Document history and status

Author	Revision	Approved by	Date approved	Revision type
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File name: t22109-rw-r01.docx

Author: Robin White

Project manager: Behnam Bordbar

Client: Future Energy Australia

Project: Lot 31 Great Southern Hwy, Dumberning

Document revision: r01

Project number: t22.109

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1 Introduction

This Transport Impact Statement has been prepared by Transcore on behalf of Future Energy Australia with regard to the proposed renewable diesel biorefinery at Lot 31 Great Southern Hwy, Dumberning, in the Shire of Narrogin.

The subject site is located approximately four kilometres south of the Narrogin townsite, on the northern side of Wanerie Road, approximately 200m west of Great Southern Highway, as shown in **Figure 1**. (The subject site is only a portion of the SU1 area outlined in red on that LPS plan.)

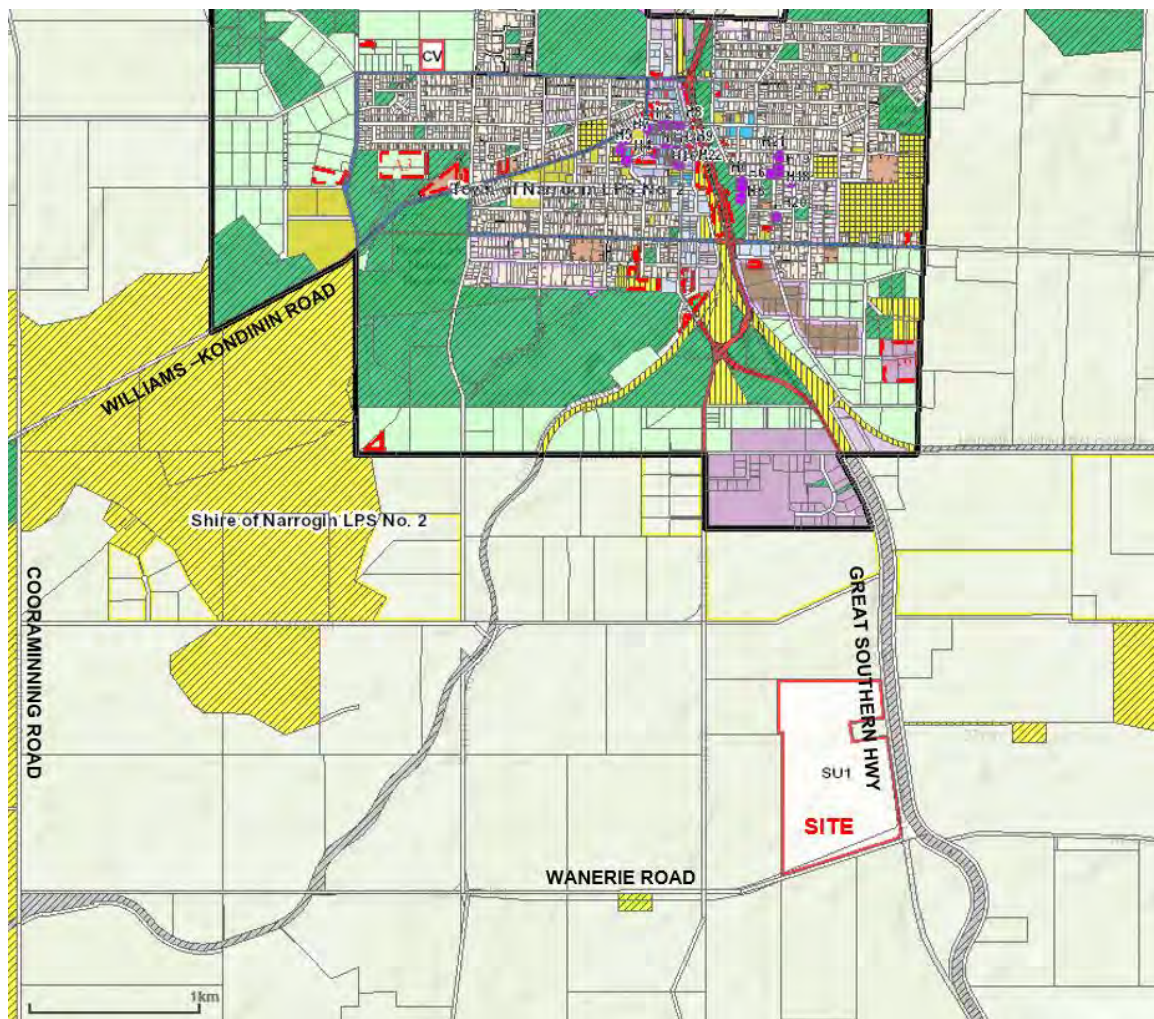


Figure 1: Location of the subject site

The WAPC *Transport Impact Assessment Guidelines* (2016) state: “A *Transport Impact Statement (TIS)* is required for those developments that would be likely to generate moderate volumes of traffic¹ and therefore would have a moderate overall impact on the surrounding land uses and transport networks”.

Section 6.1 of this report provides details of the estimated trip generation for the proposed development. Accordingly, as the total peak hour vehicular trips are estimated to be less than 100 trips, a *Transport Impact Statement* is deemed appropriate for this development.

¹ Between 10 and 100 vehicular trips per hour

2 Proposed Development

The proposed development is a renewable diesel biorefinery to convert biomass to diesel fuel. The biomass – such as agricultural waste, unused mallee plantations, construction waste and fire-affected wood – would be sustainably sourced from within 150km of the facility.

The proposed renewable diesel biorefinery is located on the northern side of Wanerie Road and approximately 200m west of Great Southern Highway, as shown in **Figure 1**.

The proposed layout of the biorefinery is shown in **Appendix A** and **Figure 2**.

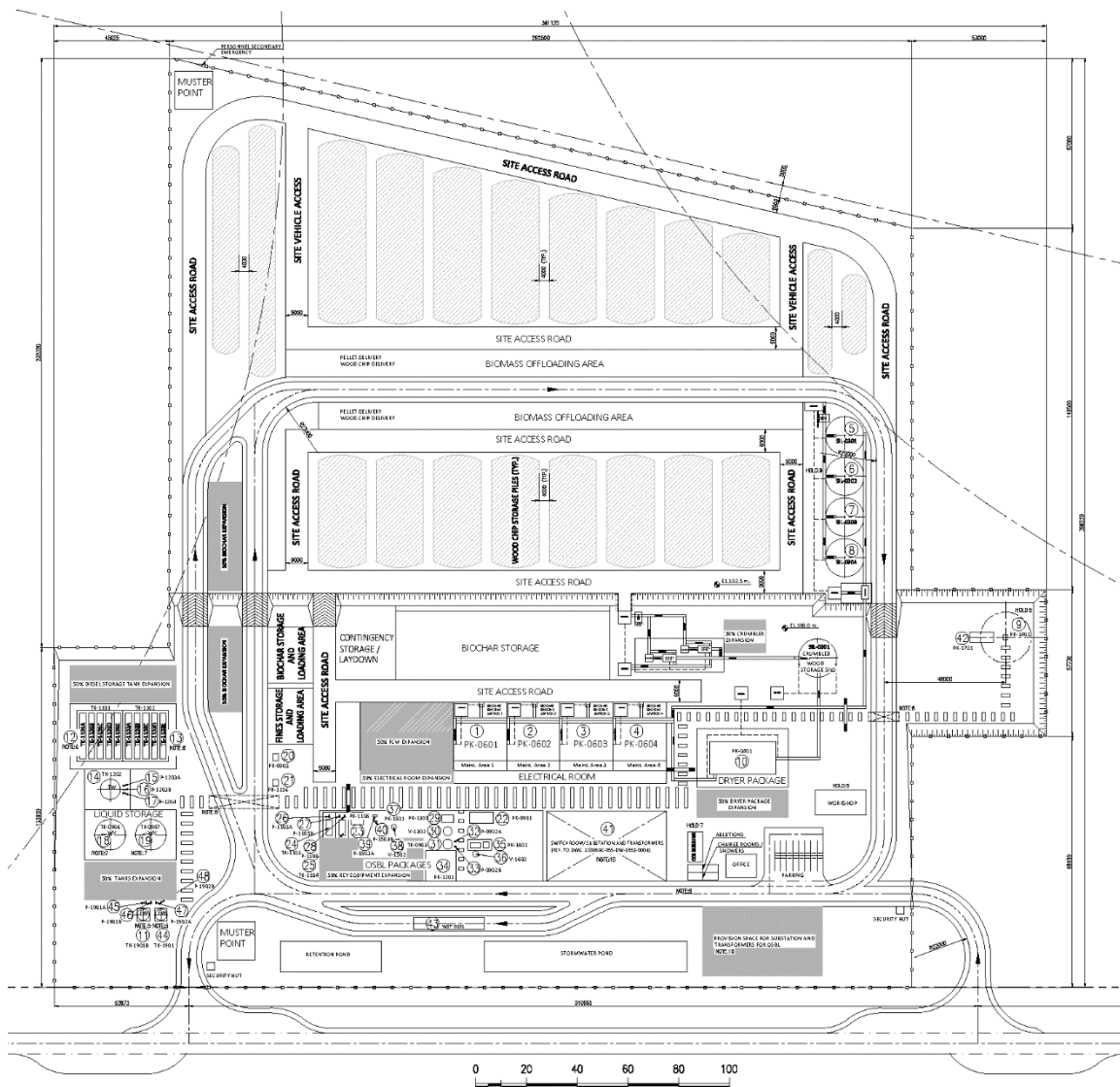


Figure 2: Proposed Development

Access to the subject site is proposed via a pair of one-way driveway crossovers on Wanerie Road, as shown in **Figure 2**. The eastern driveway will be entry only and the western driveway will be exit only. Access to the site will be controlled by security gates at both entry and exit.

Transport of biomass to the biorefinery and delivery of the products from the biorefinery (diesel fuel, wood vinegar and biochar) is anticipated to be undertaken by semi-trailer and B-double vehicles. Daily transport movements are anticipated to be slightly variable within the range of 12 to 20 truckloads per day (or 10 to 18 truckloads if a higher proportion of B-doubles are used). The 12 to 20 truckloads range would consist of 6 to 11 truckloads of biomass into the site and 6 to 9 truckloads of products out.

The biorefinery is anticipated to have a total of approximately 35 staff, working shifts as follows:

- Day shift: 12 staff
- Afternoon shift: 10 staff
- Night shift: 8 staff
- Administration: 5 staff

For the purposes of this transport impact statement, it is anticipated that shift change times would be around 7am, 3 pm and 11pm, with administration office hours typically between 8am and 5pm.



3 Vehicle Access and Parking

3.1 Access

Access to the subject site is proposed via a pair of one-way driveway crossovers on Wanerie Road, as shown in **Figure 2**. The eastern driveway at the eastern end of the site (over 200m away from the Great Southern Hwy intersection) will be entry only. The western driveway (310m further west, at the western end of the site) will be exit only.

Access to the site will be controlled by security gates at both entry and exit. The entry security gate will be located west of the entry driveway radius so that there will be approximately 65 to 70m of queuing space on the entry driveway between Wanerie Road and the entry gate. This would provide sufficient queuing space for two 27.5m B-doubles clear of Wanerie Road, if required.

Internal traffic circulation is one-way east to west in the southern portion of the site between the entry and exit gates, which also forms the southern leg of a clockwise loop within the central portion of the site, as shown by traffic flow arrows in **Figure 2**.

3.2 Parking

The proposed site layout shown in **Appendix A** and **Figure 2** shows a 16-bay car park in the southeast quadrant between the office, workshop and entry security hut. This portion of the site also has unused space for future car park expansion, if required.

4 Provision for Service Vehicles

As discussed in section 3.1, transport of biomass to the biorefinery and delivery of the products from the biorefinery is anticipated to be undertaken by semi-trailer and B-double vehicles.

Wanerie Road and Cooraminning Road are designated as a heavy vehicle route between Great Southern Highway and the Williams – Kondinin Road, as a heavy vehicle bypass southwest of Narrogin.

Wanerie Road and Cooraminning Road are included in Tandem Drive Restricted Access Vehicle (RAV) Network 7, which means vehicle combinations up to 36.5m long (such as double road trains) are permitted on this road. Therefore, the 27.5m B-doubles and 19m semi-trailers for the proposed development would already be permitted on these roads.

Turn path analysis has been undertaken for 27.5m B-doubles turning left and right at the proposed entry and exit driveways on Wanerie Road. Turn path diagrams are included in **Appendix B**.

The turn path analysis indicates that the sealed width on the bends of these entry and exit driveways should be increased to accommodate the swept paths of 27.5m vehicles on these bends. A sealed width up to approximately 8m would be required on the entry bend and up to 7m on the exit bend. Other bends of similar radius within the site would require similar widening as part of the final design for the site layout for construction.

5 Hours of Operation

Preliminary information for the proposed development indicates 24-hour operation of the biorefinery with three work shifts in operation. Anticipated staff numbers and shift times are documented in section 2 of this report. Accordingly, it is anticipated on-site operations may run continuously, 7 days per week.

The numbers of daily truck movements detailed in section 2 have been provided by the applicant based on these transport movements operating on a Monday to Friday basis.

6 Daily Traffic Volumes and Vehicle Types

6.1 Trip Generation and Distribution

Staff numbers and shift times, and daily truckloads of biomass and products to and from the site are discussed in section 2 of this report.

Maximum daily truckloads to and from the site would be up to 11 vehicles per day (vpd) delivering biomass to the site (then departing empty), and up to 9 vpd delivering products from the site (and returning to site unladen). Assuming these trips would be spread throughout the daylight hours, there would typically be up to two trucks arriving and two trucks departing per hour.

Staff movements would be concentrated at the start and end of each shift

Accordingly, the anticipated typical operational traffic flows are shown in **Table 1**.

Table 1: Traffic generation

Period	Direction	Staff traffic		HV traffic		Total Traffic	
		Split	Total	Split	Total	Split	Total
06:30 to 07:30	Inbound	12	20	2	4	14	24
	Outbound	8		2		10	
07:30 to 08:30	Inbound	5	5	2	4	7	9
	Outbound	0		2		2	
Typical Hour (daytime)	Inbound	0	0	2	4	2	4
	Outbound	0		2		2	
14:30 to 15:30	Inbound	10	22	2	4	12	26
	Outbound	12		2		14	
16:30 to 17:30	Inbound	0	5	2	4	2	9
	Outbound	5		2		7	
22:30 to 23:30	Inbound	8	18	0	0	8	18
	Outbound	10		0		10	
Total daily (24 hours)	Inbound	35vpd	70vpd	20vpd	40vpd	55vpd	110vpd
	Outbound	35vpd		20vpd		55vpd	

The applicant has provided information regarding the anticipated distribution of heavy vehicle trips based on location of anticipated suppliers and customers. It is anticipated that deliveries of biomass will primarily (90%) be to and from the west on Wanerie Road with a smaller component (assume 10%) to and from the south on Great Southern Highway. Deliveries of products from the biorefinery will primarily (at least 90%) be to and from the north on Great Southern Highway with a smaller component (up to 10%) to and from the south on Great Southern Highway.

Workforce home location is not yet known but for the purposes of this transport impact assessment it is anticipated that most would have accommodation in the nearby town of Narrogin.

The AM and PM peak hours of site traffic generation would occur around the 7am and 3pm shift change periods, as shown in **Table 1**. The resulting typical traffic movements generated by the proposed development during those AM and PM peak hours are illustrated in **Figure 3**.

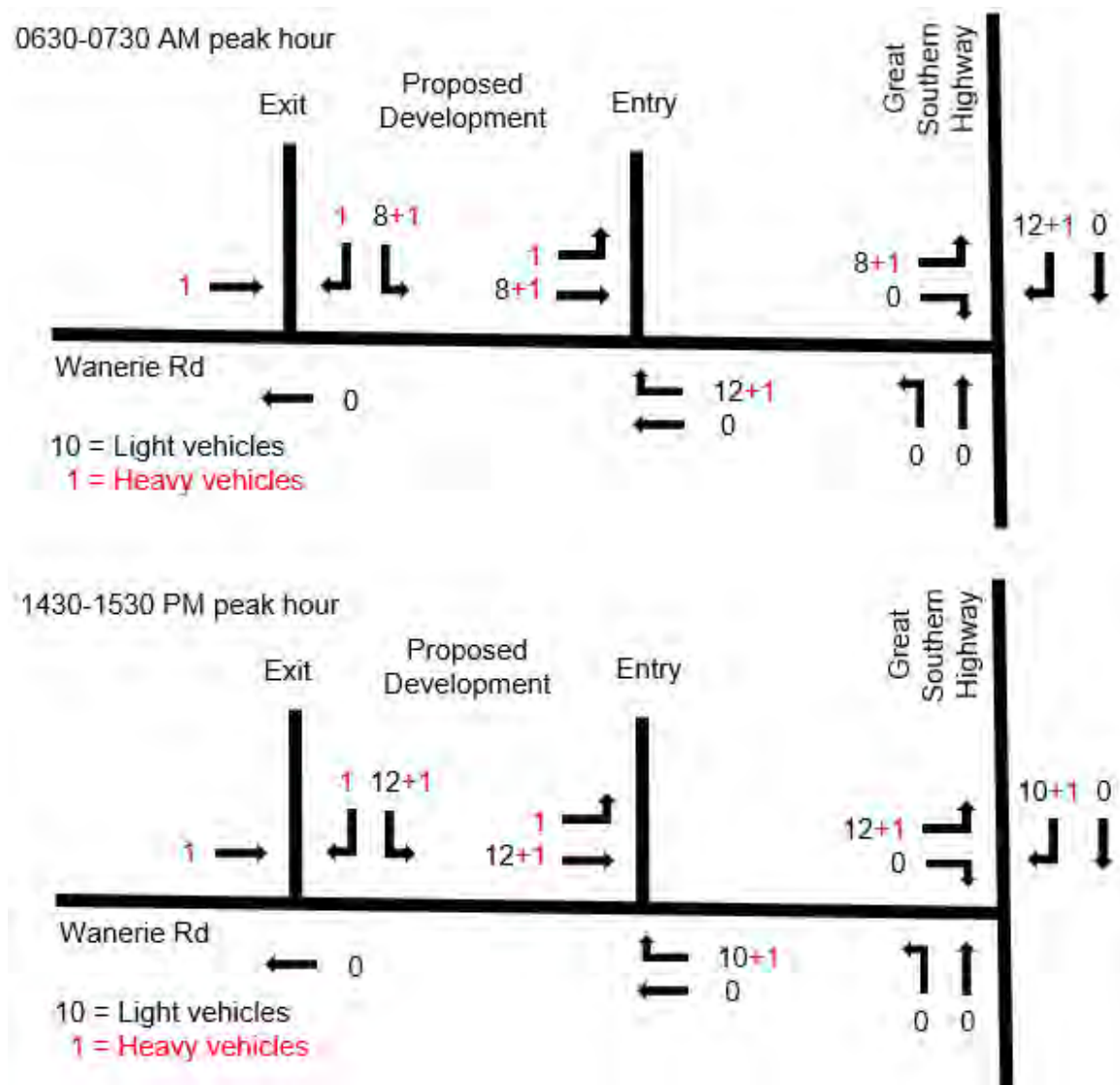


Figure 3: Peak hour traffic flows of the proposed development

6.2 Impact on Surrounding Roads

The WAPC *Transport Impact Assessment Guidelines (2016)* provides guidance on the assessment of traffic impacts:

“As a general guide, an increase in traffic of less than 10 percent of capacity would not normally be likely to have a material impact on any particular section of road but increases over 10 percent may. All sections of road with an increase greater than 10 percent of capacity should therefore be included in the analysis. For ease of assessment, an increase of 100 vehicles per hour for any lane can be considered as equating to around 10 percent of capacity. Therefore, any section of road where the development traffic would increase flows by more than 100 vehicles per hour for any lane should be included in the analysis.”

As discussed in section **6.1** of this report the highest hourly traffic generation from the proposed development is 26 vehicle trips per hour (vph), with approximately half of this inbound and half outbound traffic flows.

This is significantly less than the quoted WAPC threshold of 100vph (per lane) and therefore does not warrant further detailed analysis. Accordingly, the impact on the surrounding road network will not be significant.

7 Traffic Management on the Frontage Streets

The proposed renewable diesel biorefinery is located on the northern side of Wanerie Road and approximately 200m west of Great Southern Highway, as shown in **Figure 1**.

7.1 Existing Road Network

Wanerie Road, in the vicinity of the subject site, is a two-lane rural road with approximately 8m sealed width (two 3.5m traffic lanes) and unsealed shoulders on each side. The 110km/h default speed limit outside of built up areas applies on this section.

Wanerie Road is classified as an Access Road in the Main Roads WA functional road hierarchy.



Figure 4: Wanerie Road looking east toward Great Southern Hwy



Figure 5: Wanerie Road looking west

The Great Southern Hwy / Wanerie Rd T-intersection operates under Give Way sign control on the Wanerie Rd approach. The Highway is widened to provide a right turn lane on the northern approach and a left turn lane on the southern approach. Generous corner radii are provided to accommodate the left turn swept paths of the large vehicles (road trains) already permitted on both roads



Figure 6: Great Southern Hwy / Wanerie Rd intersection

7.2 Existing Traffic Volumes

There is currently no existing traffic count information available on Wanerie Road but on-site observation indicates traffic flows on Wanerie Road would be significantly less than on Great Southern Highway.

A selection of available traffic counts (sourced from the Main Roads WA website) outside of Narrogin townsite are listed below for comparison.

- Great Southern Hwy south of Farelly Rd (north of Narrogin): 1592vpd (2021/22)
- Great Southern Hwy south of Whinbin Rock Rd (south of Highbury): 737vpd (2020/21)
- Williams Kondinin Rd east of Tarwonga Rd (west of Narrogin): 1716vpd (2019/20)

Accordingly, it is estimated that existing weekday traffic flows on Wanerie Road would be less than 1000 vehicles per day.

7.3 Future Traffic Volumes

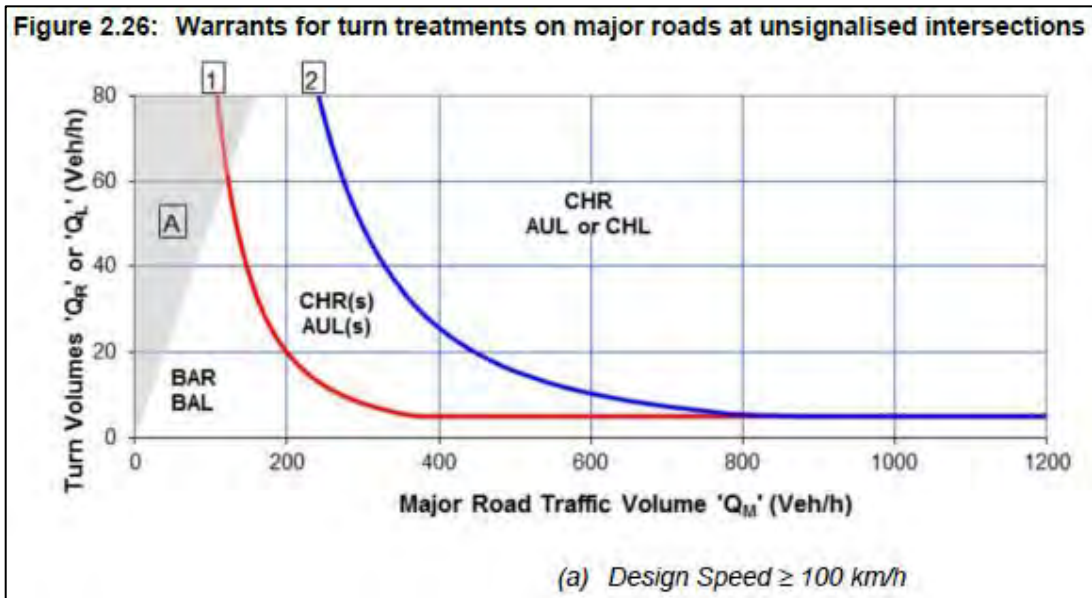
AM and PM peak hour traffic flows generated by the proposed development are shown in **Figure 3**.

Existing traffic flows on Wanerie Road are estimated to be less than 1000vpd. Peak hour traffic flows on the road network are typically in the order of 10% of daily traffic, so existing peak hour traffic flows on Wanerie Road would be less than 100vph.

7.4 Intersection Treatment

The warrants for turn lane treatments (eg. construction of left turn lanes or right turn lanes on the major road) are set out in Figure 2.26 of Austroads *Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings*. The relevant graph for design speed greater than 100km/h on the major road is Figure 2.26a, as shown below.

As virtually all of the site-generated traffic is anticipated to turn right into the entry driveway from Wanerie Road (inbound) and left out from the exit driveway onto Wanerie Road, there is no need for a left turn lane on Wanerie Road and the only potential treatment to be checked is a right turn lane on Wanerie Road.

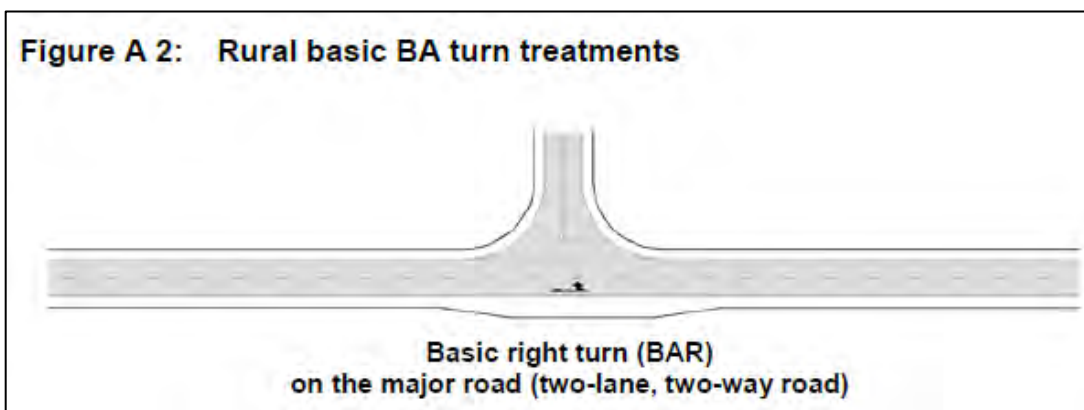


The highest inbound right turn traffic flow will occur during the AM peak hour with up to 13 vehicles turning right into the site during that peak period.

During that AM peak hour the total two-way traffic flow on Wanerie Road would be up to 100vph (existing) plus 10vph eastbound traffic generated by the proposed development. Thus the traffic flows to check on Figure 2.26 are $Q_M = 110$ vph and $Q_R = 13$ vph. Plotting those volumes on Figure 2.26a means this intersection falls into the bottom left square of that graph, well clear of the red line. This falls into the lowest volume area labelled BAR/BAL, meaning that only a basic right turn treatment (BAR) is warranted on Wanerie Road at the eastern, entry-only, driveway crossover.

As there is no traffic turning from Wanerie Road into the western, exit-only, driveway crossover, there is no warrant for any turn treatments on Wanerie Road at that western driveway crossover.

Therefore, the left and right turn treatments shown indicatively on the proposed site plan at **Appendix A** can be reduced, with the only suggested treatment being a basic right turn treatment on Wanerie Road for the eastern driveway crossover. Figure A2 from *Austrroads Guide to Road Design Part 4: Intersections and Crossings – General*, shows a typical basic right turn (BAR) treatment involving shoulder widening on the westbound traffic lane.



8 Public Transport Access

Due to the type and location of the proposed development the availability of public transport services is not relevant.



9 Pedestrian and Bicycle Access

Due to the type and location of the proposed development the availability of pedestrian and bicycle access on the surrounding road network is not relevant.

The site plan at Appendix A has security-controlled access at the southeast and southwest corners of the site controlled by the two security huts. The plan also shows a personnel secondary emergency gate at the northwest corner of the site.

10 Site Specific Issues

No site-specific issues have been identified in relation to this project.



11 Safety Issues

No traffic-related safety issues have been identified in relation to this project.



12 Conclusions

This Transport Impact Statement has been prepared by Transcore on behalf of Future Energy Australia with regard to the proposed renewable diesel biorefinery at Lot 31 Great Southern Hwy, Dumberning, in the Shire of Narrogin.

The subject site is located approximately four kilometres south of the Narrogin townsite, on the northern side of Wanerie Road, approximately 200m west of Great Southern Highway

Access to the subject site is proposed via a pair of one-way driveway crossovers on Wanerie Road. The eastern driveway will be entry only and the western driveway will be exit only. Access to the site will be controlled by security gates at both entry and exit.

Traffic generation associated with the proposed development will be moderately low with an upper estimate of daily traffic flows being approximately 110 vehicles per day (20 trucks and 35 cars in / 20 trucks and 35 cars out). The trucks involved in deliveries to and from the proposed development will be 19m semi-trailers and 27.5m B-doubles.

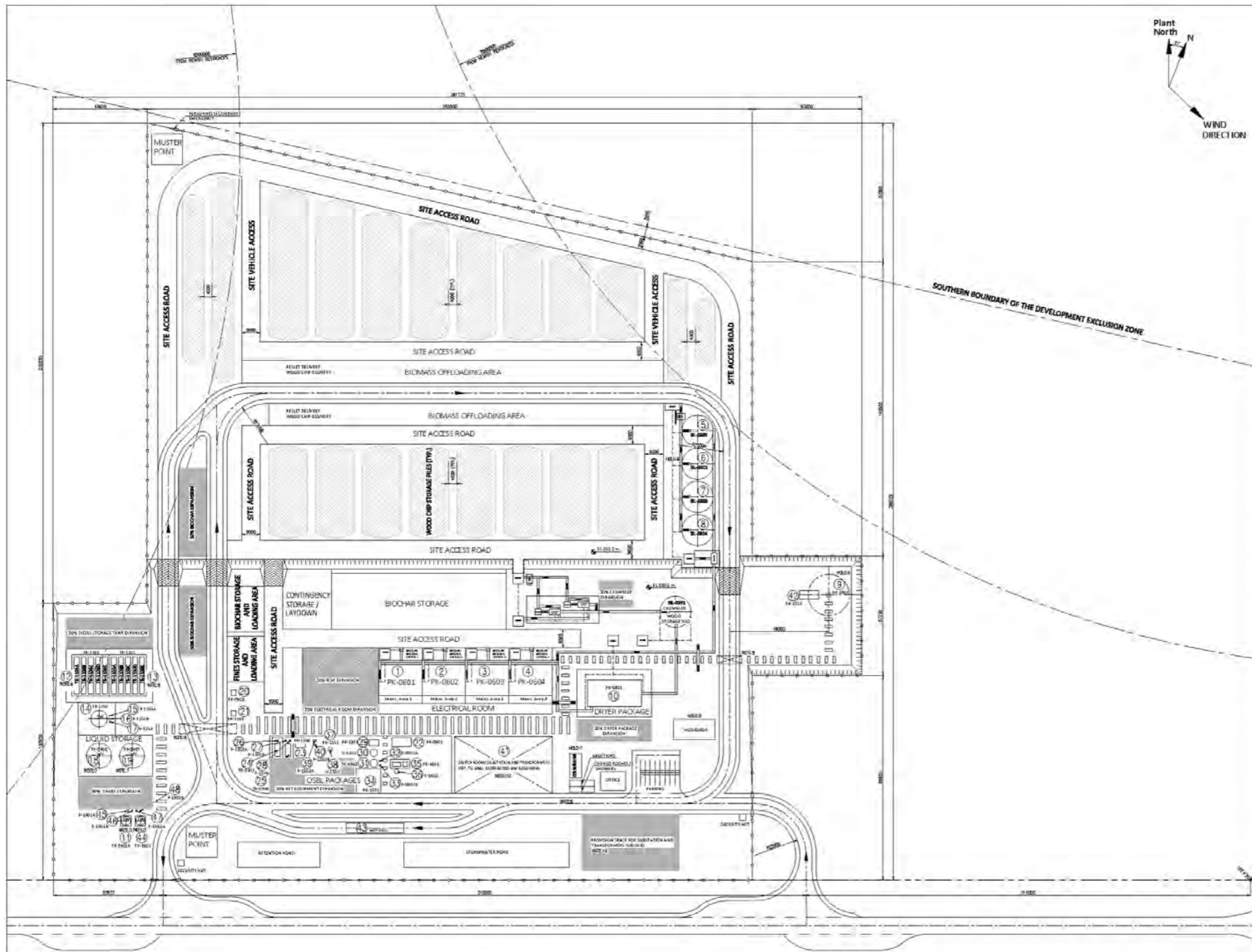
Wanerie Road is already included in Tandem Drive RAV Network 7, which permits vehicle combinations up to 36.5m long (such as double road trains), so 27.5m B-doubles are already permitted on this road.

The only road upgrade considered to be warranted for this development is a basic right turn treatment on Wanerie Road for the eastern driveway crossover – effectively just a widening of the shoulder of the westbound traffic lane on Wanerie Road in the vicinity of that eastern driveway crossover.

It is therefore concluded that traffic-related issues should not form an impediment to the approval of the proposed development.

Appendix A

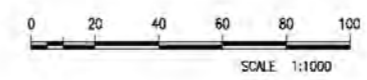
PROPOSED SITE PLAN



FACILITY LIST		
NO.	TAG NO.	DESCRIPTION
1	PK-0601	PRODUCTION MODULE 1 (PROVIDED BY ISBL (PP) VENDOR)
2	PK-0602	PRODUCTION MODULE 2 (PROVIDED BY ISBL (PP) VENDOR)
3	PK-0603	PRODUCTION MODULE 3 (PROVIDED BY ISBL (PP) VENDOR)
4	PK-0604	PRODUCTION MODULE 4 (PROVIDED BY ISBL (PP) VENDOR)
5	SIL-0301	PELLET STORAGE SILO 1
6	SIL-0302	PELLET STORAGE SILO 2
7	SIL-0303	PELLET STORAGE SILO 3
8	SIL-0304	PELLET STORAGE SILO 4
9	PK-1401	THERMAL OXIDIZER INCLUDING WASTE HEAT RECOVERY
10	PK-0401	DRYER PACKAGE 1
11	TK-1901B	FIRE WATER STORAGE TANK B
12	TK-1101	DIESEL STORAGE TANK 1 (NOTE:8)
13	TK-1102	DIESEL STORAGE TANK 2 (NOTE:8)
14	TK-1202	TREATED WATER TANK
15	P-1203A	TREATED WATER PUMP A
16	P-1203B	TREATED WATER PUMP B
17	P-1204	UTILITY WATER PUMP
18	TK-0906	WOOD VINEGAR STORAGE TANK 1 (NOTE:8)
19	TK-0907	WOOD VINEGAR STORAGE TANK 2 (NOTE:8)
20	PK-0905	WOOD VINEGAR LOADING SKID
21	PK-1116	DIESEL LOADING SKID
22	PK-0801	WOOD VINEGAR DISTILLATION MODULE
23	PK-1106	DIESEL CLARIFICATION PACKAGE (PROVIDED BY ISBL (PP) VENDOR)
24	TK-1103	DIESEL INTERMEDIATE HOLDING TANK 1
25	TK-1104	DIESEL INTERMEDIATE HOLDING TANK 2
26	P-1105A	DIESEL TRANSFER PUMP A
27	P-1105B	DIESEL TRANSFER PUMP B
28	P-1106	QIT-SPEC DIESEL TRANSFER PUMP
29	PK-1301	NITROGEN GENERATION PACKAGE
30	V-1302	NITROGEN RECEIVER
31	TK-0903	WASTE WATER TANK
32	P-0602A	WASTE WATER TRANSFER PUMP A
33	P-0602B	WASTE WATER TRANSFER PUMP B
34	PK-1201	WASTE WATER TREATMENT PACKAGE
35	PK-1601	INSTRUMENT AIR PACKAGE
36	V-1802	INSTRUMENT AIR RECEIVER
37	PK-1501	CHILLED WATER PACKAGE
38	V-1502	CHILLED WATER EXPANSION VESSEL
39	P-1503A	CHILLED WATER PUMP A
40	P-1503B	CHILLED WATER PUMP B
41	-	SWITCH ROOM/SUBSTATION, POWER TRANSFORMER AND DIESEL ENGINE GENERATOR PACKAGE
42	PK-1701	HOT OIL PACKAGE (PROVIDED BY THERMAL OXIDIZER PACKAGE VENDOR)
43	WST-0101	WEDCH STATION
44	TK-1901	FIRE WATER STORAGE TANK
45	P-1901A	FIRE WATER PUMP(DIESEL ENGINE DRIVEN)
46	P-1901B	FIRE WATER PUMP(MOTOR DRIVEN)
47	P-1902A	JOCKEY PUMP(MOTOR DRIVEN) A
48	P-1902B	JOCKEY PUMP(MOTOR DRIVEN) B

- LEGEND:**
- FENCING
 - BIH LINE
 - UNDERGROUND TRENCH
 - SLOPE ROAD
 - SLEEPERS
 - SLOPE GROUND

- HOLD:**
- PLANT BOUNDARY, DATUM, COORDINATES & ELEVATION.
 - SECURITY FENCE AREA.
 - PIPE SLEEPER, BIRTH & ELEVATION.
 - SOUND OF SIL-0301/SILO, PK-1401, SE-0201/0201/0202/0203/0204, PK-1401.
 - THE LOCATION SHALL BE CONFIRMED BY PLANT/FORT THERMAL RADIATION AND DISPERSION STUDY REPORT 203869C-025-01-1900-0001.
 - THE LOCATION SHALL BE CONFIRMED BY FIRE AND EXPLOSION CONSEQUENCE MODELLING (C3) STUDY REPORT 203869C-025-01-1900-0001.
 - THE SAFETY MITIGATION SHALL BE CONFIRMED BY FIRE AND EXPLOSION CONSEQUENCE MODELLING (C3) STUDY REPORT 203869C-025-01-1900-0001.
 - THE DIMENSION OF SUBSTATION, TRANSFORMERS AND EMERGENCY DIESEL GENERATOR SHALL BE VERIFIED DURING DETAILED DESIGN.
 - MATERIALS HANDLING LAYOUT AS SUBJECT TO CHANGE PENDING VENDOR DESIGN INPUTS.
 - THE SHELTER/ENCLOSURE DIMENSION AND LAYOUT OF BIOCHAR STORAGE, / LOADING, FINES STORAGE/LOADING, FINE STORAGE, CRUMBLER, PRODUCTION MODULE, DRYER PACKAGE.



NOTE:

- ALL DIMENSIONS ARE IN MILLIMETERS. ALL ELEVATIONS AND ALL COORDINATES ARE IN METERS UNLESS NOTED OTHERWISE.
- PLANT ELEVATION IS EQUIVALENT TO MSL. (NOTE 1).
- THE COORDINATES AT PLANT DATUM ARE N (HOLD 1) AND E (HOLD 1).
- EQUIPMENT SIZING BASED ON MECHANICAL EQUIPMENT LIST(SBL & OSBL) DOC. NO. 203869C-025-01-0001 REV. A.
- FW TANK / PUMP STATION SHALL BE AWAY FROM TK-1101, TK-1102, PK-0905 AND FUTURE PROCESS AREA >30 M.
-
- ALL PIPE SLEEPERS WHEN CROSSING THE ROAD WILL BE PIPE UNDERGROUND.
- ALL PLANT ROADS TO BE 6 METERS WIDTH MINIMUM AND ARE ONE WAY DIRECTIONAL (NOT INCLUDING SITE VEHICLE ACCESS ROADS WITHIN PROCESS AREAS).
- THE LOCATION OF SWITCHROOM AND TRANSFORMERS SHALL BE VERIFIED AS PER THE MINIMUM SAFETY CLEARANCE BETWEEN TRANSFORMERS AND PROCESS AREA DURING DETAILED DESIGN. SAFETY DISTANCE BETWEEN PROCESS EQUIPMENT / PIPING SYSTEM & UNMANNED ELECTRICAL UTILITIES SUCH AS SUBSTATIONS, TRANSFORMER THESE SHALL BE LOCATED BY 30 METERS SEPARATION AWAY REFER TO SAFETY CONCEPT PHILOSOPHY NO. 203869C-025-01-1900-0001_REV. A. THE VERIFICATION ON THE POTENTIAL HAZARD ON FLAMMABLE GAS REMAINING OR FIRE & EXPLOSION RISK SHALL BE PERFORMED IN CONSEQUENT PHASE.

CHANGES	REASON FOR ISSUE	DATE	PREPARED BY	DISCIPLINE	TECHNICAL CHECK	PROJECT APPROVAL
- B	RE-ISSUED FOR FEED	15-07-22	PKH	TUP	AST	AST
- A	ISSUED FOR FEED	08-07-22	PKH	TUP	AST	AST

DOCUMENT CONFIDENTIALITY CLASSIFICATION	INTERNAL N/A	TREATMENT	N/A	COPYING	N/A
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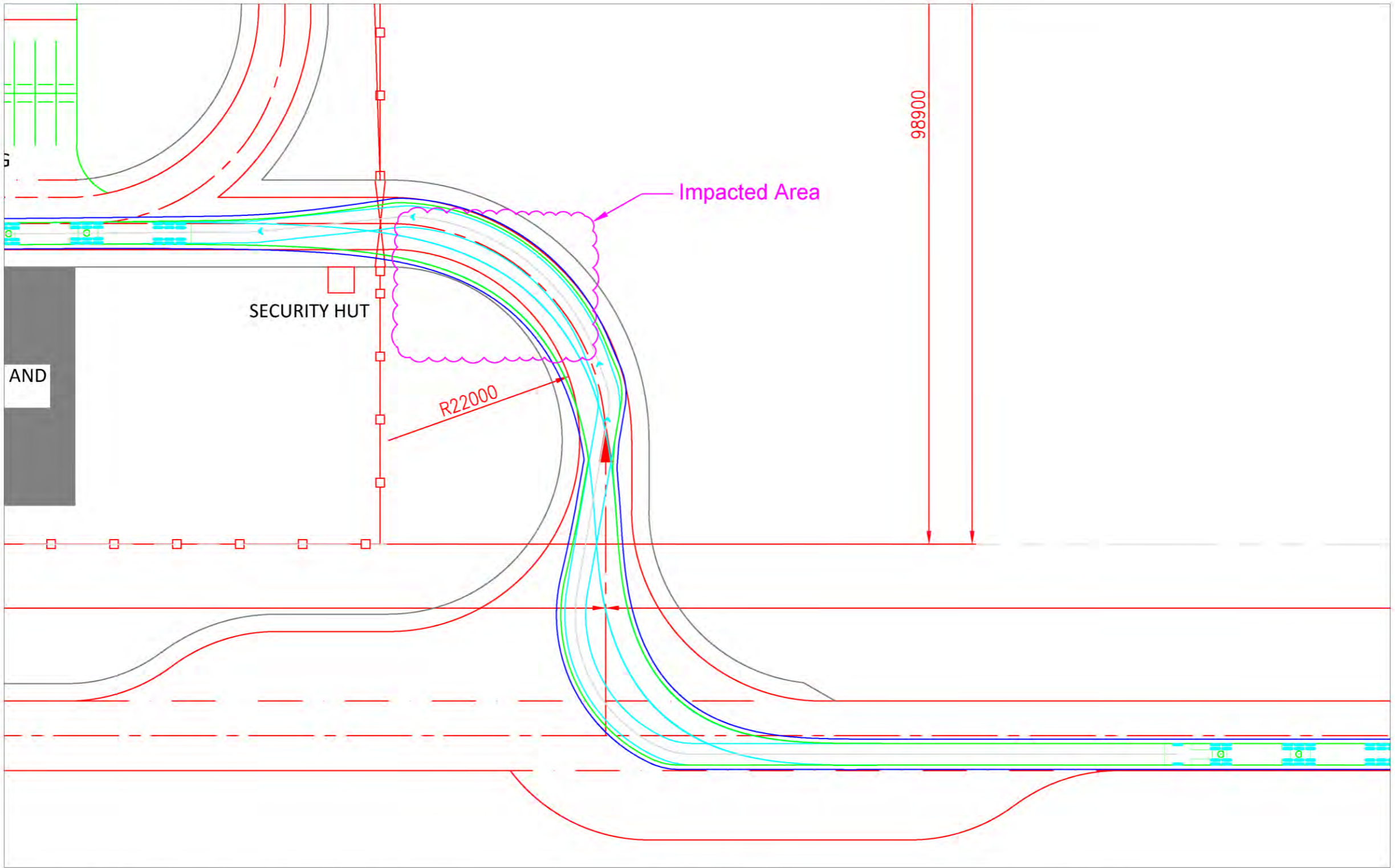
MANUAL CAD

TITLE: RENEWABLE DIESEL BIOREFINERY PROJECT
GENERAL
OVERALL PLOT PLAN-NEW

SCALE: 1:1000
DRAWING SET: A1
DRAWING NUMBER: 203869C-045-DW-0051-0001
SHEET No: 1 OF 1
REV: B




Appendix B

TURN PATH ANALYSIS



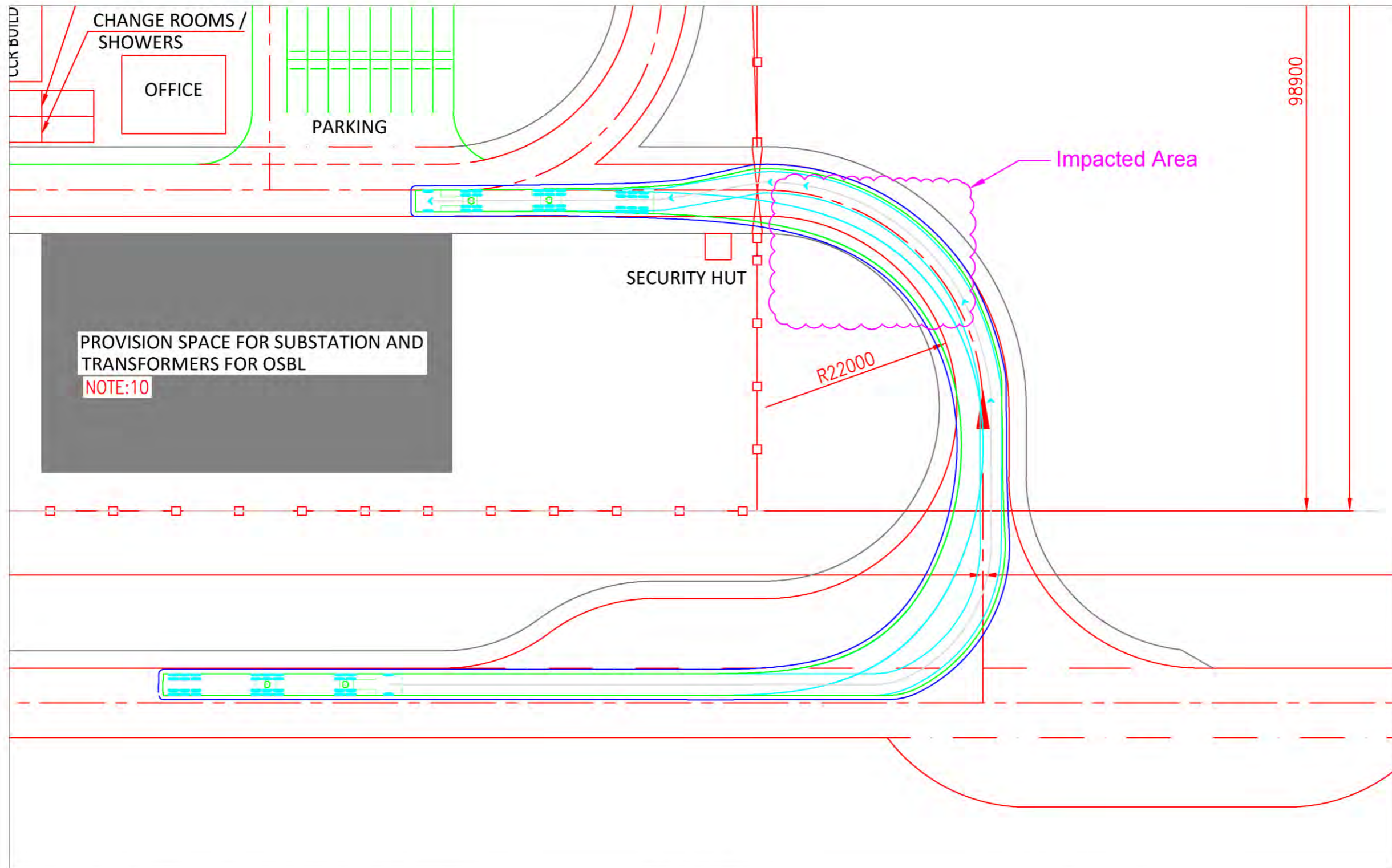
Lot 31 Great Southern Hwy, Dumberning
 27.5m Semi-Trailer
 Truck right-in movement

