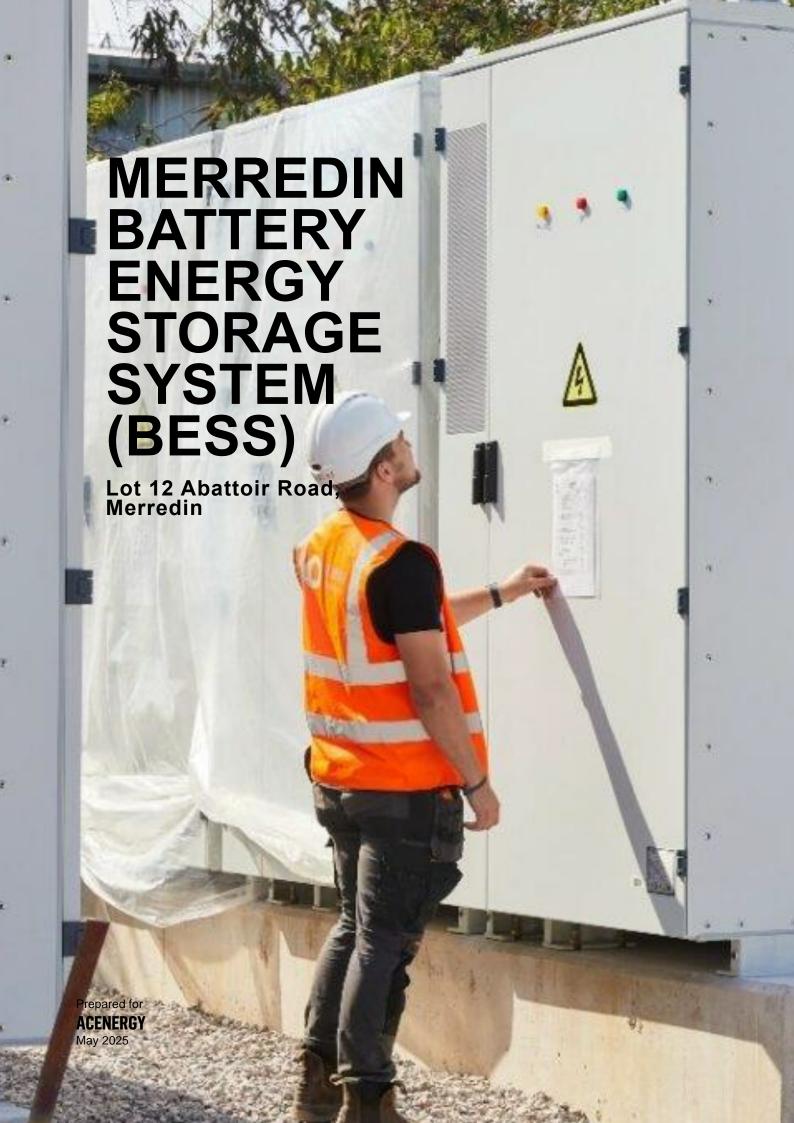


APPLICATION FOR PLANNING APPROVAL

LOCAL PLANNING SCHEME No. 6 - SCHEDULE 6 - (CLAUSE. 9.1.1)

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URBIS STAFF RESPONSIBLE FOR THIS REPORT WERE:

Director Peter Fitzgerald
Senior Planner Cameron Liebgott
Assistant Planner Elizabeth Collins
Project Code P0059184

Final

Report Number

Urbis acknowledges the important contribution that Aboriginal and Torres Strait Islander people make in creating a strong and vibrant Australian society.

We acknowledge, in each of our offices, the Traditional Owners on whose land we stand.

All information supplied to Urbis in order to conduct this research has been treated in the strictest confidence. It shall only be used in this context and shall not be made available to third parties without client authorisation. Confidential information has been stored securely and data provided by respondents, as well as their identity, has been treated in the strictest confidence and all assurance given to respondents have been and shall be fulfilled.

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1. INTRODUCTION

Urbis is pleased to represent ACEnergy Pty Ltd, the proponent for the proposed distribution-level Battery Energy Storage System (**DBESS**) and associated infrastructure. The proposed facility will be located at Lot 12, Abattoir Rd, Merredin, Western Australia, which is approximately 3 kilometres southeast of Merredin Town Centre.

The proposal represents an innovative renewable energy facility, that aligns wholly with the State's vision for a cleaner more sustainably powered future. Our client has an extensive history with the delivery and provision of modern and efficient renewable energy projects, creating the opportunity for the Shire of Merredin to supply a modern renewable energy storage facility.

This comprehensive report reveals the context of the proposal, underscoring its alignment with appropriate state and local planning frameworks. The report includes the following information in support of the approval to commence development of the proposal:

- Site details and in-depth local and regional context
- Description of the proposed development and contextual background information
- Detailed planning assessment against State and local planning frameworks
- Consideration of broader and relevant State strategic planning frameworks
- Justification and detailed input from technical reports

Table 1 – Summary of Development Site

Property Location:	Lot 12 Abattoir Road, Merredin WA			
Existing Land Use/s:	Rural Residential – Vacant site.			
Total Lot Area:	32.33ha (approx.)			
LPS Zoning:	Rural Residential (Proposed Light Industrial)			
Local Planning Scheme:	Shire of Merredin Local Planning Scheme 6			

The application is supported by:

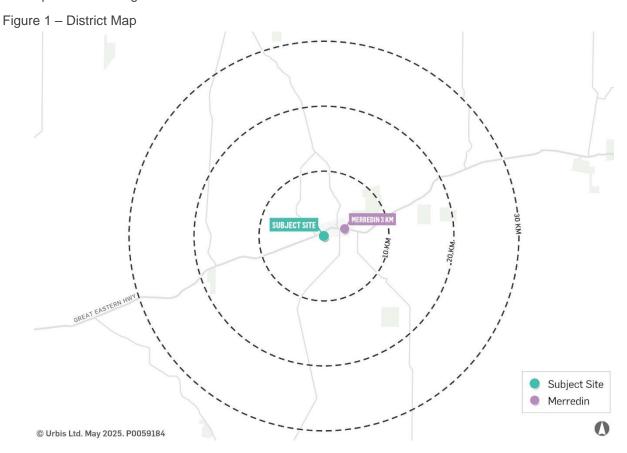
- Appendix A Certificate of Title
- Appendix B Development Plans
- Appendix C Traffic Impact Statement
- Appendix D Environmental Noise Assessment
- Appendix E Bushfire Risk Assessment
- Appendix F Landscape Plan
- Appendix G Stormwater Report
- Appendix H BESS Fire Safety

INTRODUCTION

2. SITE DETAILS

2.1. REGIONAL & DISTRICT CONTEXT

The proposal is located within the locality of Merredin in the Shire of Merredin, a major service and agricultural town in the Wheatbelt Region. The town's strategic location along the Great Eastern Highway and railway line provides connections to Perth and Kalgoorlie, which positions it as a vital transport and logistics hub within the Region. Implementing and encouraging the development of innovative and sustainable energy resources such as the proposed BESS facility will aid in facilitating sustainable development in the region.