LEGEND

Vehicle Body	
Wheel Path	
500mm Clearance	

t22.109.sk01
 11/08/2022
 Scale: 1:400 @ A3



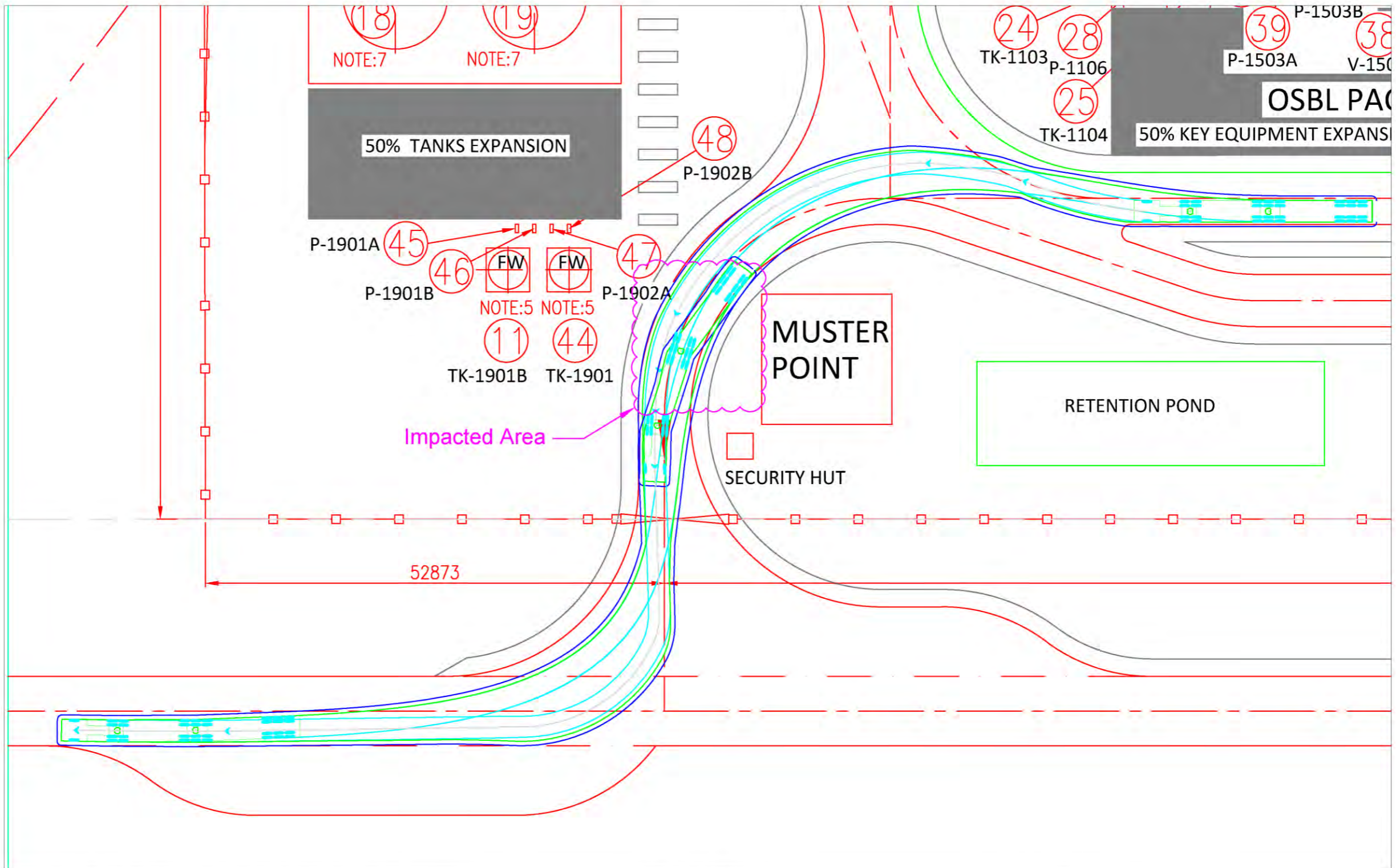


Lot 31 Great Southern Hwy, Dumberning
 27.5m Semi-Trailer
 Truck left-in movement

LEGEND
 Vehicle Body
 Wheel Path
 500mm Clearance

t22.109.sk02
 11/08/2022
 Scale: 1:400 @ A3



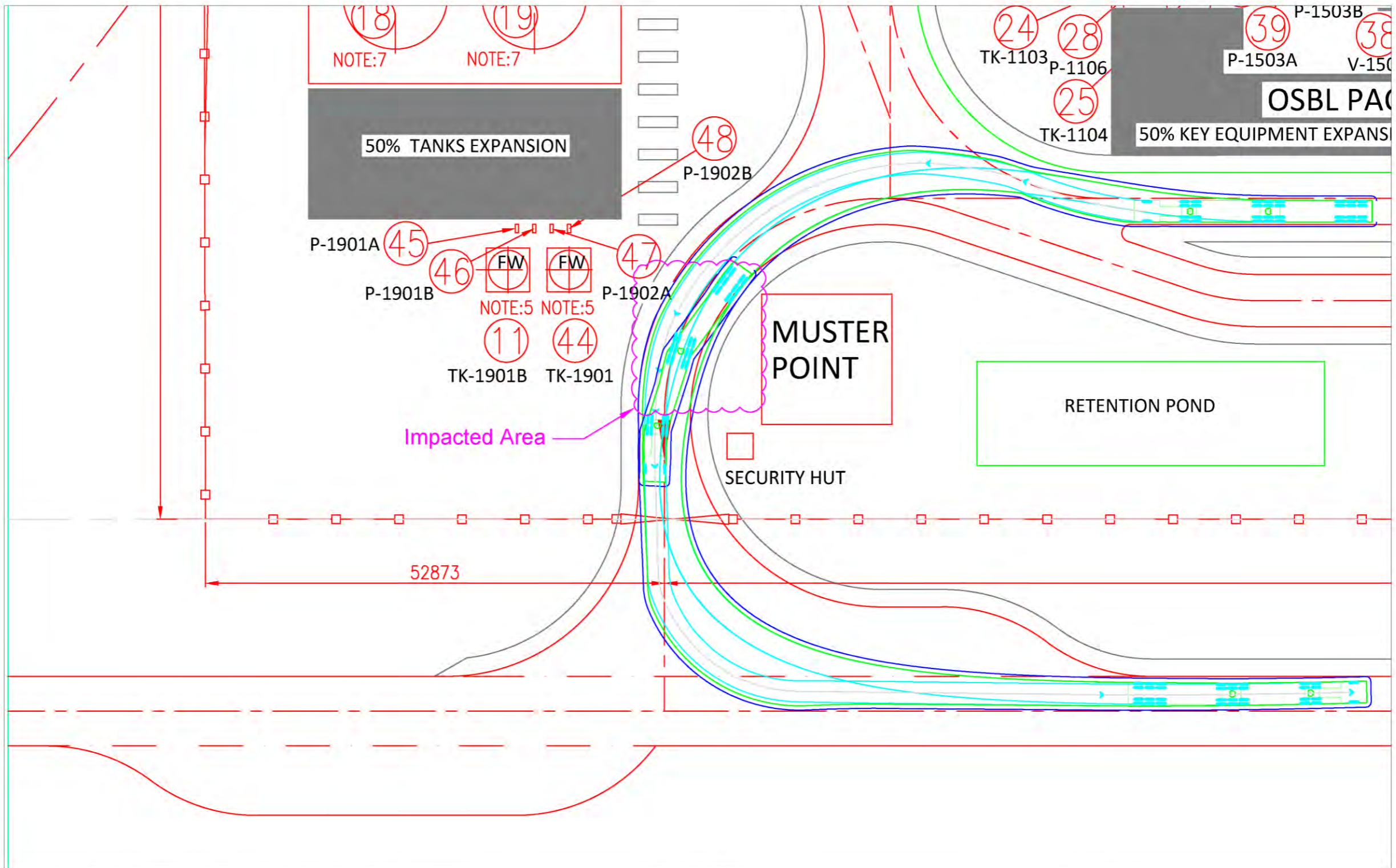


Lot 31 Great Southern Hwy, Dumberning
 27.5m Semi-Trailer
 Truck right-out movement

LEGEND
 Vehicle Body
 Wheel Path
 500mm Clearance

t22.109.sk03
 11/08/2022
 Scale: 1:400 @ A3





Lot 31 Great Southern Hwy, Dumberning
 27.5m Semi-Trailer
 Truck left-out movement

LEGEND
 Vehicle Body
 Wheel Path
 500mm Clearance

t22.109.sk04
 11/08/2022
 Scale: 1:400 @ A3





Appendix 8

Bushfire Management Plan

Bushfire management plan/Statement addressing the Bushfire Protection Criteria coversheet

Site address:

Site visit: Yes No

Date of site visit (if applicable): Day Month Year

Report author or reviewer:

WA BPAD accreditation level (please circle):

Not accredited Level 1 BAL assessor Level 2 practitioner Level 3 practitioner

If accredited please provide the following.

BPAD accreditation number: Accreditation expiry: Month Year

Bushfire management plan version number:

Bushfire management plan date: Day Month Year

Client/business name:

	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)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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 bushfire protection criteria elements)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Is the proposal any of the following (see [SPP 3.7 for definitions](#))?

	Yes	No
Unavoidable development (in BAL-40 or BAL-FZ)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Strategic planning proposal (including rezoning applications)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
High risk land-use	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Vulnerable land-use	<input type="checkbox"/>	<input checked="" type="checkbox"/>

None of the above

Note: Only if one (or more) of the above answers in the tables is yes should the decision maker (e.g. local government or the WAPC) refer the proposal to DFES for comment.

Why has it been given one of the above listed classifications (E.g. Considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

Method 2 calculate 2kW/m2 and 12kW/m2 radiant heat flux buffers. BAL ratings were calculated using Method 1. The proposal is for a biodiesel production facility which is considered a High Risk Land Use.

The information provided within this bushfire management plan to the best of my knowledge is true and correct:

Signature of report author or reviewer



Date



Renewable Diesel Biorefinery Project (Narrogin)

Bushfire Management Plan (BMP)



Lot 31 Great Southern Highway
Dumberning 6312

Shire of Narrogin

Development Application

10 October 2022

Job Reference No: 220437

BPP GROUP PTY LTD T/A BUSHFIRE PRONE PLANNING

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Cameron Leckey	cameron@riseurban.com.au	1.0	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<p><i>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.</i></p> <p><i>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.</i></p> <p><i>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.</i></p> <p><i>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.</i></p> <p><i>Copyright © 2022 BPP Group Pty Ltd: All intellectual property rights, including copyright, in format and proprietary content contained in documents created by Bushfire Prone Planning, remain the property of BPP Group Pty Ltd. Any use made of such format or content without the prior written approval of Bushfire Prone Planning, will constitute an infringement on the rights of the Company which reserves all legal rights and remedies in respect of any such infringement.</i></p>					

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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

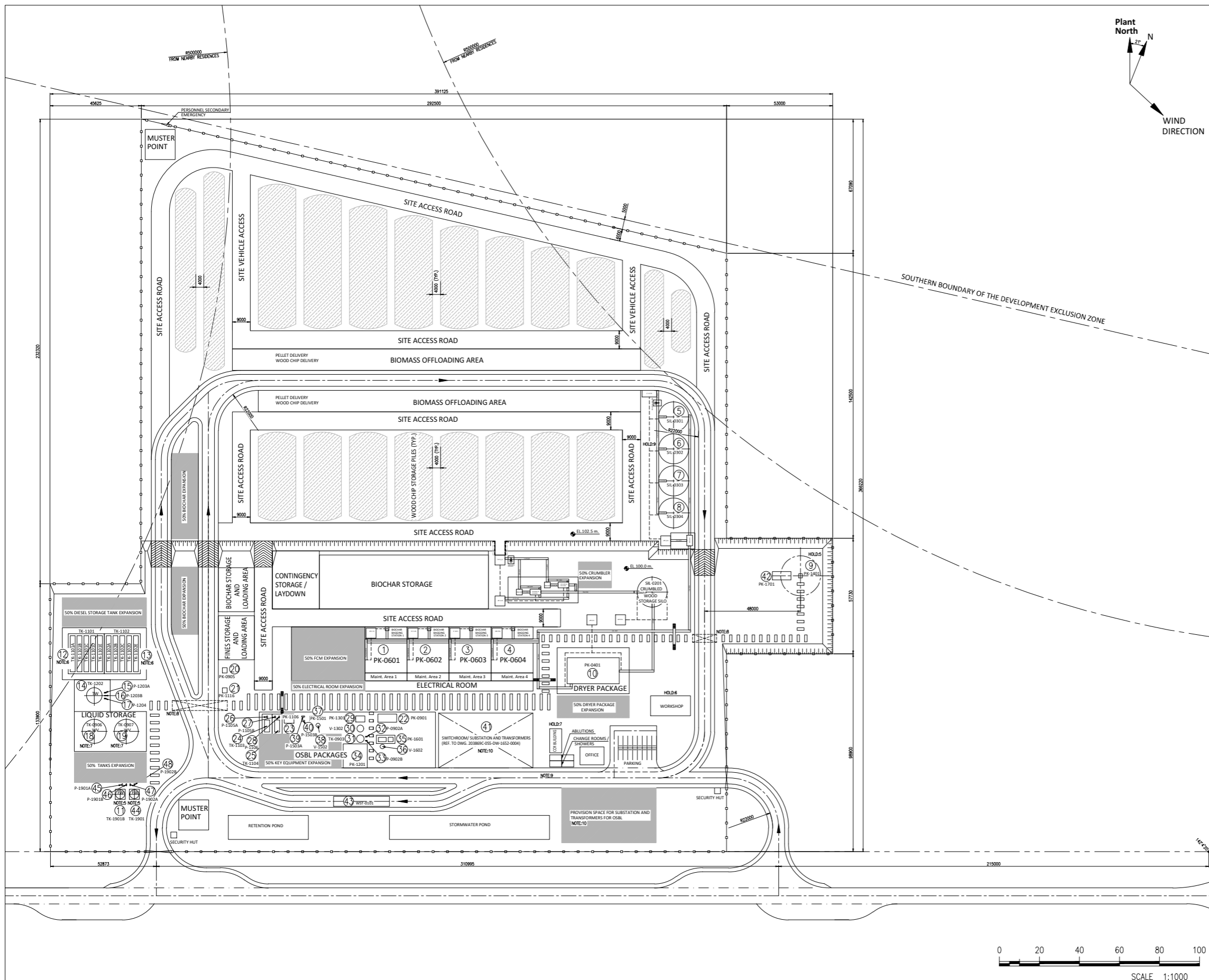
The BMP assesses the capacity of the proposed development or use to implement and maintain the required 'acceptable' solutions and any additionally recommended bushfire protection measures - or its capacity to satisfy the policy intent through the justified application of additional bushfire protection measures as supportable 'alternative' solutions.

THE PROPOSED DEVELOPMENT/USE – BUSHFIRE PLANNING COMPLIANCE SUMMARY		
Environmental Considerations		Assessment Outcome
Will identified environmental, biodiversity and conservation values limit the full application of the required bushfire protection measures?		No
Will 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?		Yes
Required Bushfire Protection Measures The Acceptable Solutions of the Bushfire Protection Criteria (Guidelines)		Assessment Outcome
Element	The Acceptable Solutions	
1: Location	A1.1 Development location	Fully Compliant
2: Siting and Design of Development	A2.1 Asset Protection Zone (APZ)	Fully Compliant
3: Vehicular Access	A3.1 Public roads	Fully Compliant
	A3.2a Multiple access routes	Fully Compliant
	A3.2b Emergency access way	N/A
	A3.3 Through-roads	Fully Compliant
	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	A4.1 Identification of future water supply	N/A
	A4.2 Provision of water for firefighting purposes	Fully Compliant
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). As necessary, relevant outcomes are also captured as responsibilities in this BMP.		Required
Bushfire Risk Assessment and Management Report		Yes
<p>Summary Statement: The proposed development is considered a 'high-risk' land use as defined by SPP 3.7 and its associated Guidelines.</p> <p>This triggers the requirement, through the development of a Risk Assessment and Management Report to:</p> <ul style="list-style-type: none"> 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. <p>The requirement for this report to be developed can be decided by the planning approval decision maker (e.g., the local government). Otherwise, SPP 3.7 states it 'should' be produced.</p>		

1 PROPOSAL DETAILS AND THE BUSHFIRE MANAGEMENT PLAN

1.1 The Proposed Development/Use Details, Plans and Maps

<p>The Proposal's Planning Stage</p> <p>For which certain bushfire planning documents are required to accompany the planning application.</p>		Development Application	
Total Area of Subject Lot/Site		64.6242 hectares	
Primary Proposed Construction	Type(s)	Infrastructure	Biodiesel Refinery
	NCC Classifications	Class 8 (factory/workshop/laboratory)	Class 10a (non-habitable building)
		Class 5 (office building - professionals)	Class 10b (certain structures)
<p>Specific 'Bushfire Planning' Land Use Type</p> <p>When applicable, this classification establishes a requirement to conduct assessments and develop documents that are additional to this Bushfire Management Plan.</p>		High Risk Land Use	
<p>Factors Determining the 'Bushfire Planning' Land Use Type</p>		<p>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).</p> <p>Business operations/activities may include those that are a potential source of ignition for onsite or offsite combustible/flammable materials, including bushfire prone vegetation.</p>	
Description of the Proposed Development/Use			
<p>The proposed Renewable Diesel Biorefinery Project will cover approximately 6 hectares of the subject lot, however the development may be expanded prior to final approval. The development exclusion zone extends 160m north of the facility. The facility will include:</p> <ul style="list-style-type: none"> • Stockpiles of feedstock, consisting of wood chips from blue gum and radiate pine. • Pellet silos (processed feedstock). • Diesel storage tanks (3 x 250KL). • Storage silos of wood vinegar and biochar by-products. • Production modules and associated infrastructure and plant. • Site office and ablutions. • Various infrastructure including a weighbridge, loading areas, electrical rooms, and stormwater and retention ponds. • Provisional area for substation and transformers (not part of the Development Application). <p>A firefighting water supply will be provided with a capacity of 2x 270,000L tanks (540,000L total capacity) with jockey, motor and diesel pumps feeding a ring main, with at least 30 hydrants distributed around the site. Fire hose reels will additionally be installed throughout the site, and automatic sprinkler systems installed on administration buildings.</p> <p>A band of revegetated Class A Forest immediately outside the southern lot boundary is required to be either removed or managed to low threat, requiring agreement, approval, or commitment from the Shire of Narrogin, or amendment of the associated Local Development Plan.</p>			



FACILITY LIST		
NO.	TAG NO.	DESCRIPTION
1	PK-0601	PRODUCTION MODULE 1 (PROVIDED BY ISBL (PPI) VENDOR)
2	PK-0602	PRODUCTION MODULE 2 (PROVIDED BY ISBL (PPI) VENDOR)
3	PK-0603	PRODUCTION MODULE 3 (PROVIDED BY ISBL (PPI) VENDOR)
4	PK-0604	PRODUCTION MODULE 4 (PROVIDED BY ISBL (PPI) VENDOR)
5	SIL-0301	PELLET STORAGE SILO 1
6	SIL-0302	PELLET STORAGE SILO 2
7	SIL-0303	PELLET STORAGE SILO 3
8	SIL-0304	PELLET STORAGE SILO 4
9	PK-1401	THERMAL OXIDIZER INCLUDING WASTE HEAT RECOVERY
10	PK-0401	DRYER PACKAGE 1
11	TK-1901B	FIRE WATER STORAGE TANK B
12	TK-1101	DIESEL STORAGE TANK 1 (NOTE:8)
13	TK-1102	DIESEL STORAGE TANK 2 (NOTE:8)
14	TK-1202	TREATED WATER TANK
15	P-1203A	TREATED WATER PUMP A
16	P-1203B	TREATED WATER PUMP B
17	P-1204	UTILITY WATER PUMP
18	TK-0906	WOOD VINEGAR STORAGE TANK 1 (NOTE:9)
19	TK-0907	WOOD VINEGAR STORAGE TANK 2 (NOTE:9)
20	PK-0905	WOOD VINEGAR LOADING SKID
21	PK-1116	DIESEL LOADING SKID
22	PK-0901	WOOD VINEGAR DISTILLATION MODULE
23	PK-1106	DIESEL CLARIFICATION PACKAGE (PROVIDED BY ISBL (PPI) VENDOR)
24	TK-1103	DIESEL INTERMEDIATE HOLDING TANK 1
25	TK-1104	DIESEL INTERMEDIATE HOLDING TANK 2
26	P-1105A	DIESEL TRANSFER PUMP A
27	P-1105B	DIESEL TRANSFER PUMP B
28	P-1106	OFF-SPEC DIESEL TRANSFER PUMP
29	PK-1301	NITROGEN GENERATION PACKAGE
30	V-1302	NITROGEN RECEIVER
31	TK-0903	WASTE WATER TANK
32	P-0902A	WASTE WATER TRANSFER PUMP A
33	P-0902B	WASTE WATER TRANSFER PUMP B
34	PK-1201	WASTE WATER TREATMENT PACKAGE
35	PK-1601	INSTRUMENT AIR PACKAGE
36	V-1602	INSTRUMENT AIR RECEIVER
37	PK-1501	CHILLED WATER PACKAGE
38	V-1502	CHILLED WATER EXPANSION VESSEL
39	P-1503A	CHILLED WATER PUMP A
40	P-1503B	CHILLED WATER PUMP B
41	-	SWITCH ROOM/SUBSTATION, POWER TRANSFORMER AND DIESEL ENGINE GENERATOR PACKAGE
42	PK-1701	HOT OIL PACKAGE (PROVIDED BY THERMAL OXIDIZER PACKAGE VENDOR)
43	WST-0101	WEIGH STATION
44	TK-1901	FIRE WATER STORAGE TANK
45	P-1901A	FIRE WATER PUMP(DIESEL ENGINE DRIVEN)
46	P-1901B	FIRE WATER PUMP(MOTOR DRIVEN)
47	P-1902A	JOCKEY PUMP(MOTOR DRIVEN) A
48	P-1902B	JOCKEY PUMP(MOTOR DRIVEN) B

- LEGEND:**
- FENCING
 - BIN LINE
 - UNDERGROUND TRENCH
 - SLOPE ROAD
 - □ □ SLEEPERS
 - ||||| SLOPE GRAOUND
- HOLDS:**
- PLANT BOUNDARY, DATUM, COORDINATES & ELEVATION.
 - SECURITY FENCE AREA.
 - PIPE SLEEPER, WIDTH & ELEVATION.
 - SIZING OF SIL-0301/0302, PK-1401, PK-1701, SIL-0201/0301/0302/0303/0304, PK-1401.
 - THE LOCATION SHALL BE CONFIRMED BY FLARE/VENT THERMAL RADIATION AND DISPERSION STUDY REPORT 203869C-025-RT-1900-0001.
 - THE LOCATION SHALL BE CONFIRMED BY FIRE AND EXPLOSION CONSEQUENCE MODELLING (2D) STUDY REPORT 203869C-025-RT-1900-0002.
 - THE SAFETY MITIGATION SHALL BE CONFIRMED BY FIRE AND EXPLOSION CONSEQUENCE MODELLING (2D) STUDY REPORT 203869C-025-RT-1900-0002.
 - THE DIMENSION OF SUBSTATION, TRANSFORMERS AND EMERGENCY DIESEL GENERATOR SHALL BE VERIFIED DURING DETAILED DESIGN.
 - MATERIALS HANDLING LAYOUT AS SUBJECT TO CHANGE PENDING VENDOR DESIGN INPUTS.
 - THE SHELTER/ENCLOSURE DIMENSION AND LAYOUT OF BIOCHAR STORAGE, BIOCHAR STORAGE / LOADING, PINES STORAGE/LOADING, FINE STORAGE, CRUMBLER, PRODUCTION MODULE, DRYER PACKAGE.

NOTE:

- ALL DIMENSIONS ARE IN MILLIMETERS, ALL ELEVATIONS AND ALL COORDINATES ARE IN METERS UNLESS NOTED OTHERWISE.
- PLANT, EL.+100.000 IS EQUIVALENT TO MSL, EL. (HOLD 1).
- THE COORDINATES AT PLANT DATUM ARE N (HOLD 1) AND E (HOLD 1).
- EQUIPMENT SIZING BASE ON MECHANICAL EQUIPMENT LIST(ISBL & OSBL) DOC. NO. 203869C-035-EL-0001 REV. A.
- FW TANK / PUMP STATION SHALL BE AWAY FROM TK-1101, TK-1102, PK-0905 AND FUTURE PROCESS AREA >30 M.
-
-
-
- ALL PIPE SLEEPERS WHEN CROSSING THE ROAD WILL BE RUN UNDERGROUND.
- ALL PLANT ROADS TO BE 6 METERS WIDTH MINIMUM AND ARE ONE WAY DIRECTIONAL (NOT INCLUDING SITE VEHICLE ACCESS ROADS WITHIN PROCESS AREAS).
- THE LOCATION OF SWITCHROOM AND TRANSFORMERS SHALL BE VERIFIED AS PER THE MINIMUM SAFETY CLEARANCE BETWEEN TRANSFORMERS AND PROCESS AREA DURING DETAILED DESIGN.
- SAFETY DISTANCE BETWEEN PROCESS EQUIPMENT / PIPING SYSTEM & UNMANNED ELECTRICAL UTILITIES SUCH AS SUBSTATIONS, TRANSFORMER THESE SHALL BE LOCATED BY 30 METERS SEPARATION AWAY REFER TO SAFETY CONCEPT PHILOSOPHY NO. 203869C-020-JSD-1900-0001 REV. A.
- THE VERIFICATION ON THE POTENTIAL HAZARD ON FLAMMABLE GAS REACHING OR FIRE & EXPLOSION RISK SHALL BE PERFORMED IN CONSEQUENT PHASE.

CHANGE NO.	REV	REASON FOR ISSUE	DATE	PREPARED BY	DISCIPLINE CHECK	TECHNICAL INTEGRITY	PROJECT APPROVAL
-	B	RE-ISSUED FOR FEED	15-07-22	PKH	TUP		AST
-	A	ISSUED FOR FEED	08-07-22				AST

DOCUMENT CONFIDENTIALITY CLASSIFICATION	MATERIAL	TREATMENT	COATING	WEIGHT
CONFIDENTIAL-NOT TO DISCLOSE WITHOUT AUTHORISATION.	N/A	N/A	N/A	N/A

TECHNIP ENERGIES DOCUMENT No.	TITLE	REFERENCE DOCUMENTS

RENEWABLE DIESEL BIOREFINERY PROJECT
GENERAL OVERALL PLOT PLAN-NEW

SCALE: 1:1000	DRAWING SIZE: A1	DRAWING NUMBER: 203869C-045-DW-0051-0001	SHEET No.: 1 OF 1	REV.: B
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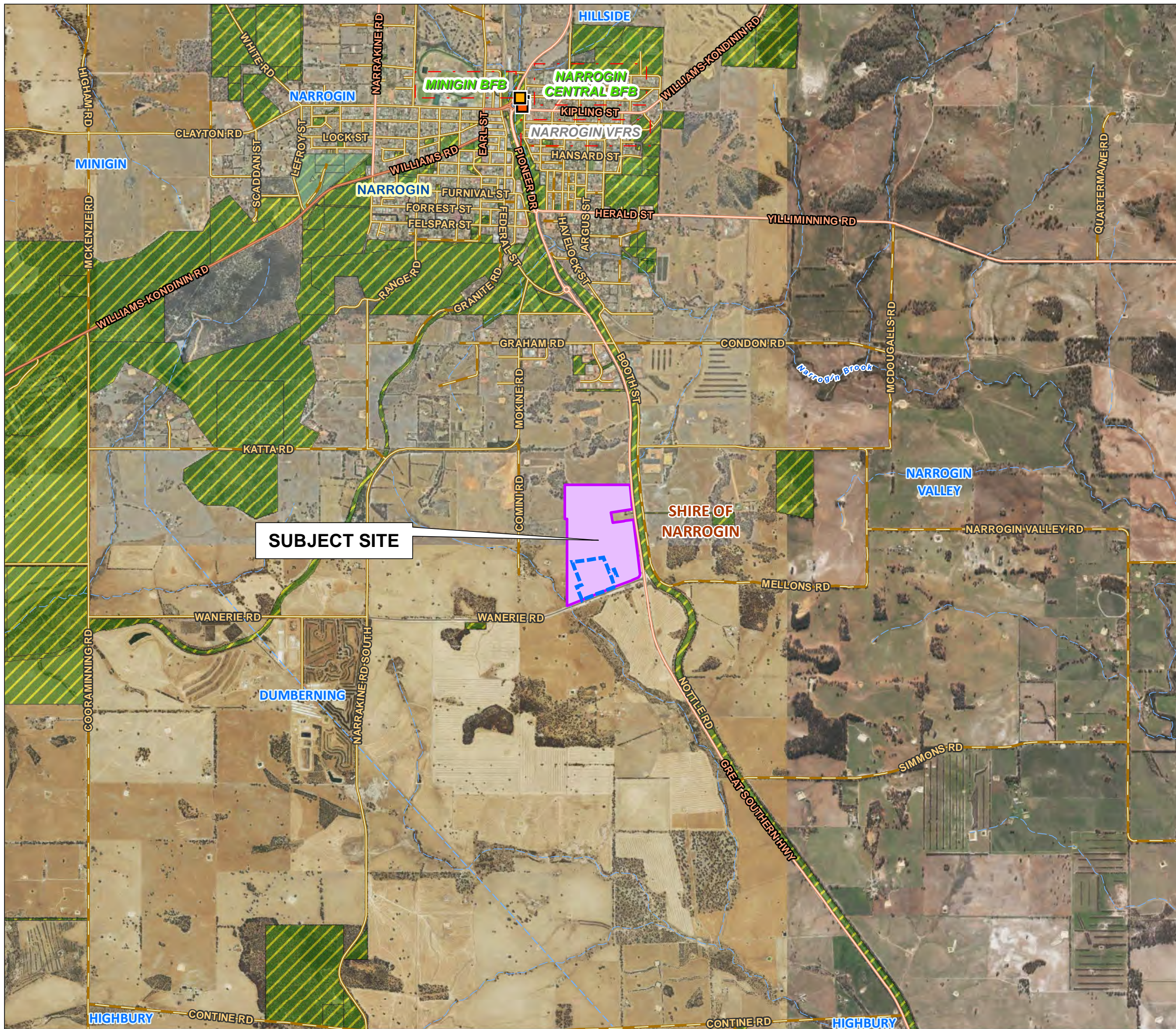
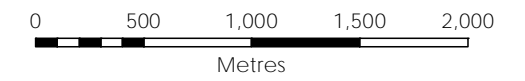


Figure 1.2
Location Plan

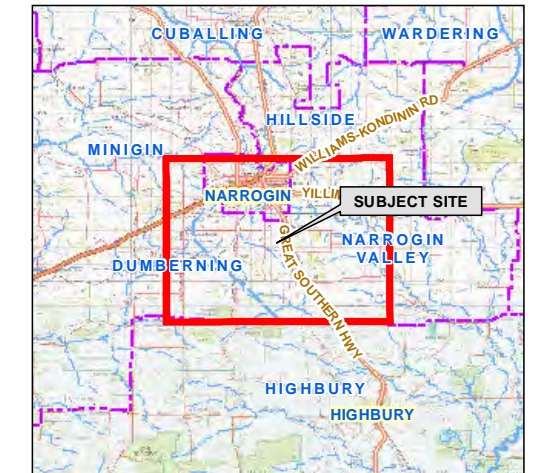
Lot 31 on Plan 4044104, Area : 64.6242 ha
Great Southern Highway
DUMBERNING
SHIRE OF NARROGIN

----- LEGEND -----

- Subject Site
 - Bush Fire Brigade
 - State Emergency Service Unit
 - Volunteer Fire & Rescue Service
 - Development Area
 - Reserves
- Legislated Lands and Waters
- Section 34A Freehold
 - Section 5(1)(g) Reserve
 - Section 5(1)(h) Reserve



----- LOCALITY -----



Aerial Imagery : Landgate/SLIP
Image Date : 2017

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
Map compiled by: Ian Ross 5/10/2022
Map updated by: Neil 5/10/2022
A3 Scale 1:35,000

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 2022\220437 - Lot 31 Great Southern Hwy Dumberning (BMP)\Mapping\MXD\220437_Fig3-2_BAL_Lot31 Great Southern Hwy.mxd

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).

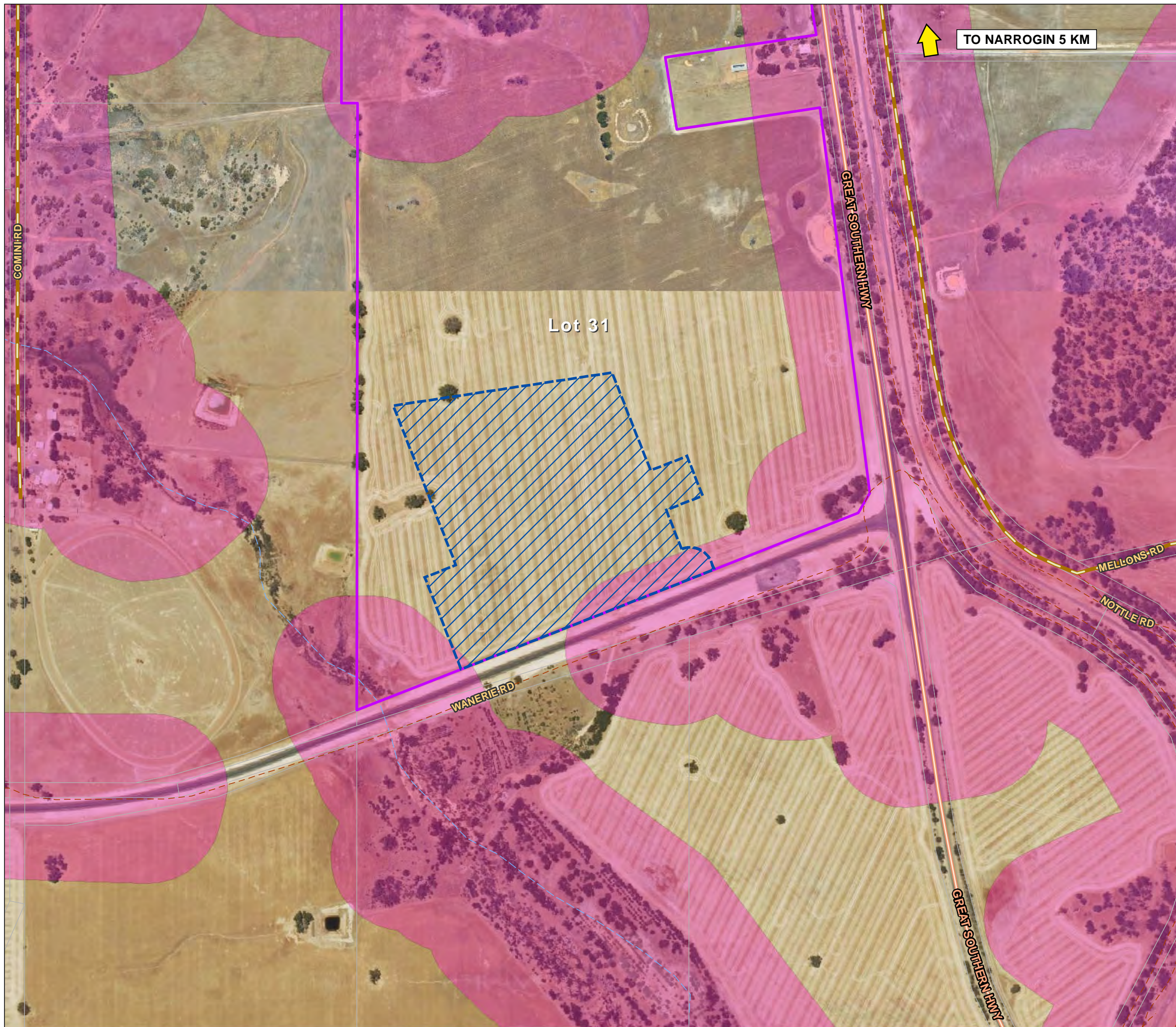




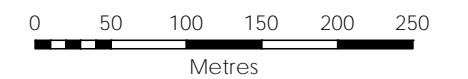


Figure 1.3
Proposed Development

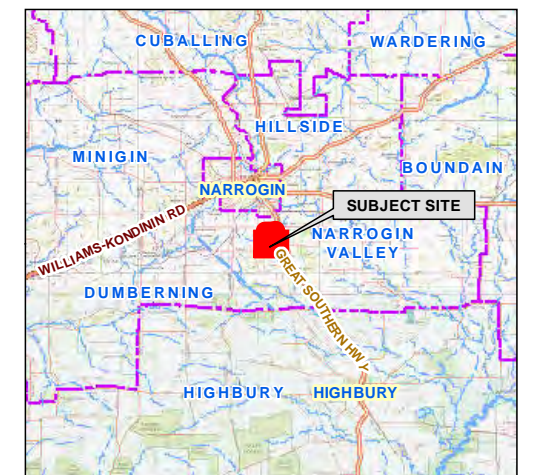
Lot 31 on Plan 4044104, Area : 64.6242 ha
Great Southern Highway
DUMBERNING
SHIRE OF NARROGIN

----- LEGEND -----

-  Subject Site
-  Other Lots
-  Development Area
- Bush Fire Prone Areas**
-  Bushfire Prone Areas (2021)



----- LOCALITY -----



Aerial Imagery : Landgate/SLIP
Image Date : 2017

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
Map compiled by: Ian Ross 1/08/2022
Map updated by: Ian Ross 1/08/2022
A3 Scale 1:5,000



1.2 The Bushfire Management Plan (BMP)

1.2.1 Commissioning and Purpose

Landowner / proponent:	Carnarvon Petroleum LTD
Bushfire Prone Planning commissioned to produce the BMP by:	Rise Urban
Purpose of the BMP:	To apply the requirements established by State Planning Policy 3.7: Planning in Bushfire Prone Areas (SPP 3.7) and accompany the development application.
BMP to be submitted to:	Shire of Narrogin

1.2.2 Existing 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 subject site and the proposal/application. They potentially have implications for the assessment of bushfire threats and the implementation of the protection measures that are dealt with in the Bushfire Management Plan.

Table 1.4: Existing documents that may impact threat assessments and protection measure development.

EXISTING RELEVANT DOCUMENTS			
Existing Document	Relevant to the Proposal and the BMP	Copy Provided by Proponent / Developer	Title
Local Development Plan	Yes	Yes	Local Development Plan: Lot 31 Great Southern Highway, Narrogin (Harley Dykstra; approved by Shire of Narrogin 22/12/2017).
Implications for the BMP: The LDP is considered in the designation of the nature strip/windbreak indicated toward the south of the subject lot. The LDP will require amendment, or agreement or approval provided, by the Shire of Narrogin to allow for the management or removal of this vegetation.			
Bushfire Risk – Assessment and Management Report	Yes	-	220690 – Renewable Diesel Biorefinery Project - Bushfire Risk Assessment and Management Report
Implications for the BMP: The Risk Management Plan 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.			
Site Plan	Yes	Yes	Renewable Diesel Biorefinery Project :General Overview Plot Plan (Technip Energies; Revision B 15/8/2022)
Implications for the BMP: The bushfire protection measures are developed from the location and layout provided.			
Basis of Design	Yes	Partly	Renewable Diesel Biorefinery Project: Process Basis of Design (Technip Energies; 7/4/2022)
Implications for the BMP: The components and specifications of the proposed facility are considered within the Risk Assessment (hazards, exposures, and vulnerabilities).			
Consequence Modelling	Yes	Yes	Renewable Diesel Biorefinery Project: Fire and Explosion Consequence Modelling (2D) Study Report (Technip Energies; 9/6/2022)

Implications for the BMP: The types of hazards and vulnerabilities of material onsite is sourced from this report.			
Information Note	Yes	N/A	DFES Information Note: Bulk Green Waste Storage Fires (DFES: September 2014)
Implications for the BMP: The Information Note contains the requirements for dimensions and maintenance of bulk green waste. This is the nearest standard to apply to the feedstock piles, and will be complied with unless site-specific design is provided by a specialised consultant.			

2 ENVIRONMENTAL CONSERVATION (DESKTOP ASSESSMENT)

Important: 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 Existing Vegetation on Private Land

2.1.1 Declared Environmentally Sensitive Areas (ESA)

Table 2.1: Identification of relevant ESA.

IDENTIFICATION OF ESA							
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	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None
Bush Forever	No	No	DPLH-022, SPP 2.8	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None
Threatened and Priority Flora + 50m Continuous Buffer	Unlikely	N/A	DBCA-036	Restricted Scale of Data Available (security)	<input type="checkbox"/>	<input type="checkbox"/>	Data not available - confirm with relevant agency
Threatened Ecological Community	Unlikely	N/A	DBCA-038		<input type="checkbox"/>	<input type="checkbox"/>	
Heritage Areas National / World	No	No	Relevant register or mapping	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None
Environmental Protection (Western Swamp Tortoise) Policy 2002	No	No	DWER-062	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None

Comment: Onsite vegetation requiring management/removal is sown pasture (grassland) only: no trees or other vegetation types are included. It is extremely unlikely that any ESA classifications apply to the sown pasture onsite. Offsite management/removal includes remnant forest in the wind break/nature strip designated in the Local Development Plan. This forest was previously cleared and has revegetated within 5 years (2017 Landgate imagery shows cleared land).

3 BUSHFIRE ATTACK LEVEL (BAL) ASSESSMENT

BUSHFIRE ATTACK LEVELS (BAL) - UNDERSTANDING THE RESULTS

The transfer (flux/flow) of radiant heat from the bushfire to a receiving object is measured in kW/m². 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 The BAL Determination Method(s) Applied and the Location of Data and Results

Procedure Method (AS 3959:2018)	Applied to the BAL Assessment	Location of the Site Assessment Data			Location of the Results
		Classified Vegetation and Topography Map(s)	Calculation Input Variables		
			Summary Data	Detailed Data with Explanatory and Supporting Information	
Method 1 (Simplified)	Yes	Figure 3.1.1	Table 3.1	Appendix A1	Assessed Bushfire Attack Levels and/or Radiant Heat Levels BAL Contour Map Table 3.1 Table 3.2 Table 3.3
Method 2 (Detailed)	Yes	Figure 3.1.1	Table 3.1	Appendix A2	
Reasons for the Application of the Method 2 Procedure					
1.	To identify the potential bushfire impact on a specific building element.				
<p>The specific issues associated with the site and/or proposed development that have necessitated the use of the Method 2 procedure:</p> <p>The BAL-29 APZ required for planning approval is not appropriate to High-Risk Land Uses, as BAL Ratings apply to construction requirements for nominated building classes rather than thresholds relevant to another asset type.</p> <p>The Method 2 procedure has been applied for two purposes:</p> <ul style="list-style-type: none"> • To calculate the required APZ to ensure electrical infrastructure is exposed to no greater than 12kW/m2 radiant heat flux (calculated at 1090K), and; 					

- To calculate the area within the proposed development suitable for open-area shelter, being exposed to no greater than 2kW/m² radiant heat flux (calculated at 1200K).

3.1.2 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 Map
The areas of classified vegetation 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, will be the relevant vegetation for the post-development BAL contour map.	Figure No 3.2

Table 3.1: 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 BUSHFIRE ATTACK 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)											
Calculation Variables Corresponding to BAL Determination Method													
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
Area	Class		Applied Range	Measured			12kW	2kW					
			degree range	degrees	degrees	metres			metres	kW/m	metres	% Reduction	
1	(A) Forest	80	Upslope or flat 0	flat 0	0	80	1090 K	1200 K	Default	Default	Default	Default	Default
2	(A) Forest	80	Downslope >0-5	d/slope 1.3	d/slope 1.3	80	1090 K	1200 K	Default	Default	Default	Default	Default
3	(B) Woodland	80	Upslope or flat 0	flat 0	0	80	1090 K	1200 K	Default	Default	Default	Default	Default
4	(B) Woodland	80	Downslope >0-5	d/slope 1.3	d/slope 1.3	80	1090 K	1200 K	Default	Default	Default	Default	Default
5	(G) Grassland	80	Upslope or flat 0	flat 0	0	110	1090 K	1200 K	Default	Default	Default	Default	Default
6	(G) Grassland	80	Downslope >0-5	d/slope 1.3	d/slope 1.3	110	1090 K	1200 K	Default	Default	Default	Default	Default

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 3.2: Vegetation separation distances corresponding to radiant heat levels and illustrated as BAL contours in Figure 3.2.

THE CALCULATED VEGETATION SEPARATION DISTANCES CORRESPONDING TO THE STATED LEVEL OF RADIANT HEAT ¹									
Vegetation Classification		Separation Distances Corresponding to Stated Level of Radiant Heat (metres)							
		Bushfire Attack Level						Maximum Radiant Heat Flux	
Area	Class	BAL-FZ	BAL-40	BAL-29	BAL-19	BAL12.5	BAL-LOW	12 kW/m ²	2 kW/m ²
1	(A) Forest	<16	16-<21	21-<31	31-<42	42-<100	>100	>43	>152
2	(A) Forest	<20	20-<27	27-<37	37-<50	50-<100	>100	>45	>158
3	(B) Woodland	<10	10-<14	14-<20	20-<29	29-<100	>100	>30	>120
4	(B) Woodland	<13	13-<17	17-<25	25-<35	35-<100	>100	>32	>124
5	(G) Grassland	<6	6-<8	8-<12	12-<17	17-<50	>50	>18	>87
6	(G) Grassland	<7	7-<9	9-<14	14-<20	20-<50	>50	>19	>90

¹ All calculation input variables are presented in Table 3.1. The summary 'printouts' of calculation input and output values for each area of classified vegetation are presented in Appendix A.

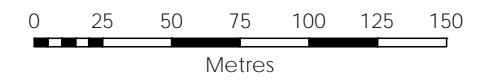
Figure 3.1
Topography & Classified Vegetation

Lot 31 on Plan 4044104, Area : 64.6242 ha
 Great Southern Highway
 DUMBERNING
 SHIRE OF NARROGIN

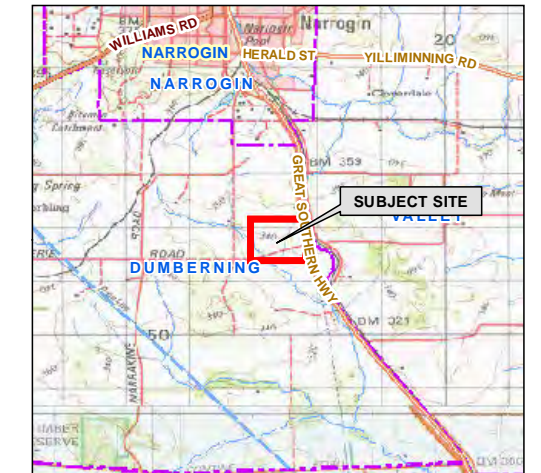


----- LEGEND -----

- Subject Site
- Other Lots
- ← Photo & Direction
- Development
- 150m Vegetation Assessment Area**
- 150m from Subject Site
- Classified Vegetation**
- Class (A) Forest
- Class (B) Woodland
- Class (G) Grassland
- Exempt 2.2.3.2



----- LOCALITY -----



Aerial Imagery : Landgate/SLIP
 Image Date : 2017

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Universal Transverse Mercator Units: Metre
 Map compiled by: Ian Ross 5/10/2022
 Map updated by: Neil 5/10/2022
 A3 Scale 1:2,750

Figure 3.1.7
Topography & Classified
Vegetation (Post Development)

Lot 31 on Plan 4044104, Area : 64.6242 ha
 Great Southern Highway
 DUMBERNING
 SHIRE OF NARROGIN



----- LEGEND -----

- Subject Site
- Other Lots
- Development

Proposed Building

- Class 5
- Class 8
- Class 10a
- Class 10b
- Biochar Storage
- Wood Chip Pile

150m Vegetation Assessment

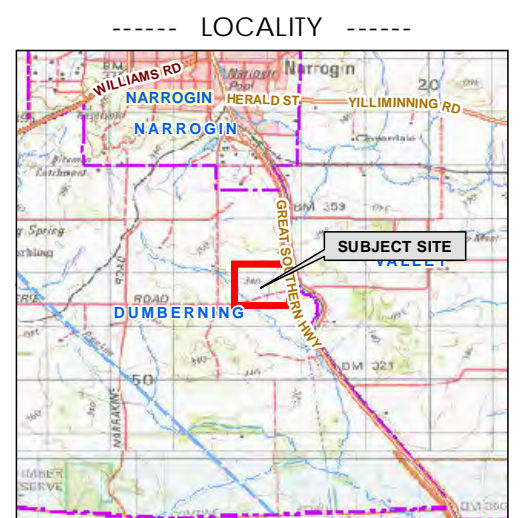
- 150m from Subject Site

Classified Vegetation

- Class (A) Forest
- Class (B) Woodland
- Class (G) Grassland
- Exempt 2.2.3.2

APZ Distance

0 25 50 75 100 125 150
 Metres



Aerial Imagery : Landgate/SLIP
 Image Date : 2017

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Universal Transverse Mercator Units: Metre
 Map compiled by: Ian Ross 5/10/2022
 Map updated by: Neil 5/10/2022
 A3 Scale 1:2,750

Figure 3.2

BAL Contour Map

Lot 31 on Plan 4044104, Area : 64.6242 ha
 Great Southern Highway
 DUMBERNING
 SHIRE OF NARROGIN

----- LEGEND -----

Radiant Heat

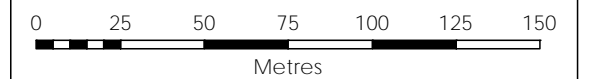
- <2kw Zone (Within Subject Site)
- <12kw Zone (Within Subject Site)
- 2kW Setback
- 12kW Setback
- 100m from Subject Site
- Classified Vegetation Boundary

Proposed

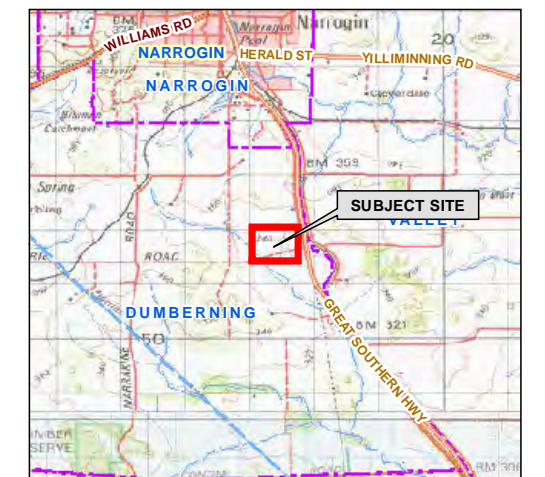
- Class 5
- Class 8
- Class 10a
- Class 10b
- Biochar Storage
- Wood Chip Pile

Indicative Bushfire Attack

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

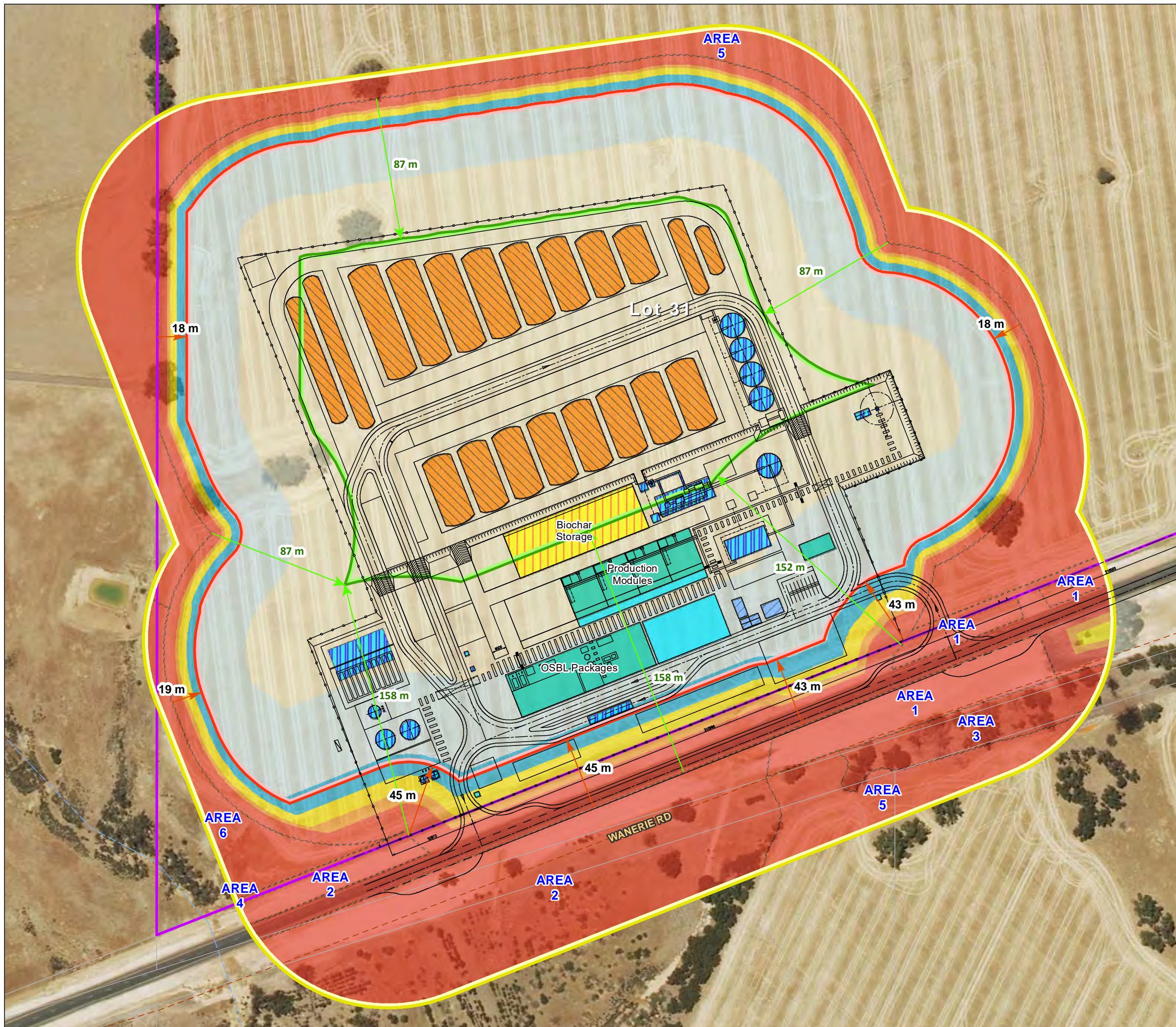


----- LOCALITY -----



Aerial Imagery : Landgate/SLIP
 Image Date : 2017

Coordinate System : GDA 1994 MGA Zone 50
 Projection : Universal Transverse Mercator Units : Metre
 Map compiled by : Ian Ross 5/10/2022
 Map updated by : Neil 5/10/2022
 A3 Scale 1:2,250



3.1.5 BAL Ratings Derived from the Contour Map

Table 3.3: Indicative and determined BAL(s) for existing and/or proposed building works.

BUSHFIRE ATTACK LEVEL FOR EXISTING/PLANNED BUILDINGS/STRUCTURE ¹			
Site Plan Reference	Building/Structure Description	Determined BAL ²	Indicative BAL ²
1-4	Production Modules	BAL-FZ	BAL-LOW
5-8	Pellet Storage Silos	BAL-FZ	BAL-LOW
9	Thermal Oxidizer and Waste Heat Recovery	BAL-FZ	BAL-LOW
10	Dryer Package	BAL-FZ	BAL-LOW
11, 44-48	Fire Water Tanks and Pumps	BAL-FZ	BAL-19
12-13	Diesel Storage Tanks	BAL-FZ	BAL-LOW
14-17	Treated Water Tanks and Pumps	BAL-FZ	BAL-12.5
18-19	Wood Vinegar Tanks	BAL-FZ	BAL-12.5
20-21	Loading Skids	BAL-FZ	BAL-LOW
22-40	OSBL Packages	BAL-FZ	BAL-12.5
41	Switchroom/Substation	BAL-FZ	BAL-12.5
42	Hot Oil Package	BAL-FZ	BAL-LOW
43	Weigh Station	BAL-FZ	BAL-19
-	Wood Chip Piles (Feedstock)	BAL-FZ	BAL-LOW
-	CCR Building	BAL-FZ	BAL-12.5
-	Ablutions	BAL-FZ	BAL-12.5
-	Office	BAL-FZ	BAL-12.5
-	Workshop	BAL-FZ	BAL-12.5
-	Security Hut (West)	BAL-FZ	BAL-29
-	Security Hut (East)	BAL-FZ	BAL-29
-	Biochar Storage	BAL-FZ	BAL-LOW
-	Crumbler	BAL-FZ	BAL-LOW
-	Crumbled Wood Silo	BAL-FZ	BAL-LOW

¹ The assessment data used to derive the BAL ratings is sourced from Table 3.1 and Figure 3.2.
² Refer to the start of Section 3 for an explanation of indicative versus determined BAL ratings.

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 – Environmental Conservation: 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 the element by being fully compliant with all applicable acceptable solutions.
Pathway Applied to Provide an Alternative Solution	N/A
Acceptable Solutions - Assessment Statements	
<p>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.</p>	
Solution Component Check Box Legend	<input checked="" type="checkbox"/> Relevant & met <input checked="" type="checkbox"/> Relevant & not met <input type="checkbox"/> Not relevant
A1.1 Development location	Applicable: Yes Compliant: Yes
ASSESSMENT AGAINST THE REQUIREMENTS ESTABLISHED BY THE GUIDELINES	
<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 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:	
<p>The subject site will achieve compliance by ensuring the development area is subject to potential radiant heat from a bushfire not exceeding 29 kW/m² (i.e., a BAL rating of BAL-29 or less will apply – refer Figures 3.2: BAL Contour Maps). This can be achieved by using positioning, design, and appropriate onsite and offsite vegetation management.</p>	
ASSESSMENTS APPLYING THE GUIDANCE ESTABLISHED BY THE WAPC ELEMENT 1 & 2 POSITION STATEMENT (2019)	
<p>"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."</p> <p>Strategic Planning Proposals: Consider the threat levels from any vegetation <u>adjoining</u> and <u>within</u> 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.</p> <p>Structure Plans (lot layout known) and Subdivision Applications: As for strategic planning proposals but <u>within</u> the subject site the relevant threat levels to consider are the radiant heat levels represented by BAL-FZ and BAL-40 ratings.</p>	
The planning proposal is a development application, consequently the referred to 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 the element by being fully compliant with all applicable acceptable solutions.
Pathway Applied to Provide an Alternative Solution	N/A
Acceptable Solutions - Assessment Statements	
<p>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.</p>	
Solution Component Check Box Legend	<input checked="" type="checkbox"/> Relevant & met <input checked="" type="checkbox"/> Relevant & not met <input type="checkbox"/> Not relevant
A2.1 Asset Protection Zone (APZ)	Applicable: Yes Compliant: Yes
UNDERSTANDING THE APZ <u>PLANNING</u> ASSESSMENT VERSUS APZ <u>IMPLEMENTATION</u> REQUIREMENTS	
<div style="border: 1px solid black; padding: 10px; margin: 10px auto; width: 80%;"> <p><i>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 is to be established and maintained.</i></p> </div>	
<p>To reduce risk to buildings (and indirectly to persons) from a bushfire event, a key bushfire protection measure required to be implemented is reducing the exposure of building elements 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 buildings.</p> <p>This is achieved by separating existing and/or proposed buildings from areas of classified bushfire prone vegetation. The total area of separation is identified as the Asset Protection Zone (APZ), which exists as an area of minimal fire fuels (or no fuel) and is considered able and likely to remain a low threat and/or be maintained to a low threat state in perpetuity. The required separation distances will vary according to the site specific conditions.</p> <p>THE APZ PLANNING ASSESSMENT: To achieve planning approval for this factor it must be demonstrated that separation distances that correspond to a maximum level of radiant transfer to a building (29 kW/m²), either exist or can be established (with certain exceptions). These separation distances are the dimensions of the 'Planning BAL-29' APZ.</p> <p>The purpose of this planning assessment is to identify and justify how this low threat area (the Planning BAL-29' APZ) can exist – or not.</p> <p>THE DIMENSIONS OF THE 'PLANNING BAL-29' APZ MAY EXTEND OUTSIDE SUBJECT LOT BOUNDARIES. THE APZ MAY NOT BE EQUIDISTANT AROUND A BUILDING AS THE REQUIRED SEPARATION DISTANCES DEPEND ON THE TYPE OF VEGETATION PRESENT IN EACH DIRECTION ALONG WITH OTHER SITE VARIABLES.</p> <p>IT IS IMPORTANT TO UNDERSTAND THAT THE 'PLANNING BAL-29' APZ IS NOT NECESSARILY THE SIZE OF THE APZ THAT MUST BE PHYSICALLY ESTABLISHED AND MAINTAINED BY A LANDOWNER. IT IS A SCREENING TOOL FOR MAKING PLANNING APPROVAL DECISIONS.</p>	

THE APZ TO BE IMPLEMENTED: The required dimensions to be established and maintained by the landowner will be those that correspond to the determined BAL rating of a relevant building but limited to the land of the subject lot (with limited exceptions). The requirement for a greater dimension within a lot will only exist if it is required by the relevant local government's annual firebreak / hazard reduction notice or the APZ size is increased as an additional bushfire protection measure as a recommendation of this BMP.

Within this BMP it is the 'Planning BAL-29' APZ that will be identified on maps, diagrams and in tables as necessary.

The exceptions are the data provided in Appendix B part B1 and when a Property Bushfire Management Statement is required to be produced for a development application, in which case the '**Landowner**' APZ dimensions will be shown on the site map (refer to s6.3.1 when relevant).

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/m².

Notes:

When established by the relevant decision maker, the meeting of this requirement may also apply to proposed non-habitable buildings and other structures.

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 BA-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 low threat vegetation and non-vegetated areas.

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 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).

Subdivision Staging: There are undeveloped future stages of subdivision, containing bushfire prone vegetation, that have been taken into consideration for their potentially 'temporary' impact on the ability to establish a 'Planning BAL-29' APZ on adjoining developed lots. A staging plan is developed to manage this.

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:

Future development on the subject site can be surrounded by an APZ that will ensure the potential radiant heat impact of a bushfire does not exceed 29 kW/m² (BAL-29). The required APZ specifications of width, location and management can be achieved. The APZs to be installed exceed the minimum BAL-29 required for planning approval. See Section 5.7.

The 'Planning BAL-29 APZ' can be contained entirely within the subject lot, however the recommended/intended APZ will extend beyond the lot boundary. Onsite vegetation will be required to be modified/removed, the authority for which will need to be received from the local government.

A band of revegetated Class A Forest immediately outside the southern lot boundary is required to be either removed or managed to low threat, requiring agreement, approval, or commitment from the Shire of Narrogin, or amendment of the associated Local Development Plan.

The APZ is expected to be entirely non-vegetated (sealed, developed, or mineral earth). Any retained vegetation 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 Load 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 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 the element by being fully compliant with all applicable acceptable solutions.
Pathway Applied to Provide an Alternative Solution	N/A
Acceptable Solutions - Assessment Statements <i>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 2 and 3. 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).</i>	
Solution Component Check Box Legend	<input checked="" type="checkbox"/> Relevant & met <input checked="" type="checkbox"/> Relevant & not met <input type="checkbox"/> Not relevant
A3.1 Public roads	Applicable: Yes Compliant: Yes
<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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).
<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	A traversable verge is available adjacent to classified vegetation (Guidelines, E3.1), as recommended.
Supporting Assessment Details: The existing road network surrounding the subject site provides public and emergency vehicles with a suitable trafficable transport route. The construction technical requirements established by the Guidelines and/or the local government have and will be complied with.	
A3.2a Multiple access routes	Applicable: Yes Compliant: Yes
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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.

<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>The two-way access <u>is</u> available at an intersection no greater than 200m from the relevant boundary of each lot, via a no-through road.</p>
<p>The two-way access is <u>not</u> 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:</p> <p><input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/> <ul style="list-style-type: none"> • 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/m²). </p>	
<p>Supporting Assessment Details:</p> <p>The site is located on the corner of Great Southern Highway and Wanerie Road, both providing access and egress to two different directions. All roads meet the requirements outlined within the Guidelines, which ensures all vehicle types under all anticipated weather conditions can use these roads.</p>	
<p>A3.2b Emergency access way</p>	<p>Applicable: No Compliant: N/A</p>
<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>The proposed or existing EAW provides a through connection to a public road.</p>
<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>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.</p>
<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>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.</p>
<p>A3.3 Through-roads</p>	<p>Applicable: Yes Compliant: Yes</p>
<p><input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> All public roads should be through-roads.</p>	
<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>A no-through public road is necessary as no alternative road layout exists due to site constraints.</p>
<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>The no-through public road length does not exceed the established maximum of 200m to an intersection providing two-way access (Guidelines, E3.3).</p>
<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>The no-through public road exceeds 200m but satisfies the exemption provisions of A3.2a as demonstrated in A3.2a above.</p>
<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>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.</p>
<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>The turnaround area requirements (Guidelines, Figure 24) can and will be complied with.</p>
<p>Supporting Assessment Details: Great Southern Highway and Wanerie Road are Through-roads.</p>	
<p>A3.4a Perimeter roads</p>	<p>Applicable: No Compliant: N/A</p>
<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>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.</p>
<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="radio"/>	<p>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:</p>

<ul style="list-style-type: none"> • 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. 			
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="radio"/>	The technical construction requirements of widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.4a) can and will be complied with.
A3.4b Fire service access route		Applicable:	No Compliant: N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="radio"/>	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.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="radio"/>	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.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="radio"/>	The FSAR can and will be signposted. Where gates are required by the relevant local government, the specifications can be complied with.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="radio"/>	Turnaround areas (to accommodate type 3.4 fire appliances) can and will be installed every 500m on the FSAR.
A3.5 Battle-axe access legs		Applicable:	No Compliant: N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="radio"/>	A battle-axe leg cannot be avoided due to site constraints.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="radio"/>	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.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="radio"/>	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.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="radio"/>	Passing bays can and will be installed every 200m with a minimum length of 20m and a minimum additional trafficable width of 2m.
A3.6 Private driveways		Applicable:	Yes Compliant: Yes
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="radio"/>	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.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	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.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Passing bays can and will be installed every 200m with a minimum length of 20m and a minimum additional trafficable width of 2m.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The turnaround area requirements (Guidelines, Figure 28, and within 30m of the habitable building) can and will be complied with.
Supporting Assessment Details:			
The development area will provide sufficient space, access, passing bays, and turnaround area (within 30m of development site) for any vehicle type. The internal road network proposed includes both perimeter and internal roads which at a minimum meet the specifications for A3.6 Private Driveways, refer to Figure 1.1.			

The construction technical requirements established by the Guidelines and/or the local government can and will be complied with. These requirements are set out in Appendix C.

5.6 Assessment Statements for Element 4: Water

FIREFIGHTING 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 the element by being fully compliant with all applicable acceptable solutions.
Pathway Applied to Provide an Alternative Solution	N/A
<p>Acceptable Solutions - Assessment Statements</p> <p><i>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.</i></p> <p><i>The technical construction requirements for access types and components, and for each firefighting water supply component, are also presented in Appendices 2 and 3. 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).</i></p>	
Solution Component Check Box Legend	<input checked="" type="checkbox"/> Relevant & met <input checked="" type="checkbox"/> Relevant & not met <input type="checkbox"/> Not relevant
A4.1 Identification of future firefighting water supply	Applicable: No Compliant: N/A
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	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.
A4.2 Provision of water for firefighting purposes	Applicable: Yes Compliant: Yes
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 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.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 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.
<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> A static water supply (tank) for firefighting purposes will be installed that is additional to any water supply that is required for drinking and other domestic purposes.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 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.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 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:

Two 270,000L firefighting water tanks (total capacity 540,000L) are proposed for the facility. A jockey pump and separate motor-driven and diesel water pumps will supply the ring main, with at least 30 water hydrants to be installed throughout the site.

For Class 1-10 buildings, the requirement applied is 10,000L per building or 50,000L per 25 buildings. The proposed facility includes <25 Class 1-10 buildings and thus a supply of 50,000L is appropriate.

The Guidelines for Planning in Bushfire Prone Areas does not establish a firefighting water requirement for High-Risk Land Uses, however the nominal recommended supply is 50,000L for large-scale developments to combat the bushfire and consequential fires. The 540,000L supply currently proposed must be considered ample for bushfire purposes.

Additional Bushfire Protection Measures in relation to the water supply have been developed through the Risk Assessment process and are applied in Section 5.7.

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 from five potential sources:

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; or
5. As a recommendation from the bushfire consultant.

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.

5.7.1 Additional Protection Measures Derived from Associated Bushfire Risk Management Documents

For the proposed development, associated risk management documents may exist or be concurrently developed with this BMP. In such instances, these may identify additional protection measures that are to be implemented by the proposed development. Primary sources of these additional protection measures include:

1. A Bushfire Emergency Plan (and the associated supporting information document when its development has been necessary); and/or
2. A Risk Assessment and Management Report.

The relevant protection measures to be applied are stated below. Where the detail is too great, a summary may be provided, and the document referenced as the location of the complete detail.

The responsibilities created by these measures are incorporated into Section 6 of this BMP as necessary.

SUMMARY OF ADDITIONAL BUSHFIRE PROTECTION MEASURES

No.	Description of the Protection Measure to Apply to the Proposed Development	The Protection Principle Being Applied		The Assessment or Document Establishing the Application of the Protection Measure	The Element and Associated Acceptable Solution(s) the Measure will Address	Application Status
		Type	Relevant Mode of Action			
1	To the greatest extent practical, apply the construction requirements (and /or their principles) that correspond to the assessed BAL rating of Class 1-9 structures (see Section 3.1.5). These requirements are established by AS 3959:2018 and/or the NASH Standard (NS 300 2021) – Steel framed construction in bushfire areas (for Class 1 buildings).	Threat Reduction	N/A	A recommendation from the bushfire consultant.	N/A	Recommended only. Future inclusion in responsibilities (Section 6) will be dependent on the planning decision maker establishing a condition.
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	N/A			
		Vulnerability Reduction – Buildings/Structures	Design and Construction (Materials)			
2	The <12kW/m2 radiant heat flux buffer provided within the BMP includes all structures within the proposed facility, and thus electrical and plumbing elements are unlikely to be compromised. As a recommended additional measure, shield exposed electrical cabling and plumbing (throughout the site and not within a structure profile) from radiant heat and consequential fire where possible/practical, by either: <ul style="list-style-type: none"> • Burying underground; • Encasing the cables within a non-combustible material, • Enclosing within a structure, or; • Installing a solid barrier (colourbond fence) between the relevant components and the vegetation (bushfire) hazard. This barrier 	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	N/A	Recommended only. Future inclusion in responsibilities (Section 6) will be dependent on the planning decision maker establishing a condition.
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	N/A			
		Vulnerability Reduction – Buildings/Structures	Design and Construction (Materials)			

	<p>should be installed within 2m of the exposed components and to a height of 1.5m or greater.</p> <p>This does not apply to suitably encased elements, or those which are non-combustible (e.g. steel plumbing).</p>					
3	It is recommended non-combustible elements are included in structure design/construction where practical.	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	N/A	Recommended only. Future inclusion in responsibilities (Section 6) will be dependent on the planning decision maker establishing a condition.
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	N/A			
		Vulnerability Reduction – Buildings/Structures	Design and Construction (Materials)			
4	Where a Class 1-10 building is enclosed, it is recommended that the structure applies ember screening to openings to roof, wall, or internal cavities. Screening should have an aperture of <2mm and be corrosion-resistant steel, bronze, or aluminium.	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	N/A	Recommended only. Future inclusion in responsibilities (Section 6) will be dependent on the planning decision maker establishing a condition.
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	N/A			
		Vulnerability Reduction – Buildings/Structures	Design and Construction (Materials)			
5	Where installed, sprinkler systems are recommended to be automatically activated.	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	Element 4 A4.2	Recommended only. Future inclusion in responsibilities (Section 6) will
		Exposure Reduction	N/A			

		Vulnerability Reduction - Persons	N/A			be dependent on the planning decision maker establishing a condition.
		Vulnerability Reduction – Buildings/Structures	Firefighting Capability			
6	<p>At the detailed design stage, it is recommended that designs are investigated for:</p> <ul style="list-style-type: none"> Roof/building complexities which may trap debris or collect embers Cabling/piping contacting the ground or any arrangement of associated structures creating a 'pocket' for accumulation of debris. <p>These complexities are recommended to be removed, enclosed, or filled with non-combustible material (such as mineral earth) where practical. Consideration should be given to making the arrangement self-cleaning through wind action to the greatest extent possible. Functionally this means preventing details which may accumulate leaf litter which will not naturally be cleared by wind.</p>	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	N/A	Recommended only. Future inclusion in responsibilities (Section 6) will be dependent on the planning decision maker establishing a condition.
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	N/A			
		Vulnerability Reduction – Buildings/Structures	Design and Construction (Materials)			
7	Water tanks are required to be constructed from concrete or steel, and routes to water tanks must be clearly signed at site access.	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	Element 4 A4.2	Required and will be established in the responsibilities (Section 6).
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	A Bushfire Emergency Firefighting Capability Exists (Response)			
		Vulnerability Reduction – Buildings/Structures	Firefighting Capability			

8	Water tanks are recommended to have an external level indicator, and should be positioned >10m from other structures where possible/practical within site constraints.	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	Element 4 A4.2	Recommended only. Future inclusion in responsibilities (Section 6) will be dependent on the planning decision maker establishing a condition.
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	A Bushfire Emergency Firefighting Capability Exists (Response)			
		Vulnerability Reduction – Buildings/Structures	Firefighting Capability			
9	Fire hose reels will be installed throughout the site (final locations to be determined in detailed engineering phase). At a minimum, two fire hose reels must be installed within 70m (10m hose stream and 60m hose lay) of all areas for storage or processing of high-risk storage or processing areas (this does not include wood chip feedstock).	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	Element 4 A4.2	Required and will be established in the responsibilities (Section 6).
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	A Bushfire Emergency Firefighting Capability Exists (Response)			
		Vulnerability Reduction – Buildings/Structures	Firefighting Capability			
10	The APZs required to be established are to extend to at least 100m (to the extent possible) from all high-risk plant, infrastructure, and use areas. The woodchip piles (feedstock) are also to comply with this APZ, to the extent possible within the lot boundary. Other assets and infrastructure are to comply with the BAL-29 dimensioned APZ required for planning approval, at a minimum.	Threat Reduction	Prevent fire Ignition and/or severity by controlling the fuel.	Bushfire Risk – Assessment and Management Report	Element 2 A2.1	Required and will be established in the responsibilities (Section 6).
		Exposure Reduction	Separation from All Bushfire Threats			
		Vulnerability Reduction - Persons	N/A			
		Vulnerability Reduction – Buildings/Structures	N/A			

11	Removal or permanent management of a portion of Vegetation Areas 1 and 2 (the revegetated forest adjoining the subject lot to the south) will be required to establish the required APZs. The measure will require approval and/or commitment from the Local Government to implement.	Threat Reduction	Prevent fire ignition and/or severity by controlling the fuel.	Bushfire Risk – Assessment and Management Report	Element 2 A2.1	Required and will be established in the responsibilities (Section 6).
		Exposure Reduction	Separation from All Bushfire Threats			
		Vulnerability Reduction - Persons	N/A			
		Vulnerability Reduction – Buildings/Structures	N/A			
12	It is recommended that any security fences or other potential fuel loads will be constructed using non-combustible material. Landscaping (gardens) which may be included within the APZ should avoid use of constructed heavy fuels (e.g. timber sleepers as garden edges, plastic or timber lattice).	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	Element 2 A2.1	Recommended only. Future inclusion in responsibilities (Section 6) will be dependent on the planning decision maker establishing a condition.
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	N/A			
		Vulnerability Reduction – Buildings/Structures	Design and Construction (Materials)			
13	Measures including preparation, responses, and training (including designation of roles such as Fire Wardens) for bushfire events are required to be included in the future site Emergency Management Plan (document title pending).	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	N/A	Required and will be established in the responsibilities (Section 6).
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	A Bushfire Emergency Firefighting Capability Exists (Response)			
		Vulnerability Reduction – Buildings/Structures	Firefighting Capability			

14	Future site Operating Procedures or Emergency Management Plan (document titles pending) identify which (if any) operations are to cease where a bushfire is identified within 10km. The operations identified should be those susceptible to ember attack.	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	N/A	Required and will be established in the responsibilities (Section 6).
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	Provision of Bushfire Emergency Information and Education			
		Vulnerability Reduction – Buildings/Structures	Ensure Effectiveness Of Applied Protection Measures is Maintained			
15	Operating and maintenance procedures are to be developed to ensure regular maintenance of firefighting equipment and clearing of accumulated debris and other consequential fire hazards.	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	N/A	Required and will be established in the responsibilities (Section 6).
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	Provision of Bushfire Emergency Information and Education			
		Vulnerability Reduction – Buildings/Structures	Management And Maintaining Effectiveness Of Applied Protection Measures			
16	The dimensions and setbacks of woodchip piles (feedstock) are to be confirmed at the detailed design stage. The layout and design will be determined by a suitably qualified specialist consultant, or otherwise will meet the specifications outlined in the <i>DFES Information Note: Bulk Green Waste Storage Fires (September 2014)</i> .	Threat Reduction	Prevent fire ignition by controlling heat energy sources.	Bushfire Risk – Assessment and Management Report	Element 2 A2.1	Required and will be established in the responsibilities (Section 6).
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	N/A			

		Vulnerability Reduction – Buildings/Structures	Design and Construction (Materials)			
17	The Narrogin State Emergency Service/Bushfire Brigade is recommended to be invited to inspect and familiarise with the site prior to operation. A manifest is to be provided and made available for future emergencies detailing site fire response procedures and hazards. Additional future invitations may be annual or ad-hoc.	Threat Reduction	N/A	Bushfire Risk – Assessment and Management Report	N/A	Recommended only. Future inclusion in responsibilities (Section 6) will be dependent on the planning decision maker establishing a condition.
		Exposure Reduction	N/A			
		Vulnerability Reduction - Persons	A Bushfire Emergency Firefighting Capability Exists (Response)			
		Vulnerability Reduction – Buildings/Structures	Firefighting Capability			

6 RESPONSIBILITIES FOR IMPLEMENTATION AND MANAGEMENT OF THE BUSHFIRE PROTECTION MEASURES

6.1 Developer / Landowner Responsibilities – Prior to Sale or Operation

DEVELOPER/LANDOWNER RESPONSIBILITIES – PRIOR TO SALE OR OCCUPANCY/OPERATION	
No.	Implementation Actions
1	<p>The local government may condition a development application approval with a requirement for the landowner/proponent to register a notification onto the certificate of title and deposited plan.</p> <p>This will be done pursuant to Section 70A <i>Transfer of Land Act 1893 as amended</i> ('Factors affecting use and enjoyment of land, notification on title'). This is to give notice of the bushfire hazard and any restrictions and/or protective measures required to be maintained at the owner's cost.</p> <p>This condition ensures that:</p> <ol style="list-style-type: none"> 1. Landowners/proponents are aware their lot is in a designated bushfire prone area and of their obligations to apply the stated bushfire risk management measures; and 2. Potential purchasers are alerted to the Bushfire Management Plan so that future landowners/proponents can continue to apply the bushfire risk management measures that have been established in the Plan.
2	<p>Establish the 'Landowner' Asset Protection Zone (APZ) around habitable buildings (and other structures as required) to satisfy:</p> <ul style="list-style-type: none"> • The minimum required dimensions. These are to be the greatest measurements derived from either the separation distances corresponding to the determined BAL rating for the subject building/structure, or the local government's annual firebreak / hazard reduction notice (issued under s33 of the Bushfires Act 1954), or a combination of these requirements [refer to Appendix B]; and • The standards established by the Guidelines DPLH, 2021 v1.4, Schedule 1, or as varied by the local government through their annually issued firebreak / hazard reduction notice when the variations have been endorsed by the WAPC and DFES as per s4.5.3 of the Guidelines. <p>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).</p> <p>This is the responsibility of the developer and landowner.</p>
3	<p>Prior to operations, the subject 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.</p> <p>This may include standards for asset protection zones that differ from Schedule 1 in the Guidelines DPLH, 2021 v1.4, with the intent to better satisfy local conditions.</p> <p>[Refer to the 'Siting and Design' assessments against the Bushfire Protection Criteria and the information presented in Appendix B].</p>
4	<p>Prior to operations, construct the private driveways to comply with the technical requirements referenced in the BMP.</p>
5	<p>Prior to operations, install the required firefighting static water supply to comply with the technical requirements stated in the BMP.</p>

6	<p>Implement 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.</p>
7	<p>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.</p> <p>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).</p>
8	<p>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.</p> <p>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.</p> <p>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.</p> <p>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).</p>

6.2 Landowner / Occupier Responsibilities – Ongoing Management

LANDOWNER/OCCUPIER – ONGOING MANAGEMENT	
No.	Management Actions
1	<p>Maintain the 'Landowner' Asset Protection Zone (APZ) around habitable buildings (and other structures as required) to satisfy:</p> <ul style="list-style-type: none"> The minimum required dimensions. These are to be the greatest measurements derived from either the separation distances corresponding to the determined BAL rating for the subject building/structure, or the local government's annual firebreak / hazard reduction notice (issued under s33 of the Bushfires Act 1954), or a combination of these requirements [refer to Appendix B]; and The standards established by the Guidelines DPLH, 2021 v1.4, Schedule 1, or as varied by the local government through their annually issued firebreak / hazard reduction notice when the variations have been endorsed by the WAPC and DFES as per s4.5.3 of the Guidelines.
2	<p>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.</p>
3	<p>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.</p>
4	<p>Maintain the static firefighting water supply tank and associated pipes/fittings/pump and vehicle hardstand in good working condition.</p>
5	<p>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.</p> <p>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.</p> <p>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.</p> <p>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).</p>
6	<p>Ensure all future buildings the landowner has responsibility for, are designed and constructed in full compliance with:</p> <ul style="list-style-type: none"> 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

	<ul style="list-style-type: none">• Any additional bushfire protection measures this Bushfire Management Plan has established are to be implemented.
7	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.

6.3 Local Government Responsibilities – Ongoing Management

LOCAL GOVERNMENT – ONGOING MANAGEMENT	
No.	Management Actions
1	<p>Monitor landowner compliance with the annual Shire of Narrogin Firebreak and Fuel Hazard Reduction Notice and with any bushfire protection measures that are:</p> <ul style="list-style-type: none"> • Established by this BMP; • Are required to be maintained by the landowner/occupier; and • Are relevant to local government operations.
2	<p>To allow for ongoing management of the vegetation in the adjoining reserve (nature strip/windbreak) as indicated in Figure 3.1.1, the Shire of Narrogin will either:</p> <ul style="list-style-type: none"> • Commit to clearing or ongoing management, or; • Provide formal approval for the clearing or ongoing management by the developer/landowner, or; • Approve (with amendment as necessary) a submitted amendment to the associated Local Development Plan, to redesignate the relevant vegetation or contain within the lot boundary. <p>Where a written management agreement / statement of responsibility is required, this will be provided as an Addendum to this BMP.</p> <p>This ensures the relevant vegetation is a low bushfire threat and is continually managed to a minimal fuel condition in accordance with AS3959:2018 cl2.2.3.2(f) (also refer to BMP Appendix B, B2).</p>

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 cl 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 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:	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				
Effective Slope	Measured	flat 0 degrees	Applied Range (Method 1)	Upslope or flat 0 degrees	
Foliage Cover (all layers)	30-70%	Shrub/Heath Height	N/A	Tree Height	Up to 30m
Dominant & Sub-Dominant Layers (species as relevant)	Forest vegetation characteristics with trees having medium single bole and are moderately spaced. Multi-tiered structure including the lower strata consisting of shrubs and grass.				
Post Development Assumptions:	N/A				
					
PHOTO ID:1			PHOTO ID: 2		
					
PHOTO ID: 3			PHOTO ID: 4		

VEGETATION AREA 2

Classification	A. FOREST				
Types Identified	Open forest A-03				
Effective Slope	Measured	1.3°	Applied Range (Method 1)	Downslope >0-5 degrees	
Foliage Cover (all layers)	30-70%	Shrub/Heath Height	N/A	Tree Height	Over 30m
Dominant & Sub-Dominant Layers (species as relevant)	Forest vegetation characteristics with trees having medium single bole and are moderately spaced. Multi-tiered structure including the lower strata consisting of shrubs and grass.				
Post Development Assumptions:	N/A				



PHOTO ID: 5



PHOTO ID: 6




PHOTO ID: 7




PHOTO ID: 8



PHOTO ID: 9

VEGETATION AREA 3					
Classification	B. WOODLAND				
Types Identified	Woodland B-05				
Effective Slope	Measured	flat 0 degrees	Applied Range (Method 1)	Upslope or flat 0 degrees	
Foliage Cover (all layers)	>30%	Shrub/Heath Height	N/A	Tree Height	Up to 30m
Dominant & Sub-Dominant Layers (species as relevant)	Woodland vegetation characteristics dominated by widely-spaced, spreading medium bole trees and a spreading habit. Single or separated dual-tiered structure including the lower strata consisting of grass and leaf litter.				
Post Development Assumptions:	N/A				
					
PHOTO ID: 10			PHOTO ID: 11		

VEGETATION AREA 4					
Classification	B. WOODLAND				
Types Identified	Woodland B-05				
Effective Slope	Measured	1.3°	Applied Range (Method 1)	Downslope >0-5 degrees	
Foliage Cover (all layers)	>30%	Shrub/Heath Height	N/A	Tree Height	Up to 30m
Dominant & Sub-Dominant Layers (species as relevant)	Woodland vegetation characteristics dominated by widely-spaced, spreading medium bole trees and a spreading habit. Single or separated dual-tiered structure including the lower strata consisting of grass and leaf litter.				
Post Development Assumptions:	N/A				
					
PHOTO ID: 12					

VEGETATION AREA 5						
Classification	G. GRASSLAND					
Types Identified	Sown pasture G-26					
Effective Slope	Measured	0°	Applied Range (Method 1)	Upslope or flat 0 degrees		
Foliage Cover (all layers)	N/A	Shrub/Heath Height	N/A	Tree Height	N/A	
Dominant & Sub-Dominant Layers (species as relevant)	Grassland vegetation characteristics, predominately Single-tiered structure with isolated trees.					
Post Development Assumptions:	N/A					
						
PHOTO ID: 13			PHOTO ID: 14			
						
PHOTO ID: 15			PHOTO ID: 16			
						
PHOTO ID: 17						

VEGETATION AREA 6						
Classification	G. GRASSLAND					
Types Identified	Sown pasture G-26					
Effective Slope	Measured	1.3°	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	N/A	Shrub/Heath Height	N/A	Tree Height	N/A	
Dominant & Sub-Dominant Layers (species as relevant)	Grassland vegetation characteristics, predominately Single-tiered structure with isolated trees.					
Post Development Assumptions:	N/A					
						
PHOTO ID: 18						

EXCLUSION	
Exclusion Clause	2.2.3.2 (f) Low threat vegetation - minimal fuel condition.
Justification:	Gravelled road
	
PHOTO ID: 19	

A1.3: EFFECTIVE SLOPE

Measuring

Effective slope refers to the slope “under the classified vegetation which most significantly influences bushfire behaviour (AS 3959:2018, clause B4, CB4). It is not the average slope.

It is described as upslope, flat or downslope when viewed from the exposed element (e.g., building) looking towards the vegetation – and measured in degrees. Ground slope has a direct and significant influence on a bushfire's rate of spread and intensity, which increases when travelling up a slope.

The slope under the vegetation in closest proximity to the exposed element(s), over the distance that will most likely carry the entire depth of the flaming front, will be a significant consideration in the determination of the effective slope. This distance is determined as a function of the potential quasi-steady rate of spread and expected residence time (i.e., the flaming combustion period at a single point on the ground), of a bushfire in the specific vegetation type/landscape scenario.

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, in accordance with AS 3959:2018 clauses 2.2.5 and C2.2.5.

Slope Variation Due to Multiple Development Sites

When the effective slope, under a given 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).

Differences in Application of Effective Slope - AS 3959:2018 Method 1 versus Method 2 Procedures

The Method 1 procedure provides five different slope ranges from flat (including all upslopes) to 20 degrees downslope to define the effective slope and bushfire behaviour model calculations apply the highest value in each range (i.e., 0°, 5°, 10°, 15° or 20°).

The Method 2 procedure requires an actual slope (up or down in degrees) to be determined. AS 3959:2018, clause B1 limits the effective slope that can be applied to 30 degrees downslope and 15 degrees upslope. Where any upslope is greater than 15 degrees, then 15 degrees is to be used.

SITE ASSESSMENT DETAILS - EXPLANATION & JUSTIFICATION

The effective slopes determined from the site assessment are recorded in Table 3.1 of this Bushfire Management Plan. When their derivation requires additional explanation and justification, this is provided below.

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 3.2 and illustrated as a BAL contour map in Figure 3.2.

A2: BAL Assessment Inputs Applied Using the Method 2 Procedure

STATING AND JUSTIFYING THE METHOD 2 CALCULATION INPUT VARIABLES APPLIED

As 3959:2018 Bal Determination Procedures: AS 3959:2018 establishes the official methodology to determine the radiant heat flux (RHF) a receiver (e.g., a building, structure, person or specified location), will potentially be exposed to from a fully developed bushfire within any adjacent classified vegetation. The methodology accounts for the configuration of a specific site and its surrounds.

The model calculations are complex. Consequently, AS 3959:2018 establishes two pathways to apply the methodology - a simplified procedure (Method 1) and a detailed procedure (Method 2).

Method 1: This procedure has limitations to both its scope and the degree to which site specific conditions can be applied. However, it requires minimal site assessment inputs and provides a standardised output that is satisfactory for many situations.

A moderate level of justification for some of the assessed inputs applied is required. This will demonstrate how the procedure detailed within AS 3959:2018 for Method 1 (Section 2) has been followed.

Method 2: This procedure is used when the site conditions are out of the scope of Method 1 or when it is necessary to produce a more specific result. Higher levels of justification will be required for many of the input variables that are able to be modified using Method 2 (AS 3959:2018 Appendix B).

Section A2.1 below identifies the input variables that have been assessed for the proposed development and indicates the level of justification required for their application. The information contained within this Appendix will provide this justification information to the degree necessary.

A2.1: SUMMARY OF CALCULATION INPUTS APPLIED AND THE LEVEL OF JUSTIFICATION REQUIRED

AS 3959:2018 BUSHFIRE ATTACK LEVEL (BAL) DETERMINATION PROCEDURES INPUT VARIABLES FOR THE FIRE BEHAVIOUR AND RADIATION MODELS						
✓	Indicates which site specific variables have been assessed and applied to the assessment of the proposed development/use.	IDENTIFICATION OF THE CALCULATION INPUT VARIABLES ASSESSED AND/OR MODIFIED FOR THE PROPOSED DEVELOPMENT/USE				
	Indicates an AS 3959 methodology or jurisdiction default variable (or a methodology calculated variable in the case of EOR or flame angle). No justification required.					
Indicates a variable that either must or can have an assessor value applied. Requires justification.						
Indicates a variable that can have an assessor value applied. Requires detailed justification.		Using Method 1		Using Method 2		
ASSESSOR QUALIFICATION REQUIRED ¹		BPAD Level 1		BPAD Level 3		
LEVEL OF JUSTIFICATION REQUIRED TO APPLY ²		None	Moderate	None	Moderate	High
Fire weather	Fire danger index (FDI/FFDI/GFDI)					
	Wind speed					
	Ambient temperature					
	Relative humidity					
Bushfire Prone Vegetation and slope of the land it grows on	Vegetation classification ³					
	Effective slope					
	Understorey and total fuel loads ⁴					
	Vegetation height					
	Fuel age					
Receiver (building) positioning parameters	Site slope					
	Separation distance					
	Elevation of the receiver (EOR).					
Bushfire flame parameters	Flame temperature ⁵					
	Flame width					
	Flame angle					
	Flame emissivity					
	Heat of combustion					
INTERMEDIATE OUTPUT FROM THE FIRE BEHAVIOUR AND RADIATION MODELS						
Rate of Spread - derived from fuel loads, fuel type, fuel height, FDI, effective slope and wind speed.						
Fire Intensity – derived from fuel loads, rate of spread and heat of combustion ⁶						
Path Length – derived from flame angle and separation distance.						
Transmittance – derived from ambient temperature and relative humidity.						
View Factor – derived from flame length, flame width, flame angle, separation distance, elevation of receiver and site slope.						
FINAL OUTPUT OF THE FIRE BEHAVIOUR AND RADIATION MODELS						
Flame Length – derived from fuel loads, ROS (for Forest, Woodland) and fire intensity (for Scrub, Shrubland, Grassland) ⁶						
Radiant Heat Flux and the Corresponding Bushfire Attack Level (BAL) – derived from view factor, flame emissivity, flame temperature, transmittance and corresponding to the worst possible flame angle.						
TABLE NOTES (see next page)						

¹ Authority to Use Method 2: Within WA, use of this procedure is restricted to bushfire practitioners who hold the BPAD Level 3 accreditation as issued by the Fire Protection Association Australia (FPAA) through their Bushfire Planning and Design Accreditation Scheme (BPAD Scheme) that complies with the Western Australian Bushfire Accreditation Framework.

² Level of Justification Required in Applying Method 2: AS 3959:2018 Appendix B establishes the detailed procedure for the Method 2 determination of BAL(s) as consisting of 10 steps. When justification is required for an assessed variable value to be applied, the required level of justification can vary. The level definitions used in this table are:

Moderate: Requires the provision of readily available and understood argument and evidence such as when:

1. The methodology step requires or allows for an input variable to be a site assessed value; or
2. A methodology step requires a jurisdictionally determined value which the relevant authority may change for different land use scenarios; or

High: Requires a detailed argument, appropriate evidence and justification when:

1. The variable is derived from the methodology step that applies an AS 3959:2018 default value or determines an intermediate output value (i.e. the result of applying a step's equations).

³ Applying a Different Vegetation Classification: This approach may be justified when certain characteristics of the site's local vegetation complex align with the broad based descriptions of AS 3959:2018, but expert knowledge identifies characteristics that would result in the applied AS 3959 bushfire behaviour model not being properly representative of a fire in the local vegetation. This potential outcome is in part due to the ecological classification of vegetation that is used in AS 3959 rather than a classification more aligned with fuel structure/fire behaviour.

The justification of using a different classification is predicated on the fact that the intent of classifying vegetation in the BAL determination methodology of AS 3959:2018, is to identify the most appropriate fire behaviour model equations to apply.

For example, with respect to contribution to potential fire behaviour, it is often more important to consider vegetation structure rather than canopy cover, yet canopy cover is a key classification factor applied in AS 3959:2018.

Also findings from more recent bushfire behaviour research is not yet incorporated into the current version of the Standard. Certain currently applied bushfire behaviour models within AS 3959:2018 are outdated and may under or over predict radiant heat flux and flame length.

⁴ Modifying Fuel Loads: Potential steady state maximum fuel loads at a specific site for a given vegetation classification may vary significantly (above and below) from those that are to be applied as the default values in AS 3959:2018.

The Standard only provides the single set of ecological descriptors and corresponding fuel loads that are to be applied to vegetation complexes across Australia, hence its accuracy for all situations will be questionable. The relevant authority for a jurisdiction can establish different fuel loads to be applied.

However, fuel loads for the purposes of determining expected fire behaviour have not currently been determined to the degree necessary in WA, which results in the default values both over and underestimating fuel loads for WA vegetation types. WA DFES in providing advice to decision makers, will currently not accept any assessment and subsequent variation of the default fuel loads. If any variation was to be applied in an assessment, it would need to be argued for based on appropriate evidence and the development of a merit based case to the satisfaction of the decision maker.

The one circumstance where Bushfire Prone Planning will reduce fuel loads is in the calculations associated with a short fire run in forest type vegetation – in which the developing fire will not crown. Therefore, most bark and all canopy fuels can justifiably be excluded from total fuel load.

Note ⁵ - Flame Temperature: The Guidelines (DPLH 2021, v1.4) Section 5.5.3.1.3 and the relevant acceptable solutions within the bushfire protection criteria, establish that the higher flame temperature of 1200 K is to be applied when determining the availability of suitable onsite sheltering options for tourism vulnerable land uses.

Note ⁶ – Fireline Intensity and Flame Length: These values are determined as intermediate and final outputs of the AS 3959:2018 modelling. Changing these values would not be a valid use of the methodology for a fully developed fire. However, for the circumstance of a developing fire in small patches or corridors of vegetation, there may be justification when an authoritative source is identified to provide an override value.