2.2. LOCAL CONTEXT

The subject site is situated approximately 3 kilometres southeast of Merredin's Town Centre in the Shire of Merredin and is comprised of cleared undeveloped land (see **Figure 2**).

The situated along Abattoir Road, which directly connects to the greater regional road network, including Great Eastern Highway to the northeast. The site is surrounded by rural lands predominantly cleared of development.

ACEnergy has secured \sim 0.65ha of land nearby key Western Power transmission infrastructure, for the purpose of developing BESS infrastructure.

Figure 2 - Aerial Imagery



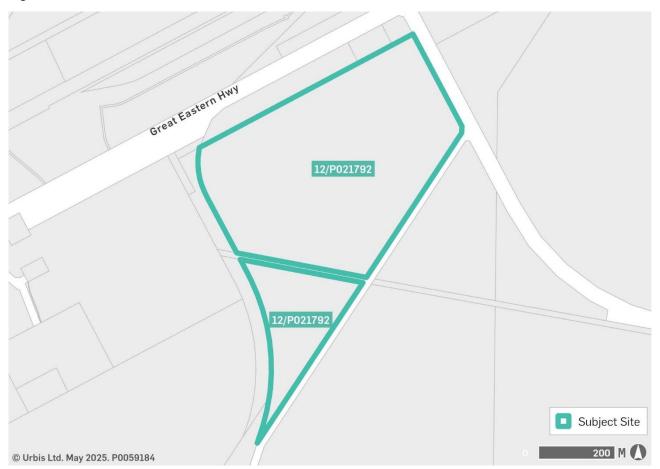
2.3. LOT DETAILS

The following table details the key lot particulars relevant to the subject site.

Table 2 - Lot Details

Lot	Plan	Area (ha)	Vol/Folio	Proprietor
12	P021 7 92	32.33ha (approx.)	2098/388	Sunshine United Developments Pty Ltd of 34 Lionel Street, Naval Base

Figure 3 - Cadastre Plan



3. PROPOSED DEVELOPMENT

3.1. BACKGROUND

The proposed DBESS will be wholly situation on Lot 12, Abattoir Road, Merredin. Urbis understands that the subject site was selected by ACEnergy due to its proximity to Western Power Transmission network infrastructure capable of supporting a 10 megawatts/40 mega-watt hours (10MW/40MWh) battery.

The proposed DBESS and supporting infrastructure will be situated within the north-eastern portion of the lot and will have a footprint of approximately 0.65 hectares on the 32-ha lot. The proposal will aim to support the efficiency of the electrical network of Merredin and its surrounds by charging from the grid during periods of low demand and discharging back to the grid during periods of higher demand.

Although DBESS infrastructure is relatively small in scale, it will greatly enhance the Town's renewable energy resources, aligning with the State's growing sustainable energy vision.

3.2. SUMMARY OF DEVELOPMENT

Figure 4 is an extract from the attached Development Plans at **Appendix B** and depicts the proposed BESS site overview, including the layout of the facility and associated infrastructure. As detailed in the layout map, the BESS facility is in the north-eastern portion of the lot covering approximately 0.65ha of land.

The proposal will comprise of the following supporting infrastructure:

- The installation of a new driveway from Abattoir Road leading to a gated entry to the BESS.
- Security fencing and landscaping around the BESS.
- Sufficient landscaping to screen the development from surrounding development.
- Electrical components of the BESS, including approximately eight (8) battery containers; two medium voltage power stations (MVPS) and high voltage switchgear; and
- Ancillary electrical transmission lines to connect the BESS to the existing powerlines to the north.

O/H E O/H E ≈8m ≈115m ≈6m ≈8m ITE ACCESS GATE OAD/HIGHWAY/RAILWAY IEW ACCESS TRACK 48477 OIR ROAD XISTING LINE EASEMENT NEIGHBOUR BOUNDARY EACH SIDE EASEMENT

Figure 4 - Site Plan (refer to Appendix B – Development Plans)

3.3. OPERATION

The proposed BESS will be a utility-scale lithium iron phosphate (**LFP**) solution designed for grid-scale applications. This containerised system, resembling a standard 20-foot shipping container, ensures efficient transport and installation. The BESS will be manufactured offsite to then be delivered to the subject site as a pre-assembled unit, facilitating streamlined installation and commissioning.

The system features modular battery units with liquid cooling technology to optimise thermal management and enhance performance. The proposal will be equipped with a comprehensive fire detection and suppression system, including thermal sensors, gas detection, and automated suppression mechanisms to mitigate any fire risks.

4. STATE PLANNING ASSESSMENT

4.1. LEGISLATIVE CONSIDERATIONS

4.1.1. Planning and Development Act 2005

The use and development of land across Western Australia is regulated by the *Planning and Development Act 2005* (PD Act). In relation to the Proposal, the PD Act facilitates the implementation of State Planning Policies and the Shire's local planning framework.

4.1.2. Environmental Protection (Noise) Regulations 1997

The *Environmental Protection (Noise)* Regulations 1997 serve to regulate and control noise emissions to protect the well-being and comfort of individuals and communities in Australia. They establish permissible noise levels, outline procedures for noise assessment, and provide guidelines for noise management and mitigation.

An Acoustic Impact Assessment has been prepared to demonstrate the extent of predicted compliance with the Noise Regulations as set out in the act and is contained within **Appendix D**. The Acoustic Assessment demonstrates compliance with the *Environmental Protection (Noise) Regulations* (EPNR) assigned noise levels at all industrial receivers, for all periods of the day with maximum duty cycle operation mode. When the BESS and MVPS units need to operate at night, they will be programmed to limit their duty cycle to 40-50% between 10pm and 7am (or 9am on Sundays and public holidays), as long as this limitation does not impact their performance.

4.2. STATE STRATEGIC FRAMEWORK

4.2.1. State Planning Strategy 2050

The State Planning Strategy 2050 outlines context and basis for the integration and coordination of land-use planning and development across state, regional and local jurisdictions. The strategy explains the context, principle and goals for land use planning in Western Australia.