A3: BAL Calculator – Copy of Input/Output Values

DETERMINING 12 kW/m² SEPARATION DISTANCES

<div style="text-align: center;"> <p>Calculated June 20, 2022, 5:46 pm (BALc v.4.9)</p> <p>Area 1</p> <p>Bushfire Attack Level calculator - AS3959-2018 (Method 2)</p> <table border="1"> <thead> <tr> <th colspan="2">Inputs</th> <th colspan="2">Outputs</th> </tr> </thead> <tbody> <tr> <td>Fire Danger Index</td> <td>80</td> <td>Rate of spread</td> <td>2.4 km/h</td> </tr> <tr> <td>Vegetation classification</td> <td>Forest</td> <td>Flame length</td> <td>19.8 m</td> </tr> <tr> <td>Understorey fuel load</td> <td>25 t/ha</td> <td>Flame angle</td> <td>73 °</td> </tr> <tr> <td>Total fuel load</td> <td>35 t/ha</td> <td>Panel height</td> <td>18.93 m</td> </tr> <tr> <td>Vegetation height</td> <td>n/a</td> <td>Elevation of receiver</td> <td>9.460000000000001 m</td> </tr> <tr> <td>Effective slope</td> <td>0 °</td> <td>Fire intensity</td> <td>43,400 kW/m</td> </tr> <tr> <td>Site slope</td> <td>0 °</td> <td>Transmissivity</td> <td>0.783</td> </tr> <tr> <td>Distance to vegetation</td> <td>43 m</td> <td>Viewfactor</td> <td>0.2017</td> </tr> <tr> <td>Flame width</td> <td>100 m</td> <td>Radiant heat flux</td> <td>12.02 kW/m²</td> </tr> <tr> <td>Windspeed</td> <td>n/a</td> <td>Bushfire Attack Level</td> <td>BAL-12.5</td> </tr> <tr> <td>Heat of combustion</td> <td>18,600 kJ/kg</td> <td></td> <td></td> </tr> <tr> <td>Flame temperature</td> <td>1,090 K</td> <td></td> <td></td> </tr> </tbody> </table> <p>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</p> </div>	Inputs		Outputs		Fire Danger Index	80	Rate of spread	2.4 km/h	Vegetation classification	Forest	Flame length	19.8 m	Understorey fuel load	25 t/ha	Flame angle	73 °	Total fuel load	35 t/ha	Panel height	18.93 m	Vegetation height	n/a	Elevation of receiver	9.460000000000001 m	Effective slope	0 °	Fire intensity	43,400 kW/m	Site slope	0 °	Transmissivity	0.783	Distance to vegetation	43 m	Viewfactor	0.2017	Flame width	100 m	Radiant heat flux	12.02 kW/m ²	Windspeed	n/a	Bushfire Attack Level	BAL-12.5	Heat of combustion	18,600 kJ/kg			Flame temperature	1,090 K			<div style="text-align: center;"> <p>Calculated October 5, 2022, 12:45 pm (BALc v.4.9)</p> <p>Area 2</p> <p>Bushfire Attack Level calculator - AS3959-2018 (Method 2)</p> <table border="1"> <thead> <tr> <th colspan="2">Inputs</th> <th colspan="2">Outputs</th> </tr> </thead> <tbody> <tr> <td>Fire Danger Index</td> <td>80</td> <td>Rate of spread</td> <td>2.62 km/h</td> </tr> <tr> <td>Vegetation classification</td> <td>Forest</td> <td>Flame length</td> <td>21.26 m</td> </tr> <tr> <td>Understorey fuel load</td> <td>25 t/ha</td> <td>Flame angle</td> <td>73.3 °</td> </tr> <tr> <td>Total fuel load</td> <td>35 t/ha</td> <td>Panel height</td> <td>20.36 m</td> </tr> <tr> <td>Vegetation height</td> <td>n/a</td> <td>Elevation of receiver</td> <td>9.16 m</td> </tr> <tr> <td>Effective slope</td> <td>1.3 °</td> <td>Fire intensity</td> <td>47,472 kW/m</td> </tr> <tr> <td>Site slope</td> <td>1.3 °</td> <td>Transmissivity</td> <td>0.78</td> </tr> <tr> <td>Distance to vegetation</td> <td>45 m</td> <td>Viewfactor</td> <td>0.2031</td> </tr> <tr> <td>Flame width</td> <td>100 m</td> <td>Radiant heat flux</td> <td>12.05 kW/m²</td> </tr> <tr> <td>Windspeed</td> <td>n/a</td> <td>Bushfire Attack Level</td> <td>BAL-12.5</td> </tr> <tr> <td>Heat of combustion</td> <td>18,600 kJ/kg</td> <td></td> <td></td> </tr> <tr> <td>Flame temperature</td> <td>1,090 K</td> <td></td> <td></td> </tr> </tbody> </table> <p>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</p> </div>	Inputs		Outputs		Fire Danger Index	80	Rate of spread	2.62 km/h	Vegetation classification	Forest	Flame length	21.26 m	Understorey fuel load	25 t/ha	Flame angle	73.3 °	Total fuel load	35 t/ha	Panel height	20.36 m	Vegetation height	n/a	Elevation of receiver	9.16 m	Effective slope	1.3 °	Fire intensity	47,472 kW/m	Site slope	1.3 °	Transmissivity	0.78	Distance to vegetation	45 m	Viewfactor	0.2031	Flame width	100 m	Radiant heat flux	12.05 kW/m ²	Windspeed	n/a	Bushfire Attack Level	BAL-12.5	Heat of combustion	18,600 kJ/kg			Flame temperature	1,090 K		
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<div style="text-align: center;"> <p>Calculated June 20, 2022, 5:54 pm (BALc v.4.9)</p> <p>Area 4</p> <p>Bushfire Attack Level calculator - AS3959-2018 (Method 2)</p> <table border="1"> <thead> <tr> <th colspan="2">Inputs</th> <th colspan="2">Outputs</th> </tr> </thead> <tbody> <tr> <td>Fire Danger Index</td> <td>80</td> <td>Rate of spread</td> <td>1.43 km/h</td> </tr> <tr> <td>Vegetation classification</td> <td>Woodland</td> <td>Flame length</td> <td>12.35 m</td> </tr> <tr> <td>Understorey fuel load</td> <td>15 t/ha</td> <td>Flame angle</td> <td>76 °</td> </tr> <tr> <td>Total fuel load</td> <td>25 t/ha</td> <td>Panel height</td> <td>11.99 m</td> </tr> <tr> <td>Vegetation height</td> <td>n/a</td> <td>Elevation of receiver</td> <td>5.99 m</td> </tr> <tr> <td>Effective slope</td> <td>0 °</td> <td>Fire intensity</td> <td>18,599 kW/m</td> </tr> <tr> <td>Site slope</td> <td>0 °</td> <td>Transmissivity</td> <td>0.8080000000000001</td> </tr> <tr> <td>Distance to vegetation</td> <td>30 m</td> <td>Viewfactor</td> <td>0.1941</td> </tr> <tr> <td>Flame width</td> <td>100 m</td> <td>Radiant heat flux</td> <td>11.93 kW/m²</td> </tr> <tr> <td>Windspeed</td> <td>n/a</td> <td>Bushfire Attack Level</td> <td>BAL-12.5</td> </tr> <tr> <td>Heat of combustion</td> <td>18,600 kJ/kg</td> <td></td> <td></td> </tr> <tr> <td>Flame temperature</td> <td>1,090 K</td> <td></td> <td></td> </tr> </tbody> </table> <p>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</p> </div>	Inputs		Outputs		Fire Danger Index	80	Rate of spread	1.43 km/h	Vegetation classification	Woodland	Flame length	12.35 m	Understorey fuel load	15 t/ha	Flame angle	76 °	Total fuel load	25 t/ha	Panel height	11.99 m	Vegetation height	n/a	Elevation of receiver	5.99 m	Effective slope	0 °	Fire intensity	18,599 kW/m	Site slope	0 °	Transmissivity	0.8080000000000001	Distance to vegetation	30 m	Viewfactor	0.1941	Flame width	100 m	Radiant heat flux	11.93 kW/m ²	Windspeed	n/a	Bushfire Attack Level	BAL-12.5	Heat of combustion	18,600 kJ/kg			Flame temperature	1,090 K			<div style="text-align: center;"> <p>Calculated October 5, 2022, 12:48 pm (BALc v.4.9)</p> <p>Area 4</p> <p>Bushfire Attack Level calculator - AS3959-2018 (Method 2)</p> <table border="1"> <thead> <tr> <th colspan="2">Inputs</th> <th colspan="2">Outputs</th> </tr> </thead> <tbody> <tr> <td>Fire Danger Index</td> <td>80</td> <td>Rate of spread</td> <td>1.57 km/h</td> </tr> <tr> <td>Vegetation classification</td> <td>Woodland</td> <td>Flame length</td> <td>13.23 m</td> </tr> <tr> <td>Understorey fuel load</td> <td>15 t/ha</td> <td>Flame angle</td> <td>77.3 °</td> </tr> <tr> <td>Total fuel load</td> <td>25 t/ha</td> <td>Panel height</td> <td>12.91 m</td> </tr> <tr> <td>Vegetation height</td> <td>n/a</td> <td>Elevation of receiver</td> <td>5.73 m</td> </tr> <tr> <td>Effective slope</td> <td>1.3 °</td> <td>Fire intensity</td> <td>20,345 kW/m</td> </tr> <tr> <td>Site slope</td> <td>1.3 °</td> <td>Transmissivity</td> <td>0.803</td> </tr> <tr> <td>Distance to vegetation</td> <td>32 m</td> <td>Viewfactor</td> <td>0.192</td> </tr> <tr> <td>Flame width</td> <td>100 m</td> <td>Radiant heat flux</td> <td>11.73 kW/m²</td> </tr> <tr> <td>Windspeed</td> <td>n/a</td> <td>Bushfire Attack Level</td> <td>BAL-12.5</td> </tr> <tr> <td>Heat of combustion</td> <td>18,600 kJ/kg</td> <td></td> <td></td> </tr> <tr> <td>Flame temperature</td> <td>1,090 K</td> <td></td> <td></td> </tr> </tbody> </table> <p>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</p> </div>	Inputs		Outputs		Fire Danger Index	80	Rate of spread	1.57 km/h	Vegetation classification	Woodland	Flame length	13.23 m	Understorey fuel load	15 t/ha	Flame angle	77.3 °	Total fuel load	25 t/ha	Panel height	12.91 m	Vegetation height	n/a	Elevation of receiver	5.73 m	Effective slope	1.3 °	Fire intensity	20,345 kW/m	Site slope	1.3 °	Transmissivity	0.803	Distance to vegetation	32 m	Viewfactor	0.192	Flame width	100 m	Radiant heat flux	11.73 kW/m ²	Windspeed	n/a	Bushfire Attack Level	BAL-12.5	Heat of combustion	18,600 kJ/kg			Flame temperature	1,090 K		
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Area 3	Area 4																																																																																																								



Calculated October 5, 2022, 12:49 pm (BALc v.4.9)

Area 5

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	110	Rate of spread	14.3 km/h
Vegetation classification	Grassland	Flame length	6.87 m
Understorey fuel load	4.5 t/ha	Flame angle	79 °
Total fuel load	4.5 t/ha	Panel height	6.74 m
Vegetation height	n/a	Elevation of receiver	3.37 m
Effective slope	0 °	Fire intensity	33,247 kW/m
Site slope	0 °	Transmissivity	0.839
Distance to vegetation	18 m	Viewfactor	0.1879
Flame width	100 m	Radiant heat flux	11.98 kW/m ²
Windspeed	n/a	Bushfire Attack Level	BAL-12.5
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 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

Area 5



Calculated October 5, 2022, 12:51 pm (BALc v.4.9)

Area 6

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	110	Rate of spread	15.64 km/h
Vegetation classification	Grassland	Flame length	7.18 m
Understorey fuel load	4.5 t/ha	Flame angle	80.3 °
Total fuel load	4.5 t/ha	Panel height	7.08 m
Vegetation height	n/a	Elevation of receiver	3.11 m
Effective slope	1.3 °	Fire intensity	36,367 kW/m
Site slope	1.3 °	Transmissivity	0.835
Distance to vegetation	19 m	Viewfactor	0.1849
Flame width	100 m	Radiant heat flux	11.75 kW/m ²
Windspeed	n/a	Bushfire Attack Level	BAL-12.5
Heat of combustion	18,600 kJ/kg		
Flame temperature	1,090 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

Area 6

DETERMINING 2 kW/m² SEPARATION DISTANCES



Calculated September 12, 2022, 3:22 pm (BALc v.4.9)

Forest 2kW

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.4 km/h
Vegetation classification	Forest	Flame length	19.8 m
Understorey fuel load	25 t/ha	Flame angle	83 °
Total fuel load	35 t/ha	Panel height	19.65 m
Vegetation height	n/a	Elevation of receiver	9.82 m
Effective slope	0 °	Fire intensity	43,400 kW/m
Site slope	0 °	Transmissivity	0.702
Distance to vegetation	152 m	Viewfactor	0.0256
Flame width	100 m	Radiant heat flux	2 kW/m ²
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

Area 1



Calculated September 12, 2022, 3:23 pm (BALc v.4.9)

Forest 2kW

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.62 km/h
Vegetation classification	Forest	Flame length	21.26 m
Understorey fuel load	25 t/ha	Flame angle	83 °
Total fuel load	35 t/ha	Panel height	21.1 m
Vegetation height	n/a	Elevation of receiver	10.55 m
Effective slope	1.3 °	Fire intensity	47,472 kW/m
Site slope	0 °	Transmissivity	0.698
Distance to vegetation	158 m	Viewfactor	0.0255
Flame width	100 m	Radiant heat flux	1.99 kW/m ²
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

Area 2



Calculated September 16, 2022, 3:07 pm (BAL v.4.9)

Wood 2kW

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	1.43 km/h
Vegetation classification	Woodland	Flame length	12.35 m
Understorey fuel load	15 t/ha	Flame angle	85 °
Total fuel load	25 t/ha	Panel height	12.31 m
Vegetation height	n/a	Elevation of receiver	6.15 m
Effective slope	0 °	Fire intensity	18,599 kW/m
Site slope	0 °	Transmissivity	0.722
Distance to vegetation	120 m	Viewfactor	0.0246
Flame width	100 m	Radiant heat flux	1.98 kW/m ²
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

Area 3



Calculated September 16, 2022, 3:08 pm (BAL v.4.9)

Wood 5 2kW

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	1.57 km/h
Vegetation classification	Woodland	Flame length	13.23 m
Understorey fuel load	15 t/ha	Flame angle	84 °
Total fuel load	25 t/ha	Panel height	13.16 m
Vegetation height	n/a	Elevation of receiver	6.58 m
Effective slope	1.3 °	Fire intensity	20,345 kW/m
Site slope	0 °	Transmissivity	0.719
Distance to vegetation	124 m	Viewfactor	0.0248
Flame width	100 m	Radiant heat flux	2 kW/m ²
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

Area 4



Calculated September 12, 2022, 1:14 pm (BAL v.4.8)

Grassland 2kW

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	110	Rate of spread	14.3 km/h
Vegetation classification	Grassland	Flame length	6.87 m
Understorey fuel load	4.5 t/ha	Flame angle	86 °
Total fuel load	4.5 t/ha	Panel height	6.85 m
Vegetation height	n/a	Elevation of receiver	3.42 m
Effective slope	0 °	Fire Intensity	33,247 kW/m
Site slope	0 °	Transmissivity	0.742
Distance to vegetation	87 m	Viewfactor	0.024
Flame width	100 m	Radiant heat flux	1.99 kW/m ²
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

Area 5



Calculated September 12, 2022, 3:20 pm (BAL v.4.9)

Grass 2kW

Bushfire Attack Level calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	110	Rate of spread	15.64 km/h
Vegetation classification	Grassland	Flame length	7.18 m
Understorey fuel load	4.5 t/ha	Flame angle	86 °
Total fuel load	4.5 t/ha	Panel height	7.17 m
Vegetation height	n/a	Elevation of receiver	3.58 m
Effective slope	1.3 °	Fire intensity	36,307 kW/m
Site slope	0 °	Transmissivity	0.74
Distance to vegetation	90 m	Viewfactor	0.0237
Flame width	100 m	Radiant heat flux	1.96 kW/m ²
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

Area 6

APPENDIX B: ONSITE VEGETATION MANAGEMENT - THE APZ

THE ASSET PROTECTION ZONE (APZ) - DESCRIPTION

This is an area surrounding a habitable building containing either no fire fuels and/or low threat fire fuels that are managed in a minimal fuel condition. The primary objectives include:

- To ensure the building is sufficiently separated from the bushfire hazard to limit the impact of its direct attack mechanisms. That is, the dimensions of the APZ will, for most site scenarios, remove the potential for direct flame contact on the building, reduce the level of radiant heat to which the building is exposed and ensure some reduction in the level of ember attack (with the level of reduction being dependent on the vegetation types of present);
- To ensure any vegetation retained within the APZ presents low threat levels and prevents surface fire spreading to the building;
- To ensure other combustible materials that can result in consequential fire (typically ignited by embers) within both the APZ and parts of the building, are eliminated, minimised and/or appropriately located or protected. (Note: The explanatory notes in the Guidelines provide some guidance for achieving this objective and other sources are available. Research shows that consequential fire, ignited by embers, is the primary cause of building loss in past bushfire events); and
- To provide a defensible space for firefighting activities.

B1: The Dimensions and Location of the APZ to be Established and Maintained

UNDERSTANDING THE APZ PLANNING ASSESSMENT VERSUS ITS IMPLEMENTATION REQUIREMENTS

THE 'PLANNING BAL-29' APZ

It is important to understand is that the 'Planning BAL-29' APZ is not necessarily the size of the APZ that must be physically established and maintained by a landowner. It is a screening tool for making planning approval decisions.

The assessment against the Bushfire Protection Criteria is conducted for planning approval purposes. To satisfy acceptable solution '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.

The required minimum separation distances are those that will ensure the potential radiant heat impact on relevant existing or future buildings does not exceed 29 kW/m². The area of land contained within these separation distances is described as an Asset Protection Zone (APZ) and is to be comprised of non-vegetated land or low threat vegetation managed in a minimal fuel condition.

The applicable minimum separation distances will vary dependent on the vegetation types, the slope of the land they are growing on and other relevant factors specific to the site and its use.

The resulting 'Planning BAL-29' APZ dimensions may extend outside subject lot boundaries.

It is the purpose of the bushfire consultant's 'Supporting Assessment Detail', that is presented in the assessment against the acceptable solution A2.1, that will identify and justify how any offsite land within the 'Planning BAL-29 APZ (which the subject landowner has no authority or responsibility to manage), will meet the requirements of being either non-vegetated land or low threat vegetation managed in a minimal fuel condition and likely to remain in this state in perpetuity. Or otherwise, explain how this condition cannot be met.

It is the 'Planning BAL-29' APZ dimensions that will be stated in relevant tables and shown on maps as necessary in this BMP. The exceptions are the tables that are included within this appendix - when relevant to the subject lot(s) - which will present 'BAL Rating' and 'Landowner' APZ dimensions.

THE 'BAL RATING' APZ

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, (i.e., those corresponding to the building/structure's determined BAL rating), are designed to resist.

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 specific building/structure. They will account for the specific conditions on and surrounding the subject lot.

*The required **dimensions of the 'BAL Rating' APZ establish the size of the APZ that must physically exist either** entirely within a subject lot or in combination with an area of adjoining land.*

If in combination with adjoining (offsite) land, it must be justified how the offsite land can most reasonably be expected to either remain unvegetated or be able to meet and maintain the APZ Standards in perpetuity, without any actions by the owner of the subject lot.

The applicable determined BAL rating will have been stated in the relevant assessment section of this BMP when it can be assessed as a 'determined' rather than 'indicative' rating. Otherwise, it will be shown on the BAL Certificate that is submitted as part of a building application.

THE 'LANDOWNER' APZ

Dimensions: The 'Landowner' APZ is to be established and maintained by the owner of the subject lot. The minimum dimensions are the 'BAL Rating' APZ dimensions except that they will be limited to the distance that they can be established within the subject lot. (Note: Any removal of native vegetation may require the approval of the relevant authority.

The remaining required separation distance outside the lot has been assessed by the bushfire consultant to be most likely to remain in a low threat state in perpetuity without any actions to be taken by the owner of the subject lot.

These minimum 'within the lot' APZ dimensions will only be greater when the relevant local government's annual firebreak / hazard reduction notice (issued under s33 of the Bushfires Act 1954), specifies the APZ dimensions to be applied within the lot and they are greater. Consequently, the 'Landowner' APZ dimensions can be a combination of the 'BAL Rating' Dimensions and the Local Government requirements. Check their annual notice for revisions to these requirements.

The dimensions of the 'Landowner' APZ establish the size of the APZ that must be established and maintained by the landowner within the subject lot.

Location: The 'Landowner' APZ for which the landowner has the responsibility to establish and maintain, is that which will exist entirely within the boundaries of the relevant lot, unless an approved formal and enforceable agreement allows them to manage a specified area of land external to the subject lot.

In most cases the landowner will only have authority and responsibility to establish and manage the APZ within the subject lot.

Otherwise, when there is a remaining part of the 'BAL Rating' APZ existing outside the subject lot, then these areas of land will, in most situations, include non-vegetated areas (e.g., roads / parking / drainage / water body), formally managed areas of vegetation (e.g., public open space / recreation areas / services installed in a common section of land) or an APZ on a neighbouring lot that is required to be established and maintained by the owner of that adjoining lot.

For vulnerable land uses, the 'BAL Rating' APZ and 'Landowner' APZ will also refer to the dimensions corresponding to radiant heat impact levels of 10 kW/m² and 2 kW/m² (calculated using 1200K flame temperature).

For development applications only, the 'Landowner' APZ dimensions are also shown on the Property Bushfire Management Statement in Section 6.3.1 of this BMP when it is a required component of the Bushfire Management Plan.

Table B1.1: The applicable 'Landowner' APZ Dimensions when the determined BAL rating (or maximum level of radiant heat i.e., kW/m²) has been established by the BMP.

THE 'LANDOWNER' APZ DIMENSIONS TO BE ESTABLISHED AND MAINTAINED						
Relevant Structure / Element	The Determined BAL Rating	The Determined Level of Radiant Heat Impact	Classified Vegetation Refer to Fig 3.1	Minimum Required Separation Distances (m) [building to vegetation]		
				The 'BAL Rating' APZ	The Radiant Heat Impact APZ	As Directed by the Applicable Local Government Firebreak / Hazard Reduction Notice
High-Risk or Potentially Combustible Elements: Production Modules Pellet Storage Silos Thermal Oxidizer Dryer Package Diesel Storage Tanks Hot Oil Package Wood Chip Piles (Feedstock) Biochar Storage Crumbler Crumbled Wood Silo	BAL-LOW	N/A	Area 1	100	100	2.5
			Area 2	100		
			Area 3	100		
			Area 4	100		
			Area 5	50		
			Area 6	50		
Electrical Infrastructure: OSBL Packages Switchroom/Substation	BAL-12.5	12 kW/m ²	Area 1	42	43	
			Area 2	50	45	
			Area 3	29	30	
			Area 4	35	32	
			Area 5	17	18	
			Area 6	20	19	
Other Structures: Fire Water Tanks and Pumps Treated Water Tanks and Pumps Wood Vinegar Tanks Loading Skids Weigh Station CCR Building Ablutions Office Workshop Security Hut (West) Security Hut (East)	BAL-29	N/A	Area 1	21	N/A	
			Area 2	27		
			Area 3	14		
			Area 4	17		
			Area 5	8		
			Area 6	9		
Comments: Refer to the Bushfire Risk Management Plan for more details on radiant heat impact assessment and recommendations.						

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.

Guidelines for
Planning in
Bushfire
Prone Areas

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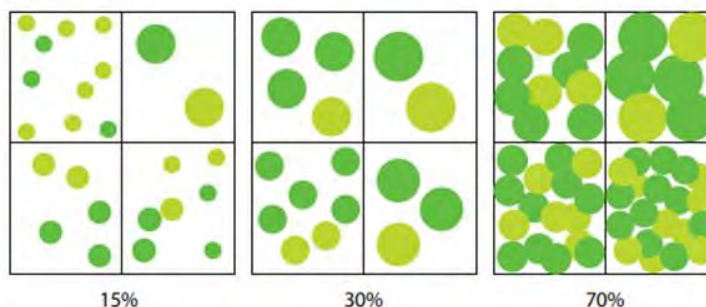


ELEMENT 2: SITING AND DESIGN OF DEVELOPMENT

SCHEDULE 1: STANDARDS FOR ASSET PROTECTION ZONES

OBJECT	REQUIREMENT
Fences within the APZ	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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



<p>Shrub* and scrub* (0.5 metres to six metres in height). Shrub and scrub >6 metres in height are to be treated as trees.</p>	<ul style="list-style-type: none"> • 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.
<p>Ground covers* (<0.5 metres in height. Ground covers >0.5 metres in height are to be treated as shrubs)</p>	<ul style="list-style-type: none"> • 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.
<p>Grass</p>	<ul style="list-style-type: none"> • 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.
<p>Defendable space</p>	<ul style="list-style-type: none"> • 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.
<p>LP Gas Cylinders</p>	<ul style="list-style-type: none"> • 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: Maintaining Low Threat and Non-Vegetated Areas Excluded from Classification

AS 3959 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 bushfire behaviour models to determine the BAL. Certain vegetation can be considered as low threat and excluded from classification. Where this has occurred in assessing the site, the extract from AS3959:2018 below state the requirements (including the size of the vegetation area if relevant to the assessment) for maintenance of those areas of land.

15	AS 3959:2018
<p>2.2.3.2 Exclusions—Low threat vegetation and non-vegetated areas</p> <p>The following vegetation shall be excluded from a BAL assessment:</p> <ul style="list-style-type: none"> (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. <p>NOTES:</p> <ul style="list-style-type: none"> 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. 	

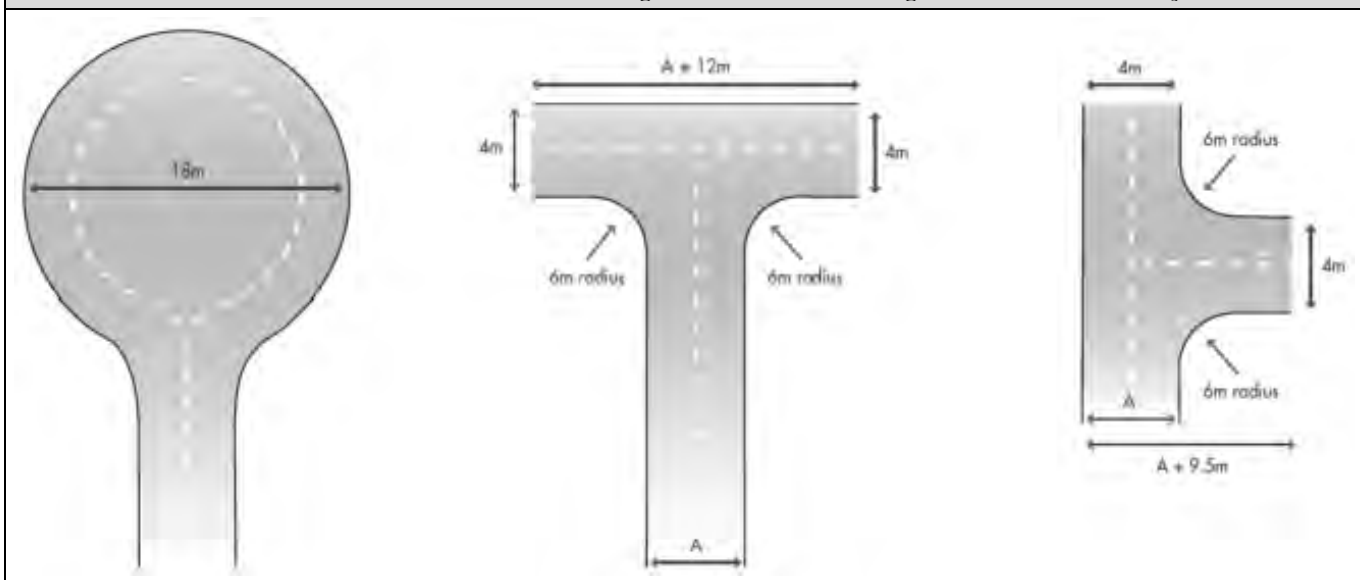
APPENDIX C: TECHNICAL REQUIREMENTS FOR VEHICULAR ACCESS

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

ADDENDUM: COMMITMENT TO OFFSITE VEGETATION MANAGEMENT

To be attached where provided by the Shire of Narrogin.



Appendix 9

Bushfire Risk Assessment and Management Plan



Renewable Diesel Biorefinery Project (Narrogin)

Bushfire Risk Assessment & Management Report

- ◇ bushfire hazard & threats
- ◇ exposure and vulnerability of elements at risk
- ◇ bushfire protection measures
- ◇ indicative/determined risk levels
- ◇ inform siting, design, construction, management, education and decision making



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Produced to meet the relevant requirements of STATE PLANNING POLICY 3.7 Planning in Bushfire Prone Areas & Guidelines

Lot 31 Great Southern Highway
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Shire of Narrogin

5 September 2022

Job Reference No: 220437

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<p><i>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.</i></p> <p><i>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.</i></p> <p><i>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.</i></p> <p><i>Copyright © 2022 BPP Group Pty Ltd: All intellectual property rights, including copyright, in format and proprietary content contained in documents created by Bushfire Prone Planning, remain the property of BPP Group Pty Ltd. Any use made of such format or content without the prior written approval of Bushfire Prone Planning, will constitute an infringement on the rights of the Company which reserves all legal rights and remedies in respect of any such infringement.</i></p>					

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1 CONSULTANT STATEMENTS

The intent of this section of the report is to assist those tasked with reading this report and making decisions by providing a subjective summary of the assessment outcomes and/or clarify the reported outcomes.

Importantly, the summary and its statements draw on the relevant practical experience of the bushfire practitioner compiling or approving this report, that has been derived from planning and managing bushfire events.

In the absence of the required set of risk factor criteria, risk level matrix and risk tolerability scale being established by the regulatory authorities to enable the derivation of a 'determined' risk level - this statement will necessarily be framed around the applied assessment process that derives an 'indicative risk' level (refer to section 2.3.4 and Appendix 2).

RECOMMENDATIONS AND REQUIREMENTS

The following are the recommended or required treatments which have been established through the risk assessment process.

Design and Construction Recommendations

The <12kW/m² radiant heat flux buffer provided within the BMP includes all structures within the proposed facility, and thus electrical and plumbing elements are unlikely to be compromised. As a recommended additional measure, shield exposed electrical cabling and plumbing (throughout the site and not within a structure profile) from radiant heat and consequential fire where possible/practical, by either:

- Burying underground;
- Encasing the cables within a non-combustible material,
- Enclosing within a structure, or;
- Installing a solid barrier (colourbond fence) between the relevant components and the vegetation (bushfire) hazard. This barrier should be installed within 2m of the exposed components and to a height of 1.5m or greater.

This does not apply to suitably encased elements, or those which are non-combustible (e.g. steel plumbing).

It is recommended non-combustible elements are included in structure design/construction where practical.

Where a Class 1-10 building is enclosed, it is recommended that the structure applies ember screening to openings to roof, wall, or internal cavities. Screening should have an aperture of <2mm and be corrosion-resistant steel, bronze, or aluminium.

Where installed, sprinkler systems are recommended to be automatically activated.

At the detailed design stage, it is recommended that designs are investigated for:

- Roof/building complexities which may trap debris or collect embers
- Cabling/piping contacting the ground or any arrangement of associated structures creating a 'pocket' for accumulation of debris.

These complexities are recommended to be removed, enclosed, or filled with non-combustible material (such as mineral earth) where practical. Consideration should be given to making the arrangement self-cleaning through wind action to the greatest extent possible. Functionally this means preventing details which may accumulate leaf litter which will not naturally be cleared by wind.

Water tanks are required to be constructed from concrete or steel, and routes to water tanks must be clearly signed at site access.

Water tanks are recommended to have an external level indicator, and should be positioned >10m from other structures where possible/practical within site constraints.

Fire hose reels will be installed throughout the site (final locations to be determined in detailed engineering phase). At a minimum, two fire hose reels must be installed within 70m (10m hose stream and 60m hose lay) of all areas for storage or processing of high-risk storage or processing areas (this does not include wood chip feedstock).

Asset Protection Zones

The APZs required to be established are to extend to at least 100m (to the extent possible) from all high-risk plant, infrastructure, and use areas. The woodchip piles (feedstock) are also to comply with this APZ, to the extent possible within the lot boundary. Other assets and infrastructure are to comply with the BAL-29 dimensioned APZ required for planning approval, at a minimum.

Removal or permanent management of a portion of Vegetation Areas 1 and 2 (the revegetated forest adjoining the subject lot to the south) will be required to establish the required APZs. The measure will require approval and/or commitment from the Local Government to implement.

It is recommended that any security fences or other potential fuel loads will be constructed using non-combustible material. Landscaping (gardens) which may be included within the APZ should avoid use of constructed heavy fuels (e.g. timber sleepers as garden edges, plastic or timber lattice).

Details/Requirements for Future Operational Documents (Operating Procedures and Emergency Plans)

Measures including preparation, responses, and training (including designation of roles such as Fire Wardens) for bushfire events are required to be included in the future site Emergency Management Plan (document title pending).

Future site Operating Procedures or Emergency Management Plan (document titles pending) identify which (if any) operations are to cease where a bushfire is identified within 10km. The operations identified should be those susceptible to ember attack.

Operating and maintenance procedures are to be developed to ensure regular maintenance of firefighting equipment and clearing of accumulated debris and other consequential fire hazards.

The dimensions and setbacks of woodchip piles (feedstock) are to be confirmed at the detailed design stage. The layout and design will be determined by a suitably qualified specialist consultant, or otherwise will meet the specifications outlined in the *DFES Information Note: Bulk Green Waste Storage Fires (September 2014)*.

The Narrogin State Emergency Service/Bushfire Brigade is recommended to be invited to inspect and familiarise with the site prior to operation. A manifest is to be provided and made available for future emergencies detailing site fire response procedures and hazards. Additional future invitations may be annual or ad-hoc.

CONDUCTING THE ASSESSMENT

A site assessment was conducted to analyse the location and identify:

- The vegetation and potential impact on the proposed infrastructure; and
- Topography in relation to potential fire behaviour.

THE PRIMARY RISK AND ITS ASSESSMENT

The proposed High-Risk Land Use must consider the dual risk of:

- an independent bushfire event causing damage, failure, or loss of the facility, and;
- site operations, accident, or failure causing a bushfire event.

Rather than assess the likelihood of failure/damage causing ignition of a high-risk asset (not due to bushfire), this potential ignition is assumed for the purposes of this assessment. This assumption allows this potential for ignition to be dealt with by the appropriate persons (manufacturers or designers), whilst the potential for such a fire to ignite a bushfire can be considered by bushfire practitioners. The factors considered in assessing the hazard posed by such onsite fires are:

- The separation of ignition sources (storage and processing areas of combustible materials) from bushfire prone vegetation;
- Presence of combustible material around ignition sources to spread fire;
- Fuel types within the facility and the APZ which may generate embers;
- Shielding of potential fire locations to either contain the fire, or eliminate flame protrusion and reduce radiated heat flux;
- Capacity for fire to spread between combustible materials onsite, including specific heat capacity, separation between hazards, and fire attack vectors (flame, radiant heat, ember, explosion);
- Automatic detection, shutdown, and/or suppression to prevent fire spread;
- The capacity for staff to contain any onsite ignition, including training, communication, firefighting utilities and water supply;
- Ensuring appropriate responses of staff or emergency services are possible and that access and water supply is available;
- Availability of emergency services.

The primary risk being considered in this report is the potential for diesel, feedstock, or by-product storage, or processing areas, to be structurally compromised and/or ignite during a bushfire event.

The assessment of the level of risk that applies to the facility (both inherent and residual), is a function of the threat levels presented by the bushfire prone vegetation and the exposure and vulnerability of the facility to these threats.

The factors considered in assessing the bushfire hazard threat levels includes:

- The types of vegetation adjacent to the development area in terms of its structure, species assemblage (including flammability and firebrand generation), arrangement, quantity, and potential future condition;
- The potential for accumulation of debris around the structures and components as a potential source of consequential fire;
- The potential level of radiant heat that can be emitted by a fire in the vegetation;
- Potential flame lengths and flame residence time which influences time the structures and components will be subject to the maximum radiant heat levels; and
- The potential for application of protection measures to reduce threat levels.

The factors considered in assessing the exposure of the structures and components to bushfire threats includes:

- The separation distance between the vegetation and the structures/storage and associated components;
- The potential for application of additional separation and/or shielding protection measures to reduce exposure.

The factors considered in assessing the vulnerability of the structures and components to bushfire threats includes:

- The type of structural materials and manufacturing applied to the relevant components;
- The temperature or heat flux at which the structural and operational integrity of relevant components are likely to be compromised (e.g. critical point);
- The existence of constructed consequential fire fuels and their capacity to be compromised (specific heat capacity);
- The potential for application of protection measures to reduce vulnerability.

This risk assessment assumes that a fire within the diesel, feedstock, or by-product storage, or processing areas, will occur, and that emergency services may not be available.

The risk of any event within the Renewable Diesel Biorefinery Project igniting a bushfire is considered below. Classified vegetation may be ignited through ember attack, radiant heat flux, or direct flame contact.

- **Ember Attack:** Liquid fires do not generate embers. Diesel processing and storage poses a hazard of radiant heat flux and flame contact only. Wood chip feedstock will be coarse >6mm woodchips (high density), and non-aerated fuels will smoulder at the surface level, generating potentially large quantities of smoke but little flame or embers. Any embers would need to carry beyond the required 100m APZ to pose an ignition hazard to classified vegetation.
- **Radiant Heat Flux:** All high-risk plant, infrastructure, and use areas are positioned within BAL-12.5 or BAL-LOW. The potential temperature of a fire within the combustible materials onsite is unknown, however a BAL-12.5 setback is based on an assumed bushfire flame temperature of 1090K. The inverse heat flux received by the classified vegetation is unknown but likely relatively low. The ignition point of cured grass on temperature alone (no flame or ember contact) varies, but is at least 250 degrees Celsius (no calculation is available to translate to kW/m² radiant heat flux).
 - Biochar requires significant aeration to ignite but airborne biochar dust can pose an explosion hazard. A blast of sufficient size and emissive heat flux to ignite classified vegetation >100m from the source would be extremely hazardous (potentially fatal) to persons within this radius. The potential for explosion and its relative intensity (from any material including biochar) is assumed to be dealt with by the appropriate persons/standards.
- **Flame Contact:** Consequential fires are generally assumed as 2 times the height of the object (not including the object itself). A hazard would need to be a minimum of 33m tall to exceed the >100m APZ. Additionally, this ignores that flame burns vertically rather than horizontally.

High-risk storage and processing will be located on a mineral earth or sealed hardstand without vegetation (including low threat vegetation) or other adjacent consequential fire hazards.

The setbacks and spacing of structures onsite have been designed based on an assumed radiant heat threshold of 37.5kW/m² from *Renewable Diesel Biorefinery Project – Fire and Explosion Consequence Modelling (2D) Study Report (Technip Energies June 2022)*.

THE OUTCOME OF THE ASSESSMENT

The inherent risk level (i.e., the current risk after accounting for existing and any 'planned' protection measures), to the proposed Renewable Diesel Biorefinery Project from a bushfire event in adjacent vegetation is MODERATE for fixed infrastructure (including flammable material storage) and LOW for all other elements at risk.

The tolerability rating of the inherent risk level is determined as either TOLERABLE or ACCEPTABLE, however it is not 'as low as reasonably practical'. With due consideration of acceptability, practicality and cost, the risk can be lowered by the application of the recommended protection measures.

The residual risk level (i.e., risk which remains after the application of protection measures that are additional to those that already exist or are 'planned') is LOW for persons on access/egress routes (as this element is not able to be reduced further) and VERY LOW for all other elements at risk.

The tolerability rating of all residual risk levels is determined as ACCEPTABLE because they are 'as low as reasonably practical'.

The recommended protection measures that have had the greatest impact on reducing the risk level are those that reduce the vulnerability of the facility (primarily the infrastructure assets) to the threats of the bushfire hazard. The required >100m APZ from all high-risk plant, infrastructure, and use areas reduces exposure in all cases.

2 INTRODUCTION

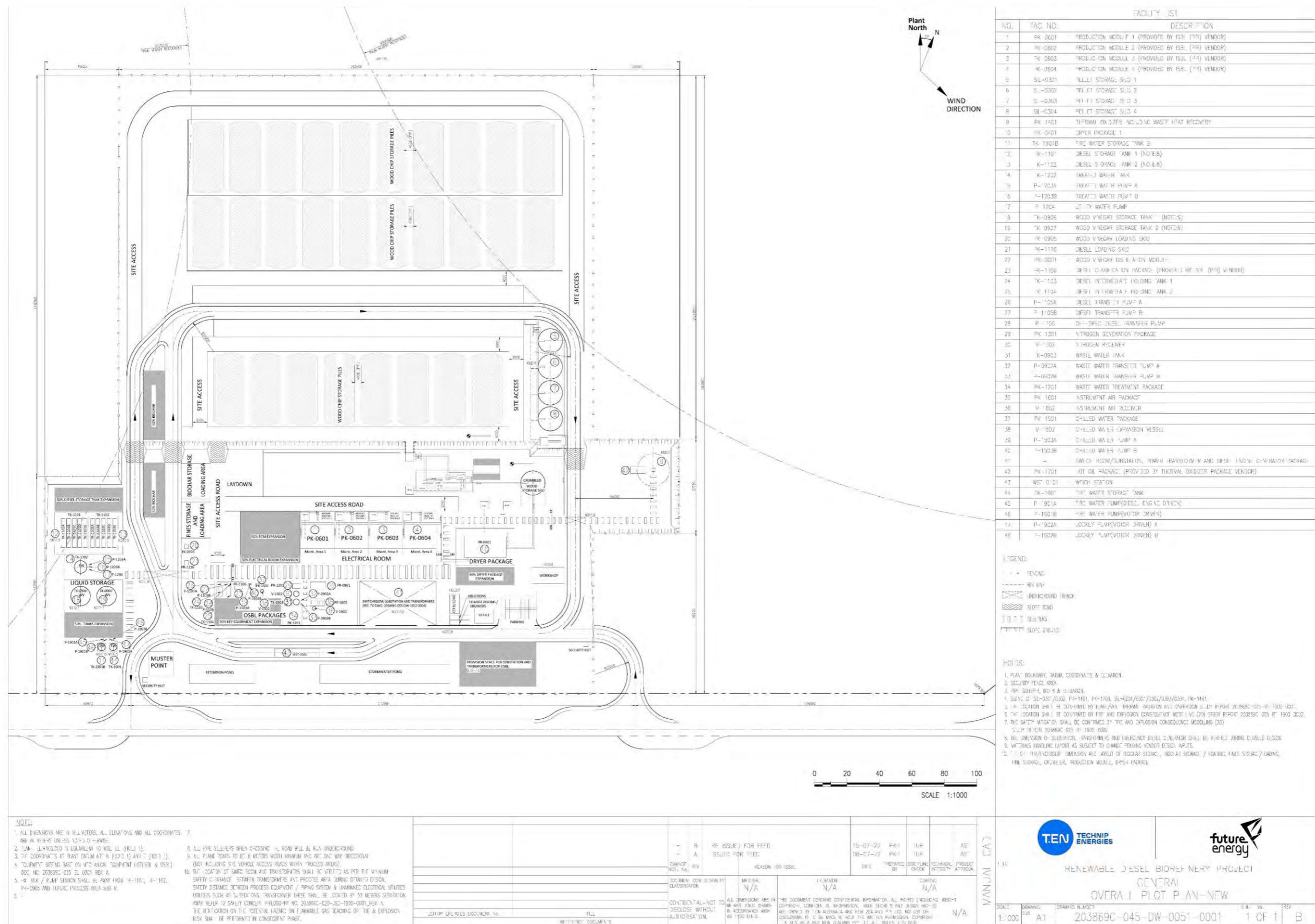
2.1 THE ASSET (DEVELOPMENT) AND/OR USE SUBJECT TO ASSESSMENT

The development and subject of this document is the proposed Renewable Diesel Biorefinery Project at Lot 31 Great Southern Highway, Dumberning, approximately 2.5km south of the Narrogin townsite. The subject lot and neighbouring lots are cleared of native vegetation and are dominated by pasture, with few to no trees within the development exclusion zone. Vegetation along the road reserve of Wanerie Road has re-established and will require agreement with the Shire of Narrogin to ensure ongoing management to reduce both onsite and offsite fire risk.

The facility will be Australia's first renewable diesel biorefinery, which will process feedstock (primarily chipped tree stumps) and result in diesel product as well as biochar, wood vinegar, and wood vinegar tailings as saleable by-products.

The facility is spaced to allow for future expansion of each component.

Figure 2.1: Site diagram/plan



2.2 THE RISK ASSESSMENT OBJECTIVES

Establishing the objectives directs the way the assessment process is conducted, and the type of information reported. Relevant objectives are typically determined by the applicability of one or more of the following three key factors:

1. The type of proposed or existing development. This can include:
 - a) Construction or modification of buildings, structures and infrastructure assets; or
 - b) Subdivision of land.
2. The type of proposed or ongoing land use. This can include:
 - a) Those defined as industrial, commercial or residential; and
 - b) Including those that have a planning classification of 'high risk' or 'vulnerable' - including tourism and event uses.
3. The relevant stage of planning. This can include but is not limited to:
 - a) An existing development and/or use for which an assessment of the necessity for and the potential to improve bushfire resilience is conducted and the consequent lowering of the associated risks identified.
 - b) At the strategic planning stage of new development/use when final details of the proposed development/use are not fully known and therefore relevant protection measures can potentially be identified and incorporated into design.
 - c) At the final planning stage that requires approval or a 'decision to proceed'. All relevant details of the proposed development/use are known. The requirement at this stage is to inform decision makers by providing an assessment of the residual bushfire risk.

The primary objectives for the subject development and/or use are collated as a summary in Table 2.1.

Table 2.1: Identifying the risk assessment objectives for the subject development/use.

RISK ASSESSMENT OBJECTIVES - INFORMATION TO BE DERIVED
<p>Identify: The types of bushfire prone vegetation (considering factors that include components, arrangement and fuel loads), that exist onsite and offsite.</p> <p>Initially this may be limited to a desktop assessment with ground truthing to follow at a later date.</p>
<p>Determine: The relative threat levels each bushfire hazard attack mechanism (direct and indirect) presents.</p> <p>Determine if the broader physical landscape surrounding the subject development/use has the potential to increase or decrease the levels of those threats.</p>
<p>Identify: All at risk physical elements that are exposed to the potential threats of the bushfire hazard.</p>
<p>Identify: Assets that owners/operators are prepared to lose from consequential fire resulting from a bushfire event, rather than apply sufficient protection measures i.e., the asset loss risk is to be retained. This may be due to cost or practicability.</p> <p>Consideration the consequent risk from asset abandonment and the availability of person risk mitigation measures.</p>
<p>Identify: All at risk human elements that are exposed to the potential threats of the bushfire hazard.</p>
<p>Identify: Bushfire protection measures that have or can be applied to reduce bushfire hazard threat levels to the greatest extent allowable and practicable.</p>
<p>Identify: Bushfire protection measures that have or can be applied to reduce the exposure and vulnerability of buildings/structures, infrastructure and other physical assets, to the potential threats of the bushfire hazard.</p> <p>The intent being to increase asset resilience to the threats to the greatest extent practicable.</p>

RISK ASSESSMENT OBJECTIVES - INFORMATION TO BE DERIVED

Identify: Bushfire protection measures that have or can be applied to reduce the exposure and vulnerability of persons to the potential threats of the bushfire hazard to the greatest extent practicable.

Identify: Bushfire protection measures that have or can be applied to reduce the exposure and vulnerability of the bushfire prone vegetation to site activities which may pose an ignition hazard.

Applicable to New Development and/or Use: Inform relevant persons (planners / designers / operators / owners), at the appropriate planning stage, of available bushfire protection measures to be incorporated into siting, design, construction, education and management, to optimise bushfire performance.

Identify site specific protection measures, from the defined sets of bushfire protection measure principles, that have the potential to be applied as a package of protection measures. The intent is to achieve at least a tolerable level of risk to persons and property by ensuring that:

- Buildings, structures and other physical assets are resilient against bushfire hazard threats, to the greatest extent practicable.
- Persons have their exposure and vulnerability to bushfire hazard threats reduced, to the greatest extent practicable.

Provide implementation advice as necessary.

Assess: The indicative residual risk levels to inform planners / designers / operators / owners and/or relevant decision makers.

This is to be achieved through the application of the following information that has been established by the bushfire consultant:

- The process for determining relative threat, exposure and vulnerability levels;
- the indicative risk matrix; and
- the risk tolerance scale.

(Refer to Section 2.3.4, Appendix 2 and the glossary for additional information).

2.3 THE APPLIED RISK ASSESSMENT PROCESS

2.3.1 THE DEFINITION OF RISK

For the applied risk assessment process, the relevant risks are 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 the bushfire as a natural hazard.

2.3.2 THE ASSESSMENT PROCESS (FRAMEWORK)

To conduct and report the risk assessment process, Bushfire Prone Planning has adapted the understanding of disaster risk as described by the United Nations Office for Disaster Risk Reduction (UNDRR) and shown in Figure 2.2.