The strategy undertakes particular focus on the renewable energy sector, highlighting the increase in global demand and continued diversification of Western Australia's economic base, as core drivers for the increasing demand for renewable energy generation and technology.

The proposal directly aligns with *State Planning Strategy 2050* by providing additional renewable energy storage capacity capable of supporting the State's increasing renewable energy generation on the grid.

4.2.2. Western Australia Future Battery Industry Strategy Western Australia

The Western Australian Future Battery Industry Strategy outlines the state's plan to develop a sustainable and globally competitive battery industry. The plan is designed to leverage Western Australia's plentiful supply of essential minerals to create a thriving sector focused on the production and manufacturing of battery materials.

There are several focus areas identified across the Strategy that this proposal directly aligns with, including:

- The proposal provides significant opportunity for regional/domestic integration of renewable, battery energy storage systems.
- The proposal's location within a planned industrial area provides opportunity for future battery maintenance, management and other associated industrial uses to be located within close proximity.

4.2.3. Energy Transformation Strategy

Western Australia's Energy Transformation Strategy outlines the State's plan to shift focus towards the transition to cleaner and more renewable energy technologies. The energy sector in Western Australia is experiencing a significant transformation, with renewable technologies becoming more cost-effective and consumers increasingly generating their own electricity through rooftop solar PV systems. Battery systems are also improving, offering efficient energy storage solutions.

The strategy sets out a detailed action plan across four key themes, including modernising energy systems, decarbonising energy supply, optimising energy use and empowering consumers. This proposal wholly aligns with the vision of this Strategy, specifically:

- Provision of a decarbonised energy storage solution, reducing energy sector carbon emissions
- Ensuring the provision of a dependable energy supply
- Increasing the State's transition towards cleaner, more renewable energy storage

The proposal will also contribute to the objectives of this Strategy through:

- Utilising proven grid-following technology to ensure reliable performance and inertial response to the transition from coal fired power generation and firming the supply of intermittent renewable energy sources
- The development of the proposed BESS at this specific location will maximise system utilisation and minimise the need for the augmentation of the existing network, supporting the affordable supply of energy to households and businesses
- Provide much needed capacity and support for a growing renewable energy sector within the region
- Provide additional job opportunities and training for skilled workers in the region, which will ultimately be required to further support the States energy transition into the future

4.2.4. Position Statement – Renewable Energy Facilities

This document presents the Western Australian Planning Commission's (WAPC) guidelines for the consistent development and provision of renewable energy facilities in Western Australia, replacing the 2004 Guidelines for Wind Farm Development. It outlines assessment measures to ensure renewable energy facilities are developed in areas that balance environmental and urban impact with energy production and operational efficiency.

The document delivers an outline of a framework for assessing and determining renewable energy projects. This includes guidelines for construction, site selection, design and operation. This proposal considers these Guidelines and remains clearly consistent with the document's intentions, including the development of infrastructure and contextual impact of site selection. This has been done by facilitating early stakeholder engagement with stakeholders, specifically the Shire, proposing sufficient landscaping to screen the BESS from adjoining landowners/development and effective land selection in order to reduce environmental impacts and visual impact.

4.3. STATE PLANNING POLICIES

4.3.1. State Planning Policy 2.0 – Environmental and Natural Resources Policy

State Planning Policy 2.0 (SPP2.0) outlines the following as core objectives:

- Integrate environment and natural resource management with broader land use planning and decisionmaking.
- Protect, conserve and enhance the natural environment.
- Promote and assist in the wise and sustainable use and management of natural resources.

The proposal considers and adheres to the intentions of these policies throughout the entirety of the development process. The assessment concludes that the proposal is wholly consistent with the objectives of SPP2.0, with particular focus on the conservation of the natural environment and the natural resources. The proposal is a renewable energy project which has been contextually selected due to the land being cleared. This has been determined appropriate to be compliant with the policy and is deemed a low impact development site.

4.3.2. State Planning Policy 2.5 – Rural Planning

SPP2.5 outlines policy objectives aimed at safeguarding rural land resources, recognising their significant contributions to the economy, natural resource management, food production, environmental conservation, and landscape aesthetics.

The site is currently used for Rural purposes, which will result in a loss of rural land, however the site is earmarked under the Local Planning Strategy to be rezoned to light industry. As such this proposal will have no impact or loss on rural land, deeming it compliant with the Policy.

4.3.3. State Planning Policy 3.7 – Planning in Bushfire Prone Areas

SPP 3.7 directs how land use should address bushfire risk management in Western Australia. It applies to all land designated as bushfire prone by the Fire and Emergency Services (DFES) Commissioner. It applies to all higher order strategic planning documents, strategic planning proposals, subdivision and development applications located in designated bushfire prone areas.

None of the site is located within a bushfire prone area, therefore no Bushfire Management Plan (BMP) has been prepared. However, a Bushfire Attack Level (BAL) Assessment Report (refer **Appendix E**) has been prepared in support of the proposal, and to demonstrate the proposal's consistency with the provisions of SPP 3.7. The BAL concludes that the proposed BESS is sited appropriately to ensure that the radiant heat exposure of renewable energy assets during a bushfire is reduced so that it does not exceed 10 kW/m2 at a flame temperature of 1090 K, which is considered best practice in Western Australia.

LOCAL PLANNING ASSESSMENT 5.

SHIRE OF MERREDIN (DRAFT) LOCAL PLANNING STRATEGY 5.1.

The Shire has prepared a draft local planning strategy, which was advertised for public comment in December 2024.

The Shire's Draft Local Planning Strategy (DLPS) considers a variety of strategic planning considerations at a regional level to determine the planning direction and objectives for the Shire's development. Aiming to be consistent with the broader State Planning Frameworks, the DLPS highlights unresolved planning challenges and proposes necessary actions to resolve them. The strategy additionally offers a broad roadmap for land use planning in the Shire for the upcoming 10-15 years.

The strategy emphasises crucial planning considerations, such as the increased demand for industrial infrastructure within the Merredin Town Centre, and the sustainable use of land and water resources, in ensuring planning accommodates future needs and that decisions create opportunities to enhance local attributes.

The DLPS identifies a number of sites within the municipality that are well suited to support industrial infrastructure, which encompasses the subject site. As identified in Figure 2 'Lots 12 and 13 Abattoir Road' of the DLPS, it is proposed that the subject lot will be designated to 'Light Industrial/Commercial' uses as opposed to its current 'Rural Residential' due to its proximity to Western Power and Water Corporation Infrastructure

The proposal introduces significant opportunity for planning to accommodate future energy needs. The provision of sustainable energy storage directly addresses the State and regions' future need for a more renewable, decarbonised system of energy storage. The proposal brings opportunities for job creation during both the construction and operational phases within the Shire and the broader district. The emergence of new business, industrial, and employment possibilities could have a multiplying effect on the economic activity in Merredin and its neighbouring regions. It is overall submitted that the proposal greatly aligns with the broader strategic planning objectives of the DLPS.

5.2. SHIRE OF MERREDIN LOCAL PLANNING SCHEME NO.6

Pursuant to the Shire of Merredin Local Planning Scheme No.6 (LPS6) the subject site is zoned 'Rural Residential'. Although this is the current zoning of the site, it is understood that the Shire is intending to rezone the site to 'Light Industrial' in accordance with the draft DLPS and replicated within the Shire's new Local Planning Scheme, Given that the Local Planning Strategy has been advertised, it is now a seriously entertained document, and it is entirely appropriate that the objectives of 'Light Industry' is applied to the land. The proposed development is consistent with the objectives of the proposed zone and an assessment of the objectives are as follows:

Table 3 - Objectives Assessment

Objective	Response
To provide for service industries and light industries that will not have a detrimental effect on nearby residential or other sensitive uses;	The proposal covers a minimal area on a currently rural site (proposed to change to light industry) and there are no sensitive land uses within proximity, other than an unused resident at Lot 11 to the East. Additionally, the proposal has been supported by an Acoustic Assessment outlining its compliance with the Noise Regulations. A landscape plan has been prepared to effectively screen the BESS with vegetation
To provide for home business type uses where caretakers' dwellings may be permitted;	Not applicable to this application

Objective	Response
To provide for a range of employment opportunities;	The BESS will facilitate 2 maintenance personnel which attend site every fortnight over its lifetime
To preclude the storage of bulky and unsightly goods where they may be in public view; and	N/A, no storage of bulky goods are proposed
To ensure the appropriate use of setback areas and the provision of landscaping to the local government's satisfaction; and	The BESS development is effectively setback from all lot boundaries and adjoining development. In addition to this, the development has been supported with a Landscape Plan demonstrating effective use of landscaping to screen the development.
To allow light and service industries that are compatible with nearby uses; and	Noted, currently will be the first development within the re zoned light industry area.
To provide areas with easy access and parking; and	One crossover is proposed along Abattoir Road and will easily accommodate the proposed capacity for workers accessing the site.
To minimise land use conflicts and address environmental impacts.	The proposal complies with Federal and State objectives to deliver renewable energy without impacting the environment.

It is submitted that the proposal aligns with the objectives of the 'Light Industry' zone as it will provide a service industry, particularly with the provision of sustainable energy, without being a detriment to surrounding land uses.

Figure 5 - LPS2 Map



5.2.1. Land Use Permissibility

The proposal's primary land use function is the provision of electricity storage. This involves the development of associated infrastructure to control and distribute energy to the grid as required.

As there is no land use zone that describes the proposed works outlined in this proposal, it is submitted that the proposed BESS facility is considered as a 'Use not Listed' within Table One – Zoning Table. However as noted the proposal aligns with the objectives of the 'Light Industry' zone and on this basis, it should be considered under clause 3.4.2 of the scheme, which allows the local authority to approve unlisted uses subject to advertising. The BESS infrastructure does not align with any land use classifications within the scheme, with 'wind farm or wind energy facility' being the closes, being consistent with a renewable energy facility. The Renewable Energy Facility Position Statement outlines that this classification should be replaced within planning schemes, to "Renewable Energy Facility'. The current scheme is yet to be updated/amended to be consistent with the current renewable policies.

5.2.2. Zone Development Requirements

Schedule 4 of LPS2 outlines further general zone development requirements. While there are no development requirements for 'Light Industry' zones, clause 4.7.1 sets out the following:

Where requirements for a particular use are not set out in this Scheme, the development shall conform to the provisions for the predominant use of the zone in which it is situated, as determined by the local government. Where such provisions are inappropriate, development shall conform to such requirements as the local government shall determine. For the purposes of this Clause, the predominant uses in zones and local reserves shall be deemed to be as outlined in their respective objectives.

It is considered that the provisions of clause 4.7.1 shall be applicable to the proposed development. The proposal is supported by sufficient and relevant technical information from certified specialists, informing provisions of detailed design and development. The development is consistent with the Light Industrial objectives as mentioned above, deeming it appropriate to be located within the Light Industrial zone. Given the above the technical reporting assisted the placement of the BESS posing sufficient setbacks being approx. 32m from Abattoir Road and approx. 59m from the adjoining norther lot. Additionally, the landscaping has been informed by the height of the BESS, with a 5m height covering the infrastructure effectively.

TECHNICAL CONSIDERATIONS 6.

TRAFFIC IMPACT STATEMENT 6.1.

Traffic Impact Statement prepared by Level 5 Design (Appendix C)

A Transport Impact Statement (TIS) has been prepared by Level 5 Design to consider the traffic and transport impacts of the proposed development on the adjacent transport network with a detailed focus on vehicle access, car parking, service vehicles and traffic management. The findings of the report demonstrate the that subject site is suitable of accommodating the vehicle movements required during construction. Once constructed and operational, the development will generate little or no traffic.

The TIS concludes the following:

- The existing traffic volumes are estimated to be less than 50 vehicles a day and the roads are operating within their traffic capacity.
- The proposed development has been designed to be accessed during construction by standard B-Double trucks up to a maximum length of 27.5 metres, weight and dimensions falling within the allowable limits of the road network.
- A crossover is proposed on Abattoir Road to enable forward entry. This will be designed as a minimum with MRWA rural driveway requirements for light vehicles. The driveway will be installed prior to battery delivery and installation.
- During operation the site will generate an average of 1 light vehicle per week.
- During construction, traffic generation will be as follows:
 - (i) Max No. trucks per hour = 1
 - (ii) Max. No. light vehicles per hour = 6
- During operation the surrounding road network and access points are appropriately equipped to manage the level of traffic

It is concluded that the proposed design for the Site fully satisfies the requirements for safe vehicular access and parking, and it is forecast to have negligible traffic impact on the surrounding road network.