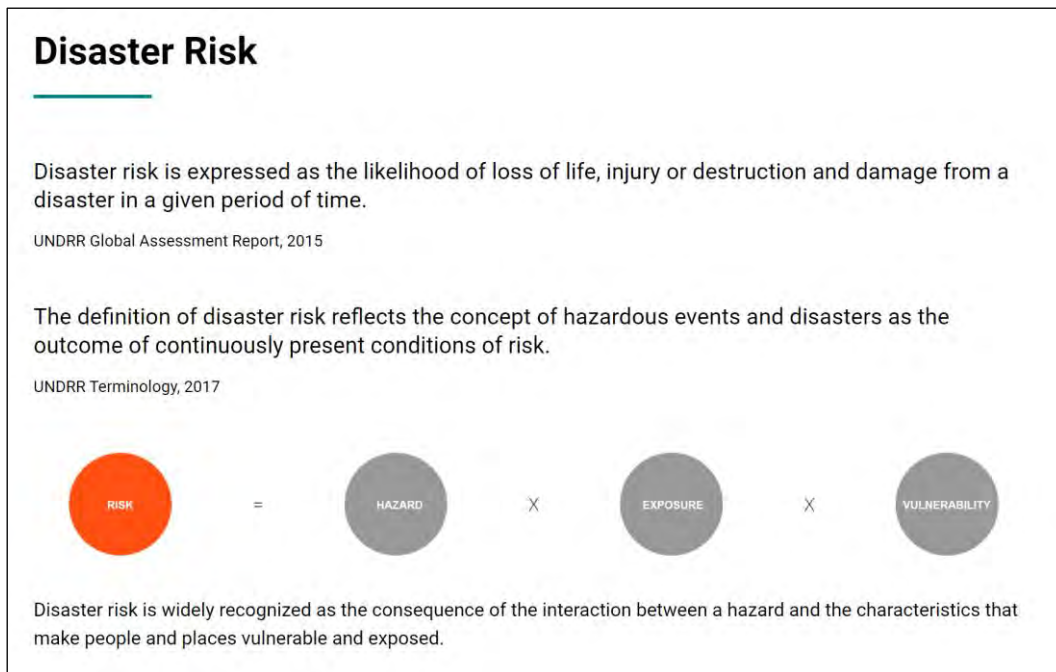


Figure 2.2: Understanding disaster risk (Source: United Nations Office for Disaster Risk Reduction [46]).

Although the UNDRR approach is designed to address disaster risk at large scale strategic levels, it can justifiably be applied to all scales of planning because it is focused on natural hazards and establishes a concept that can be readily adapted. The rationale for adopting this approach, rather than the methodology established by the National Emergency Risk Assessment Guidelines (AIDR 2020, NERAG), is provided in Appendix 1.

Also utilised within this assessment approach are relevant principles and measures to be applied in the development of bushfire risk mitigation strategies that are detailed in the Bushfire Verification Method Handbook [14].

PROCESS OVERVIEW

The risk presented by a natural hazard (such as a bushfire) is a consequence of the interaction between the potential threats associated with the hazard and the exposure and vulnerability of any elements at risk from those threats (the 'exposed elements').

The application of available protection measures will lower the risk by:

1. Reducing the number and/or level of the hazard threats; and/or
2. Reducing the level of exposure and/or vulnerability of the elements at risk.

Figure 2.3 illustrates the framework of the adapted risk assessment process (refer to the glossary for terminology information and Appendix 2 provides greater detail of the risk analysis component of the assessment process).

THE FRAMEWORK OF **BUSHFIRE PRONE PLANNING'S** APPLIED RISK ASSESSMENT PROCESS

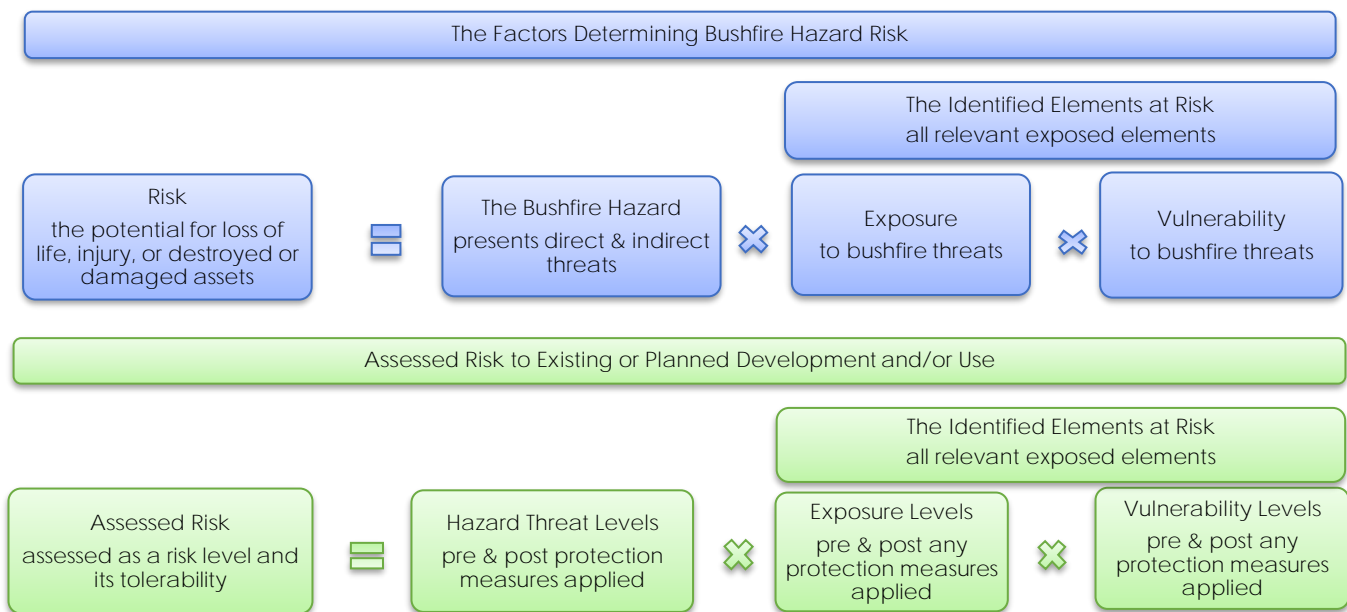


Figure 2.3: Framework of the applied risk assessment process.

2.3.3 RISK LEVEL ANALYSIS

(Refer to Appendix 2 and 3 and the Glossary for additional information.)

When the derivation of risk levels is a stated assessment objective, the risk analysis will derive a risk level as a summary outcome. The required risk level analysis can be conducted for either each exposed element separately and/or the proposed or existing development/use overall.

The risk level can be reported as either indicative or determined:

- **Indicative Risk Level:** This is derived based on a comparison of the numbers of protection measures able to be applied with the number of possible measures in the protection measure 'universe'. Appropriate weighting is given to the level of effectiveness of each of the measures. The intent is to provide a qualitative understanding of the level of risk that exists, to assist with making the required decisions.
- **Determined Risk Level:** This is derived using defined sets of risk factor criteria that correspond to each hazard threat level, exposure level and vulnerability level, for the elements at risk. Subsequently, how these defined levels are then applied to establish a determined risk level and its tolerability, is defined by an accepted risk level matrix and risk tolerance scale.

The risk factor criteria must reflect societies preparedness to tolerate risk and should be determined by regulatory authorities exercising their responsibilities. The criteria will vary dependent on development/use type and scale.

Consequently, the risk factor criteria (and potentially the risk level matrix and risk tolerance scale) need to be defined by the regulatory authorities before they can be applied in assessing a determined risk level.

Dependent on the stage of development/use, or to meet differing assessment objectives, the risk level can also be reported as:

- **Inherent Risk:** As the current risk when the assessment has only accounted for the bushfire protection measures that are either already in place (for existing development/use), or are planned to be incorporated into the proposed development/use; or
- **Residual Risk:** As the remaining risk when the assessment has also accounted for the application of any additional protection measures recommended by this report. If there are none, the residual risk is the same as the inherent risk.

2.3.4 USING THE ASSESSMENT PROCESS TO MEET THE STATED OBJECTIVES

The reporting objectives (established in Section 2.2) will vary for different types and stages of proposed (or existing) development/use. However, the same base framework is able to be utilised and the process can be adapted to achieve the required outcomes.

Figure 2.4 provides further detail of the adopted assessment process, based on the framework shown in Figure 2.3.

2.3.5 BUSHFIRE PROTECTION MEASURE EFFECTIVENESS RATINGS

The following effectiveness ratings (refer to Table 2.2) are applied to the applicable bushfire protection measures, as part of the risk assessment process, and as a factor applied in deriving 'relative' threat, exposure and vulnerability levels.

The more effective a bushfire protection measure is, the greater its value in increasing bushfire resilience (buildings/structures), and/or increasing the safety of persons and in decreasing the level of risk associated with bushfire.

The effectiveness ratings incorporate the qualities of:

1. Independence: As a qualitative assessment of the extent to which the protection measure has the capacity to reduce threat, exposure and vulnerability levels as a standalone measure as opposed to requiring the cumulative capacity of additional protection measures (an additional one or more as a package); and
2. Passiveness: The capacity of protection measures to function without the active involvement of persons.

The rating assumes that the greater the independence and passiveness of a protection measure, the greater is its effectiveness.

Table 2.2: Bushfire protection measure effectiveness ratings.

THE APPLIED BUSHFIRE PROTECTION MEASURE EFFECTIVENESS RATINGS	
Rating / Descriptor	Protective Characteristics and Capability
Very High (Independent and Passive)	Very significant risk reduction as an independent (standalone) measure. Impact on risk reduction is immediate and persistent in all scenarios. Operates passively with no or minimal requirement for ongoing implementation, management and maintenance. A priority measure to be implemented wherever possible.
High (Independent and Passive)	Material risk reduction as an independent (standalone) measure; Operates passively with none or minimal requirement for ongoing implementation, management and maintenance.
Effective (Independent and Active)	Material risk reduction as an independent (standalone) measure; Effectiveness relies on active implementation, management, maintenance and/or response.
Moderate (Dependant and Passive or Active)	Alone the measure will have limited impact on risk reduction. It has additive value when combined with other protection measures to create a 'package' of bushfire protection measures. Effectiveness is achieved both passively and/or with active implementation, management, maintenance and/or response.
Not Relevant	The measure is not relevant to the type of development/use. (Note: this is different to not being able to be applied – it is just not relevant to any configuration of the subject development/use).

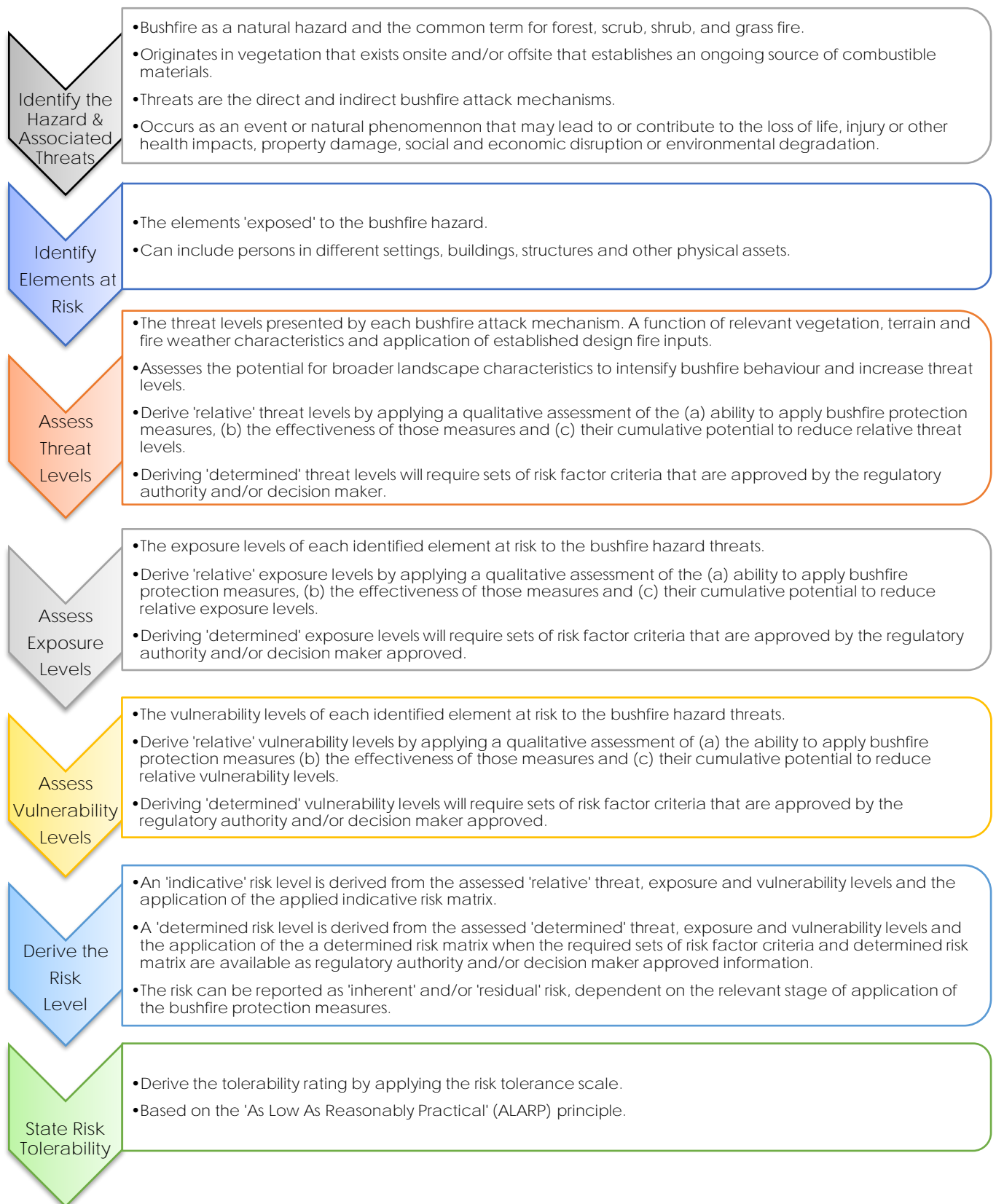


Figure 2.4: Outline of the adapted risk assessment process applied in this report.

2.4 THE BUSHFIRE HAZARD - BEHAVIOUR AND ATTACK MECHANISMS

Information regarding bushfire attack mechanisms and the potential influence of the broader landscape on the intensification of fire behaviour, is provided in Appendix 4 and 5. The content of these appendices is outlined below. Providing this information is intended to:

1. Assist those tasked with making design, construction, planning and management decisions (based on the information and assessments presented in this report), to have a better understanding of bushfire hazards where this may not be within their general field of expertise. This knowledge may also benefit development of innovative protection measures to increase the bushfire resilience of buildings/structures and/or improve persons safety and/or reduce bushfire threat levels; and
2. Assist readers understand why the assessment of the bushfire hazard threats and the presentation of the identified protection measures is organised the way it is in this report. It can also assist with guiding the search for additional information when necessary.

CONTENT OF APPENDIX 4

1. Factors Influencing Bushfire Behaviour
 - Vegetation and other fuels - key characteristics
 - Weather
 - Topography
2. Bushfire Direct Attack Mechanisms
 - Ember attack
 - Radiant heat attack
 - Bushfire flame attack
 - Surface fire attack
3. Bushfire Indirect Attack Mechanisms
 - Debris accumulation
 - Consequential fire
 - Fire driven wind
 - Tree strike and/or obstruction

CONTENT OF APPENDIX 5

1. Recent bushfire research
2. Dynamic Fire Behaviours
 - Spotting
 - Fire whirl/tornado
 - Junction fire
 - Crown fire
 - Eruptive fire
 - Fire channelling (vorticity-driven lateral spread)
 - Conflagrations
 - Downbursts
 - Pyroconvective events.
3. Drivers of deep flaming
4. Extreme bushfire events
5. Physical requirements of terrain, fuel load (and windspeed) for deep flaming.

3 ASSESSMENT SUMMARY

The assessment summary is presented in three parts:

Section 3.1 states the derived bushfire threat levels, and the exposure and vulnerability levels of each element at risk – as the factors from which the risk levels are derived.

Section 3.2 two shows the type of risk level that is to be reported, states the derived risk levels and the tolerability of that risk - for each exposed element and each identified area of bushfire prone vegetation.

Section 3.3 presents a summary of the bushfire protection measures that can be applied and are currently implemented or are recommended to be implemented. The operational document in which the measures should be identified is noted.

3.1 THE ASSESSED THREAT, EXPOSURE AND VULNERABILITY LEVELS ESTABLISHING THE RISK LEVEL

Table 3.1: The assessed threat levels of the bushfire hazard.

ASSESSED HAZARD THREAT LEVELS ¹		
Bushfire Prone Vegetation	Relative Threat Level ²	
	Inherent	Residual
All bushfire prone vegetation within the subject lots, and within 150m of the proposed development. All vegetation within the Lot is considered onsite vegetation and vegetation beyond the Lot boundary is considered off site.	Moderate	Very Low
All bushfire prone vegetation within the broader locality (10km radius) including along access routes.	Moderate	

¹ Refer to Section 6 for detailed assessment information.
² Refer to Appendix 2 for explanatory information.

Table 3.2: The assessed exposure and vulnerability levels for each exposed element to the stated area of bushfire prone vegetation.

ASSESSED EXPOSURE AND VULNERABILITY LEVELS OF IDENTIFIED ELEMENTS AT RISK ¹				
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.			
Elements At Risk ²	Relative Exposure Level ³		Relative Vulnerability Level ³	
Description	Inherent	Residual	Inherent	Residual
Persons located onsite and temporarily offsite	Very Low		Low	Very Low
Buildings/Structures - NCC Classes 1-10	Moderate	Very Low	Low	Very Low
Fixed (hard) infrastructure assets	Moderate	Very Low	Moderate	Low

¹ Refer to Sections 7 and 8 for detailed assessment information.
² Refer to their identification in Section 5.
³ Refer to Appendix 2 for explanatory information.

Vegetation Area / Location	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.			
Elements At Risk ²	Relative Exposure Level ³		Relative Vulnerability Level ³	
Description	Inherent	Residual	Inherent	Residual
Persons on access/egress routes (in vehicles) or pathways	Moderate		Low	

¹ Refer to Sections 7 and 8 for detailed assessment information.

² Refer to their identification in Section 5.

³ Refer to Appendix 2 for explanatory information.

3.2 THE ASSESSED RISK LEVEL ASSOCIATED WITH A BUSHFIRE EVENT AND ITS TOLERABILITY

Table 3.3: Identifying the 'type' of risk level being assessed and reported in this report.

THE TYPE OF RISK LEVEL DERIVED FROM THE ASSESSMENT ¹			
Indicative Risk		Determined Risk	
Inherent	Residual	Inherent	Residual
✓	✓	☐	☐

¹ Refer to Section 2, Appendix 2 and the glossary for explanatory information (inherent/residual corresponds to the level that available protection measures have been considered in the assessment with 'residual' including recommended measures).

Table 3.4: The tolerability of the assessed risk levels for each exposed element and corresponding to the identified areas of bushfire prone vegetation.

THE ASSESSED BUSHFIRE RISK LEVEL AND TOLERABILITY ²					
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.				
Elements At Risk ¹	Indicative Risk Level ²		Inherent Risk Tolerability (ALARP) ³	Residual Risk Tolerability (ALARP) ³	Adjusted Residual Risk Tolerability (ALARP) ⁴
Description	Inherent	Residual			
Persons located onsite and temporarily offsite	L4	VL1	Acceptable but NOT ALARP	Acceptable	N/A
Buildings/Structures - NCC Classes 1-10	L5	VL1	Acceptable but NOT ALARP	Acceptable	N/A
Fixed (hard) infrastructure assets	M7	VL2	Tolerable but NOT ALARP	Acceptable	N/A
Vegetation Area / Location	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.				
Elements At Risk ¹	Indicative Risk Level ²		Inherent Risk Tolerability (ALARP) ³	Residual Risk Tolerability (ALARP) ³	Adjusted Residual Risk Tolerability (ALARP) ⁴
Description	Inherent	Residual			
Persons on access/egress routes in vehicles	L6		Acceptable as IS ALARP	Acceptable as IS ALARP	N/A
Supporting Comments: The Tolerability or Acceptability of a risk level is determined by whether it is 'reasonably practical' for the inherent risk level to be lowered further with the application of the assessed available and recommended bushfire protection measures.					

¹ Refer to their identification in Section 5.

² Refer to Section 2, Appendix 2 and the glossary for explanatory information (inherent/residual corresponds to the level that available protection measures have been considered in the assessment with 'residual' including recommended measures).

³ Refer to Appendix 3 for information supporting the application of the tolerance scale.

⁴ Refer to Section 3.2.1 for adjustment justification when applicable.

3.2.1 ADJUSTMENT OF RESIDUAL RISK TOLERABILITY

Development/use scenarios can exist where - for certain elements at risk - high and extreme levels of residual risk might be considered to be a tolerable or acceptable level of risk.

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.

The knock-on risk implications to persons who might be associated with these elements will need to be part of the tolerability adjustment assessment.

Table 3.5: Identification of relevant exposed elements and justification for adjustment of risk tolerability.

ELEMENTS AT RISK SUBJECT TO ADJUSTMENT OF RISK TOLERANCE	
Elements At Risk ¹	Justification For Risk Tolerance Adjustment
Description	
Fixed (hard) infrastructure assets: Feedstock (Wood Chips)	Raw feedstock is easily replaceable and has not been considered an asset for the purposes of this Risk Assessment (the tolerability is not adjusted). It is instead considered a consequential fire hazard.
Fixed (hard) infrastructure assets: Stormwater and Retention Ponds	Ponds are non-combustible, excepting some infrastructure which may be associated (e.g. pumps and piping). Ponds have not been considered an asset for the purposes of this Risk Assessment (the tolerability is not adjusted).
¹ Refer to their identification in Section 5.	

3.3 BUSHFIRE PROTECTION MEASURE APPLICATION & IMPLEMENTATION SUMMARY

ENSURING THE PROTECTION MEASURES ARE APPLIED THROUGH THE RELEVANT OPERATIONAL DOCUMENTS

The assessed 'base' hazard threat level and the ability to apply bushfire protection measures, are the key determinants of the risk to persons and property associated with the subject development/use.

Existing, planned and recommended protection measures have been accounted for in the derivation of the inherent and residual risk levels for each identified element at risk.

Consequently, it is crucial that these applied protection measures are incorporated into the relevant operational documents to ensure their actual implementation - if proceeding with the development/use is approved.

The relevant operational documents will likely be comprised of one or more of the following:

- Bushfire Management Plan (BMP). This could be either:
 - The BMP developed to satisfy planning approval requirements in which a limited number of bushfire protection measures are being addressed as the bushfire protection criteria to be met. The BMP also has scope to recommend additional protection measures as required and justifiable; or
 - A BMP that has been produced as part of an organisations operational requirements;
- Bushfire Emergency Plan (BEP) - which addresses a particular set of bushfire protection measures associated with the prevention, preparation, response and recovery procedures for a bushfire emergency event, particularly for those land uses that involve 'vulnerable' persons.:
- Site Emergency Plan – which typically is prepared for uses associated with higher risk operations that involve flammable/hazardous materials or may present a source of ignition for bushfire prone vegetation. For these uses, there is a regulatory requirement for an appropriate site emergency plan to establish how a range of relevant emergency events is to be prepared for and responded to. A bushfire event is an additional emergency that must be incorporated into that plan; or
- Project Design Documents – which are in the development phase and require specific information about the protection measures that can be incorporated to mitigate risk associated with a bushfire event.
- Bushfire Resilience Works Program – for an existing or planned development/use (operation) the works program document will detail additional works and procedures (i.e. protection measures) that need to be conducted to improve the bushfire resilience of persons and property – as a once off or annually. It also identifies the priority level for individual works so that potentially limited funds can be allocated in the most effective way.

The relevant information is derived from the results of this Bushfire Risk – Assessment and Management Report which essentially is utilised as a bushfire threat and resilience audit for the existing operation.

The check to ensure the incorporation of bushfire protection measures into the relevant operational document is established within the tables below. It is aligned with each individual bushfire protection measure that is presented as a summary description grouped by element at risk and the protection principle being employed.

The detailed protection measure information is contained within Sections 6, 7 and 8 of this report.

Table 3.6 summarises the bushfire protection measures that currently exist and/or are recommended to be implemented and that are to be maintained into the future.

The detail of these measures is set out in the Hazard Threat Level, Exposure and Vulnerability assessment tables.

The checklist identifies the Future Energy Australia operational documents that are recommended to be updated and/or created to incorporate the requirements and responsibilities into the documents.

3.3.1 THREAT (BUSHFIRE HAZARD) REDUCING PROTECTION MEASURES

Table 3.6: Summarised application of threat reducing protection measures (refer to section 6.1 for details).

Threat Reducing Protection Measure			Application Status		Checklist – Incorporate into Stated Operational Documents				
Protection principle	Ref. No.	Brief Description	Exists or Planned (fully/partly)	Additionally Recommended	Bushfire Management Plan	Bushfire Emergency Plan	Site Emergency Plan	Project Design	Works Program
Prevent fire ignition and/or severity by controlling the fuel	1.1	Remove offsite bushfire fuel	✓	✓	✓				✓
	1.2	Reduce offsite bushfire fuel - hazard reduction burning							
	1.3	Reduce offsite bushfire fuel- mechanical							
	1.4	Remove onsite bushfire fuel	✓	✓	✓				
	1.5	Reduce onsite bushfire fuel - hazard reduction burning							
	1.6	Reduce onsite bushfire fuel - mechanical							
	1.7	Reduce onsite consequential fire fine fuels	✓		✓				
	1.8	Reduce road verge fuel	✓	✓	✓				✓
	1.9	Greater enforcement applied to compliance with the local government's fire break and fuel load notice							
Prevent fire ignition by controlling heat energy sources	1.10	Operational procedures – fire safe site procedures		✓			✓		
	1.11	Operational procedures – hazard reduction burning							
	1.12	Equipment design – limit potential for spark production	✓					✓	
	1.13	Legal enforcement – of total fire bans	✓				✓		
	1.14	Legal enforcement – methods to reduce arson							
	1.15	Education of persons							
Prevent fire ignition by controlling heat energy source and fuel interactions	1.16	Shielding of ignition sources from bushfire fuels							
	1.17	Separation of ignition sources from bushfire fuels	✓	✓	✓				
	1.18	Equipment design – control energy transfer to fuels							

3.3.2 EXPOSURE REDUCING PROTECTION MEASURES - PERSONS

Table 3.7: Summarised application of exposure reducing protection measures for the subject persons (refer to sections 7.1.1 & 7.2.1 for details).

Exposure Reducing Protection Measure - Persons			Application Status Subject Development/Use		Checklist – Incorporate into Stated Operational Documents				
Protection Principle	Ref. No.	Brief Description	Exists or Planned (fully/partly)	Additionally Recommended	Bushfire Management Plan	Bushfire Emergency Plan	Site Emergency Plan	Project Design	Works Program
Separation from All Bushfire Threats	Persons Located Onsite and Temporarily Offsite								
	2.1	Stay away from the subject site							
	2.2	Stay within the subject site – remote offsite hazard							
	2.3	Relocate away from remote offsite hazard - safer offsite location available							
	2.4	Evacuate from the subject site - safer offsite location(s) available	✓					✓	
	2.5	Relocate within the subject site - safer onsite area	✓		✓				
	2.6	Relocate within the subject site – pathway to safer onsite area/building							
	2.7	Pre-emptively relocate away from the subject site							
	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	✓	✓	✓			✓	
	Shielding from All Bushfire Threats	Persons Located Onsite and Temporarily Offsite							
2.8		On-site shelter building – community bushfire refuge standard							
2.9		On-site shelter building – accommodation not part of site use							
2.10		On-site shelter building – appropriate threat resilience							
2.11		On-site shelter structure – Class 10c							
2.12		Constructed barrier – shield persons in the open							

	2.13	Natural barrier - shield persons in the open							
	2.14	Constructed/natural barrier – shielding for persons on pathways to safer onsite area/building:							
	Persons on Access / Egress Routes in Vehicles								
	3.5	Vehicle type – protection level							

3.3.3 VULNERABILITY REDUCING PROTECTION MEASURES - PERSONS

Table 3.8: Summarised application of vulnerability reducing protection measures for the subject persons (refer to sections 8.1.1 & 8.2.1 for details).

Vulnerability Reducing Protection Measure - Persons			Application Status Subject Development/Use		Checklist – Incorporate into Stated Operational Documents				
Protection Principle	Ref. No.	Brief Description	Exists or Planned (fully/partly)	Additionally Recommended	Bushfire Management Plan	Bushfire Emergency Plan	Site Emergency Plan	Project Design	Works Program
Transport and Multiple Evacuation Destinations and Routes Available	Persons Located Onsite and Temporarily Offsite								
	7.1	Sufficient evacuation transport available	✓					✓	
	7.2	Multiple safer offsite locations available	✓					✓	
Provision of Bushfire Emergency Information and Education	7.3	Bushfire emergency plan							
	7.4	Bushfire emergency poster							
	7.5	Bushfire protection measures to be implemented are published in the relevant operational documents		✓				✓	
	7.6	Prominent display of information stating safe early evacuation is the primary procedure							
	7.7	Egress pathway signage							
	7.8	Trained personnel onsite	✓	✓				✓	
	7.9	Build community resilience through education							
	7.10	Encourage 'property bushfire resilience assessments'							
A Bushfire Emergency Firefighting Capability Exists (Response)	7.11	Personnel onsite can manage bushfire emergency procedures		✓				✓	
	7.12	Personnel onsite can operate firefighting equipment	✓					✓	
	7.13	Locations of vulnerable persons are registered							
	7.14	External emergency services available	✓	✓				✓	✓
Apply Best (Safer) Road Design and Construction (Materials)	Persons on Access / Egress Routes in Vehicles								
	8.1	Road width	✓					✓	
	8.2	Road gradient	✓					✓	

	8.3	Road Clearance	✓					✓	
	8.4	Road Surface Materials	✓					✓	
	8.5	Driver road ahead visibility and signage	✓					✓	
	8.6	Road length	✓					✓	
	8.7	Interconnected roads	✓					✓	
Evacuees Self-Sufficient (Local Awareness and Transport)	8.8	Persons onsite have local awareness	✓					✓	
	8.9	Persons onsite have own transport	✓					✓	

3.3.4 EXPOSURE REDUCING PROTECTION MEASURES – BUILDINGS / OTHER STRUCTURES/ INFRASTRUCTURE

Table 3.9: Summarised application of exposure reducing protection measures for the subject buildings / other structures / infrastructure (refer to sections 7.3.1 & 7.4.1 for details).

Exposure Reducing Protection Measure - Buildings / Other Structures/ Infrastructure			Application Status Subject Development/Use		Checklist – Incorporate into Stated Operational Documents				
Protection Principle	Ref. No.	Brief Description	Exists or Planned (fully/partly)	Additionally Recommended	Bushfire Management Plan	Bushfire Emergency Plan	Site Emergency Plan	Project Design	Works Program
Separation from All Bushfire Threats	4.1, 6.1	Asset protection zone (APZ)	✓	✓	✓				
	4.2, 6.2	Siting of buildings/structures - wind							
	4.3, 6.3	Use of non-vegetated areas and/or public open space							
	4.4, 6.4	Landscaping - tree location	✓					✓	
	4.5, 6.5	Separation of stored flammable products - gas in cylinders	✓					✓	
	4.6, 6.6	Separation from stored flammable products – fuels / other hazardous materials							
	4.7, 6.7	Separation from stored and constructed combustible items	✓	✓	✓			✓	
Shielding from All Bushfire Threats	4.8, 6.8	Constructed Barrier – shielding from bushfire							
	4.9, 6.9	Constructed Barrier – shielding from consequential fire							
	4.10, 6.10	Natural Barrier - landforms							
	4.11, 6.11	Planted Barrier - vegetation							
	4.12, 6.12	Shield non-structural essential elements	✓	✓	✓				

3.3.5 VULNERABILITY REDUCING PROTECTION MEASURES – BUILDINGS / OTHER STRUCTURES / INFRASTRUCTURE

Table 3.10: Summarised application of vulnerability reducing protection measures for the subject buildings / other structures / infrastructure (refer to sections 8.3.1 & 8.4.1 for detail).

Vulnerability Reducing Protection Measure - Buildings / Other Structures/ Infrastructure			Application Status Subject Development/Use		Checklist – Incorporate into Stated Operational Documents					
Protection Principle	Ref. No.	Brief Description	Exists or Planned (fully/partly)	Additionally Recommended	Bushfire Management Plan	Bushfire Emergency Plan	Site Emergency Plan	Project Design	Works Program	
Design and Construction (Materials)	9.1, 11.1	Construction to a standard - AS 3959:2018	✓		✓			✓		
	9.2, 11.2	Construction to a standard – NASH Standard								
	9.3, 11.3	Construction materials – external and internal cavity building elements		✓	✓			✓		
	9.4, 11.4	Construction materials – consequential fire fuels	✓	✓	✓					
	9.5, 11.5	Construction – resistant to high wind	✓					✓		
	9.6, 11.6	Construction – gas supply	✓					✓		
	9.7, 11.7	Construction - electricity supply and/or non-structural essential elements	✓	✓	✓			✓		
	9.8, 11.8	Minimise debris and ember accumulation – re-entrant detail	✓	✓	✓			✓		
	9.9, 11.9	Minimise debris and ember accumulation – trapping surfaces	✓	✓	✓			✓		
	9.10, 11.10	Minimise debris and ember accumulation – roof plumbing		✓	✓					
	9.11, 11.11	Minimise debris and ember accumulation – construction cavities		✓	✓					
	9.12, 11.12	Minimise flame/radiant heat/ember/debris entry - external openings	✓						✓	
	9.13, 11.13	Screening and sealing - gaps and penetrations		✓						✓
	9.14, 11.14	Screening - external doors and windows								
	9.15, 11.15	Shutters - external doors and windows								
	9.16, 11.16	Landscaping construction - fences and walls		✓	✓	✓				

Firefighting Capability	9.17, 11.17	Firefighting water supply	✓	✓	✓		✓	✓	
	9.18, 11.18	Firefighting equipment – active operation	✓	✓	✓		✓		
	9.19, 11.19	Firefighting equipment – passive operation		✓				✓	
	9.20, 11.20	Firefighting equipment – maintain operability		✓			✓		
	9.22, 11.21	Firebreaks – primarily for access	✓					✓	
Management And Maintaining Effectiveness Of Applied Protection Measures	9.22, 11.22	Formal management / maintenance plan – actions and responsibilities	✓	✓			✓		

4 IDENTIFICATION OF THE ELEMENTS AT RISK

Elements at risk are those exposed to the bushfire hazard threats identified in Section 5. This section establishes the generic list of possible elements at risk and identifies the exposed elements of the subject development/use.

Table 4.1: Identification of the elements at risk for which this risk assessment and management report is produced.

THE ELEMENTS AT RISK (THE EXPOSED ELEMENTS)	
Type Description	Identification of Relevant Elements
Persons located onsite: as part of site operations or visitors) and Persons temporarily offsite as part of site operations: (e.g. tourism day trips)	✓
Persons on Access/Egress Routes (in Vehicles): i.e., roads, driveways, access ways	✓
Buildings - NCC Class 1 & 2: residential - of a domestic nature	
Buildings - NCC Class 3: residential – of long term or transient nature, for unrelated people	
Buildings – NCC Class 5: offices for professional or commercial purposes	
Buildings – NCC Class 6: shops selling retail goods or services to the public	
Buildings – NCC Class 7: warehouses & carparks - storage – wholesale goods / vehicles	
Buildings – NCC Class 8: factory / workshop / laboratory - in which a process is carried out	✓
Buildings – NCC Class 9: health care / residential care / assembly	
Buildings or Structures – NCC Class 10: non-habitable – shed / carport / garage / fence / retaining wall etc.	✓
Non-Building Accommodation: caravans / camper trailers / tents etc	
Fixed (Hard) Infrastructure Assets: telecommunications / power generation / transport / water supply / waste management	✓
Livestock/Animals: as part of commercial or private operations (saleyards / events / wildlife sanctuaries).	

Table 4.2: Description of the elements at risk that are subject to assessment for the proposed/existing development and/or use.

ELEMENT AT RISK DETAIL FOR THE SUBJECT DEVELOPMENT/USE	
Elements At Risk	Element Description
Persons located onsite and temporarily offsite	<p>The site will be staffed with approximately 17 personnel during standard working hours Monday to Friday, with a potential maximum of 30 during shift change.</p> <p>Potential transient staff include maintenance/construction contractors and truck drivers delivering feedstock.</p> <p>Major maintenance that might be required would include replacement of equipment or infrastructure as needed. This would involve larger numbers of personnel for limited periods as required.</p>
Persons on access/egress routes in vehicles	Staff, contractors and/or emergency services accessing to / egressing from the facility.

Buildings/Structures - NCC Classes 1-10	The biorefinery plant as a whole has been designated a Class 8, type C building under the NCC. The site includes multiple potential designations including the Site Office (Class 5) and storage sheds (Class 10a).
Fixed (hard) infrastructure assets	<p>Diesel storage tanks</p> <p>Wood vinegar tanks</p> <p>Biochar storage</p> <p>Manufacturing and processing plant including distillation modules, pumps, piping, holding tanks etc.</p> <p>Thermal oxidiser</p> <p>Crumbler</p> <p>Substation and transformers</p> <p>Associated electrical infrastructure</p>

5 IDENTIFICATION OF THE BUSHFIRE HAZARD

ONSITE AND OFFSITE VEGETATION – RATIONALE FOR SEPARATE IDENTIFICATION

The approach adopted in this report is to separately identify onsite and offsite bushfire prone vegetation when the distinction exists, and it is necessary.

Onsite Vegetation

This is considered to be vegetation that exists on a given lot or lots or a large area of land that can be considered a tenement (e.g. a mining tenement) and for which the owner or occupier has certain rights to conduct activities upon. The 'onsite' land is the subject site on which the existing or proposed development and/or use is to be conducted.

The existence of these rights makes it more likely that an authority will exist to make and maintain any required **changes to the extent and the composition of any bushfire prone vegetation that exists 'onsite'**. The only constraint will be any environmental conditions established by relevant authorities.

Offsite Vegetation

This is considered to be vegetation that exists external to what can be considered 'onsite'. For these lands the owner/operator does not normally have any authority to modify or manage this bushfire prone vegetation to reduce threats and maintain that reduction in perpetuity. Rather, the authority for modifying and managing 'offsite' vegetation resides with a third party such as another landowner or a government authority.

Implications for Risk Assessment and Implementation of Relevant Protection Measures

- It is likely to be near certain that a greater number of relevant bushfire protection measures can be established on land identified as 'onsite' compared to land that is identified as 'offsite'.
- A responsibility can be established for owners and/or operators of onsite land to ensure the ongoing maintenance of those protection measures.
- In comparison, management of offsite vegetation requires the establishment of enforceable vegetation management agreements if any reduction in threat level is to be achieved and accounted for in the threat level assessment. These can be problematic to establish.

The required assessment of the broader landscape's influence on bushfire hazard threat levels will most likely be considering vegetation and terrain that is external to the subject development/use site and therefore needs to be separately identified.

For the Renewable Diesel Biorefinery Project, the risk assessment will consider the hazard posed by bushfire prone vegetation at two scales:

- The vegetation within the subject lots and within 150m of the proposed development area, which presents the direct bushfire hazard (including following AS3959 BAL Methodology); and
- The vegetation within the broader locality, nominally to a 10km radius. This vegetation impacts access routes, the severity of potential landscape-scale fires impacting the immediate (150m) surrounds, and may impact the site with medium to long range ember attack and smoke.

5.1 ONSITE BUSHFIRE PRONE VEGETATION

Map I.D. / Area No. / Location	All bushfire prone vegetation within 150m of the proposed development. Refer to Figure 5.1.		
Classification or Exclusion Clause	Class A Forest	Effective Slope (deg)	Upslope or flat 0
			Downslope >0-5
	Class B Woodland		Upslope or flat 0
			Downslope >0-5
	Class G Grassland		Upslope or flat 0
			Downslope >0-5
Types Identified	Open forest A-03	Woodland B-05	Sown pasture G-26
Description & Classification Justification	The vegetation onsite is largely short-cropped pasture (grassland) with a limited section of woodland to the south-western corner of the lot. Offsite vegetation is similar assemblage of grassland and woodland, with forest having been sown and revegetated in a band along Wanerie Road. The area has a gentle downslope to the southwest, thus all areas are either upslope or 0-5 degrees downslope relative to development locations.		
Post Development Assumptions:	APZs will be established as described in the BMP. In all cases, the APZ established will exceed the BAL-29 APZ required for planning approval. A portion of the revegetated forest along the southern boundary (outside the lot boundary) will require management to achieve the minimum 100m APZ intended for all high risk plant, infrastructure, and uses. This will require agreement and commitment from the Shire of Narrogin.		



Revegetated Forest



Woodland



Grassland (pasture)

Figure 5.7
**Topography & Classified
 Vegetation (Post Development)**

Lot 31 on Plan 4044104, Area : 64.6242 ha
 Great Southern Highway
 DUMBERNING
 SHIRE OF NARROGIN



----- LEGEND -----

- Subject Site
- Other Lots
- Development

Proposed Building

- Class 5
- Class 8
- Class 10a
- Class 10b
- Biochar Storage
- Wood Chip Pile

150m Vegetation Assessment

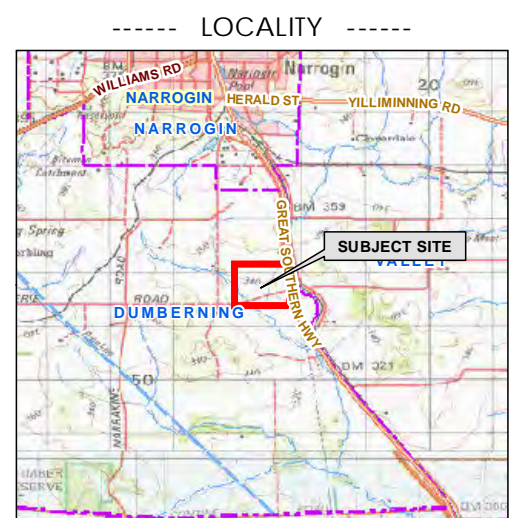
- 150m from Subject Site

Classified Vegetation

- Class (A) Forest
- Class (B) Woodland
- Class (G) Grassland
- Exempt 2.2.3.2

↔ APZ Distance

0 25 50 75 100 125 150
 Metres



Aerial Imagery : Landgate/SLIP
 Image Date : 2017

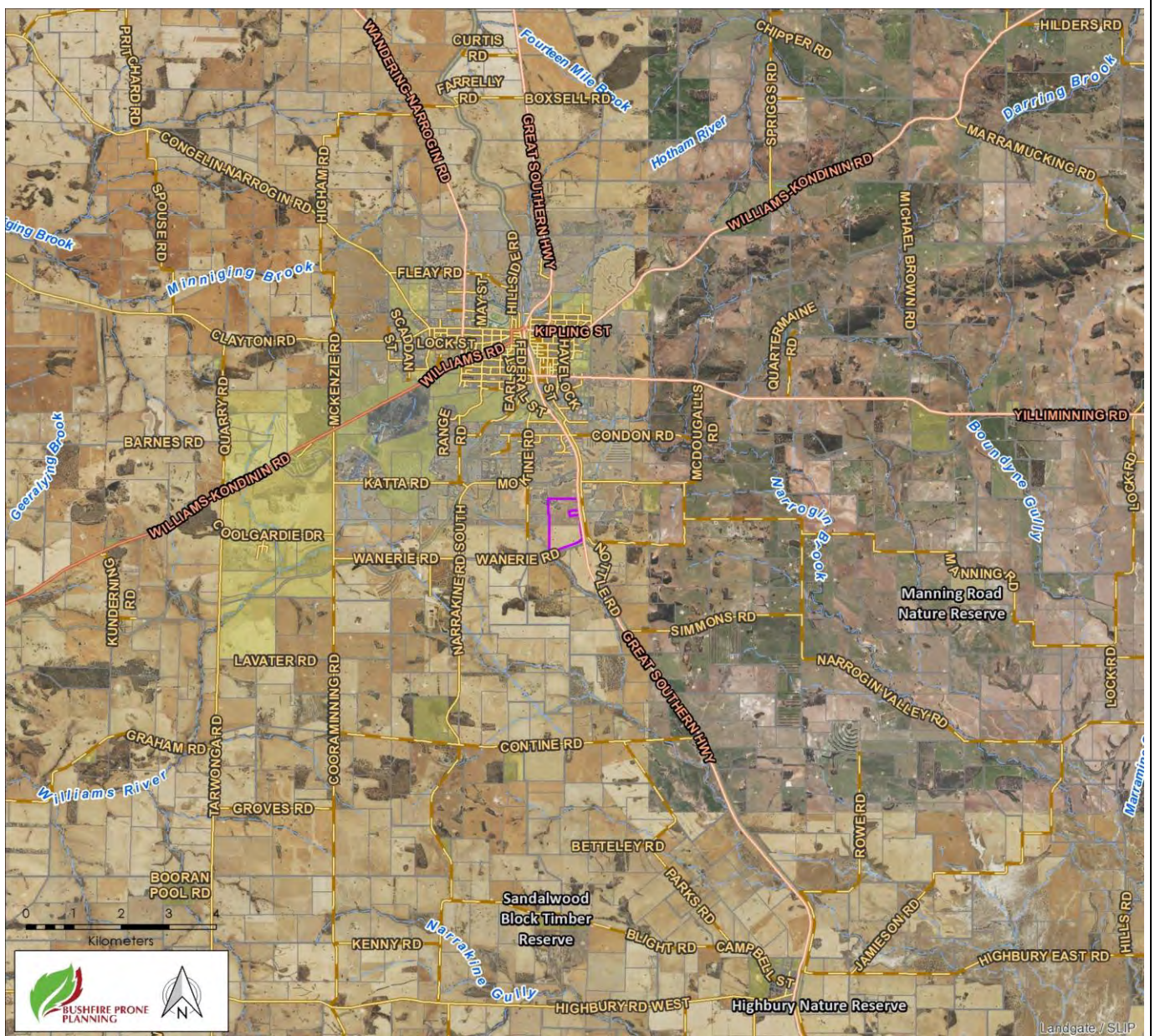
Coordinate System: GDA 1994 MGA Zone 50
 Projection: Universal Transverse Mercator Units: Metre
 Map compiled by: Ian Ross 5/10/2022
 Map updated by: Neil 5/10/2022
 A3 Scale 1:2,750

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 2022\220437 - Lot 31 Great Southern Hwy Dumberning (BMP)\Mapping\MXD\220437_Fig3-1-1_VEG-POST_Lot31 Great Southern Hwy.mxd

5.2 OFFSITE BUSHFIRE PRONE VEGETATION

Map I.D. / Area No. / Location	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.		
Classification or Exclusion Clause	Class A Forest	Effective Slope (deg)	Upslope or flat 0
	Class B Woodland		Downslope >0-5
	Class G Grassland		
Types Identified	Open forest A-03	Woodland B-05	Sown pasture G-26
Description & Classification Justification	The vegetation offsite within the broader locality is comparable to that within the assessment area. The area is dominated by sown pasture with fragmented areas of woodland and forest. Larger sections of remnant forest do exist within the locality, the closest being approximately 500m east of the proposed development footprint.		



Date map compiled/updated: 6/10/2022 © 2022 BPP Group Pty Ltd Map Document Name: 220457_5-2_REGION_Lot31 Great Southern Hwy

5.3 THE BROADER LANDSCAPE/ENVIRONMENT AND ITS POTENTIAL TO INTENSIFY FIRE BEHAVIOUR

More recent research into bushfire propagation has highlighted the role of environmental factors that are responsible for dynamic bushfire propagation and subsequent extreme fire development. Dynamic fire propagation arises from complex interactions between the terrain, the atmosphere and the fire. The intensified fire behaviour of an extreme bushfire event will significantly increase the threat levels generated by the bushfire attack mechanisms. Refer to Appendix 5 for an explanation of dynamic fire behaviours (DFBs) and their involvement in extreme bushfire events.

Consequently, in assessing the bushfire hazard threat levels to which the at risk elements could be exposed, the potential for dynamic bushfire propagation and subsequent development of extreme bushfire events within the broader landscape surrounding a subject site, must be assessed. The results of this assessment are incorporated into the assessed bushfire hazard threat levels for each attack mechanism in Section 5.5.

Table 5.2: Broader landscape assessment – the potential for extreme fire events to increase threat levels.

ASSESSING THE POTENTIAL FOR AN EXTREME BUSHFIRE EVENT TO DEVELOP AND INCREASE THE LEVEL OF THREATS IMPACTING THE SUBJECT SITE			
Relevant Physical Factors ¹	Factor Existence in Surrounding Landscape	Potential to Increase Bushfire Threat Levels	Assessment Comments
Physical factors more typically associated with conflagrations that are more likely to exist as large surface based bushfire events			
Large continuous areas of bushfire prone vegetation	Partially Exists	Low	The region is dominated by sown pasture (grassland). Pockets of forest and woodland exist but are considerably separated and/or irregularly shaped, such that a continuous fire run displaying forest or woodland fire behaviour is limited.
Heavier fuel loads	Does Not Exist		Remnant forest and woodland structure is generally grasses (<30cm) with canopy elevated to 1m. A dense understory is rare. Pasture (grassland) is generally cropped <10cm. The grassland at assessment is in fact excludable, but is necessary to classify as a worst-case scenario. Fuels loads associated with each vegetation type are very low.
Fuel types (bark) that produce significant quantities of embers / firebrands (spotting) and can be long lasting;	Does Not Exist		Grassland fuels do not generate long distance embers. The remnant forest assemblages are dominated by casuarina (tight, scaly bark) and wandoo (smooth bark).
Sufficient area of land and vegetation to support multiple fires of scale	Substantially Exists		Multiple fires may exist and the intensity will vary due to the fragmentation of grassland and forest pockets.
Terrain that can facilitate development of topographically modified winds (e.g. scarp or foehn-like)	Does Not Exist		The landscape is gently undulating, with total elevation changes up to 30m but with slopes not exceeding 5 degrees.

ASSESSING THE POTENTIAL FOR AN EXTREME BUSHFIRE EVENT TO DEVELOP AND INCREASE THE LEVEL OF THREATS IMPACTING THE SUBJECT SITE

Relevant Physical Factors ¹	Factor Existence in Surrounding Landscape	Potential to Increase Bushfire Threat Levels	Assessment Comments
Strong synoptic winds (i.e., not fire driven)	Possible to Occur		The closest BOM station is in Narrogin (<5km away). The average summer wind speed is approximately 21km/h. Wind speeds >31km/h have an occurrence of approximately 10%. Strong winds are possible and cannot be accurately predicted in advance.
Physical factors with identified links to deep flaming and the development of pyroconvective, coupled atmosphere, bushfire events			
Terrain slopes of approximately 24° or greater - or some degrees lower with greater wind speeds (increases potential for eruptive fire).	Does Not Exist	Moderate	The landscape is gently undulating, with total elevation changes up to 30m but with slopes not exceeding 5 degrees.
Rugged terrain with local relief in the order of at least 300m (increases potential for eruptive fire).	Does Not Exist		
Terrain with leeward slopes >20-25 degrees (increases potential for vorticity-driven lateral spread)	Does Not Exist		
Wind direction within 30-40° of topographic aspect (increases potential for vorticity-driven lateral spread)	Partially Exists		The closest BOM station is in Narrogin (<5km away). The recorded summer weather wind rose does not show a dominant wind direction.
Wind speed in excess of approximately 20 km/hr (increases potential for vorticity-driven lateral spread)	Substantially Exists		A 20km/h wind speed is approximately average for summer, therefore frequency of wind speeds exceeding 20km/h approximately 50%. Wind speeds exceed 31km/h with approximately 10% frequency.
Heavy forest fuel types with loads in excess of 15-20 t/ha (increases potential for vorticity-driven lateral spread)	Does Not Exist		Remnant forest and woodland structure is generally grasses (<30cm) with canopy elevated to 1m. A dense understory is rare. Fuel loads will generally be <15t/ha.
Fuel moisture content around 5% or less (associated with vorticity-driven lateral spread)	Substantially Exists		Low fuel moisture is likely, as the understory is generally grassy (fine fuels cure more readily).
Sufficiently sized areas (scale) of bushfire prone vegetation to potentially support deep flaming and supply the required quasi-instantaneous energy release.	Does Not Exist		Bushfire prone vegetation is of sufficient extent to support deep flaming. The vegetation types, fuel loads, and topography do not support the atmospheric/localised effects of deep flaming.
Atmospheric instability to create opportunity for atmospheric coupling and violent pyroconvection.	Possible to Occur		It will be assumed, as a minimum, that at most locations, the potential for vertical movement of air without any resistance to that movement (e.g. temperature inversions) can always exist. That is, it is not sufficiently risk averse to assume that atmospheric instability will never exist – different temperature air masses can

ASSESSING THE POTENTIAL FOR AN EXTREME BUSHFIRE EVENT TO DEVELOP AND INCREASE THE LEVEL OF THREATS IMPACTING THE SUBJECT SITE

Relevant Physical Factors ¹	Factor Existence in Surrounding Landscape	Potential to Increase Bushfire Threat Levels	Assessment Comments
			always interact as a consequence of the passage of different weather systems at any location.

¹ These are physical terrain / environment factors that are either required for certain dynamic fire behaviours or will enhance the potential for and the development of an extreme bushfire event.

5.4 ASSESSMENT OF VEGETATION CHARACTERISTICS DRIVING BUSHFIRE ATTACK MECHANISM THREAT LEVELS

This qualitative assessment derives the base threat levels of identified areas of bushfire prone vegetation by accounting for:

1. Fuel types, arrangement and quantities; and
2. The existence of relevant characteristics within the broader landscape that have the potential to intensify bushfire behaviour and increase threat levels.

Note: This assessment does not account for the existence or potential application of threat reducing protection measures or the level of exposure and vulnerability of elements at risk. These are accounted for in subsequent steps of the risk assessment process that results in the derivation of inherent and/or residual risk levels.

Table 5.3: The assessed potential for bushfire attack mechanisms originating from vegetation to adversely impact exposed elements.

CHARACTERISTICS ASSESSMENT OF THE BUSHFIRE PRONE VEGETATION AND ITS POTENTIAL TO IMPACT ¹ ELEMENTS AT RISK – THE BASE THREAT LEVEL		
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.	
Identified Characteristics that will Contribute to the Severity of the Attack Mechanism and Consequent Base Threat Level to All Elements at Risk		Base Threat Level (the relative potential for adverse impact on exposed elements)
Direct Bushfire Attack Mechanisms		
<p>Ember Attack: This threat level is strongly correlated with the existence of bark fuels.</p> <p>The varied typical rates of spread and residence time for flame fronts in different vegetation types is also incorporated into the threat level assessment (these impact on time available to make decisions and time exposed to threats).</p>	<p>Ember Attack can result from both immediate and regional vegetation. Other attack mechanisms below have not considered vegetation within the broader locality.</p> <p>Within 150m of the development: The grass type fuels are finer fuels and will produce very little, short distance small embers with short lives. The majority of these embers will be consumed as part of the flame front which will have a residence time (the flaming phase at a point on the ground) typically less than 10 seconds. Consequently, embers from grassland presents a limited threat. The remnant forest and woodland vegetation is dominated by casuarina (tight, scaly bark) and wandoo (smooth bark) which generally will not carry for sufficient distance to impact the site.</p> <p>The revegetation immediately south of the development includes a mix of species and can impact the site with short-distance spotting. This poses the primary ember hazard.</p>	<p>Moderate</p>

CHARACTERISTICS ASSESSMENT OF THE BUSHFIRE PRONE VEGETATION AND ITS POTENTIAL TO IMPACT 1 ELEMENTS AT RISK – THE BASE THREAT LEVEL

Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.	
	<p>Within the locality: Landscape-scale pasture and the pockets of casuarina/wandoo remnant forest are unlikely to generate embers sufficient to impact the site from >150m.</p>	
<p>Radiant Heat Attack: This threat level is a function of fuel characteristics (size, shape, quantity, type, arrangement and moisture content) and the landscape and weather factors that can intensify fire behaviour.</p> <p>Larger flame sizes and higher temperatures produce higher levels of heat.</p> <p>The varied typical rates of spread and residence time for flame fronts in different vegetation types is also incorporated into the threat level assessment (these impact on time available to make decisions and time exposed to threats).</p>	<p>Fine fuel loads for the grassland (pasture) vegetation ranges from 2-4 t/ha, with 2 t/ha being more common due to livestock grazing.</p> <p>The modelled solid portion flame lengths for the identified grassland vegetation type, on land ranging from flat to 0-5 degrees downslope, are up to 7m to 9m. These are shorter to medium flame lengths.</p> <p>The potential impact of the radiant heat transfer is going to be moderated by the short residence time (the flaming phase at a point on the ground) for the flame front. For much of the identified grassland vegetation types, the residence time will typically be less than 10 seconds. The residual radiant heat after the passage of the fire front will be low.</p> <p>The revegetated forest to the south of the proposed development poses a greater threat of radiant heat attack. The vegetation has not yet fully established but includes mid-story (acacia), sub-dominant (casuarina) and dominant (eucalyptus) layers.</p>	Low
<p>Bushfire Flame Attack: This threat level is a function of potential flame lengths which are significantly influenced by fine fuel loads and the slope of the land on which the fire is burning.</p> <p>The varied typical rates of spread and residence time for flame fronts in different vegetation types is also incorporated into the threat level assessment (these impact on time available to make decisions and time exposed to threats).</p>	<p>The modelled solid portion flame lengths for the identified grassland vegetation type, on land ranging from flat to 0-5 degrees downslope, are up to 7m to 9m.</p> <p>The modelled flame lengths for forest in the same range are 19.8m to 26.2m.</p> <p>The setbacks to establish the BAL-29 APZ required for planning approval, are 8m flat/ 9m downslope for grassland and 21/27m for forest, exceeding the maximum flame lengths in both cases.</p>	Low
<p>Surface Fire Attack: This threat level is a function of the existence of intermittent surface fuels surrounding and leading up to exposed elements.</p>	<p>Grassland does not accumulate significant surface fuels/debris. Forest vegetation produces sufficient leaf litter (surface fuel) that the hazard must be considered.</p>	Moderate
Indirect Bushfire Attack Mechanisms		

CHARACTERISTICS ASSESSMENT OF THE BUSHFIRE PRONE VEGETATION AND ITS POTENTIAL TO IMPACT ¹ ELEMENTS AT RISK – THE BASE THREAT LEVEL

Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.	
Debris Accumulation: This threat level is a function of having a source of vegetative debris, its extent and proximity to exposed elements.	There will be limited debris accumulation due to predominantly grassland vegetation. Some debris will exist within the forest areas.	Low
Consequential Fire: This threat level is a function of the existence of accumulated debris (fine fuels) and stored or constructed combustible / flammable items that exist either as part of the site use or operations or are adjoining/adjacent buildings/structures (heavy fuels).	The potential for debris accumulation has been assessed. The site operations results in considerable consequential fire hazards being available. Wood chips (feedstock), diesel, and intermediate inputs or by-products (biochar) are all consequential fire hazards or possible sources of onsite ignition.	High
Fire Driven Wind: This threat level is correlated with the potential for development of extreme bushfire events (refer to Appendix 5).	The assessment in Section 4.2 identifies the potential for an extreme bushfire event to develop to be low and the potential to further increase bushfire threat levels through the development of a pyroconvective event to be moderate. Consequently, the base threat level of this attack mechanism is low.	Low
Tree Strike and Obstruction: This threat level is a function of the existence of trees, their proximity to exposed elements and an exposed element that can subsequently be vulnerable to other bushfire attack mechanisms due to damage or obstruction.	The proposed location of the facility is relatively clear, but some trees will exist within 50m. An element may be considered at risk where the setback from the tree is <1.5x the mature height of that tree.	Moderate

¹ Refer to glossary.

5.5 THE MODELLED BUSHFIRE - POTENTIAL RADIANT HEAT TRANSFER AND FLAME LENGTH

For the identified vegetation the modelled (design) fire will apply the most applicable fire behaviour and radiant heat models in determining the level of threat presented by the flame contact and radiant heat direct attack mechanisms of fire.

These models will be either those applied to Bushfire Attack Level (BAL) determination within AS 3959:2018 or other models as identified and justified in this report. The information in this section states the levels of radiant heat transfer at the stated distances from the element at risk in either BAL ratings or kW/m² (and flame lengths as relevant).

This information is considered in assessing threat levels in Section 5. Refer to Appendix 7 for additional information.

Table 5.4: Vegetation separation distances corresponding to radiant heat transfer levels (and illustrated as BAL contours in Figure 3.2 of the associated BMP).

THE CALCULATED VEGETATION SEPARATION DISTANCES CORRESPONDING TO THE STATED LEVEL OF RADIANT HEAT ¹										
Vegetation Classification ¹		Effective Slope [degree range]	Separation Distances (m) Corresponding to Stated Level of Radiant Heat							
			Bushfire Attack Level						Radiant Heat kW/m ²	
Area /Location	Class		BAL-FZ	BAL-40	BAL-29	BAL-19	BAL12.5	BAL-LOW	12 kW/m ²	2 kW/m ²
1	(A) Forest	Upslope or flat 0	<16	16-<21	21-<31	31-<42	42-<100	>100	>43	>152
2	(A) Forest	Downslope >0-5	<20	20-<27	27-<37	37-<50	50-<100	>100	>45	>158
3	(B) Woodland	Upslope or flat 0	<10	10-<14	14-<20	20-<29	29-<100	>100	>30	>120
4	(B) Woodland	Downslope >0-5	<13	13-<17	17-<25	25-<35	35-<100	>100	>32	>124
5	(G) Grassland	Upslope or flat 0	<6	6-<8	8-<12	12-<17	17-<50	>50	>18	>87
6	(G) Grassland	Downslope >0-5	<7	7-<9	9-<14	14-<20	20-<50	>50	>19	>90

¹ Derived from the application of method 1 BAL determination methodology (AS 3959:2018 Section 2, Table 2.5). All modelling input and output values in the associated BMP.

6 BUSHFIRE HAZARD THREAT LEVELS ASSESSMENT

SUMMARY OF THE QUALITATIVE ASSESSMENT PROCESS

1. Identify all protection measures (grouped by protection principle) that are available to reduce threat levels and rate their effectiveness;
2. Produce a numerical summary of all potential threat reducing protection measures that are available and determine their application status;
3. Assess the potential threat reducing impact of the package of protection measures that is able to be applied. The effectiveness rating weights the potential impact of an individual measure; and
1. Derive the threat level, for each identified area of bushfire prone vegetation, by accounting for:
 - The relevant characteristics of the vegetation as they influence the bushfire attack mechanisms and establish the base threat level;
 - The potential threat increasing influence of the broader landscape; and
 - The impact of the applied package of protection measures in reducing threat levels (refer to Section 2.3.3 and Appendix 2 for additional risk assessment process information).

6.1 PROTECTION MEASURES AVAILABLE TO REDUCE BUSHFIRE THREAT LEVELS AND THEIR APPLICATION STATUS

Table 6.1: For the stated area of vegetation, all available bushfire protection measures for preventing or reducing the potential for fire ignition and eliminating or reducing its threat levels.

PROTECTION MEASURES TO REDUCE BUSHFIRE THREAT LEVELS		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.					
PROTECTION PRINCIPLE - PREVENT FIRE IGNITION AND/OR SEVERITY BY CONTROLLING THE FUEL: Eliminate or reduce vegetation fuel loads, modify their properties (vegetation types and the arrangement of the fuels). Maintain the measures over time to eliminate bushfire or lower the severity of fire behaviours and the consequent threat levels. The measures may conflict with desired / regulated environmental conservation outcomes and this remains a potential limitation.						
1.1	Remove Offsite Bushfire Fuel: Remove fuel permanently by clearing bushfire prone vegetation when an authority exists.	Very High	Yes	No	Yes	Yes
<i>Informative and/or Site Specific Comment/Assessment: Removal or permanent management of a portion of Vegetation Areas 1 and 2 (the revegetated forest adjoining the subject lot to the south) will be required to establish the 100m APZ from high-risk plant, infrastructure, and use areas. The measure will require approval and/or commitment from the Local Government to implement.</i>						

PROTECTION MEASURES TO REDUCE BUSHFIRE THREAT LEVELS		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
1.2	Reduce Offsite Bushfire Fuel: Programmed hazard reduction burning when an authority exists to conduct and maintain (refer to Appendix 6 for additional information).	Not Relevant	N/A	N/A	N/A	N/A
1.3	Reduce Offsite Bushfire Fuel: Mechanical fuel reduction to 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, minimise 'ladder' fuels' - when an authority exists to conduct and maintain.	Not Relevant	N/A	N/A	N/A	N/A
1.4	Remove Onsite Bushfire Fuel: Remove fuel permanently by clearing bushfire prone vegetation when approved.	Very High	Yes	Yes	Yes	Yes
<i>Informative and/or Site Specific Comment/Assessment: Remnant vegetation onsite has previously been cleared and the remaining bushfire prone vegetation is sown pasture (grassland). Clearing a portion of this grassland is required to establish the required 100m APZ from high-risk plant, infrastructure, and use areas.</i>						
1.5	Reduce Onsite Bushfire Fuel: Programmed hazard reduction burning (refer to Appendix 6 for additional information).	Not Relevant	N/A	N/A	N/A	N/A
1.6	Reduce Onsite Bushfire Fuel: Mechanical fuel reduction to 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, minimise 'ladder' fuels' - when approved.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: Hazard reduction burning or mechanical reduction of onsite grassland (sown pasture) would need to be completed annually. Reduction/modification over time is not applicable to grassland.</i>						
1.7	Reduce Onsite Consequential Fire Fine Fuels: Apply the specifications for an Asset Protection Zone (APZ) surrounding the exposed element(s) to ensure this area contains minimal consequential fire fuels and is maintained in a low threat state. The specifications are established in the Guidelines [22] within the <i>Explanatory Notes for Element 2 of the Bushfire Protection Criteria and Schedule 1: Standards for Asset Protection Zones</i> .	Effective	Yes	No	Yes	No
<i>Informative and/or Site Specific Comment/Assessment: The APZ requirements are applied through the associated BMP. There are no trees onsite within the APZ.</i>						
1.8	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.	Effective	Yes	No	Yes	Yes
<i>Informative and/or Site Specific Comment/Assessment: Offsite vegetation may be either cleared or managed to low threat and maintain a level of canopy cover (at request of the local government). Both onsite and offsite retained vegetation must meet the specifications outlined in Schedule 1 of the Guidelines.</i>						
1.9	Greater Enforcement Applied to Compliance with the Local Government's Fire Break and Fuel Load Notice: Inform the relevant landowners of the high level of enforcement that will be applied under the authority conferred through Section 33 of the Bush Fires Act 1954.	Effective	Yes	No	No	No

PROTECTION MEASURES TO REDUCE BUSHFIRE THREAT LEVELS		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
<i>Informative and/or Site Specific Comment/Assessment: The level of enforcement is determined by the Local Government.</i>						
PROTECTION PRINCIPLE – PREVENT FIRE IGNITION BY CONTROLLING HEAT ENERGY SOURCES: Fire prevention focussed on potential ignition sources from human actions and/or faulty or poorly designed equipment. Natural causes of ignition (lightning) cannot be controlled and are a limitation.						
1.10	Operational Procedures: Apply fire safe principles to site operation procedures including: <ul style="list-style-type: none"> 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.	Moderate	Yes	No	No	Yes
<i>Informative and/or Site Specific Comment/Assessment: The operating procedures of the development have not yet been developed. Biodiesel refineries must necessarily be extremely stringent in controlling ignition sources. Additional measures to reduce the risk of bushfire ignition are not applicable, as these measures are assumed to be implemented in reducing the risk of igniting onsite hazards.</i> <i>It is recommended the future site operating procedures or emergency management plan (document titles pending) identify which (if any) operations are to cease where a bushfire is identified within 10km. The operations identified should be those susceptible to ember attack.</i>						
1.11	Operational Procedures: Ensure proper management of hazard reduction burning as an unintended ignition source.	Not Relevant	N/A	N/A	N/A	N/A
1.12	Equipment Design: 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.	Moderate	Yes	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: To be included in equipment design at purchase stage. All equipment must meet minimum national and state standards and guidelines, and this is considered adequate.</i>						
1.13	Legal Enforcement: Impose restrictions on source of ignition operations by enforcing total fire bans.	Effective	Yes	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: Total fire bans will be complied with. Total fire ban exemptions will be applied for if necessary for site functionality (e.g. use of the thermal oxidiser).</i>						
1.14	Legal Enforcement: Reduce arson events by monitoring / enforcement / penalties.	Moderate	Yes	No	No	No
<i>Informative and/or Site Specific Comment/Assessment: Unlikely to have any impact given the scale of relevant vegetation and the population density of the region. Arson of the biodiesel plant is extremely dangerous (potentially deadly) and additional penalties are unlikely to have an impact.</i>						
1.15	Education: Educate persons to reduce the occurrence of accidental ignitions in vegetation by persons and/or vehicles, particularly with regard to road reserves.	Not Relevant	N/A	N/A	N/A	N/A

PROTECTION MEASURES TO REDUCE BUSHFIRE THREAT LEVELS		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
PROTECTION PRINCIPLE - PREVENT FIRE IGNITION BY CONTROLLING HEAT ENERGY SOURCE AND FUEL INTERACTIONS: Fire prevention focussed on limiting potential ignition sources by preventing a source and a fuel being able to interact.						
1.16	Shielding of Ignition Sources: Utilise physical barriers (shielding) between bushfire fuels and heat energy sources such as electricity generation / transmission, fuel supplies, stored flammable products etc. Examples include appropriate walls, enclosures, and underground transmission of electricity or liquid/gas fuels.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: The measure is not practical or necessary where additional setbacks can be achieved (>100m APZ)</i>						
1.17	Separation of Ignition Sources: Establish sufficient separation distance between bushfire fuels and heat energy sources such as electricity generation / transmission, fuel supplies, stored flammable products etc.	Moderate	Yes	No	Yes	Yes
<i>Informative and/or Site Specific Comment/Assessment: The required 100m APZ will establish an ample separation from ignition sources. Consequential fires are generally assumed as 2 times the height of the object. An assumed flame length of 3 times the height of a 10m tall feedstock pile OR diesel tank (conservative estimate) provides a total 40m flame length (including elevation of the feedstock). The ignition point of cured grass on temperature alone (no flame or ember contact) varies, but is at least 250 degrees Celsius (no calculation is available to translate to kW/m2 radiant heat flux). Liquid fires (diesel) do not generate embers. Feedstock will be coarse >6mm woodchips (high density) which do not carry significant distances as firebrands.</i>						
1.18	Equipment Design: Through design and materials, control heat energy transfer via conduction, convection and radiation of heat energy.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: All equipment must meet minimum national and state standards and guidelines, and this is considered adequate. Controls applied are independent of bushfire requirements. Strict controls are applied to biodiesel refineries, independent of bushfire requirements.</i>						
¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining. ² Protection Measure Application Status: <ul style="list-style-type: none"> • Possible: Protection measures that can potentially be applied to the proposed development/use; • Exists: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary); • Planned: Protection measures that: <ul style="list-style-type: none"> • Are incorporated into the site plans; • Exist in an <u>approved</u> 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 TO REDUCE BUSHFIRE THREAT LEVELS	Effectiveness Rating ¹	Application Status ²			
		Possible	Exists	Planned	Additionally Recommend
<ul style="list-style-type: none"> Exist in a <u>yet to be submitted</u> 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. <p>These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).</p> <ul style="list-style-type: none"> Additionally Recommend: Protection measures that: <ul style="list-style-type: none"> Exist in a <u>yet to be submitted</u> 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. <p>These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).</p>					

6.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 6.2: For the stated area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

BUSHFIRE THREAT REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating ¹	Numbers of Protection Measures				
		Total Available	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
Prevent Fire Ignition and/or Severity by Controlling the Fuel	Very High	2	2	1	2	2
	High	-	-	-	-	-
	Effective	3	3	-	2	1
	Moderate	-	-	-	-	-
	Not Relevant	5	-	-	-	-
Prevent Fire Ignition by Controlling Heat Energy (Ignition) Sources	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	1	-	-
	Moderate	3	3	1	-	1
	Not Relevant	2	-	-	-	-
Prevent Fire Ignition by Controlling Heat Energy Source and Fuel Interactions	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	1	1	-	1	1
	Not Relevant	2	-	-	-	-
Total Numbers	Very High	2	2	1	2	2
	High	-	-	-	-	-
	Effective	4	4	1	2	1
	Moderate	4	4	1	1	2
	Not Relevant	8	-	-	-	-
	Totals	18	10	3	5	5
¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining. ² Protection Measure Application Status: Refer to table footnotes on previous page.						

6.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (THREAT REDUCTION)

Table 6.3: The potential impact of the applied protection measures in reducing threat levels in the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (THREAT REDUCTION)								
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.							
Threat Reducing Protection Measures Applied to Assessment ¹	The Bushfire Hazard Threats ²							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Minimal	Medium	Significant	Minimal	Minimal	Medium	Minimal	Minimal
	Medium				Minimal			
Existing, Planned and Recommended (applied to residual risk)	Significant	Very Significant	Very Significant	Very Significant	Very Significant	Medium	Minimal	Very Significant
	Very Significant				Significant			

¹ Corresponds to the stage at which the risk level is to be reported i.e. inherent or residual (refer to Section 2.3.3)
² Refer to Appendix 4 for explanatory information.

Assessment Comments: Existing and Planned measures include the application of the BAL-29 APZ required for planning approval. Recommended measures include the application of the >100m APZ from high-risk plant, infrastructure, and use areas. This includes a portion of the offsite nature strip along Wanerie Road, under the control of the Shire of Narrogin.

6.4 ASSESSED HAZARD THREAT LEVELS

Assessed as a function of the base threat levels of the bushfire hazard (refer to Section 5.5) and the number and effectiveness of protection measures that will be applied and their ability to reduce the base levels of threat from the identified areas of bushfire prone vegetation (Note: This assessment is independent of the exposure level and vulnerability level assessments).

Table 6.4: The assessed threat levels corresponding to the stated area of bushfire prone vegetation.

ASSESSED HAZARD THREAT LEVELS								
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.							
Threat Reducing Protection Measures Applied to Assessment ¹	The Bushfire Hazard Threats ²							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Moderate	High	Low	Moderate	Low	High	Low	Low
	Moderate							
Existing, Planned and Recommended (applied to residual risk)	Low	Very Low	Very Low	Very Low	Very Low	Low	Low	Very Low
	Very Low							

¹ Corresponds to the stage at which the risk level is to be reported i.e. inherent or residual (refer to Section 2.3.3).
² Refer to Appendix 2 for explanatory information.

Assessment Comments: The hazard of ember attack cannot be reduced below 'Low' due to the forest vegetation present in the locality. In extreme cases embers can be carried >1km.

7 EXPOSURE LEVEL ASSESSMENT OF THE ELEMENTS AT RISK

SUMMARY OF THE QUALITATIVE ASSESSMENT PROCESS

4. Identify all protection measures (grouped by protection principle) that are available to reduce exposure levels and rate their effectiveness;
5. Produce a numerical summary of all potential exposure reducing protection measures that are available and determine their application status;
6. Assess the potential exposure reducing impact of the package of protection measures that is able to be applied. The effectiveness rating weights the potential impact of an individual measure; and
7. Derive the exposure level of the identified element at risk, to the threats presented by each identified area of bushfire prone vegetation (refer to Section 2.3.3 and Appendix 2 for additional risk assessment process information).

7.1 PERSONS ONSITE OR TEMPORARILY OFFSITE

7.1.1 PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS AND THEIR APPLICATION STATUS

Table 7.1: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: PERSONS LOCATED ONSITE AND TEMPORARILY OFFSITE						
PROTECTION PRINCIPLE – SEPARATION FROM THE HAZARD: 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: In response to a pre-determined fire danger rating and/or total fire ban or set months of the year (bushfire season), prevent access to, occupancy or operation of the subject site (i.e. closure of use). The relevant conditions and the requirement to stay away will be established through a Bushfire Emergency Plan.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: The measure is unnecessarily restrictive to commercial operations.</i>						
2.2	Stay Within the Subject Site – Remote Hazard: For offsite tourism operations, all associated persons (staff, guests, visitors), in response to a pre-determined fire danger rating and/or total fire ban, will remain on-site as better communication and sheltering options exist on-site. The relevant conditions and the requirement to stay will be established through a Bushfire Emergency Plan.	Not Relevant	N/A	N/A	N/A	N/A

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
2.3	Relocate Away from Remote Hazard - Safer Offsite Location Available: For offsite tourism operations (where persons are to be moved 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. That is, two safer locations will exist.	Not Relevant	N/A	N/A	N/A	N/A
2.4	Evacuate from the Subject Site: Safer Offsite Location(s) Available: A building/area is 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 very unlikely to be simultaneously impacted by a bushfire event.	Moderate	Yes	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: Staff will commute to the site daily (likely living in the local area) and self-evacuate.</i>						
2.5	Relocate Within the Subject Site - Safer Onsite 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.	Moderate	Yes	No	Yes	No
<i>Informative and/or Site Specific Comment/Assessment: With the establishment of the required minimum 100m APZ, an area subject to <2kW/m2 radiant heat flux is available for open area shelter. This has been designated within the associated BMP.</i>						
2.6	Relocate Within the Subject Site – Pathway to Safer Onsite Area/Building: To facilitate the lower risk movement, on foot, 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]: <ul style="list-style-type: none"> At least 4m from stored heavy fuels (refer to Appendix 4). At least 6m from stored and constructed large heavy fuels (refer to Appendix 4). At least 12m from constructed large heavy fuels that are buildings/structures other than the one being evacuated. Additionally: <ul style="list-style-type: none"> 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. 	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: The measure is not practical for the facility use type, as fuels are located in various locations onsite.</i>						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
2.7	Pre-Emptively Relocate Away from the Subject Site: In response to a pre-determined fire danger rating and/or total fire ban or other established conditions, 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 a Bushfire Emergency Plan.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: The measure is unnecessarily restrictive to commercial operations.</i>						
PROTECTION PRINCIPLE – SHIELDING FROM THE HAZARD: 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 Refuge: For a 'vulnerable land use' (defined by SPP 3.7 [43]), 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: preferred floor area per person is an increase from 0.75 m ² to 1.0 m ² (Guidelines v1.4) [22].	Not Relevant	N/A	N/A	N/A	N/A
2.9	On-site Shelter Building – No Accommodation in the Site Use: For a 'vulnerable land use' (defined by SPP 3.7 [43]), and for which 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).	Not Relevant	N/A	N/A	N/A	N/A
2.10	On-site Shelter Building – Appropriate Threat Resilience: For other than a 'vulnerable land use' (defined by SPP 3.7 [43]), provide a building that incorporates sufficient design and construction protection measures to reduce the building vulnerability to bushfire and consequential fire threats to an appropriate level (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).	Effective	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 <i>Performance Standard – The design and construction of private bushfire shelter (ABCB 2014)</i> . This is not a standalone measure but an additional measure as a last resort.	Not Relevant	N/A	N/A	N/A	N/A
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).	Not Relevant	N/A	N/A	N/A	N/A

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	<p>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.</p> <p>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].</p>					
<i>Informative and/or Site Specific Comment/Assessment: The measure is not required as a safer onsite area is available subject to <2kW/m2 radiant heat flux.</i>						
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.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: No such landforms exist.</i>						
2.14	<p>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).</p> <p>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.</p> <p>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].</p>	Moderate	Yes	No	No	No
<i>Informative and/or Site Specific Comment/Assessment: Persons onsite can quickly move between areas and the <2kW/m2 radiant heat flux safer onsite area. The measure would have no effect.</i>						
<p>¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.</p> <p>² Protection Measure Application Status:</p> <ul style="list-style-type: none"> • Possible: Protection measures that can potentially be applied to the proposed development/use; • Exists: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary); • Planned: Protection measures that: <ul style="list-style-type: none"> • Are incorporated into the site plans; 						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating ¹	Application Status ²			
		Possible	Exists	Planned	Additionally Recommend
<ul style="list-style-type: none"> Exist in an <u>approved</u> 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 <u>yet to be submitted</u> 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. <p>These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).</p> <ul style="list-style-type: none"> Additionally Recommend: Protection measures that: <ul style="list-style-type: none"> Exist in a <u>yet to be submitted</u> 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. <p>These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).</p>					

7.1.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 7.2: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

EXPOSURE REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Persons located onsite and temporarily offsite					
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating ¹	Numbers of Protection Measures				
		Total Available	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
Separation from the Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	2	2	1	1	-
	Not Relevant	5	-	-	-	-
Shielding from the Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	-	-
	Moderate	1	1	-	-	-
	Not Relevant	5	-	-	-	-
Total Numbers	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	-	-
	Moderate	3	3	1	1	-
	Not Relevant	10	-	-	-	-
	Totals	14	4	1	1	-
¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining. ² Protection Measure Application Status: Refer to table footnotes on previous page.						

7.1.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (EXPOSURE REDUCTION)

Table 7.3: For the stated element at risk, The potential impact of the applied protection measures in reducing exposure levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (EXPOSURE REDUCTION)								
Element at Risk	Persons located onsite and temporarily offsite							
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.							
Exposure Reducing Protection Measures Applied to Assessment ¹	The Bushfire Hazard Threats ²							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accum.	Conseq. Fire	Fire Driven Wind	Tree Strike / Obstruct
Existing and Planned (applied to inherent risk)	Medium	Significant	Very Significant	Very Significant	Very Significant	Significant	Medium	Significant
	Significant				Significant			
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 4 for explanatory information.								

7.1.4 ASSESSED EXPOSURE LEVELS

Assessed as a function of the capacity to apply sufficient exposure reducing protection measures, their individual effectiveness and their combined impact in reducing the exposure of the identified element at risk (Note: This assessment is independent of the threat level and vulnerability level assessments).

Table 7.4: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED EXPOSURE LEVELS	
Element at Risk	Persons located onsite and temporarily offsite
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.
Exposure Reducing Protection Measures Applied to Assessment ¹	Relative Exposure Level ²
Existing and Planned	Very Low
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 2 for explanatory information.	

Assessment Comments: The only existing protection measure is the availability of offsite safer location(s), where staff are able to self-evacuate. The planned protection measure is the ability to shelter-in-place within the <2kW/m² area within the subject site. No recommendations are applied. Note the relative exposure considers bushfire hazard, not onsite hazards- excepting the potential ignition of consequential fires through bushfire impacts.

7.2 PERSONS ON ACCESS/EGRESS ROUTES IN VEHICLES

7.2.1 PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS AND THEIR APPLICATION STATUS

Table 7.5: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: PERSONS ON ACCESS/EGRESS ROUTES IN VEHICLES						
Access/Egress Route Bushfire Hazard:	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.					
PROTECTION PRINCIPLE - SEPARATION FROM ALL BUSHFIRE THREATS: To utilise distance away from all relevant bushfire hazard threats (direct and indirect attack mechanisms) while traversing an access/egress route in a vehicle to lower the exposure of persons to the threats for the expected time on the route.						
3.1	Locating 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
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	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: Wanerie Road and Great Southern Highway are bounded by sown pasture (grassland) comparable to that within the assessment area. The routes do not exist or travel away from vegetation hazards, however the hazard is primarily grassland and the route(s) pass areas of vegetation of a greater hazard (forest or woodland) for relatively short distances (<150m). Larger forested sections are not adjacent to the route.</i>						
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.	Not Relevant	N/A	N/A	N/A	N/A
3.4	Reduce and Maintain Road Verge Fuel to Low Threat State: Road verges, or part off, have vegetation removed or reduced to a minimal fuel, low threat state annually to increase the separation distance from the bushfire hazard. This is practical when an authority exists to conduct the management and will have greater impact as a protection measure if there is certainty it will be carried out.	Not Relevant	N/A	N/A	N/A	N/A

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
<p><i>Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner. The vegetation to be managed on the adjacent verge immediately outside the subject lot boundary covers a minimal proportion of the route.</i></p>						
<p>PROTECTION PRINCIPLE - SHIELDING FROM ALL BUSHFIRE THREATS: To utilise constructed or natural shielding to reduce the exposure of persons traversing the access/egress routes to the direct attack mechanisms of bushfire. 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.</p>						
3.5	<p>Vehicle Type – Protection Level: 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.</p> <p>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).</p> <p>The availability such vehicles of required capacity can contribute to reduced exposure to the bushfire threats for persons on access/egress routes.</p>	Not Relevant	N/A	N/A	N/A	N/A
<p><i>Informative and/or Site Specific Comment/Assessment: Most evacuees vehicles will have an enclosed cabin, but it is unreasonable for this to be assumed, expected, or required.</i></p>						
<p>¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.</p> <p>² Protection Measure Application Status:</p> <ul style="list-style-type: none"> • Possible: Protection measures that can potentially be applied to the proposed development/use; • Exists: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary); • Planned: Protection measures that: <ul style="list-style-type: none"> • Are incorporated into the site plans; • Exist in an <u>approved</u> 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 <u>yet to be submitted</u> 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. <p>These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).</p> • Additionally Recommend: Protection measures that: 						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating ¹	Application Status ²			
		Possible	Exists	Planned	Additionally Recommend
<ul style="list-style-type: none"> Exist in a <u>yet to be submitted</u> 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. <p>These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).</p>					

7.2.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 7.6: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

EXPOSURE REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Persons on access/egress routes in vehicles					
Access/Egress Route Bushfire Hazard:	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.					
The Protection Principle	Effectiveness Rating ¹	Numbers of Protection Measures				
		Total Available	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
Separation from the Bushfire Hazard	Very High	1	-	1	-	-
	High	1	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	-	-	-	-	-
	Not Relevant	2	-	-	-	-
Shielding from the Bushfire Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	-	-	-	-	-
	Not Relevant	1	-	-	-	-
Total Numbers	Very High	1	-	1	-	-
	High	1	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	-	-	-	-	-
	Not Relevant	3	-	-	-	-
	Totals	5	-	1	-	-
¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining. ² Protection Measure Application Status: Refer to table footnotes on previous page.						

7.2.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (EXPOSURE REDUCTION)

Table 7.7: For the stated element at risk, The potential impact of the applied protection measures in reducing exposure levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (EXPOSURE REDUCTION)								
Element at Risk	Persons on access/egress routes in vehicles							
Access/Egress Route Bushfire Hazard:	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.							
Exposure Reducing Protection Measures Applied to Assessment ¹	The Bushfire Hazard Threats ²							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Minimal	Minimal	Medium	Medium	Significant	Medium	Medium	Significant
	Minimal				Medium			

¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3
² Refer to Appendix 4 for explanatory information.

7.2.4 ASSESSED EXPOSURE LEVELS

Assessed as a function of the capacity to apply sufficient exposure reducing protection measures, their individual effectiveness and their combined impact in reducing the exposure of the identified element at risk (Note: This assessment is independent of the threat level and vulnerability level assessments).

Table 7.8: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED EXPOSURE LEVELS	
Element at Risk	Persons on access/egress routes in vehicles
Access/Egress Route Bushfire Hazard:	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.
Exposure Reducing Protection Measures Applied to Assessment ¹	Relative Exposure Level ²
Existing and Planned (applied to inherent risk)	Moderate

¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3
² Refer to Appendix 2 for explanatory information.

Assessment Comments: The local and regional road network and its proximity to bushfire prone vegetation is not under the control of the landowner. No recommendations are applied.

The evacuation routes available are effective at allowing for rapid egress from the local area without exposing evacuees to bushfire impacts. Evacuation routes travel through bushfire prone vegetation for most of their length, however the vegetation bounding the route is generally grassland with limited pockets of forest. Larger forested sections are located away from the existing roads. The relative exposure level is a function of the hazard posed based on the existing vegetation structure and location rather than protection measures applicable.

7.3 BUILDINGS AND STRUCTURES NCC CLASSES 1-10 (ELEMENT AT RISK CATEGORIES 3-10)

7.3.1 PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS AND THEIR APPLICATION STATUS

Table 7.9: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: BUILDINGS/STRUCTURES - NCC CLASSES 1-10 (CATEGORIES 5, 8, 10a, 10b)						
PROTECTION PRINCIPLE – SEPARATION FROM ALL BUSHFIRE THREATS (SITING): To locate (site) the buildings and attached/adjacent structures at distances away from the direct and indirect attack mechanisms of bushfire (the hazard threats) to reduce their exposure. The required distances will be dependent on the relative threat levels and the degree of bushfire resilience that is or is planned to be incorporated into the exposed elements through design and construction.						
4.1	<p>Asset Protection Zone (APZ): Ensure an APZ can be established surrounding the exposed element(s) to create the required separation distance from the bushfire hazard and its threats (the direct and indirect attack mechanisms). This is to be an area containing minimal fire fuels and maintained in a low threat state. The <i>Explanatory Notes for Element 2 of the Bushfire Protection Criteria and Schedule 1: Standards for Asset Protection Zones</i> established in the Guidelines [22] provides the key requirements for establishing and maintaining an APZ.</p> <p>Additional requirements may exist within a relevant local governments firebreak notice, or the responsibilities established by an applicable Bushfire Management Plan (BMP).</p> <p>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 different authority (e.g. firebreak notice of BMP). As a minimum avoid dimensions (separation distances) that correspond to BAL-FZ and BAL-40 ratings for any given site/vegetation combination of relevant the parameters (Note: this will also apply to BAL-29 separation distances if flame length modelling indicates potential contact due to specific site and effective slope configurations).</p> <p>The APZ should be contained solely within the boundaries of each lot, except in instances where the neighbouring lot(s) or adjacent public land will be managed in a low-fuel state on an ongoing basis, in perpetuity.</p> <p><i>Note that the APZ does not provide separation from the consequential fire attack mechanism. Separation from consequential fire fuels requires additional assessment and management.</i></p>	Effective	Yes	No	Yes	Yes
Informative and/or Site Specific Comment/Assessment: A BAL-29 APZ can be established around all structures and relevant assets onsite, as outlined in the associated BMP. A 100m APZ is established as a requirement for the proposed facility, surrounding high-risk plant, infrastructure, and use areas.						
4.2	Siting of Buildings/Structures - Wind: Site the buildings and attached/adjacent structures in locations that have lower wind exposure. Avoid the top and sides of ridges which are especially vulnerable to fire driven winds as well as topographically	Not Relevant	N/A	N/A	N/A	N/A

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	influenced winds. Winds can directly or indirectly (carrying materials/debris) cause damage to the external building envelope potentially allowing flame, radiant heat and ember entry.					
<i>Informative and/or Site Specific Comment/Assessment: The local area is gently undulating. There is little difference in wind exposure between possible locations.</i>						
4.3	Use of Non-Vegetated Areas and/or Public Open Space: Reduce exposure by increasing separation from APZ landscaping vegetation and/or the bushfire hazard by incorporating these lowest threat areas adjacent to buildings/structures and/or adjacent to the bushfire hazard. These lowest threat components of the APZ include non-vegetated areas (e.g. footpaths, paved areas, roads, parking, drainage, swimming pools), formally managed areas of vegetation (public open space and other recreation areas) and services installed in a common section of non-vegetated land. These elements create robust and easier managed asset protection zones.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: There are no such areas existing or proposed.</i>						
4.4	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. <ul style="list-style-type: none"> 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 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. 	Moderate	Yes	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: Trees (both existing and revegetating) are not present within 30m of any Class 1-10 buildings (assumed 1.5 x 20m height).</i>						
4.5	Separation of 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 and LP Gas cylinder safety in bushfire prone areas (Energy Safety – Govt. of WA). Otherwise, the required separation distance is 6m from any combustible materials.	Moderate	Yes	Yes	No	No

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	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).					
<i>Informative and/or Site Specific Comment/Assessment: LPG will be stored onsite and will be used in the start-up phase of the thermal oxidiser. The LPG will be stored in compliance with AS 1596.</i>						
4.6	Separation from Stored Flammable Products – Fuels / Other Hazardous Materials: Establish sufficient separation distance between the consequential fire fuels and buildings/structures. The required separation distance will be dependent on the fuel and storage type.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: Fuels and hazardous materials will be stored throughout the site and within structures as part of site operations.</i>						
4.7	<p>Separation from Stored and Constructed Combustible Items: These consequential fire fuels include:</p> <ul style="list-style-type: none"> • Stored Combustible Items - Heavy Fuels e.g. building materials, packaging materials, firewood, 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. • 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]. <p><i>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”.</i></p> <p>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]:</p> <ul style="list-style-type: none"> • 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; 	Not Relevant	N/A	N/A	N/A	N/A

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	<ul style="list-style-type: none"> 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. 					
<p><i>Informative and/or Site Specific Comment/Assessment: 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. See Renewable Diesel Biorefinery Project – Fire and Explosion Consequence Modelling (2D) Study Report (Technip Energies June 2022).</i></p>						
<p>PROTECTION PRINCIPLE – SHIELDING FROM ALL BUSHFIRE 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.</p>						
4.8	<p>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 threats to vulnerable exposed elements.</p> <p>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.</p> <p>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]</p>	Not Relevant	N/A	N/A	N/A	N/A
4.9	<p>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:</p> <ul style="list-style-type: none"> 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. 	Not Relevant	N/A	N/A	N/A	N/A

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
<i>Informative and/or Site Specific Comment/Assessment: The measures are not cost-effective for the scale which would be required to be effective (functional height and perimeter).</i>						
4.10	Natural Barrier - Landforms: Use existing natural landforms to reduce buildings/structures exposure to radiant heat, and lower wind speeds (prevailing synoptic and/or fire driven).	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: No landforms are present.</i>						
4.11	Planted Barrier - 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).	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: Tall vegetation is not intended or advised within the APZ to prevent debris accumulation and contain any potential onsite fire.</i>						
4.12	Shield Non-Structural Essential Elements: These are elements essential to the continued operation of the building/structure which are potentially exposed to fire attack mechanisms of both bushfire and consequential fire. They include cabling and plumbing associated with power / data transmission and water / fuel 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 bushfire threats. Shielding includes underground installation.	Moderate	Yes	No	Yes	Yes
<i>Informative and/or Site Specific Comment/Assessment: The area within the development area subject to <12kW/m2 radiant heat flux has been provided within the associated BMP. Common electrical cabling reaches its critical point at >12kWm2. It is recommended that exposed electrical cabling outside this area, be shielded from radiant heat and consequential fire by burying underground, enclosing within a structure, or shielding with non-combustible material. Exposed plumbing (poly pipe) should be buried or shielded with non-combustible material wherever practical– maximum exposure 120 degrees Celsius.</i>						
¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.						
² Protection Measure Application Status: <ul style="list-style-type: none"> • Possible: Protection measures that can potentially be applied to the proposed development/use; • Exists: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary); • Planned: Protection measures that: <ul style="list-style-type: none"> • Are incorporated into the site plans; 						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating ¹	Application Status ²			
		Possible	Exists	Planned	Additionally Recommend
<ul style="list-style-type: none"> Exist in an <u>approved</u> 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 <u>yet to be submitted</u> 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. <p>These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).</p> <ul style="list-style-type: none"> Additionally Recommend: Protection measures that: <ul style="list-style-type: none"> Exist in a <u>yet to be submitted</u> 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. <p>These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).</p>					

7.3.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 7.10: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

EXPOSURE REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Buildings/Structures - NCC Classes 1-10					
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating ¹	Numbers of Protection Measures				
		Total Available	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
Separation from the Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	1	1
	Moderate	2	2	2	-	-
	Not Relevant	4	-	-	-	-
Shielding from the Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	1	1	-	1	1
	Not Relevant	4	-	-	-	-
Total Numbers	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	1	1
	Moderate	3	3	2	1	1
	Not Relevant	8	-	-	-	-
	Totals	12	4	2	2	2

¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

² Protection Measure Application Status: Refer to table footnotes on previous page.

7.3.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (EXPOSURE REDUCTION)

Table 7.11: For the stated element at risk, The potential impact of the applied protection measures in reducing exposure levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (EXPOSURE REDUCTION)								
Element at Risk	Buildings/Structures - NCC Classes 1-10							
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.							
Exposure Reducing Protection Measures Applied to Assessment ¹	The Bushfire Hazard Threats ²							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accum.	Conseq. Fire	Fire Driven Wind	Tree Strike / Obstruct
Existing and Planned (applied to inherent risk)	Minimal	Medium	Significant	Minimal	Significant	Minimal	Medium	Very Significant
	Medium				Medium			
Existing, Planned and Recommended (applied to residual risk)	Significant	Very Significant	Very Significant	Very Significant	Very Significant	Very Significant	Significant	Very Significant
	Very Significant				Very Significant			

¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3

² Refer to Appendix 4 for explanatory information.

7.3.4 ASSESSED EXPOSURE LEVELS

Assessed as a function of the capacity to apply sufficient exposure reducing protection measures, their individual effectiveness and their combined impact in reducing the exposure of the identified element at risk (Note: This assessment is independent of the threat level and vulnerability level assessments).

Table 7.12: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED EXPOSURE LEVELS	
Element at Risk	Buildings/Structures - NCC Classes 1-10
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.
Exposure Reducing Protection Measures Applied to Assessment ¹	Relative Exposure Level ²
Existing and Planned (applied to inherent risk)	Moderate
Existing, Planned and Recommended (applied to residual risk)	Very Low

¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3

² Refer to Appendix 2 for explanatory information.