6.2. ENVIRONMENTAL NOISE ASSESSMENT

Environmental Noise Assessment prepared by Acoustics Consultant Australia (Appendix D)

Acoustics Consultant Australia have prepared an environmental noise assessment to report any potential impact and considerations with regard to noise emissions generated from the construction and operation of the Merredin BESS facility. The development's compliance is assessed using the requirements from the Environmental Protection (Noise) Regulations 1997.

The assessment identifies the following results:

- Compliance with the Environmental Protection (Noise) Regulations (EPNR) assigned noise levels at all industrial receivers, for all periods of the day with maximum duty cycle operation mode.
- Compliance with the EPNR assigned noise levels at all highly sensitive receivers:
 - Running at maximum duty cycle for all days between 7am and 10pm; and
 - Running at a reduced duty cycle for periods between 10pm and 7am the following day (or 9am for Sundays or public holidays),
- With noise barriers 2.8 m high built around the BESS and MVPS compound, the predictions indicate compliance with the EPNR assigned noise levels at adjacent lots, should future residential development take place on such lots.

It is noted that the operation of the BESS and MVPS units, running at maximum duty cycle, either after 10pm or before 7am, is highly unlikely as temperatures in the project area would drop by at least 10 degrees Celsius during night-time in the worst-case scenario (winter). This means that maximum duty cycle

ventilation of the units during night-time is unreasonable to assume. Thus, a 40%-50% duty cycle has been adopted in this assessment as a reasonable operational assumption.

The noise emitted by the BESS and MVPS units will generally be low. Measures to ensure compliance with noise criteria will be confirmed and included in the final project design. The assessment is based on preliminary equipment selections, and the actual noise mitigation measures will be finalised once the specific products are confirmed. These measures—such as noise barriers, noise reduction kits, or cooling load adjustments—will be implemented as needed, subject to the capabilities of the selected equipment, to ensure that operational noise levels remain consistent with the outcomes presented in the noise assessment. Noise predictions for Scenarios 1A and 2A, with noise barriers in place, show that noise levels at the boundaries of adjacent lots are within acceptable limits for both day and night, meeting EPNR requirements. Scenario 1, without barriers, indicates a compliance zone for night-time noise, particularly around highly sensitive buildings like residential dwellings.

6.3. **BUSHFIRE ATTACK LEVEL ASSESSMENT**

Bushfire Attack Level Report prepared by Western Environmental (Appendix E)

Western Environmental has prepared a Bushfire Attack Level (BAL) Assessment Report for the proposal. The proposed Battery Energy Storage System (BESS) is strategically sited to limit radiant heat exposure to renewable energy assets during a bushfire, ensuring it does not exceed 10 kW/m2 at a flame temperature of 1090 K. This placement also aims to prevent fires originating from the infrastructure from spreading to nearby vegetation. This approach is recognised as best practice in Western Australia. A comprehensive assessment against the relevant Guidelines and Country Fire Authority (CFA) Guidelines will be conducted if required by the Shire as a condition of development approval. The facility is capable of meeting these requirements and is recommended for approval, provided a Bushfire Management Plan (BMP) is prepared to ensure the design minimises risks to operators, firefighters, and the community.

The BESS is also supported by a BESS Fire Safety FAQ, provided by ACEnergy, found in Appendix H. The proposed battery system prioritises safety using stable lithium-iron phosphate (LFP) chemistry and rigorous fire safety testing. Key features include a containerised design, in-built fire suppression, and a comprehensive Battery Management System (BMS) that continuously monitors and addresses potential issues early. Measures to mitigate fire risks within the BESS container include adequate separation distances, an Asset Protection Zone, dedicated water supply, emergency access, and a Bushfire and Fire Management Plan. The system meets international safety standards and ensures minimal air quality impacts in the event of a fire.

LANDSCAPE CONCEPT PLAN 6.4.

Landscape Plan prepared by Ground Control (Appendix F)

Ground Control prepared a Landscape Concept Plan for the Merredin Distribution BESS which provides one row of screening via landscape to each of the north, south and east sides of the proposed BESS. Each row is proposed to be 2m wide and includes the 200 plants total, including:

- 28 small trees
- 86 large shrubs
- 58 medium shrubs
- 28 small shrubs

The row of planning is proposed to be a minimum of 10 meters from the BESS as per DFES requirements. Small trees will occasionally achieve a maximum height of 5-6m and shrubs to generally reach 3-3.5m, which will effectively screen the BESS.

STORMWATER DRAINAGE STRATEGY 6.5.

Stormwater Drainage Strategy prepared by Premise (Appendix G)

Premise prepared a Stormwater Drainage Strategy and associated calculations/drawings to support the proposed BESS. The drainage calculations demonstrate the robustness of the drainage system. Premise is confident that this strategy will effectively manage flood risk while maintaining pre-development flow paths.

It is advisable for the Contractor to ensure that, upon topsoil stripping, the finished surface level for the BESS Infrastructure Pad is 150mm above the existing surface level.

For detailed calculations and plans, please refer to the diagrams and strategy sections.

7. CONCLUSION

The proposed Merredin BESS is an important renewable energy project which will contribute to the State's renewable energy future. The site has been selected based on detailed investigations and the site's current land use. The proposal wholly aligns with local, State and objectives and vision.

The proposal has been considered at a detailed level and this report demonstrates that it complies with all relevant technical and planning legislation and frameworks

It is respectfully requested that this application be approved, subject to fair and reasonable conditions.

8. DISCLAIMER

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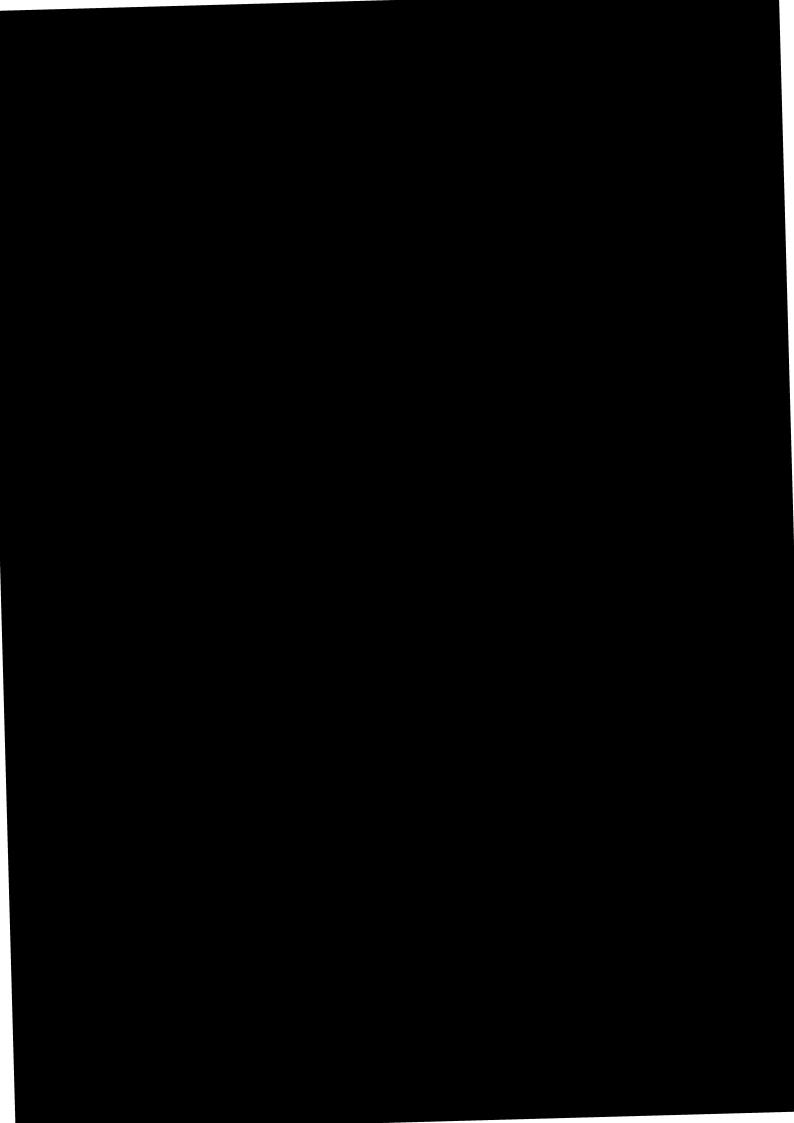
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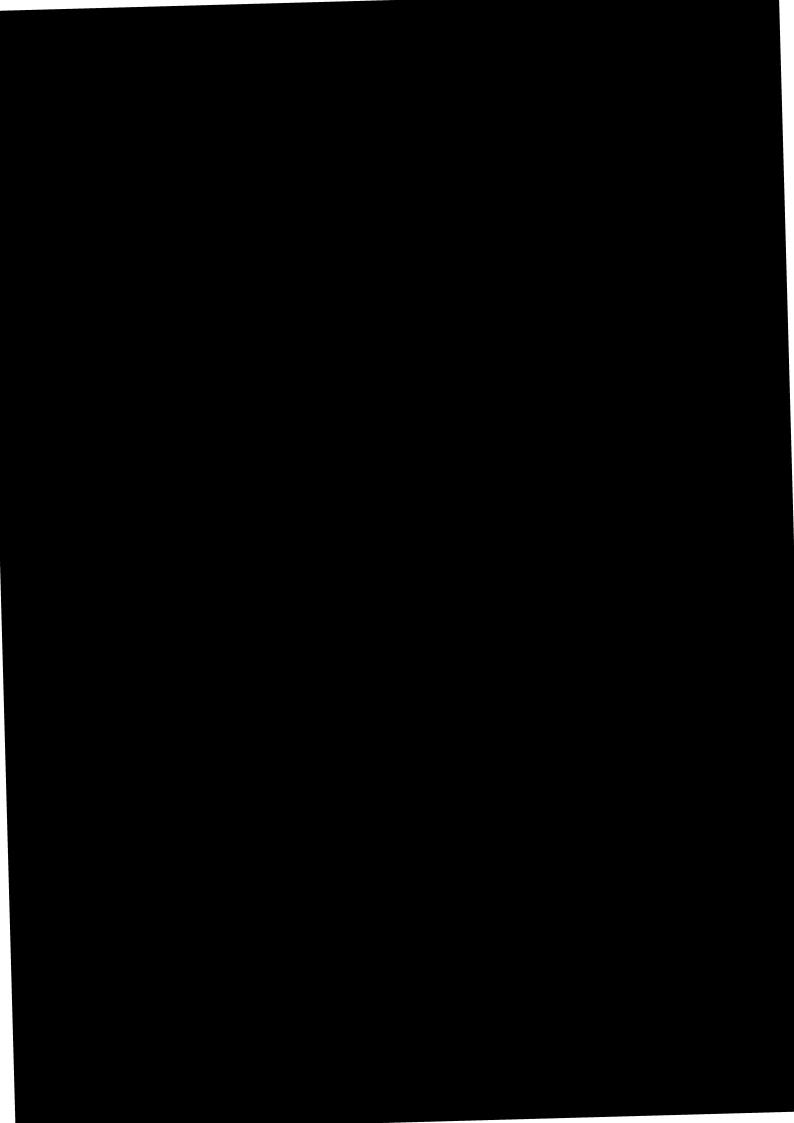