Assessment Comments: The relative exposure levels consider the BAL-29 APZ required for planning approval (including potential retained vegetation maintained to low threat), against the required >100m APZ (clear of all vegetation) from high-risk plant, infrastructure, and use areas.

7.4 FIXED (HARD) INFRASTRUCTURE ASSETS

7.4.1 PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS AND THEIR APPLICATION STATUS

Table 7.13: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: FIXED (HARD) INFRASTRUCTURE ASSETS						
PROTECTION PRINCIPLE – SEPARATION FROM ALL BUSHFIRE THREATS (SITING): To locate (site) the buildings and attached/adjacent structures at distances away from the direct and indirect attack mechanisms of bushfire (the hazard threats) to reduce their exposure. The required distances will be dependent on the relative threat levels and the degree of bushfire resilience that is or is planned to be incorporated into the exposed elements through design and construction.						
6.1	<p>Asset Protection Zone (APZ): Ensure an APZ can be established surrounding the exposed element(s) to create the required separation distance from the bushfire hazard and its threats (the direct and relevant indirect attack mechanisms).</p> <p>This is to be an area containing minimal fire fuels and maintained in a low threat state. The <i>Explanatory Notes for Element 2 of the Bushfire Protection Criteria and Schedule 1: Standards for Asset Protection Zones</i> established in the Guidelines [22] provides the key requirements for establishing and maintaining an APZ.</p> <p>Additional requirements may exist within a relevant local governments firebreak notice, or the responsibilities established by an applicable Bushfire Management Plan (BMP).</p> <p>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 different authority (e.g. firebreak notice or BMP). As a minimum avoid dimensions (separation distances) that correspond to BAL-FZ and BAL-40 ratings for any given site/vegetation combination of the relevant parameters. Note that this will also apply to BAL-29 separation distances if flame length modelling indicates potential contact due to specific site and effective slope configurations.</p> <p>The APZ should be contained solely within the boundaries of each lot, except in instances where the neighbouring lot(s) or adjacent public land will be managed in a low-fuel state on an ongoing basis, in perpetuity.</p> <p><i>Note that the APZ does not provide separation from the consequential fire attack mechanism. Separation from consequential fire fuels requires additional assessment and management.</i></p>	Effective	Yes	No	Yes	Yes
<p><i>Informative and/or Site Specific Comment/Assessment: A BAL-29 APZ can be established around all structures and relevant assets onsite, as outlined in the associated BMP. A 100m APZ is established as a requirement for the proposed facility, surrounding high-risk plant, infrastructure, and use areas.</i></p>						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
6.2	Siting of Buildings/Structures - Wind: Site the buildings/structures/infrastructure in locations that have lower wind exposure. Avoid the top and sides of ridges which are especially vulnerable to fire driven winds as well as topographically influenced winds. Winds can directly or indirectly (carrying materials/debris) cause damage to the external building envelope potentially allowing flame, radiant heat and ember entry.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: The local area is consistent and re-siting will have little effect on wind experienced.</i>						
6.3	Use of Non-Vegetated Areas and/or Public Open Space: Reduce exposure by increasing separation from APZ landscaping vegetation and/or the bushfire hazard by incorporating these lowest threat areas adjacent to buildings/structures and/or adjacent to the bushfire hazard. These lowest threat components of the APZ include non-vegetated areas (e.g. footpaths, paved areas, roads, parking, drainage, swimming pools), formally managed areas of vegetation (public open space and other recreation areas) and services installed in a common section of non-vegetated land. These elements create robust and easier managed asset protection zones.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: There are no such areas existing or proposed.</i>						
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. <ul style="list-style-type: none"> 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. 	Moderate	Yes	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: Trees (both existing and revegetating) are not present within 30m of any proposed fixed infrastructure (assumed 1.5 x 20m height).</i>						
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 and LP Gas cylinder safety in bushfire prone areas (Energy Safety – Govt. of WA).	Moderate	Yes	Yes	No	No

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	<p>Otherwise, the required separation distance is 6m from any combustible materials.</p> <p>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).</p>					
<p><i>Informative and/or Site Specific Comment/Assessment: LPG will be stored onsite and will be used in the start-up phase of the thermal oxidiser. The LPG will be stored in compliance with AS 1596.</i></p>						
6.6	<p>Separation from Stored Flammable Products – Fuels / Other Hazardous Materials: Establish sufficient separation distance between the consequential fire fuels and buildings/structures. The required separation distance will be dependent on the fuel and storage type.</p>	Not Relevant	N/A	N/A	N/A	N/A
<p><i>Informative and/or Site Specific Comment/Assessment: Fuels and hazardous materials will be stored throughout the site and within structures as part of site operations.</i></p>						
6.7	<p>Separation from Stored and Constructed Combustible Items: These consequential fire fuels include:</p> <ul style="list-style-type: none"> • 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. • 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]. <p><i>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”.</i></p> <p>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]:</p> <ul style="list-style-type: none"> • 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; 	Moderate	Yes	Yes	No	Yes

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	<ul style="list-style-type: none"> 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. 					
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Within the provided <i>Renewable Diesel Biorefinery Project – Fire and Explosion Consequence Modelling (2D) Study Report (Technip Energies June 2022)</i>, structures onsite have an input heat flux threshold of 37.5kW/m² for 30 minutes against onsite fires. A separation distance of 4 times the height of the consequential fire source should be considered appropriate from the diesel storage tanks. The tanks are proposed approximately 70m from the nearest other relevant infrastructure asset, being the OBSL packages area, and thus are appropriate to a height of 17.5m. The height of tanks are unknown but likely far less than this.</p> <p>Biochar storage and wood vinegar is not considered in this regard, as neither is a potential consequential fire source. Airborne biochar dust can pose an explosion hazard but this is not a consequential fire with setbacks to apply.</p> <p>Feedstock piles (windrows) are accumulations of dead vegetative matter and through decomposition may present a spontaneous combustion hazard. The dimensions and setbacks of windrows are to be confirmed at the detailed design stage. The layout and design will be determined by a suitably qualified specialist consultant, or otherwise will meet the specifications outlined in the <i>DFES Information Note: Bulk Green Waste Storage Fires (September 2014)</i>. The feedstock is not intended to decompose, and the coarse non-aerated fuels will smoulder at the surface level, generating potentially large quantities of smoke but little flame or embers. Final separation distances are likely to be less than those listed above.</p>						
<p>PROTECTION PRINCIPLE – SHIELDING FROM ALL BUSHFIRE 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.</p>						
6.8	<p>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 threats to vulnerable exposed elements.</p> <p>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.</p> <p>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]</p>	Not Relevant	N/A	N/A	N/A	N/A

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
6.9	<p>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:</p> <ul style="list-style-type: none"> 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. 	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: The measure is not cost-effective for the scale which would be required to be effective (functional height and perimeter).</i>						
6.10	Natural Barrier - Landforms: Use existing natural landforms to reduce buildings/structures exposure to radiant heat, and lower wind speeds (prevailing synoptic and/or fire driven).	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: No landforms are present.</i>						
6.11	Natural Barrier – Vegetation: 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).	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: Tall vegetation is not advisable within the APZ to contain any potential onsite fire.</i>						
6.12	<p>Shield Non-Structural Essential Elements: These are elements essential to the continued operation of the built asset which are potentially exposed to fire attack mechanisms of both bushfire and consequential fire. They include cabling and plumbing associated with power / data transmission and water / fuel transport.</p> <p>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.</p>	Moderate	Yes	No	Yes	Yes
<i>Informative and/or Site Specific Comment/Assessment: The area within the proposed development subject to <12kW/m2 radiant heat flux has been provided within the associated BMP. Common electrical cabling reaches its critical point at >12kWm2. It is recommended that exposed electrical cabling outside this area, be shielded from radiant heat and consequential fire by burying underground, enclosing within a structure, or shielding with non-combustible material. Exposed plumbing (poly pipe) should be buried or shielded with non-combustible material wherever practical (maximum exposure 120 degrees Celsius, relative heat flux not available).</i>						
<p>¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.</p> <p>² Protection Measure Application Status:</p> <ul style="list-style-type: none"> Possible: Protection measures that can potentially be applied to the proposed development/use; Exists: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary); 						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating ¹	Application Status ²			
		Possible	Exists	Planned	Additionally Recommend
<ul style="list-style-type: none"> Planned: Protection measures that: <ul style="list-style-type: none"> Are incorporated into the site plans; Exist in an <u>approved</u> 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 <u>yet to be submitted</u> 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. <p>These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).</p> Additionally Recommend: Protection measures that: <ul style="list-style-type: none"> Exist in a <u>yet to be submitted</u> 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. <p>These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).</p> 					

7.4.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 7.14: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

EXPOSURE REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Fixed (hard) infrastructure assets					
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating ¹	Numbers of Protection Measures				
		Total Available	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
Separation from the Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	1	1
	Moderate	3	3	3	-	1
	Not Relevant	3	-	-	-	-
Shielding from the Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	1	1	-	1	1
	Not Relevant	4	-	-	-	-
Total Numbers	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	1	1
	Moderate	4	4	3	1	2
	Not Relevant	7	-	-	-	-
	Totals	12	5	3	2	3

¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

² Protection Measure Application Status: Refer to table footnotes on previous page.

7.4.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (EXPOSURE REDUCTION)

Table 7.15: For the stated element at risk, The potential impact of the applied protection measures in reducing exposure levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (EXPOSURE REDUCTION)								
Element at Risk	Fixed (hard) infrastructure assets							
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.							
Exposure Reducing Protection Measures Applied to Assessment ¹	The Bushfire Hazard Threats ²							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Minimal	Medium	Significant	Medium	Medium	Minimal	Medium	Significant
	Medium				Medium			
Existing, Planned and Recommended (applied to residual risk)	Significant	Very Significant	Very Significant	Very Significant	Very Significant	Very Significant	Very Significant	Very Significant
	Very Significant				Very Significant			
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 4 for explanatory information.								

7.4.4 ASSESSED EXPOSURE LEVELS

Assessed as a function of the capacity to apply sufficient exposure reducing protection measures, their individual effectiveness and their combined impact in reducing the exposure of the identified element at risk (Note: This assessment is independent of the threat level and vulnerability level assessments).

Table 7.16: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED EXPOSURE LEVELS	
Element at Risk	Fixed (hard) infrastructure assets
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.
Exposure Reducing Protection Measures Applied to Assessment ¹	Relative Exposure Level ²
Existing and Planned (applied to inherent risk)	Moderate
Existing, Planned and Recommended (applied to residual risk)	Very Low
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 2 for explanatory information.	

Assessment Comments: Existing and Planned measures include the implementation of the BAL-29 APZ required for planning approval. Additionally recommended measures include the establishment of the 100m APZ (to the extent possible) from high-risk plant, infrastructure, and use areas. Shielding of electrical cabling and removal of trees within the APZ have a relatively minor impact as most of the site will be subject to <12kW/m² radiant heat flux, and contains few to no trees regardless (excepting offsite).

8 VULNERABILITY LEVEL ASSESSMENT OF THE ELEMENTS AT RISK

SUMMARY OF THE QUALITATIVE ASSESSMENT PROCESS

1. Identify all protection measures (grouped by protection principle) that are available to reduce vulnerability levels and rate their effectiveness;
2. Produce a numerical summary of all potential vulnerability reducing protection measures that are available and determine their application status;
3. Assess the potential vulnerability reducing impact of the package of protection measures that is able to be applied. The effectiveness rating weights the potential impact of an individual measure; and
4. Derive the vulnerability level of the identified element at risk, to the threats presented by each identified area of bushfire prone vegetation (refer to Section 2.3.3 and Appendix 2 for additional risk assessment process information).

8.1 PERSONS ONSITE OR TEMPORARILY OFFSITE

8.1.1 PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS AND THEIR APPLICATION STATUS

Table 8.1: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: PERSONS LOCATED ONSITE AND TEMPORARILY OFFSITE						
PROTECTION PRINCIPLE – TRANSPORT AND MULTIPLE EVACUATION DESTINATIONS AND ROUTES AVAILABLE						
7.1	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.	Effective	Yes	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: The location is relatively remote from settlements (no public transport). All staff must necessarily have their own transport.</i>						
7.2	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:	Very High	Yes	Yes	No	No

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	<ul style="list-style-type: none"> 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. 					
<i>Informative and/or Site Specific Comment/Assessment: Two-way access is available immediately on leaving the site. Multiple routes are available to multiple destinations within the local region including the townsites of Narrogin, Williams, and Wagin.</i>						
PROTECTION PRINCIPLE – PROVISION OF BUSHFIRE EMERGENCY INFORMATION AND EDUCATION						
7.3	Bushfire Emergency Plan: Is produced and appropriately located within the site of the subject development/use. It is an operational document that details site specific preparation, response, recovery and review procedures. It is produced for use by the site owners, managers, operators and occupants (as relevant).	Effective	Yes	No	No	No
7.4	Bushfire Emergency Poster: A poster is prominently displayed, for the attention of all persons onsite. It presents the key emergency contacts, information sources and response procedures in the event of a bushfire event. It has increased value attached to its display when there are no bushfire emergency trained persons onsite or no persons that are familiar with the site and local area.	Moderate	Yes	No	No	No
7.5	Bushfire Protection Measures to be Implemented are Published in the Relevant Operational Documents: The relevant documents can include the Bushfire Management Plan (BMP), the Bushfire Emergency Plan (BEP), the Site Emergency Plan (as required to be developed by the operators of 'high risk' land uses), and any relevant documents associated with a projects design phase. The purpose of this measure is to ensure the application of relevant protection measures, that have been identified in this Bushfire Risk Assessment and Management Report, will be acted upon through responsibilities created by the operational documents.	Effective	Yes	No	No	Yes
<i>Informative and/or Site Specific Comment/Assessment: The proposed facility has limited staffing (maximum 17 persons operational, 30 staff changeover) and all will likely live within the local area, or else be familiar with evacuation routes. Site staff are to be familiar with emergency procedures and preparation/display of separate bushfire emergency procedures is not necessary.</i> <i>The relevant information is to be included in the site Emergency Management Plan (document title pending), to include preparation and responses to bushfire emergencies.</i>						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
7.6	<p>Prominent Display of Information Stating Safe Early Evacuation is the Primary Procedure: For the subject development/use evacuation in the event of a bushfire within the locality has or is likely to be determined as the primary response procedure and that it must be conducted early. This option is available.</p> <p>The emphasis on early rather than a late evacuation is important. Analysis of past events identify that most people who die in bushfires are caught in the open, either in vehicles or on foot, because they have left their property too late. For evacuation to provide the safest response for occupants, it must be conducted early. Being on roads when a bushfire is close is a high risk action. Otherwise, sheltering-in-place is likely to provide greater protection to persons – particularly when a suitable onsite shelter place is identified.</p>	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: Site staff will be aware of the emergency response procedure, and can direct contractors (if present).</i>						
7.7	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.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: Staff will be familiar with the site and most of the site will be trafficable by foot. Occupants can quickly move between areas of the site if a location becomes untenable.</i>						
7.8	Trained Personnel Onsite: Operational persons (staff) are provided with bushfire emergency management training, aligned with the subject site's prepared Bushfire Emergency Plan (BEP). The intent also includes identifying the specific roles and persons to fill any required responsibilities that have determined through the BEP construction process.	Moderate	Yes	No	Yes	Yes
<i>Informative and/or Site Specific Comment/Assessment: The site Emergency Management Plan (document title pending) will designate Fire Wardens who will be trained in implementing the site responses to bushfire.</i>						
7.9	<p>Build Community Resilience Through Education: When relevant to the type and scale of proposed development/use, the delivery of effective education programs can result in lowering the vulnerability of the community to a bushfire event, once the information has been acted upon and packages of protection measures put in place.</p> <p>Local government develops an ongoing program of innovative and leading edge community and landowner education that builds on the information presented within this Bushfire Risk Assessment and Management Report.</p> <p>Subsequent implementation of recommended/required protection measures can be encouraged through legislation, education, audits, enforcement and penalties as appropriate.</p> <p>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.</p>	Not Relevant	N/A	N/A	N/A	N/A

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
7.10	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 buildings and persons. It identifies appropriate protection measures to increase bushfire resilience.	Not Relevant	N/A	N/A	N/A	N/A
PROTECTION PRINCIPLE – A BUSHFIRE EMERGENCY FIREFIGHTING CAPABILITY EXISTS (RESPONSE)						
7.11	<p>Personnel Onsite Can 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:</p> <ul style="list-style-type: none"> 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 site preparation, response and recovery procedures from the required 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 required Bushfire Emergency Plan for the subject development/use and will ensure the preparation, response and recovery procedures established by the required Bushfire Emergency Plan are conducted appropriately and provide emergency event guidance to any other persons onsite. 	Effective	Yes	No	No	Yes
<i>Informative and/or Site Specific Comment/Assessment: The site Emergency Management Plan (document title pending) will designate Fire Wardens who will be trained in implementing the site responses to bushfire.</i>						
7.12	Personnel Onsite 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.	Moderate	Yes	No	Yes	No
<i>Informative and/or Site Specific Comment/Assessment: Staff will receive basic instruction on operation of firefighting equipment and procedures for suppression or prevention of fire spread.</i>						
7.13	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 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.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment: No vulnerable persons will be onsite.</i>						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
7.14	<p>External Emergency Services Available: An emergency service with a bushfire response capability is located within a realistic operational distance of the subject development/use. Bushfire services include volunteer bushfire brigades, volunteer fire and emergency services, DFES career fire and Rescue Service or Parks and Wildlife.</p> <p>Even if an emergency service response capability exists, effectiveness will be limited by number of resources and their availability likelihood at the crucial time.</p> <p><i>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.”</i></p>	Effective	Yes	Yes	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment: It is recommended that the Narrogin State Emergency Service is invited to inspect and familiarise with the site. Provide information in site fire response procedures. This invitation may be annual or ad-hoc.</i></p>						
<p>¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.</p> <p>² Protection Measure Application Status:</p> <ul style="list-style-type: none"> • Possible: Protection measures that can potentially be applied to the proposed development/use; • Exists: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing ‘inherent’ risk levels (refer to Glossary); • Planned: Protection measures that: <ul style="list-style-type: none"> • Are incorporated into the site plans; • Exist in an <u>approved</u> 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 <u>yet to be submitted</u> 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. <p>These planned measures are accounted for in assessing ‘inherent’ risk levels (refer to Glossary).</p> • Additionally Recommend: Protection measures that: 						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating ¹	Application Status ²			
		Possible	Exists	Planned	Additionally Recommend
<ul style="list-style-type: none"> Exist in a <u>yet to be submitted</u> 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. <p>These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).</p>					

8.1.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 8.2: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

VULNERABILITY REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Persons located onsite and temporarily offsite					
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating ¹	Numbers of Protection Measures				
		Total Available	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
Transport and Multiple evacuation destinations and routes available	Very High	1	1	1	-	-
	High	-	-	-	-	-
	Effective	1	1	1	-	-
	Moderate	-	-	-	-	-
	Not Relevant	-	-	-	-	-
Provision of bushfire emergency information and education	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	2	2	-	-	1
	Moderate	2	2	-	1	1
	Not Relevant	4	-	-	-	-
A bushfire emergency firefighting capability exists (response)	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	2	2	1	-	2
	Moderate	1	1	-	1	-
	Not Relevant	1	-	-	-	-
Total Numbers	Very High	1	1	1	-	-
	High	-	-	-	-	-
	Effective	5	5	2	-	3
	Moderate	3	3	-	2	1
	Not Relevant	5	-	-	-	-
	Totals	14	9	3	2	4

¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

² Protection Measure Application Status: Refer to table footnotes on previous page.

8.1.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (VULNERABILITY REDUCTION)

Table 8.3: For the stated element at risk, The potential impact of the applied protection measures in reducing vulnerability levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (VULNERABILITY REDUCTION)								
Element at Risk	Persons located onsite and temporarily offsite							
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.							
Vulnerability Reducing Protection Measures Applied to Assessment ¹	The Bushfire Hazard Threats ²							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	N/A	Medium	Significant	N/A	Medium	Medium	N/A	N/A
	Significant				Medium			
Existing, Planned and Recommended (applied to residual risk)	N/A	Very Significant	Significant	N/A	Medium	Very Significant	N/A	N/A
	Very Significant				Significant			
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 4 for explanatory information.								

Assessment Comments: Persons are not vulnerable to direct ember attack or surface fire impacts, and will receive training in firefighting responses and evacuation. Recommendations are for the inclusion of preparation, responses and training for bushfire events to be included in the future site Emergency Management Plan (document title pending) and for the Narrogin Bush Fire Brigade to be invited to familiarise with the site. An area subject to <2kW/m² radiant heat flux will be available within the site with the establishment of the required 100m APZ, and all occupants will be aware of evacuation routes and have transport available.

8.1.4 ASSESSED VULNERABILITY LEVELS

Assessed as a function of the capacity to apply sufficient vulnerability reducing protection measures, their individual effectiveness and their combined impact in reducing the vulnerability of the identified element at risk (Note: This assessment is independent of the threat level and exposure level assessments).

Table 8.4: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED VULNERABILITY LEVELS	
Element at Risk	Persons located onsite and temporarily offsite
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.
Vulnerability Reducing Protection Measures Applied to Assessment ¹	Relative Vulnerability Level ²
Existing and Planned (applied to inherent risk)	Low
Existing, Planned and Recommended (applied to residual risk)	Very Low
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 2 for explanatory information.	

Assessment Comments: After preparation, responses and training for bushfire events to be included in the future site Emergency Management Plan (including nominating Fire Wardens).

8.2 PERSONS ON ACCESS/EGRESS ROUTES (IN VEHICLES) OR PATHWAYS

8.2.1 PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS AND THEIR APPLICATION STATUS

Table 8.5: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: PERSONS ON ACCESS/EGRESS ROUTES IN VEHICLES						
Access/Egress Route Bushfire Hazard:	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.					
<p>PROTECTION PRINCIPLE – APPLY BEST (SAFER) ROAD DESIGN AND CONSTRUCTION (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.</p> <p>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.</p>						
8.1	<p>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.</p> <p>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).</p>	High	No	Yes	No	No
<p><i>Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. Wanerie Road is approximately 8m wide, usually with trafficable shoulders for a minimum 10m trafficable horizontal clearance. Wanerie Road has a relatively low usage as it does not provide access to any residential or major commercial areas. Great Southern Highway is a major state artery with approximately 10m trafficable width at its narrowest points.</i></p>						
8.2	<p>Road Gradient: Ensure appropriate road gradients are available. Lower gradients ensure traction and speed can be maintained and 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.</p>	High	No	Yes	No	No
<p><i>Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. The road gradients are almost entirely flat.</i></p>						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
8.3	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;	High	No	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. The minimum horizontal clearance is the road width of 6m and generally 8m. Trees and powerlines do not overhang the road, so vertical clearance is unrestricted.</i>						
8.4	Road Surface Materials: 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.	High	No	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. Wanerie Road has a sealed, all-weather surface designed to carry heavy and industrial vehicles, as evidenced by the existing Narrogin Hay distribution centre located on the road. There is no limitation for the residential vehicles (<2 ton) used by site staff.</i>						
8.5	Driver Visibility and Road Ahead Signage: Ensure that road design provides high levels of visibility ahead (at least 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 'blind' corners and crests to the greatest extent possible.	High	No	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. Wanerie Road and Great Southern Highway have long straight sections (minimum length 1km) with gentle curves (<20 degrees).</i>						
8.6	Road / Pathway Length: Shorter distances to safer locations reduce the length of time persons remain vulnerable to bushfire threats.	Very High	No	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. The nearest low threat area is Narrogin townsite, reached after approximately 4.2km (4 mins) travel.</i>						
8.7	Interconnected Roads: Ensuring that the design of the road network provides through roads and avoids dead-end roads, provides the choice of alternative routes for drivers to minimise close contact with a bushfire event. Otherwise vehicles and persons can be trapped.	High	No	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. Some minor side roads in the area are no through-roads. All major roads are through-roads, and only major roads are required for access/egress from either direction (Great Southern Highway, Wanerie Road, Cooramining Road).</i>						
PROTECTION PRINCIPLE – EVACUEES SELF-SUFFICIENT (LOCAL AWARENESS AND 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.						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
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 meet the SPP 3.7 definition of 'vulnerable' where the most vulnerable are likely to be less 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.						
8.8	Self Sufficient Persons with Local Awareness: These are the type of persons that will be present on the site of the proposed development/use.	Effective	Yes	Yes	No	No
8.9	Persons Onsite Have Own Transport: There is no need to have arrangements in place for external provision of evacuation vehicles.	Effective	Yes	Yes	No	No
<i>Informative and/or Site Specific Comment/Assessment: Staff will likely live within the local area, or else be familiar with the road network and evacuation routes. Staff and contractors/visitors must necessarily have their own transport to access the site.</i>						
<p>¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.</p> <p>² Protection Measure Application Status:</p> <ul style="list-style-type: none"> • Possible: Protection measures that can potentially be applied to the proposed development/use; • Exists: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary); • Planned: Protection measures that: <ul style="list-style-type: none"> • Are incorporated into the site plans; • Exist in an <u>approved</u> 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 <u>yet to be submitted</u> 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. <p>These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).</p> • Additionally Recommend: Protection measures that: <ul style="list-style-type: none"> • Exist in a <u>yet to be submitted</u> 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. 						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating ¹	Application Status ²			
		Possible	Exists	Planned	Additionally Recommend
These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).					

8.2.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 8.6: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

VULNERABILITY REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Persons on access/egress routes in vehicles					
Access/Egress Route Bushfire Hazard:	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.					
The Protection Principle	Effectiveness Rating ¹	Numbers of Protection Measures				
		Total Available	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
Road Design and Construction (Materials)	Very High	1	-	1	-	-
	High	6	-	6	-	-
	Effective	-	-	-	-	-
	Moderate	-	-	-	-	-
	Not Relevant	-	-	-	-	-
Evacuees Self-Sufficient in Transport and Local Knowledge	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	2	2	2	-	-
	Moderate	-	-	-	-	-
	Not Relevant	-	-	-	-	-
Total Numbers	Very High	1	-	1	-	-
	High	6	-	6	-	-
	Effective	2	2	2	-	-
	Moderate	-	-	-	-	-
	Not Relevant	-	-	-	-	-
	Totals	9	2	9	-	-

¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

² Protection Measure Application Status: Refer to table footnotes on previous page.

8.2.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (VULNERABILITY REDUCTION)

Table 8.7: For the stated element at risk, the assessed impact of the applied protection measures corresponding to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (VULNERABILITY REDUCTION)								
Element at Risk	Persons on access/egress routes in vehicles							
Access/Egress Route Bushfire Hazard:	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.							
Vulnerability Reducing Protection Measures Applied to Assessment ¹	The Bushfire Hazard Threats ²							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Medium	Very Significant	Significant	Significant	N/A	N/A	Minimal	Medium
	Significant				Medium			
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 4 for explanatory information.								

8.2.4 ASSESSED VULNERABILITY LEVELS

Assessed as a function of the capacity to apply sufficient vulnerability reducing protection measures, their individual effectiveness and their combined impact in reducing the vulnerability of the identified element at risk (Note: This assessment is independent of the threat level and exposure level assessments).

Table 8.8: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED VULNERABILITY LEVELS	
Element at Risk	Persons on access/egress routes in vehicles
Access/Egress Route Bushfire Hazard:	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.
Vulnerability Reducing Protection Measures Applied to Assessment ¹	Relative Vulnerability Level ²
Existing and Planned (applied to inherent risk)	Low
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 2 for explanatory information.	

Assessment Comments: No recommendations are applicable. The inherent and residual risk are the same. Suitable transportation, awareness, and suitable egress route(s) are all available and are not under the control of the developer to improve.

8.3 BUILDINGS AND STRUCTURES NCC CLASSES 1-10 (ELEMENT AT RISK CATEGORIES 3-10)

8.3.1 PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS AND THEIR APPLICATION STATUS

Table 8.9: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: BUILDINGS/STRUCTURES - NCC CLASSES 1-10						
<p>PROTECTION PRINCIPLE – DESIGN AND CONSTRUCTION (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.</p> <p>The constructed systems should utilise the following properties to the greatest extent possible: <u>reliability</u> (which requires their durability over time, low maintenance and being unlikely to change over time), <u>robustness</u> (which limits damage spread from minor sources, continue to protect when thermally loaded and protects vulnerable elements), <u>resilience</u> (which enables their return to a functional state following an overload) and <u>redundancy</u> (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.</p> <p>The principle is also applicable to constructed consequential fire fuels.</p>						
9.1	<p>Construction to a Standard - 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.</p> <p><i>“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”.</i></p> <p>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:</p> <ul style="list-style-type: none"> 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	Yes	Yes	No	No
9.2	Construction to a Standard – NASH Standard [33]: Apply the specified requirements to construction. The Standard:	Not Relevant	N/A	N/A	N/A	N/A

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating ¹	Application Status ²			
		Possible	Exists	Planned	Additionally Recommend
<p>“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.”</p> <p>Key attributes of the Standard include:</p> <ul style="list-style-type: none"> 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; <div> </div> <ul style="list-style-type: none"> 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. 					
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Most structures are not enclosed and therefore do not have a construction which can comply with AS 3959 or NASH. Any relevant buildings (such as a site office or enclosed warehouse) are recommended to be constructed to their assessed BAL, however this will not influence the High Risk components of the proposed use. These are addressed in Section 8.4 as a Fixed (Hard) Infrastructure Asset.</p>					

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
<p>Within the provided <i>Renewable Diesel Biorefinery Project – Fire and Explosion Consequence Modelling (2D) Study Report (Technip Energies June 2022)</i>, structures onsite have an input heat flux threshold of 37.5kW/m² for 30 minutes against onsite fires. Structures must be considered resilient against the impacts of radiant heat they will experience, given that most structures are subject to <2kW/m² radiant heat flux and a rating of BAL-LOW.</p>						
9.3	<p>Construction Materials – External And Internal Cavity Building Elements: Excluding 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.</p>	Very High	Yes	Unknown	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> The construction of proposed structures is currently unknown. They will likely be primarily masonry, steel, aluminium and cement sheeting. It is recommended non-combustible elements are included where practical.</p>						
9.4	<p>Construction Materials – Consequential Fire Fuels: For constructed large consequential fire fuels, construct using non-combustible materials to the fullest extent possible. These include:</p> <ul style="list-style-type: none"> Surrounding landscaping items - fences/screens, retaining walls, gazebos, plastic water tanks etc; Attached structures - decks, verandahs, stairs, carports, garages, pergolas, patios, etc; 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]. 	Very High	Yes	Yes	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Non-structural features such as lattice, garden edging, fencing etc are recommended to be composed from non-combustible materials where practical.</p>						
9.5	<p>Construction – Resistant To High Wind: 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.</p> <p>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.</p> <p>Additional fixings for building envelope claddings and protection of the most vulnerable elements, such as glazing, from debris impact, are key considerations.</p> <p>Consider applying the principles of the NASH Standard [33] design solution to construction.</p> <p>“Potential wind effects directly associated with bushfire events have been considered in this Standard. Wind actions may affect houses subject to a bushfire attack in various ways including:</p> <ul style="list-style-type: none"> 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 	High	Yes	Yes	No	No

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	<ul style="list-style-type: none"> • Wind can drive embers into the building envelope.” <p>Most applicable when the physical requirements exist for the development of an extreme bushfire event within the surrounding broader landscape.</p>					
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Due to the location of the site being almost entirely sown pasture on flat ground, it is extremely unlikely that fire-driven wind would be sufficient to compromise structural integrity. Ember screening and enclosed subfloors will reduce the impact of wind-blown embers. No measures are available in management of wind-blown embers for open-faced structures.</p>						
9.6	<p>Construction – Gas Supply: All gas cylinders are installed and maintained in accordance with AS 1596. This standard includes requirements for small portable cylinders and larger cylinders used for domestic house supply. These include:</p> <ul style="list-style-type: none"> • 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. <p>The objective is to reduce the risk of local 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 local 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.</p>	Moderate	Yes	Yes	No	No
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Gas cylinders will be positioned >6m from stored combustible material and comply with AS1596.</p>						
9.7	<p>Construction - Electricity Supply: Cabling to be shielded (includes installing underground within subject property boundary) from applicable bushfire attack mechanisms.</p> <p>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.</p>	Moderate	Yes	No	Yes	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> The area within the development area subject to <12kW/m2 radiant heat flux has been provided within the associated BMP. Common electrical cabling reaches its critical point at >12kWm2. It is recommended that exposed electrical cabling outside this area, be shielded from radiant heat and consequential fire by burying underground, enclosing within a structure, or shielding with non-combustible material.</p>						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
9.8	<p>Minimise Debris and Ember Accumulation – Re-Entrant Detail: Avoid or minimise the accumulation of unburnt debris and embers by avoiding re-entrant details and/or adopting aerodynamic forms that will self-shed windblown debris and embers. For example:</p> <ul style="list-style-type: none"> 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). 	High	Yes	Unknown	No	Yes
9.9	<p>Minimise Debris and Ember Accumulation – Trapping Surfaces: Avoid or minimise the use of exposed combustible surfaces that can trap and accumulate embers. These can include:</p> <ul style="list-style-type: none"> 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). 	Moderate	Yes	Unknown	No	Yes
9.10	<p>Minimise Debris and Ember Accumulation – Roof Plumbing: 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.</p>	Moderate	Yes	Unknown	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> The design of Class 1-10 buildings is unknown at this stage but are likely relatively simple. It is recommended that future designs are investigated for complexities which may trap debris or collect embers, and remove or enclose these complexities where practical. Functionally this means preventing details which may accumulate debris and leaf litter which will not naturally be cleared by wind.</p>						
9.11	<p>Minimise Debris and Ember Accumulation – Construction Cavities: 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.</p>	Moderate	Yes	Unknown	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Any subfloor cavities must be enclosed, sealed with non-combustible material, or have ember screening installed. Some proposed structures have open faces as part of the core design.</p>						
9.12	<p>Minimise Flame/Radiant Heat/Ember/Debris Entry - External Openings: Limit potential sites for entry through the external envelope to internal spaces and combustible materials within (as consequential fire fuels).</p>	High	Yes	No	Yes	No
9.13	<p>Screening and Sealing - Gaps and Penetrations: Apply fire rated sealants and/or install metal screening (corrosion resistant steel, bronze, aluminium <2mm aperture).</p>	Moderate	Yes	No	No	Yes

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	<p>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).</p> <p>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.</p>					
<p><i>Informative and/or Site Specific Comment/Assessment:</i> It is recommended that any enclosed Class 1-10 buildings have ember screening/sealants installed on any gaps and penetrations.</p>						
9.14	<p>Screening - 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.</p>	Moderate	Yes	No	No	No
9.15	<p>Shutters - External Doors and Windows: Fire rated shutters Installed to significantly increase bushfire resistance of the vulnerable building elements. Any requirement for onsite manual activation is a potential limitation to effectiveness.</p>	Moderate	Yes	No	No	No
<p><i>Informative and/or Site Specific Comment/Assessment:</i> The primary hazard is the interaction of onsite fuels (diesel, feedstock, and process products) and bushfire prone vegetation. The measures are excessive for the minor improvement of resilience in relevant buildings.</p>						
9.16	<p>Landscaping Construction - Fences and Walls: Non-combustible materials are used for fences, walls (including retaining walls), screens, garden edging, play equipment and other built structures - as potential consequential fire fuels.</p> <p>Where relevant, the capacity to resist high winds, to minimise potential for impact damage to subject building/structure, should also be incorporated.</p>	Moderate	Yes	No	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Any security fences or other potential fuel loads should be constructed using non-combustible material. Landscaping (gardens) which may be included within the APZ should avoid use of constructed heavy fuels (e.g. timber sleepers as garden edges, plastic or timber lattice).</p>						
<p>PROTECTION PRINCIPLE – FIREFIGHTING CAPABILITY: Provide sufficient, reliable and bushfire resilient water supply and delivery capability as is necessary for active and/or passive systems.</p>						
9.17	<p>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:</p> <ul style="list-style-type: none"> 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; It is the only source of firefighting water. 	Effective	Yes	Yes	No	No

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	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.					
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Two 270,000L firefighting water tanks (total capacity 540,000L) are proposed for the facility. A jockey pump and separate motor-driven and diesel water pumps will supply the ring main, with at least 30 water hydrants to be installed throughout the site.</p> <p>For Class 1-10 buildings, the requirement applied is 10,000L per building or 50,000L per 25 buildings. The proposed facility includes <25 Class 1-10 buildings and thus a supply of 50,000L is appropriate. The remaining 490,000L firefighting water capacity can be considered the supply for High-Risk Uses (assessed under Fixed (Hard) Infrastructure Assets).</p>						
9.18	<p>Firefighting Equipment – Active Operation: In addition to a dedicated water supply, appropriate firefighting equipment is installed (pumps, hoses, sprinklers etc). 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).</p> <p>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.</p>	Effective	Yes	Yes	No	No
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Fire hose reels will be installed throughout the site (final locations to be determined in detailed engineering phase). Sprinkler systems are to be installed for administration and workshop buildings and for dust extraction units.</p> <p>Staff will receive basic training in the use of firefighting equipment (e.g. fire hoses and extinguishers).</p>						
9.19	<p>Firefighting Equipment – Passive Operation: 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).</p>	Not Relevant	N/A	N/A	N/A	N/A
9.20	<p>Firefighting Equipment – Maintain Operability: 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.</p>	Not Relevant	N/A	N/A	N/A	N/A
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Passive operations are not proposed for Class 1-10 buildings. Measure 9.7 addresses electrical cabling.</p>						
9.21	<p>Firebreaks – Primarily for Access: Installation and maintenance of firebreaks to remove vegetation, limit surface fire progression and facilitate firefighting access / backburning.</p>	Moderate	Yes	Yes	No	No

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
<p><i>Informative and/or Site Specific Comment/Assessment:</i> The site will comply with the Shire of Narrogin Firebreak Notice. The >100m APZ will be largely trafficable (excepting rocky outcrops) and thus access throughout the lot will be unrestricted.</p>						
<p>PROTECTION PRINCIPLE – MANAGEMENT AND MAINTAINING 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.</p>						
9.22	<p>Formal Management/Maintenance Plan – Actions and Responsibilities: Through a bushfire management plan, site operations emergency plan, bushfire emergency plan, operational annual works plan and/or a 'firebreak' notice, a mechanism is put in place to ensure that:</p> <ul style="list-style-type: none"> 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; and The relevant protection measures are known and understood; and Responsibilities are created <p>The different documents will be able to satisfactorily perform this function to differing extents.</p>	Effective	Yes	No	Yes	No
<p><i>Informative and/or Site Specific Comment/Assessment:</i> The Bushfire Management Plan and Shire of Narrogin Firebreak Notice will enforce the requirements to a satisfactory extent. Vegetation within the required 100m APZ from high-risk plant, infrastructure, and use areas, will be cleared. Ongoing management requirements are clear. Any landscaped gardens must comply with Schedule 1 of the Guidelines.</p>						
<p>¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.</p> <p>² Protection Measure Application Status:</p> <ul style="list-style-type: none"> Possible: Protection measures that can potentially be applied to the proposed development/use; Exists: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary); Planned: Protection measures that: <ul style="list-style-type: none"> Are incorporated into the site plans; Exist in an <u>approved</u> 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 						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating ¹	Application Status ²			
		Possible	Exists	Planned	Additionally Recommend
<ul style="list-style-type: none"> Exist in a <u>yet to be submitted</u> 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. <p>These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).</p> <ul style="list-style-type: none"> Additionally Recommend: Protection measures that: <ul style="list-style-type: none"> Exist in a <u>yet to be submitted</u> 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. <p>These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).</p>					

8.3.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 8.10: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

VULNERABILITY REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Buildings/Structures - NCC Classes 1-10					
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating ¹	Numbers of Protection Measures				
		Total Available	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
Design and Construction (Materials)	Very High	2	2	1	-	2
	High	4	4	2	1	1
	Effective	-	-	-	-	-
	Moderate	9	9	1	1	6
	Not Relevant	1	-	-	-	-
Firefighting Capability	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	2	2	2	-	-
	Moderate	1	1	1	-	-
	Not Relevant	2	-	-	-	-
Management and Maintaining Effectiveness of Applied Protection Measures	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	1	-
	Moderate	-	-	-	-	-
	Not Relevant	-	-	-	-	-
Total Numbers	Very High	2	2	1	-	2
	High	4	4	2	1	1
	Effective	3	3	2	1	-
	Moderate	10	10	2	1	6
	Not Relevant	3	-	-	-	-
	Totals	22	19	7	3	9
¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining. ² Protection Measure Application Status: Refer to table footnotes on previous page.						

8.3.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (VULNERABILITY REDUCTION)

Table 8.11: For the stated element at risk, The potential impact of the applied protection measures in reducing vulnerability levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (VULNERABILITY REDUCTION)								
Element at Risk	Buildings/Structures - NCC Classes 1-10							
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.							
Vulnerability Reducing Protection Measures Applied to Assessment ¹	The Bushfire Hazard Threats ²							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Significant	Medium	Significant	Very Significant	Medium	Significant	Medium	Medium
	Significant				Medium			
Existing, Planned and Recommended (applied to residual risk)	Significant	Very Significant	Very Significant	Very Significant	Very Significant	Very Significant	Medium	Medium
	Very Significant				Significant			
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 4 for explanatory information.								

Assessment Comments: The protection measures concentrate on reducing the vulnerability of building(s) to ember attack, including ember screening, construction to AS 3959, and preventing leaf litter/debris accumulation. The structural components of the proposed Class 1-10 buildings are likely already resistant to bushfire impacts but are recommended to be non-combustible to the highest practical level.

8.3.4 ASSESSED VULNERABILITY LEVELS

Assessed as a function of the capacity to apply sufficient vulnerability reducing protection measures, their individual effectiveness and their combined impact in reducing the vulnerability of the identified element at risk (Note: This assessment is independent of the threat level and exposure level assessments).

Table 8.12: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED VULNERABILITY LEVELS	
Element at Risk	Buildings/Structures - NCC Classes 1-10
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.
Vulnerability Reducing Protection Measures Applied to Assessment ¹	Relative Vulnerability Level ²
Existing and Planned (applied to inherent risk)	Low
Existing, Planned and Recommended (applied to residual risk)	Very Low
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 2 for explanatory information.	

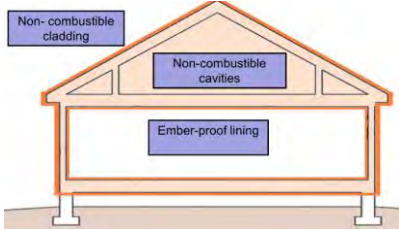
Assessment Comments: Class 1-10 buildings will be robust against bushfire impacts.