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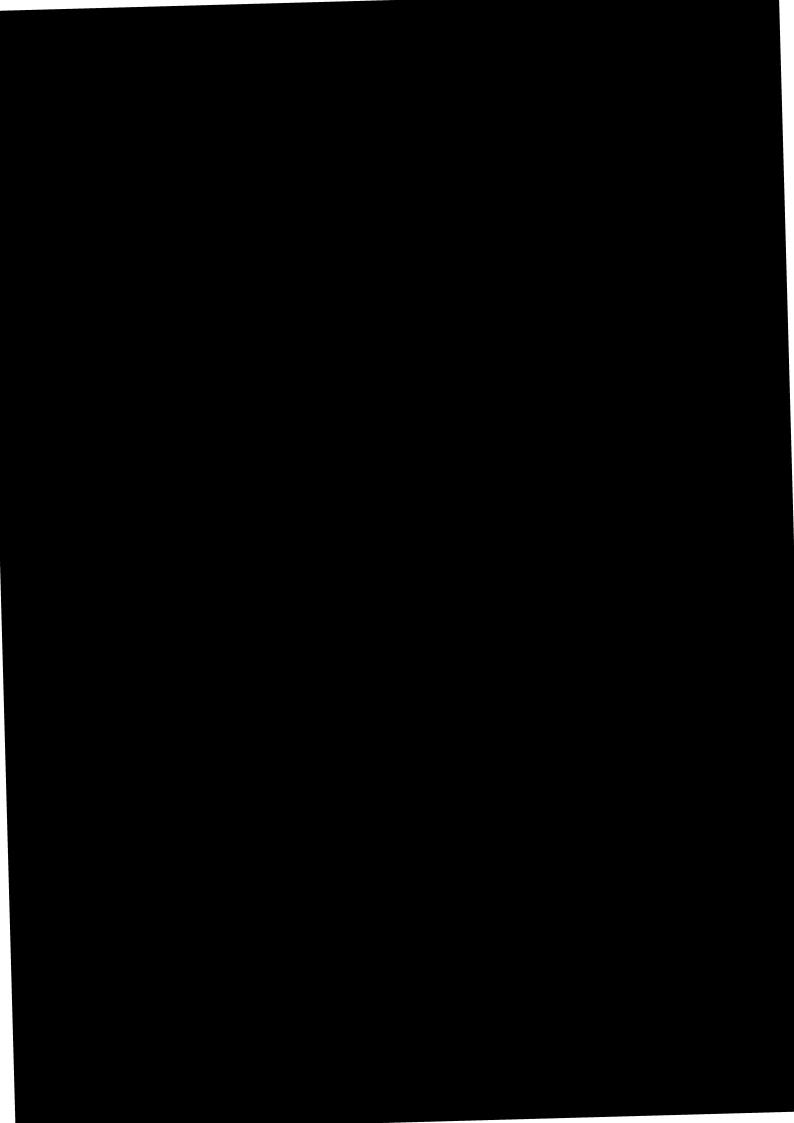
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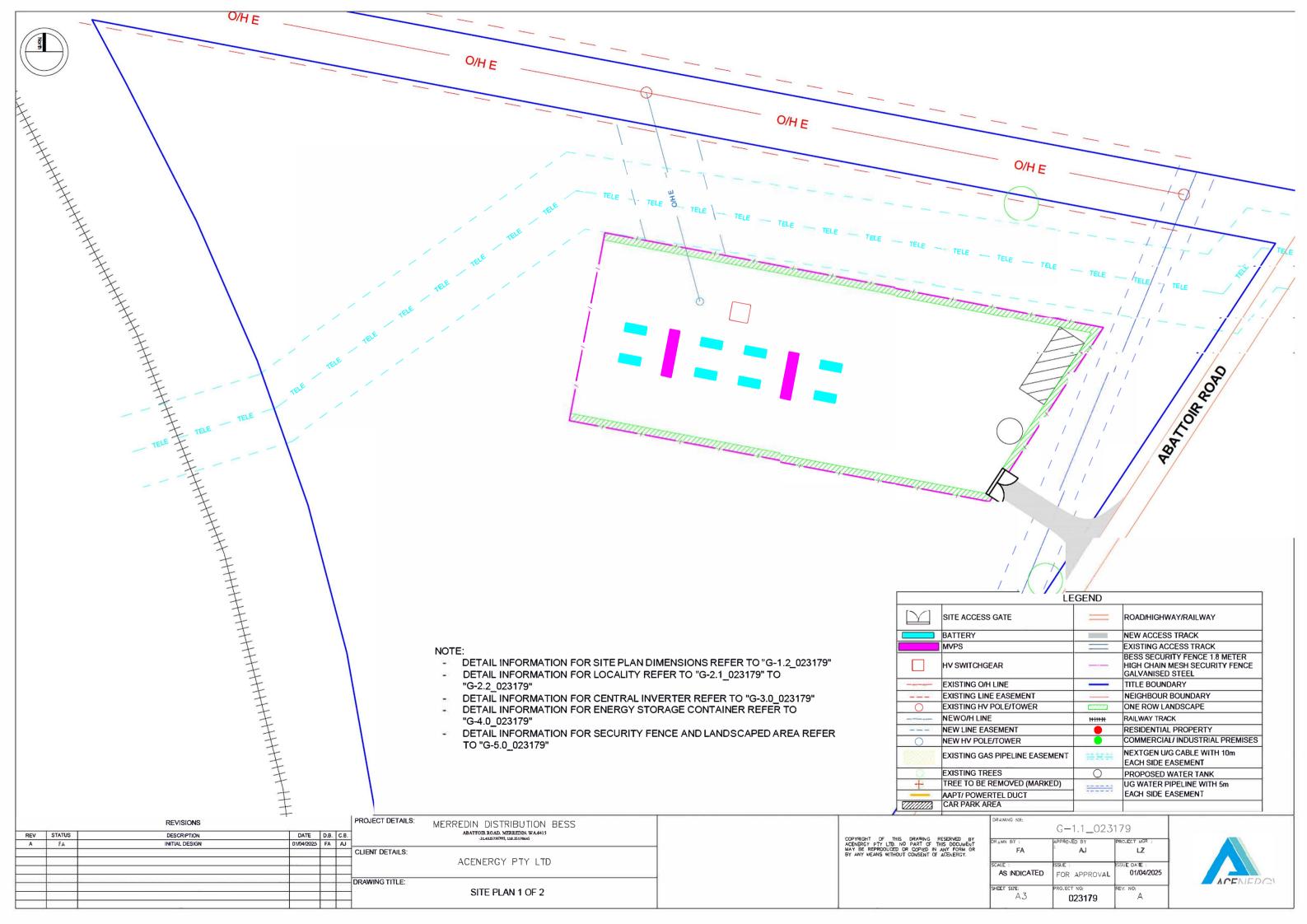
APPENDIX A CERTIFICATE OF TITLE