8.4 FIXED (HARD) INFRASTRUCTURE ASSETS

8.4.1 PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS AND THEIR APPLICATION STATUS

Table 8.13: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: FIXED (HARD) INFRASTRUCTURE ASSETS						
<p>PROTECTION PRINCIPLE – DESIGN AND CONSTRUCTION (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.</p> <p>The constructed systems should utilise the following properties to the greatest extent possible: <u>reliability</u> (which requires their durability over time, low maintenance and being unlikely to change over time), <u>robustness</u> (which limits damage spread from minor sources, continue to protect when thermally loaded and protects vulnerable elements), <u>resilience</u> (which enables their return to a functional state following an overload) and <u>redundancy</u> (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.</p> <p>The principle is also applicable to constructed consequential fire fuels.</p>						
11.1	<p>Construction to a Standard - 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.</p> <p>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:</p> <ul style="list-style-type: none"> • 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. 	Not Relevant	N/A	N/A	N/A	N/A

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
11.2	<p>Construction to a Standard – 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.</p> <p>Key attributes of the Standard that may have relevance to other built assets include:</p> <ul style="list-style-type: none"> 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;  <ul style="list-style-type: none"> 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. 	Not Relevant	N/A	N/A	N/A	N/A
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Most infrastructure assets do not have a design which is able to comply with the above standards. The exterior of storage tanks, water tanks and infrastructure, and silos is entirely non-combustible and sealed.</p> <p>Within the provided <i>Renewable Diesel Biorefinery Project – Fire and Explosion Consequence Modelling (2D) Study Report (Technip Energies June 2022)</i>, structures onsite have an input heat flux threshold of 37.5kW/m² for 30 minutes against onsite fires. Structures must be considered resilient against the impacts of radiant heat they will experience, given that all infrastructure is subject to <12kW/m² radiant heat flux and a rating of either BAL-12.5 or BAL-LOW, excepting the firefighting water tanks which are subject to BAL-29.</p> <p>Site layout and design has intentionally positioned some assets within BAL-12.5 where the contents/processes are non-combustible (e.g. wood vinegar is 98-99% water).</p>						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
11.3	Construction Materials – External and Internal Cavity Building Elements: Excluding 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	Unknown	No	Yes
11.4	Construction Materials – Consequential Fire Fuels: For constructed large consequential fire fuels, construct using non-combustible materials to the fullest extent possible. These can include attached structures, adjacent structures and surrounding landscaping items.	Very High	Yes	Unknown	No	Yes
<i>Informative and/or Site Specific Comment/Assessment:</i> The construction of infrastructure assets will likely be primarily masonry, steel, aluminium and cement sheeting. No combustible structural elements have been identified. Constructed potential fuels are advised to be constructed of non-combustible materials, wherever possible.						
11.5	<p>Construction – Resistant To High Wind: 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.</p> <p>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.</p> <p>Additional fixings for building envelope claddings and protection of the most vulnerable elements, such as glazing, from debris impact, are key considerations.</p> <p>Consider applying the principles of the NASH Standard [33] design solution to construction.</p> <p>"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:</p> <ul style="list-style-type: none"> • 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." <p>Most applicable when the physical requirements exist for the development of an extreme bushfire event within the surrounding broader landscape.</p>	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment:</i> Due to the location of the site being almost entirely sown pasture on flat ground, it is unlikely that fire-driven wind would be sufficient to compromise structural integrity. No measures have been identified to apply.						
11.6	Construction – 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:	Moderate	Yes	Yes	No	No

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	<ul style="list-style-type: none"> 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. <p>The objective is to reduce the risk of local 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 local 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.</p>					
<i>Informative and/or Site Specific Comment/Assessment:</i> Gas cylinders will be positioned >6m from stored combustible material and comply with AS1596.						
11.7	<p>Construction Materials – Non-Structural Essential Elements: Utilise fire/radiant heat rated products (rated to the level determined as necessary), for the construction of non-structural elements that are essential to the continued operation of the built asset and are exposed to a bushfire hazard. These include cabling and plumbing associated with power / data transmission and water / fuel transport.</p>	High	Yes	Unknown	No	Yes
<i>Informative and/or Site Specific Comment/Assessment:</i> It is recommended that exposed electrical cabling is shielded from radiant heat and consequential fire by burying underground or shielding with non-combustible material – common electrical cabling reaches its critical point at >12kWm ² . It is recommended that PVC piping is to be buried or shielded with non-combustible material – maximum exposure 120 degrees Celsius. This does not apply to suitably encased elements, or those which are non-combustible (e.g. steel plumbing).						
11.8	<p>Minimise Debris and Ember Accumulation – Re-Entrant Detail: Avoid or minimise the accumulation of unburnt debris and embers by avoiding re-entrant details and/or adopting aerodynamic forms that will self-shed windblown debris and embers. For example:</p> <ul style="list-style-type: none"> 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). 	High	Yes	Unknown	Yes	Yes
11.9	<p>Minimise Debris and Ember Accumulation – Trapping Surfaces: Avoid or minimise the use of exposed combustible surfaces that can trap and accumulate embers. These can include:</p>	Moderate	Yes	Unknown	Yes	Yes

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
	<ul style="list-style-type: none"> 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). 					
<p><i>Informative and/or Site Specific Comment/Assessment:</i> The structure design and construction allow for little debris accumulation.</p> <p>Where the electrical cabling 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.</p>						
11.10	Minimise Debris and Ember Accumulation – Roof Plumbing: 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.	Moderate	Partly	Unknown	No	No
<p><i>Informative and/or Site Specific Comment/Assessment:</i> It is unknown if roof plumbing will be present on assets. Screening of roof plumbing has a negligible reduction in risk, as there are no trees proposed >50m of any asset and shed leaves will rarely fall on roofs.</p>						
11.11	Minimise Debris and Ember Accumulation – Construction Cavities: 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.	Not Relevant	N/A	N/A	N/A	N/A
11.12	Minimise Flame/Radiant Heat/Ember/Debris Entry - External Openings: Limit potential sites for entry to internal spaces through the external envelope and combustible materials within (as consequential fire fuels).	Not Relevant	N/A	N/A	N/A	N/A
11.13	<p>Screening and Sealing - Gaps And Penetrations: Apply fire rated sealants and/or install metal screening (corrosion resistant steel, bronze, aluminium <2mm aperture).</p> <p>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).</p> <p>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.</p>	Not Relevant	N/A	N/A	N/A	N/A
11.14	Screening - 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.	Not Relevant	N/A	N/A	N/A	N/A

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
11.15	Shutters - External Doors and Windows: Fire rated shutters Installed to significantly increase bushfire resistance of the vulnerable building elements. Any requirement for onsite manual activation is a potential limitation to effectiveness.	Not Relevant	N/A	N/A	N/A	N/A
<i>Informative and/or Site Specific Comment/Assessment:</i> Fixed assets do not have the above components.						
11.16	Landscaping Construction - Fences and Walls: Non-combustible materials are used for fences, walls (including retaining walls), screens and other built structures - as potential consequential fire fuels. Where relevant, the capacity to resist high winds, to minimise potential for impact damage to subject building/structure, should also be incorporated.	Moderate	Yes	No	No	Yes
<i>Informative and/or Site Specific Comment/Assessment:</i> Any security fences or other potential fuel loads should be constructed using non-combustible material. Landscaping (gardens) which may be included within the APZ should avoid use of constructed heavy fuels (e.g. timber sleepers as garden edges, plastic or timber lattice).						
PROTECTION PRINCIPLE – FIREFIGHTING CAPABILITY: Provide sufficient, reliable and bushfire resilient water supply and delivery capability as is necessary for active and/or passive systems.						
11.17	<p>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:</p> <ul style="list-style-type: none"> 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; It is the only source of firefighting water. <p>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.</p> <p>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.</p>	Effective	Yes	Yes	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Two 270,000L firefighting water tanks (total capacity 540,000L) are proposed for the facility. A jockey pump and separate motor-driven and diesel water pumps will supply the ring main, with at least 30 water hydrants to be installed throughout the site.</p> <p>The Guidelines for Planning in Bushfire Prone Areas does not establish a firefighting water requirement for High-Risk Land Uses, however the nominal recommended supply is 50,000L for large-scale developments to combat the bushfire and consequential fires. The 540,000L supply currently proposed must be considered ample for bushfire purposes.</p> <p>Water tanks are:</p> <ul style="list-style-type: none"> Required to be constructed from concrete or steel. 						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
<ul style="list-style-type: none"> Routes to water tanks are required to be clearly signed at site access. Are recommended to have an external water level indicator. Are recommended to be positioned >10m from other structures where possible/practical within site constraints. 						
11.18	<p>Firefighting Equipment – Active Operation: 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).</p> <p>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.</p>	Effective	Yes	Yes	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Fire hose reels will be installed throughout the site (final locations to be determined in detailed engineering phase). At a minimum, two fire hose reels must be installed within 70m (10m hose stream and 60m hose lay) of all high-risk storage or processing areas (this does not include wood chip feedstock). Hose reels, ring main, and hydrants must meet the specifications of AS 2419. Staff must be trained in the use of firefighting equipment.</p>						
11.19	<p>Fire Fighting Equipment – Passive Operation: 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).</p>	High	Yes	Unknown	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Sprinkler systems are recommended to be automatically activated. A fire within the facility (independent of bushfire) is potentially extremely dangerous. The design requirements and state/national standards are assumed to address this potential hazard to an acceptable level.</p> <p>Note that measures undertaken to decrease the likelihood of onsite fires (independent of bushfire), do not reduce the vulnerability or risk posed, as the methodology for this Risk Assessment assumes that fire occurs.</p>						
11.20	<p>Fire Fighting Equipment – Maintain Operability: 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.</p>	Moderate	Yes	No	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> Operating and maintenance procedures are to be developed to ensure regular maintenance.</p>						
11.21	<p>Firebreaks – Primarily for Access: Installation and maintenance of firebreaks to remove vegetation, limit surface fire progression and facilitate firefighting access / backburning.</p>	Moderate	Yes	Yes	No	No

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating ¹	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
<p><i>Informative and/or Site Specific Comment/Assessment:</i> The site will comply with the Shire of Narrogin Firebreak Notice. The >100m APZ will be largely trafficable (excepting rocky outcrops) and thus access throughout the lot will be unrestricted.</p>						
<p>PROTECTION PRINCIPLE – MANAGEMENT AND MAINTAINING 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.</p>						
11.22	<p>Formal Management/Maintenance Plan – Actions and Responsibilities: Through a bushfire management plan, site operations emergency plan, bushfire emergency plan, operational annual works plan and/or a 'firebreak' notice, a mechanism is put in place to ensure that:</p> <ul style="list-style-type: none"> 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; and The relevant protection measures are known and understood; and Responsibilities are created <p>The different documents will be able to satisfactorily perform this function to differing extents.</p>	Effective	Yes	No	No	Yes
<p><i>Informative and/or Site Specific Comment/Assessment:</i> The documents have been or will be produced. Ongoing requirements established in this Risk Assessment and Section 5.7 of the associated Bushfire Management Plan, must be included in operational documents.</p>						
<p>¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.</p> <p>² Protection Measure Application Status:</p> <ul style="list-style-type: none"> Possible: Protection measures that can potentially be applied to the proposed development/use; Exists: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary); Planned: Protection measures that: <ul style="list-style-type: none"> Are incorporated into the site plans; Exist in an <u>approved</u> 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 <u>yet to be submitted</u> 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. 						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating ¹	Application Status ²			
		Possible	Exists	Planned	Additionally Recommend
<p>These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).</p> <ul style="list-style-type: none"> • Additionally Recommend: Protection measures that: <ul style="list-style-type: none"> • Exist in a <u>yet to be submitted</u> 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. <p>These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).</p>					

8.4.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 8.14: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

VULNERABILITY REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Fixed (hard) infrastructure assets					
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating ¹	Numbers of Protection Measures				
		Total Available	Application Status ²			
			Possible	Exists	Planned	Additionally Recommend
Design and Construction (Materials)	Very High	2	2	-	-	2
	High	2	2	-	1	2
	Effective	-	-	-	-	-
	Moderate	4	4	1	1	2
	Not Relevant	8	-	-	-	-
Firefighting Capability	Very High	-	-	-	-	-
	High	1	1	-	-	1
	Effective	2	2	2	-	2
	Moderate	2	2	1	-	1
	Not Relevant	-	-	-	-	-
Management and Maintaining Effectiveness of Applied Protection Measures	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	-	1
	Moderate	-	-	-	-	-
	Not Relevant	-	-	-	-	-
Total Numbers	Very High	2	2	-	-	2
	High	3	3	-	1	3
	Effective	3	3	2	-	3
	Moderate	6	6	2	1	3
	Not Relevant	8	-	-	-	-
	Totals	22	14	4	2	11

¹ Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

² Protection Measure Application Status: Refer to table footnotes on previous page.

8.4.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (VULNERABILITY REDUCTION)

Table 8.15: For the stated element at risk, The potential impact of the applied protection measures in reducing vulnerability levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (VULNERABILITY REDUCTION)								
Element at Risk	Fixed (hard) infrastructure assets							
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.							
Vulnerability Reducing Protection Measures Applied to Assessment ¹	The Bushfire Hazard Threats ²							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Very Significant	Significant	Significant	Medium	Minimal	Medium	Significant	Medium
	Significant				Medium			
Existing, Planned and Recommended (applied to residual risk)	Very Significant	Very Significant	Significant	Significant	Significant	Very Significant	Significant	Medium
	Very Significant				Significant			
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 ² Refer to Appendix 4 for explanatory information.								

Assessment Comments: The most significant of the available vulnerability reducing protection measures are associated with:

- Ensuring that the design and construction of all fixed assets units can limit locations for accumulation of debris and facilitates self-cleaning by the wind;
- Ensuring that construction materials used are non-combustible to the greatest extent possible, to remove the threat of consequential fire from this source; and
- Having firefighting resources available to combat/extinguish consequential fires (not the bushfire) or provide cooling to assets (through sprinklers and hose reels).

8.4.4 ASSESSED VULNERABILITY LEVELS

Assessed as a function of the capacity to apply sufficient vulnerability reducing protection measures, their individual effectiveness and their combined impact in reducing the vulnerability of the identified element at risk (Note: This assessment is independent of the threat level and exposure level assessments).

Table 8.16: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED VULNERABILITY LEVELS	
Element at Risk	Fixed (hard) infrastructure assets
Vegetation Area / Location	All bushfire prone vegetation within 150m of the proposed development.
Vulnerability Reducing Protection Measures Applied to Assessment ¹	Relative Vulnerability Level ²
Existing and Planned (applied to inherent risk)	Moderate
Existing, Planned and Recommended (applied to residual risk)	Low
¹ Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3	

² Refer to Appendix 2 for explanatory information.

Assessment Comments: As the fixed assets include or contain potentially combustible materials, a residual risk rating below 'LOW' is unlikely to be achieved.

APPENDIX 1: RATIONALE FOR THE SELECTION OF THE APPLIED RISK ASSESSMENT PROCESS

The following information regarding the selection and adaptation of the risk assessment process applied in this report is presented to help inform persons tasked with understanding this report.

KEY DRIVERS

Bushfire Prone Planning has considered the following key drivers in determining the most appropriate risk assessment process to apply:

1. The relevant hazard types.

Bushfire hazards are a natural hazard rather than a human-induced hazard (refer to glossary and see limitations of ISO 31000 in the next section). Natural processes and phenomena present unique types of threats.

Consequently, the assessment process needs to be able to specifically deal with the unique characteristics of bushfire hazards in a way that derives meaningful risk-based information that can be readily interpreted and applied.

A logical framework is needed around which the development of bushfire protection measures (risk treatments) can be constructed, assessed and understood by those tasked with making decisions based on the provided information.

2. The relevant risks to be addressed.

The specific risks are limited to the potential loss of life, injury, or destroyed or damaged assets that are associated with a bushfire hazard. These originate from the hazard's direct and indirect bushfire attack mechanisms and the response of persons and property to these threats.

3. The complexity and/or scale of proposed development/use.

For different development/use proposals, there are significant differences in the types of information required for the hazard risk assessments and the derivation of operationally useful information that is to be applied to mitigating the associated risks.

These differences include scale e.g. from development or activities on a single lot to development or activities within a region.

Also, different uses may be able to tolerate different levels of risk. For example the Guidelines v1.4 cl 5.5.2 establish that "different tourism land uses ... may require different levels of risk management".

Consequently, the applied risk management process needs to be able to accommodate these differences and remain both logical, useable and efficient to compile. It needs to be capable of being relatively easy to scale up or down to provide a relevant and actionable report.

LIMITATIONS OF ISO 31000:2018 AND NERAG

The approach adopted by Bushfire Prone Planning (BPP) contrasts with the typical approach historically used in various Australian jurisdictions. This historical approach conducts the risk management process by applying the *National Emergency Risk Assessment Guidelines (AIDR 2020, NERAG)*.

However, the considered view of BPP is that the *NERAG* approach is unable to effectively provide (a) the required assessment methodology for assessing risk associated with a bushfire hazard or (b) evaluate the impact of specific bushfire protection measures - to the level of detail and relevance required for the planning of development and uses. That is, the key drivers determining the suitable methodology cannot be satisfied.

It is not practical to fully justify the above statement here, but the following is noted:

The determination of pre and post treatment risk levels is a key objective of *NERAG*. These are determined as the product of consequence and likelihood ratings. These ratings have the following inherent weaknesses in meeting the risk assessment requirements for a natural bushfire hazard:

1. Consequence ratings are derived from a set of established qualitative and quantitative criteria - which are very broad based and have less relevance at smaller scales of development/use. No direct link between the application of a risk treatment(s) and how they can justifiably be assessed as being able to alter a consequence level is established; and

- Likelihood ratings of both the emergency event and the consequences are difficult to separate. They are derived from a set of established quantitative (probability) criteria. They also typically look backward and not forward and their determination is problematic with respect to sourcing relevant and sufficient data.

Varying the levels of likelihood has limited applicability when the pragmatic requirement is to assume an emergency event will occur. The level of risk to which the at risk elements are exposed and vulnerable when a bushfire does occur, should have the most relevance to planning its location, design and construction, or allowing it.

The determination of level of relevant risks by relying on the accuracy and relevance of the probability of the bushfire occurring should be given much less weighting. A more robust reduction in risk will result from being protected by something more physical/tangible than probability.

Also relevant is that the *NERAG* state they are “primarily focussed on assessing emergency risks” and that they are “structured to align broadly with relevant sections of *ISO 31000:2018 – Risk Management Guidelines*”.

ISO 31000:2018 states that its intended use is “... to provide guidelines on managing risk faced by organisations”.

The key point is that organisational risk is derived from a ‘human-induced hazard’ rather than a natural hazard (refer to the glossary). However, it is the bushfire natural hazard that is the source of risk being addressed by requirements established by SPP 3.7 and the associated Guidelines.

Consequently, it is BPP’s considered opinion that applying *ISO 31000:2018* and *NERAG* (in its current form) to assessing risk associated with a bushfire hazard has significant application and relevance limitations.

THE APPLIED ADAPTED RISK ASSESSMENT APPROACH

In acknowledging the key drivers, and the limitations of the risk management process developed by *ISO 31000* and adapted by *NERAG*, Bushfire Prone Planning has adapted the understanding of disaster risk that is used by the United Nations Office for Disaster Risk Reduction (*UNDRR*).

Although the *UNDRR* approach is designed to addresses disaster risk at large scale strategic levels, it can justifiably be applied to all scales of planning because it is focused on natural hazards and establishes a concept that can be readily adapted.

The risk assessment report that is developed applying this process presents relevant, logical, comprehensive and practical facts, to appropriately inform those persons tasked with either:

- Planning the siting, design, construction and management of development/use to ensure an appropriate level of bushfire resilience is achieved and limiting associated risks to tolerable levels; or
- With making pragmatic planning approval decisions.

The Figure below (copy of Figure 2.3) illustrates the framework of the adapted risk assessment process (refer to the glossary for terminology information and Appendix 2 provides greater detail of the risk analysis component of the assessment process).

THE FRAMEWORK OF BUSHFIRE PRONE PLANNING’S APPLIED RISK ASSESSMENT PROCESS



APPENDIX 2: RISK LEVEL ANALYSIS – ADDITIONAL EXPLANATION

INDICATIVE RISK LEVELS

Justification for reporting indicative risk levels is based on the following factors:

1. There is a finite 'universe' of bushfire protection measure principles that can be applied to reducing hazard threats and the exposure and vulnerability of at risk elements;
2. There will be a range of development/use specific protection measures associated with each protection measure principle. The number of available protection measures will vary dependent on the type and scale of development/use, but effectively there will also be a practical limit; and
3. Bushfire protection measures will vary in their standalone effectiveness at mitigating risk (refer to section 2.3.5);

Consequently, an indication of the level of risk – for a given development/use - can be gained by:

1. Assessing 'relative' threat levels.
2. Deriving 'relative' exposure and vulnerability levels by:
 - a) Assessing how many protection measure principles and associated measures are applicable and can be applied;
 - b) Assessing the relative effectiveness of each protection measure; and
 - c) Comparing the numbers of applied protection measures with the number of possible measures in the protection measure 'universe'.
3. Making a qualitative assessment of the potential impact of the applied protection measures (including appropriate weighting given to their individual effectiveness) that can reduce the relative threat, exposure and vulnerability levels.
4. Derive the indicative risk level by applying the risk matrix shown as Table A2.1 and establish the tolerability of the risk by applying the risk tolerance scale of Table A3.2, Appendix 3.

Providing an indicative risk level establishes a qualitative understanding of the level of risk that potentially exists and is intended to inform and assist with making various planning decisions.

Deriving indicative risk levels is essentially a compilation and assessment of physical facts rather than determinations of what is to constitute different levels of threat, exposure and vulnerability and subsequently intolerable, tolerable and acceptable levels of risk for every development/use scenario.

An indicative risk level can be derived from an assessment of the site, the planned development/use and the knowledge and experience of the bushfire practitioner – such that an opinion can be provided regarding risk levels.

DETERMINED RISK LEVELS

Reporting determined risk levels will require reference information being available to the assessor so that 'determined' levels of threat, exposure and vulnerability can be established (this contrasts with the 'relative' levels required in deriving an indicative risk level).

The required reference information are the risk factor criteria, the risk level matrix and the risk tolerability scale.

Risk Factor Criteria

The required risk factor criteria will 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 will 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 will be required. The rationale for this statement includes:

- 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;
- Recognition that different levels of risk can be tolerated by different development, use and scale is indicated in the Guidelines v1.4 where cl 5.5.2 establishes that "different tourism land uses ... may require different levels of risk management"; and
- To account for the variation, one risk level matrix could establish a moderate determined risk level for a given development type/use/scale and combination of threat, exposure and vulnerability levels.

For the same combination of threat, exposure and vulnerability levels but for a different development type/use/scale, a different risk level matrix could establish an extreme determined risk level; and

Risk Tolerance Scale

After the 'determined' risk level has been derived from the risk assessment process, a methodology is required to classify the risk level as either unacceptable, tolerable or acceptable. Currently Bushfire Prone Planning is applying the ALARP principle and associated risk tolerance scale (refer to Appendix 3).

The Current Limitations to Deriving a Determined Risk Level

The required reference information (i.e. the risk factor criteria, sets of risk matrices and the risk tolerance scale) is necessarily required to be provided by the relevant regulatory authorities /decision makers. The rationale for this statement is:

1. The information must reflect the expectations and understanding and accepting of risk as held by society and communities, and directed through its governing bodies;
2. The information must be standardised to the greatest extent possible so that it provides an acceptable and trusted basis on which the determined risk level can be derived and be relied upon in making decisions.
3. Properly establishing the reference information cannot be justifiably relegated to individual assessors with varied expertise, qualification and without any approved responsibility to provide such information. Their expertise might more appropriately be utilised in assisting the responsible authorities to establish the information.

Where the required reference information has not been established and provided by the responsible authorities, determined risk levels cannot be the final outcome when using this risk assessment process. Currently, this reference information does not exist.

HOW THE LIKELIHOOD OF A BUSHFIRE EVENT OCCURRING HAS BEEN DEALT WITH

The approach taken with the applied risk assessment process is to apply the pragmatic assumption that a bushfire will occur. It is assumed it 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 accepts 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.

This contrasts with applying a quantitative approach based on the historical record of past bushfire event 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. It cannot 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 much easier, more practical (and likely economical), to incorporate at initial planning stages rather than the retro-establishment of protection measures when circumstances change 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.

Table A2.1: Risk matrix for deriving indicative risk levels from the assessed relative levels of threat, exposure and vulnerability.

INDICATIVE RISK LEVEL MATRIX						
Relative Threat Level (a)	Relative Exposure Level (b)	Relative 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	M8	H9	H10
	Moderate (3)	M7	M8	H9	H10	H11
	High (4)	M8	H9	H10	H11	E12
	Extreme (5)	H9	H10	H11	E12	E13

Indicative risk level key: VL = very low, L = low, M = moderate, H = high, E = extreme.
 The qualitative relative levels are assigned a numerical value.
 The indicative risk value is calculated as = (a + b + c) – 2 and range from 1 (lowest) to 13 (greatest).
 The indicative 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.

APPENDIX 3: THE ALARP PRINCIPLE AND THE RISK TOLERANCE SCALE APPLIED

The following information is intended to provide an understanding of the ALARP principle and provide justification for its application in this risk assessment report.

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 – including its adaption for use in the following Australian guidelines:

- 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 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.

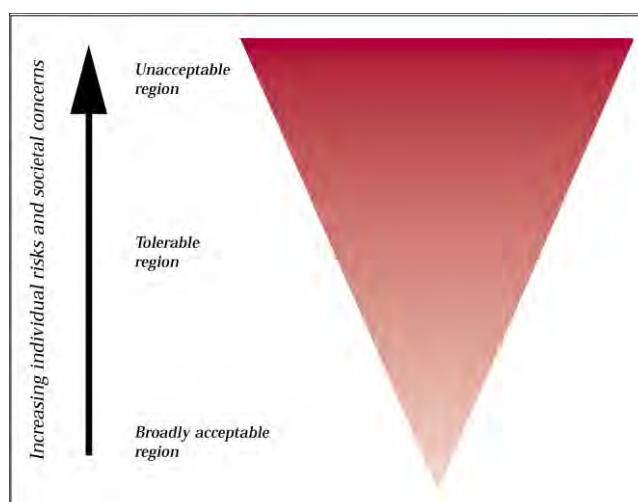


Figure A3.1: HSE framework for the tolerability of risk (source: HSE-UK, 2001)

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 A3.1: The risks associated with the risk tolerance regions (adapted from HSE-UK, 2001)

THE ALARP PRINCIPLE – DEFINING THE REGIONS OF RISK TOLERANCE	
Unacceptable Region	<p>For practical purposes, a particular risk falling into this region is regarded as unacceptable whatever the level of benefits associated with the activity.</p> <p>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.</p>
Tolerable Region	<p>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:</p> <ul style="list-style-type: none"> • 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	<p>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.</p> <p>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.</p>
<p>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 particular 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.</p>	

RISK TOLERANCE SCALE

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. Where planning approval is being sought, identify if the determined residual risk levels can be considered as tolerable or acceptable and therefore capable of being approved for this factor, or not.

The risk tolerance scale to be applied within the risk assessment report, when the required risk factor criteria and risk level matrix are available, is established in Table A3.2.

Table A3.2: The applied risk tolerance scale

APPLIED RISK TOLERANCE SCALE - INCORPORATING THE ALARP PRINCIPLE		
Indicative / Determined Risk Level	Tolerability Description and Action Required	Risk Tolerance Level ¹
Extreme	<p>The risks are unacceptable and require immediate implementation of risk management measures to eliminate or reduce risk to tolerable or acceptable levels.</p> <p>Proposed development giving rise to risks in this region would not be approved unless there are exceptional reasons for the development to proceed.</p>	Unacceptable
High	<p>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.</p>	Intolerable - if <u>not</u> ALARP -
Moderate		Tolerable - if ALARP -
Low	<p>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.</p> <p>Risk management measures may be needed to reduce risk to more acceptable levels where possible – or accept the risk.</p>	Tolerable - if <u>not</u> ALARP -
Very Low		Acceptable - if ALARP -
<p>¹ Refer to the glossary for definitions of the tolerance levels.</p>		

APPLICATION JUSTIFICATION

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.

APPENDIX 4: THE BUSHFIRE HAZARD – BEHAVIOUR AND ATTACK MECHANISMS

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 (broader landscape scale) can have additional implications for the development of extreme bushfire events and the consequent increase in bushfire threat levels (refer to Appendix 5 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 broader landscape scale can have implications for the development of extreme bushfire events and consequent increase in bushfire threat levels (refer to Appendix 5 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 broader 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 5 for additional information).

BUSHFIRE DIRECT ATTACK MECHANISMS

EMBER ATTACK: Ember attack is the most common way for 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 – Bianchi R. et.al. 2005 - Bianchi R. et.al. 2006).

Embers are the primary ignition source for consequential fire:

- They accumulate around and on vulnerable parts of structures (roofs, gutters, doors, windows, re-entrant corners)
- They enter gaps in structures envelopes to vulnerable internal cavities and spaces.
- 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.

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 has collected or been placed on the ground.

Of the plant materials, bark is the predominant source of embers but built timber elements will also produce embers.

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 tree tops 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 that are lower than fine fibrous or ribbon barks.

(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).

The importance of establishing protection measures to mitigate the potential impact of consequential fire ignited by the ember attack mechanism, cannot be overstated.

RADIANT HEAT ATTACK: This heat radiates in all directions from a bushfire and can potentially be felt hundreds of meters away. The amount of heat that a flame can transfer to other objects is influenced by the flame size and its 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 the weather and topography factors that can intensify fire behaviour (described at end of this section).

Radiant heat:

- Can damage or destroy elements that are vulnerable to higher levels of heat;
- 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 people when they are not physically shielded. Protective clothing can provide only limited protection.

BUSHFIRE FLAME ATTACK: When flames make contact with structures they can flow over, under and around – impacting surfaces not directly facing the bushfire.

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.

SURFACE FIRE ATTACK: These are low intensity fires (less than 0.5m high) burning along the ground consuming mostly intermittent fine fuels such as vegetation debris, litter, and mulches. They are typically patchy and erratic in their direction and short lived (<40 seconds) when burning in the absence of heavier fuels.

Typically these fires will be on the land immediately surrounding buildings and associated structures and other heavy fuels. Their importance as a threat is the bringing of direct flame contact, higher radiant heat and embers closer to these exposed elements.

BUSHFIRE INDIRECT ATTACK MECHANISMS

DEBRIS ACCUMULATION: The relevant debris are combustible fine fuels that can accumulate (by falling or being windblown) in close proximity to subject structures and their surrounding structures and other heavy fuels. This makes the burning of these structures/fuels much easier and more likely through the ignition of the accumulated debris by ember attack.

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 potential threat level will be determined by:

- The presence of vegetation types that produce quantities of debris with those that produce in the driest and hottest part of the year presenting a greater threat;
- The extent of this vegetation; and
- The proximity of this vegetation to the exposed and vulnerable structures.

CONSEQUENTIAL FIRE:

Consequential fire is the burning of vulnerable (combustible/flammable) materials, items and structures that exist within the area surrounding the subject building or structure – the surrounding vulnerable elements.

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 are threats that are separate from and additional to the threats generated by the bushfire front itself - which can be and often is, a considerable distance away.

The importance of establishing protection measures to mitigate the potential impact of consequential fire cannot be overstated.

Consequential fire fuels consist of both fine and heavy fuels.

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.

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;
 - 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].

FIRE DRIVEN WIND: Severe bushfires are commonly accompanied by high winds due to the prevailing weather conditions. Localised high winds can be induced by the bushfire. When the required factors exist, the bushfire can couple with the atmosphere (pyro-convective) resulting in extreme bushfire events and gusty, severe windspeeds.

These winds can directly damage the external envelope of a building or structure by pressure (low and high) or the carriage of varying types of solid debris. This provides openings for other bushfire attack mechanisms to enter and ignite internal cavities.

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:
- Fall and obstruct access to or egress from, a structure or site being impacted by bushfire.

APPENDIX 5: THE BROADER LANDSCAPE AND EXTREME BUSHFIRE EVENTS

The content of this appendix is an overview of information that supports the assessment approach of section 5.4 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 broader 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, a number of 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 particular relevance to this risk assessment are the topographic aspects of the broader 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 or 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 pyrocumululus (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 broader 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 and 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 5.5.

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:

- o Leeward slopes greater than 20-25° are required;
- o Wind direction must be within 30-40° of the topographic aspect;
- o Wind speed in excess of about 20 km h⁻¹ are required;
- o Generally VLS is only observed in heavy forest fuel types with load in excess of 15-20 t ha; and
- o 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 air mass. 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 6: HAZARD REDUCTION BURNING – ADDITIONAL INFORMATION

The following information provides supporting guidance to the relevant bushfire protection measures that reduce bushfire hazard threat levels by reducing fuel levels.

1. SIGNIFICANT AREAS (LARGER) AREAS OF BUSHFIRE PRONE VEGETATION

Annually

Prior to the bushfire season ensure the following management of the identified areas of vegetation is conducted:

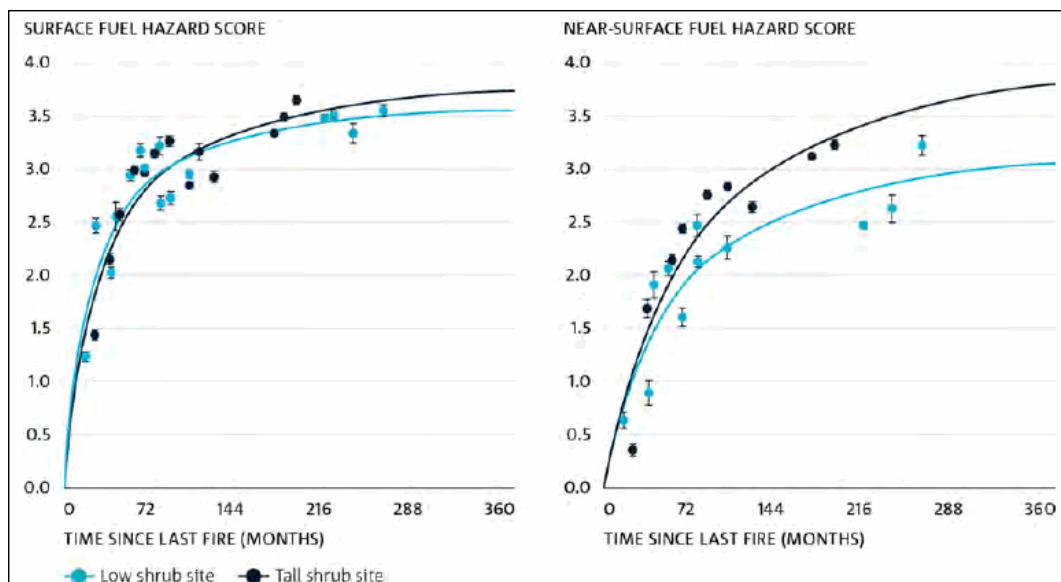
- Maintain the pruning of all trees and tall shrubs to a height of at least 2m from the ground and remove the material; and
- Remove any dead trees (that are not habitat trees), fallen branches and dead shrubs.

Burn Interval

Conduct hazard reduction burns at intervals that will ensure surface and near surface fuel loads (i.e. fine fuels – accumulated leaf litter, combustible plant materials and twigs up to 6mm diameter) remain less than 8 t/ha at all times.

It is likely the burning interval will need to be shorter than that which is typically currently conducted. The following statement and data from the Climate and Disaster Technical Report, CSIRO, 2020 [17] indicates the requirement for increased frequency of hazard reduction due to the rapid increase in surface and near surface fuel loads after hazard reduction burning.

“The only study published on the dynamics and structure of fine fuel in dry eucalypt forest following prescribed fire is that of Gould et al. (2011) utilising data to drive an exponential fuel accumulation relation for the key fuel attributes of surface fuel hazard and near-surface fuel hazard. In this study of time since fire in jarrah forest (Eucalyptus marginata), it was found that, over the 20-year period of the study (1979-1999) while surface fuel loads continued to increase indefinitely (up to and beyond 20 years), attributes such as percent cover and hazard score essentially plateaued after 6-9 years. Similarly, near-surface fuel loads were found to stop increasing significantly after 15-18 years whereas near-surface height and hazard score stopped increasing significantly after 9-12 years and 12-15 years, respectively (Figure 14). Bark hazard was found to be affected by hazard reduction burning for up to 12 years after hazard reduction burning”



“Figure 14 Recovery of surface (left) and near-surface fuel hazard (right) in Jarrah Forest following hazard reduction burning. Under these conditions these fuel attributes returned to equivalent long unburnt state after approximately 12-15 years but the response in the first few years following burning is extremely rapid, achieving 75% of fuel hazard within 4 years (surface) and 5-7 years (near-surface) depending on presence of shrub layer (Redrawn from Gould et al. 2011)”

2. THE BROADER LANDSCAPE

The following information has merit for consideration and is taken from the peer reviewed paper 'A framework for prioritising prescribed burning on public land in Western Australia'; Howard T. et al, DBCA and DFES; *International Journal of Wildland Fire* 2020, 29, 314-325.

To develop and apply this protection measure it is likely interested entities, such as local government will need to engage and work with the relevant state government agency responsible for the identified areas of vegetation.

The collaboration will be necessary to establish the required indicators of acceptable risk - as they are determined through the application of the following published framework - and to establish a responsibility to conduct the ongoing management of these areas of vegetation to maintain compliance with the established indicators.

KEY RELEVANT POINTS FROM THE FRAMEWORK (QUOTED)

Introduction to the framework:

- *The framework provides principles and a rationale for programming fuel management with indicators to demonstrate that bushfire risk has been reduced to an acceptable level.*
- *Each bushfire risk management zone is divided into fire management areas, based on the management intent. These are areas where fuels will be managed primarily to minimise the likelihood of fire causing adverse impacts on human settlements or critical infrastructure, to reduce the risk of bushfire at the landscape scale or to achieve other land management outcomes. Indicators of acceptable bushfire risk are defined for each fire management area and are modified according to the distribution of assets and potential fire behaviour in the landscape.*
- *The framework establishes principles and a rationale for programming fuel management and, critically, provides indicators that demonstrate that bushfire risk has been reduced to an acceptable level. The acceptable level of bushfire risk is determined through a risk assessment and prioritisation process.*

Principles for managing bushfire risk applied in the framework:

- *Consistent with international standard: The regional risk framework commits to applying risk management in a manner that is consistent with AS ISO 31000: 2018 Risk management guidelines (Standards Australia 2018). This involves adherence to the principles of risk management, and applying the risk management process to the identification, assessment and treatment of risk.*
- *Fuels are managed to reduce the harm: Managing the fuel available to burn is critical to managing the threat posed by bushfire. The available fuel, and its structure, affect the speed and intensity of a bushfire, which, in turn, determine both its potential to cause damage and suppression difficulty. Done at appropriate temporal and spatial scales, managing the quantity, structure and distribution of fuel available has been demonstrated to be an effective and efficient way to reduce the severity and extent of damage by bushfires.*
- *Fuel management does not eliminate risk: Fuel management aims to reduce the negative consequences of bushfires rather than prevent their occurrence. Given the importance of fire to maintaining ecosystem health and resilience, it is neither desirable nor feasible to eliminate bushfire from natural landscapes and it is recognised that both planned and unplanned fire can have benefits. Fuel management aims to reduce risk to an acceptable level by greatly enhancing and supporting the effectiveness of other measures, including bushfire law, fire suppression, urban planning, building codes for fire-prone areas and community preparedness.*
- *Fuel management is planned and integrated. Bushfire management puts people first, risk is managed at an appropriate scale and ecological requirements are considered when managing fuel.*

Framework for managing bushfire risk by prescribed burning:

- *The framework identifies bushfire risk management zones (BRMZ), recognises different fuel types (and associated fuel accumulation and fire behaviour models), classifies public lands within each zone into fire management areas (FMA) - with the Settlement-Hazard Separation classification being the relevant fire management area for the Mundaring town centre - and develops indicators of acceptable risk.*
- *Bushfire Risk Management Zones: The framework identifies eight bushfire risk management zones (BRMZ) characterised by broad consistency of land use, asset distribution, fire environment (vegetation, fuels and climate) and fire management practices that combine to create a characteristic risk profile (Fig. 2). The Southwest zone includes the majority of the state's population, urban development and infrastructure.*
- *Fuel Types: The framework recognises 13 broad types across Western Australia. Fuel types are based primarily on structural attributes of the vegetation that influence fire behaviour. For each fuel type, best available information*

has been assembled regarding post-fire patterns of fuel accumulation, fire ecology, including the requirements of fire sensitive species and communities, harmful fire regimes and fire regimes compatible with ecosystem health. Where possible, the framework assigns each fuel type appropriate fuel accumulation and fire behaviour models and identifies the key weather attributes required to model fire behaviour. These models are used when setting indicators of acceptable bushfire risk, which are defined for different fuels according to the rates of fuel accumulation and the fire behaviour they may support.

- *Fire Management Areas: Public lands within each BRMZ are further classified into four fire management areas (FMAs) characterised as Settlement-Hazard Separation, Critical Infrastructure Buffer, Landscape Risk Reduction and Remote Area Management. These FMAs are defined by the primary intent of fuel management, which is a function of potential fire behaviour and the type and distribution of assets characteristic of the area. The framework recognises six classes of assets that may be affected by bushfire: settlements, dispersed populations, critical infrastructure, protected species and communities, economic assets and other assets (non-critical infrastructure, ecological, cultural).*
- *The Settlement-Hazard Separation FMA provides an area proximal to settlements where fuels are managed relatively intensively to minimise the likelihood of a bushfire being sustained, damaging properties or endangering people. Here, fuel management to protect settlements takes precedence over other land management objectives, though other land management outcomes can be pursued to the extent that they do not conflict with the primary management intent.*
- *The extent of the area described by each FMA varies according to the fuel type and the BRMZ in which it occurs ... The breadth of the Settlement-Hazard Separation FMA is calculated to be sufficient to significantly reduce the likelihood of damage to assets from direct flame contact, radiant heat and ember attack and to provide adequate opportunity for fire suppression. This calculation is based on a combination of data derived from fire behaviour models and expert practitioner judgement. The Settlement-Hazard Separation FMAs are the largest in forest fuels that are prone to long-range spotting, severe ember storms and crown fire behaviour.*
- *Indicators of Acceptable Bushfire Risk: Are set for bushfire-prone fuel types in each FMA ... Indicators are expressed in terms of the proportion of the landscape that is managed such that the treated fuels will not support a head fire of an intensity that precludes effective suppression action under weather conditions corresponding to the 95th percentile fire danger index ... Weather conditions (air temperature, relative humidity, wind speed) corresponding to the 95th percentile FFDI are identified and used as inputs to fire behaviour models for calculating forward rate of spread and fire intensity (Table 1).*
- *The intent of fuel management is to reduce the quantity and alter the arrangement of fuels such that a bushfire is likely to spread more slowly, burn with lower intensity, be easier to suppress and cause less damage.*
- *The indicators of acceptable risk for the Settlement-Hazard Separation FMA for open eucalypt forest and tall/open eucalypt forest is a target of 60% of fuel less than threshold intensity for a distance of 5km surrounding settlements.*

As an open eucalypt forest example at the Perth rural urban interface, the fuel age and load to achieve threshold fire intensity under weather conditions representing 95th percentile values of the FFDI for the Bickley location are stated as 5 years and 8 t/ha.

APPENDIX 7: BUSHFIRE ATTACK LEVELS AND BAL CONTOUR MAPS EXPLAINED

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/m²."

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 results in different separation distances, away from bushfire prone vegetation, corresponding to a given BAL rating.

In assessing risk, knowing the separation distances away from each identified area of classified vegetation that correspond to a BAL rating, assists with evaluating threat levels from that bushfire hazard and the exposure levels of elements at risk.

Bushfire Attack Level	Explanation [Source AS3959:2018]
BAL – LOW	There is insufficient risk to warrant specific construction requirements but there is still some risk. <i>Important Note: For AS3959:2018 purposes, BAL-LOW will exist at 100m from classified vegetation (50m for Grassland).</i> <i>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.</i>
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 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 .

THE BAL CONTOUR MAP - ILLUSTRATING THE CALCULATED SEPARATION DISTANCES CORRESPONDING TO BAL RATINGS

The BAL contour map illustrates different coloured contour intervals extending out from each different area of classified bushfire prone vegetation. The minimum and maximum distances of each contour, from each area of vegetation, is a diagrammatic representation of the calculated separation distances that correspond to each BAL rating. These take into account the specific site conditions.

Each coloured contour represents a different bushfire attack level and anything within that contour will be subject to that BAL rating and its corresponding level of radiant heat.

ADDENDUM 1

1. ADDENDUM SUB-HEADING

GLOSSARY

APPLIED TERMINOLOGY	
Consequence	<p>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)</p> <p>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).</p> <p>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)</p>
Controls	<p>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)</p> <p>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)</p> <p><i>Note: 'Protection Measures' and 'Risk Treatments' will be alternative terms used in this risk assessment report.</i></p>
Decision Maker	<p>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)</p> <p>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.</p>
Elements At Risk	<p>The population, buildings and civil engineering works economic activities, public services and infrastructure, etc. exposed to hazards. (Australian Institute for Disaster Resilience, 2019)</p>
Exposure	<p>Refers to the people and things in the path of potential hazards. (Source: AIDR LUPDRC, 2020)</p> <p>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)</p> <p>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)</p>

Hazard	<p>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.</p> <p>Hazards may be natural, anthropogenic or socionatural in origin.</p> <ul style="list-style-type: none"> • 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. <p>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.</p> <p><i>(Source: UNDRR Terminology 2017)</i></p> <p>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. <i>(Source: AIDR Knowledge Hub; Glossary)</i></p>
Hazardous Event	<p>The manifestation of a hazard in a particular place during a particular period of time.</p> <p>[Severe hazardous events can lead to a disaster as a result of the combination of hazard occurrence and other risk factors.]</p> <p><i>(Source: United Nations Office for Disaster Risk Reduction, 2017)</i></p>
Hazard Identification	<p>The process of recognising that a hazard exists and defining its characteristics. <i>(Australian Institute for Disaster Resilience, 2019)</i></p>
Hazard - Bushfire	<p>A fuel complex, defined by amount, type condition, arrangement, and location, that determines the degree of hazard. <i>(Source: AIDR Knowledge Hub; Glossary)</i></p> <p>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.</p>
Hazard - Urban Fire	<p>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. <i>(Source: AIDR Knowledge Hub; Glossary)</i></p>
Hazardous Material	<p>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. <i>(Source: AIDR Knowledge Hub; Glossary)</i></p>
Impact	<p>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.</p>
Likelihood	<p>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. <i>(Source: AIDR NERAG, 2020)</i></p> <p>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. <i>(Source: ISO Guide 73:2009)</i></p>

	<p>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).</p>
Mitigation	<p>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)</p>
Reliability	<p>Refers to the expected reliability of a designed solution (protection measure). Over time it will be a function of:</p> <ul style="list-style-type: none"> • 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. <p>(Adapted from Kelly M. et al; <i>Structural Design Options for Residential Buildings in Bushfire Areas</i>, Australasian Structural Engineering Conference November 2016)</p>
Resilience	<p>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)</p> <p>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:</p> <ul style="list-style-type: none"> • 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. <p>(Adapted from Kelly M. et al; <i>Structural Design Options for Residential Buildings in Bushfire Areas</i>, Australasian Structural Engineering Conference November 2016)</p>
Robustness	<p>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:</p> <ul style="list-style-type: none"> • 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). <p>(Adapted from Kelly M. et al; <i>Structural Design Options for Residential Buildings in Bushfire Areas</i>, Australasian Structural Engineering Conference November 2016)</p> <p>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)</p>

<p>Redundancy</p>	<p>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)</p> <p>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.</p>
<p>Risk</p>	<p>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)</p> <p>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)</p> <p>Risk is the chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood. In <u>emergency management</u> 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)</p>
<p>Risk Management</p>	<p>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)</p> <p>Coordinated activities of an organisation or a government to direct and control risk. The risk management process includes the activities of:</p> <ul style="list-style-type: none"> • Communication and consultation; • Establishing the context; • Risk Assessment (risk identification, risk analysis, risk evaluation); • Risk Treatment; and • Monitoring and Review. (Source: AIDR NERAG, 2020)
<p>Risk Identification</p>	<p>Process of finding, recognising and describing sources of risks, their causes and their potential consequences. (Source: ISO Guide 73:2009)</p> <p>It is a process used to find, recognise, and describe the risks that could affect the achievement of objectives. (Source: Praxiom)</p>
<p>Risk Source</p>	<p>An element which, alone or in combination, has the intrinsic potential to give rise to risk. (Source: ISO Guide 73:2009)</p>
<p>Risk Assessment</p>	<p>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)</p> <p>The overall process of risk identification, risk analysis and risk evaluation. (Source: ISO Guide 73:2009)</p>

<p>Risk Analysis</p>	<p>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)</p> <p>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)</p> <p>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.</p> <p>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.</p> <p>The required risk level analysis can be conducted for either each exposed element separately and/or the proposed or existing development/use overall.</p>
<p>Risk Evaluation</p>	<p>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)</p> <p>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 3 for further information).</p> <p>This process can only be conducted when <u>determined</u> risk levels have been derived.</p>
<p>Risk Factor Criteria</p>	<p>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.</p> <p>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.</p>
<p>Risk Level Matrix</p>	<p>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.</p> <p>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.</p>
<p>Risk Tolerance Scale</p>	<p>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).</p> <p>The risk tolerance scale can be applied within the risk assessment report when the required risk factor criteria and risk level matrix are available.</p>
<p>Risk - Inherent</p>	<p>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).</p>

	<p>'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.</p> <p>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.</p> <p>1. Source: www.fairinstitute.org</p> <p><i>"Confusion exists between Inherent Risk and Residual Risk ... Here are the standard definitions of the two concepts:</i></p> <ul style="list-style-type: none"> • <i>Inherent risk represents the amount of risk that exists in the absence of controls.</i> • <i>Residual risk is the amount of risk that remains after controls are accounted for.</i> <p><i>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.</i></p> <p><i>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:</i></p> <ul style="list-style-type: none"> • <i>Inherent risk is current risk level given the existing set of controls rather than the hypothetical notion of an absence of any controls; and</i> • <i>Residual risk would then be whatever risk level remain after additional controls are applied."</i> <p>2. Source: Wikipedia:</p> <p><i>Inherent risk, in risk management is:</i></p> <ul style="list-style-type: none"> • <i>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</i> • <i>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.</i>
Risk - Residual	<p>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)</p> <p>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)</p> <p>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</p>

	<p>consequences, changed the probabilities, transferred the risk, or retained the risk. (Source: Praxiom)</p> <p>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)</p> <p>Residual risk can contain unidentified risk. Residual risk can also be known as retained risk. (Source: ISO Guide 73:2009)</p>
Risk Level - Determined	<p>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:</p> <ol style="list-style-type: none"> 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	<p>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.</p> <p>Overall, more applicable and applied measures is better and the measures with a higher effectiveness rating have greater weighting in the analysis.</p>
Risk - Acceptable	<p>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)</p> <p>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)</p> <p>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)</p> <p><i>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.</i></p>
Risk - Tolerable	<p>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, if deemed necessary. (Source: DPLH, 2019)</p> <p>Certain levels of risk may be tolerated, provided that the risks are known and managed. (Source: AIDR LUPDRC, 2020)</p>

	<p>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)</p> <p>A level of risk that defines the ALARP region, as risks that should be driven to the broadly acceptable region. (Source: PIA, 2015)</p>
Risk - Intolerable	<p>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)</p> <p>Risk that is unacceptable in any circumstances or at any level. (Source: DPLH, 2019)</p>
Risk Treatment	<p>Risk treatment options available as part of the risk management process are generally categorised as follows:</p> <ul style="list-style-type: none"> • 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. <p>(Source: AIDR LUPDRC, 2020)</p>
Retrofitting	<p>Reinforcement or upgrading of existing structures to become more resistant and resilient to the damaging effects of hazards.</p> <p>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)</p>
Structural and Non-Structural Measures	<p>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.</p> <p>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.</p> <p>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)</p>
Threats	<p>The mechanisms by which hazards can impact exposed elements.</p>
Vulnerability	<p>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)</p> <p>The characteristic or property of a community, system or object that makes it susceptible to the damaging effects of a specific hazard.</p> <p>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.</p>

	<p>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.</p> <p>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. <i>(Source: State Government of Queensland, CSIRO, 2020; Bushfire Resilient Building Guidance for Queensland Homes)</i></p>
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Appendix 10

Approved Local Development Plan -
Lot 31 Great Southern Highway



PROVISIONS

1. All dwellings shall be connected to a potable water supply.
2. If the provision of a reticulated water supply is deemed unfeasible dwellings should be provided with rainwater water tanks that have a minimum capacity of 90,000L and that are provided separate to any fire firefighting or industrial requirements.
3. All development application and building permit applications must address the disposal of waste water in accordance with local and state health policies.
4. All development applications and building permit applications must address and comply with the requirements of the provision of this Local Development Plan.
5. A compliant Bushfire Management Plan addressing the whole site will be prepared and submitted for consideration with the first stage subdivision application.
6. Wind breaks and Nature Strips shall comprise of rows of trees and shrubs no great than 20m in width and will typically comprise 2 rows of trees and 2 rows of shrubs.
7. All lots shall be managed in accordance with an approved Bushfire Management Plan.
8. Lots adjacent to Wanerie Road and Great Southern Highway are not permitted to obtain vehicular access directly on to these roads.
9. No development shall occur in the Development Exclusion Zone.
10. Residential and enterprise development must occur within the respective Building and Rural Enterprise Envelopes, unless otherwise approved by the Local Authority.
11. Waste Disposal in the Rural Enterprise zone shall occur within the relevant Rural Enterprise envelope and behind the Building Envelope as viewed from the street.
12. Waste Disposal in the Industrial zone shall occur behind the building line and adjacent to the building.
13. The subdivider shall ensure that stormwater is treated in accordance with the requirements of the 'Stormwater Management Manual of WA (DoW 2004-7)' and 'Decision Process for Stormwater Management in Western Australia' (Note: DWER have indicated that an LWMS is not required in support of subdivision at this site).

LEGEND

- Local Development Boundary
- Proposed Roads
- Special Rural Precinct
- Rural Enterprise Precinct
- Industrial Precinct
- Wind Break / Nature Strip
- Building Envelope (1200m²)
- Rural Enterprise Envelope (1200m²)
- Development Exclusion Zone

Shire of Narrogin

This plan forms part of Development Approval

Chief Executive Officer

22.12.2017
Date

LOCAL DEVELOPMENT PLAN

Lot 31 Great Southern Highway,
NARROGIN
Shire of Narrogin

Plan No. | 20377-08E
Date | 30/11/17
Drawn | BDR
Checked | CP
Revision | E

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Scale | 1:5000@A3

0 50m 100m 150m

Minutes Ordinary Council Meeting 20 December 2017

Harley Dykstra

PLANNING & SPATIAL SOLUTIONS

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