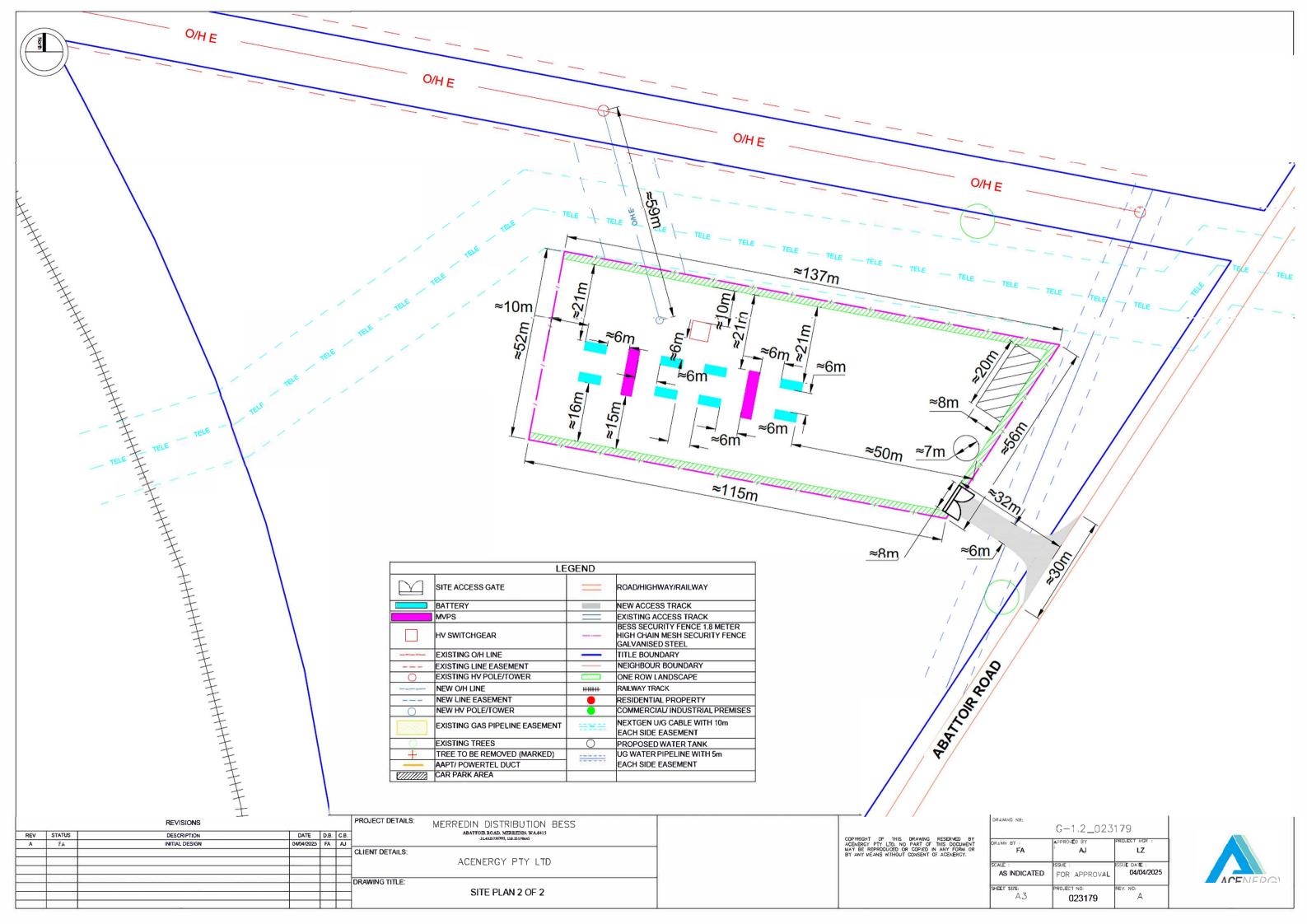


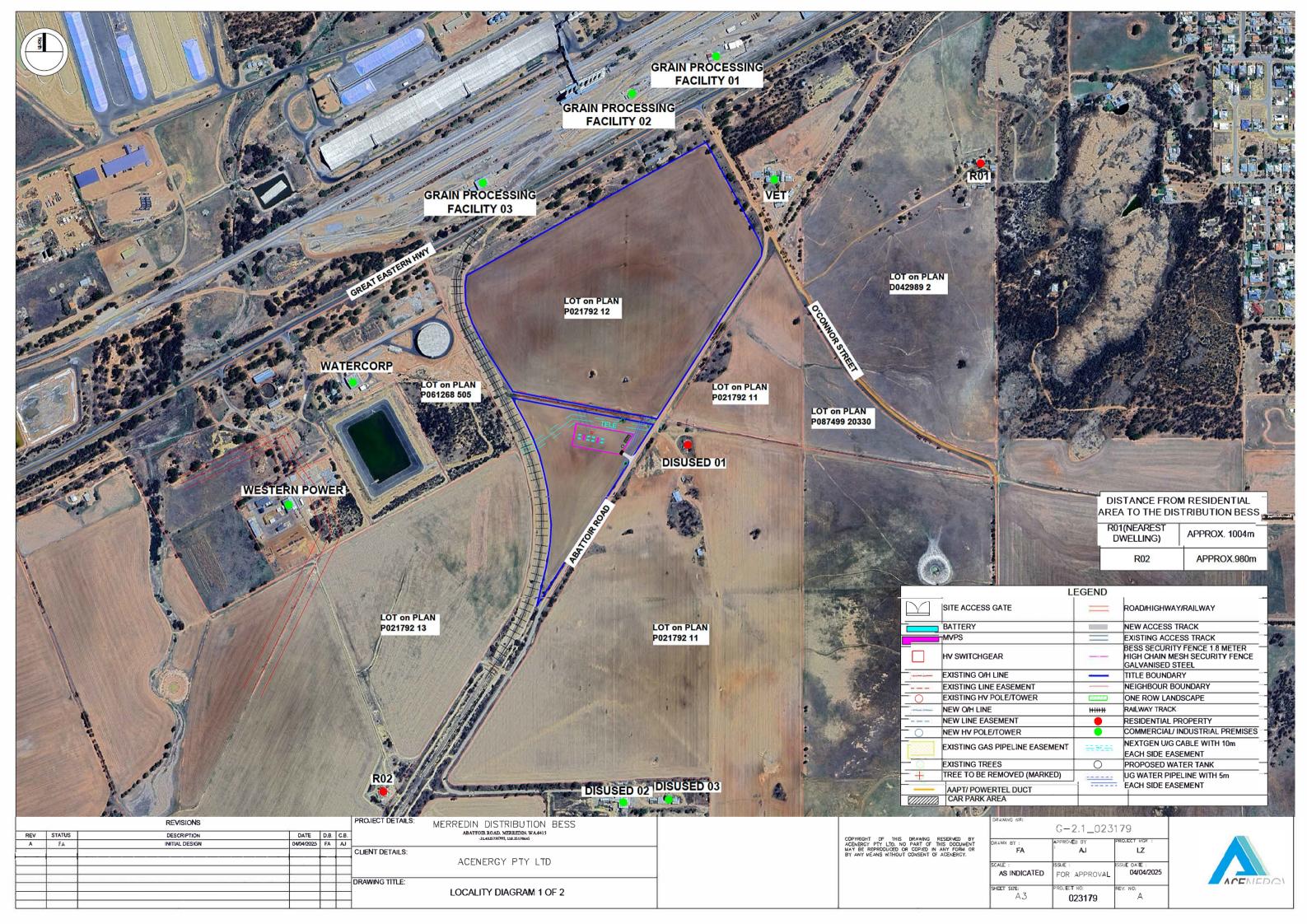


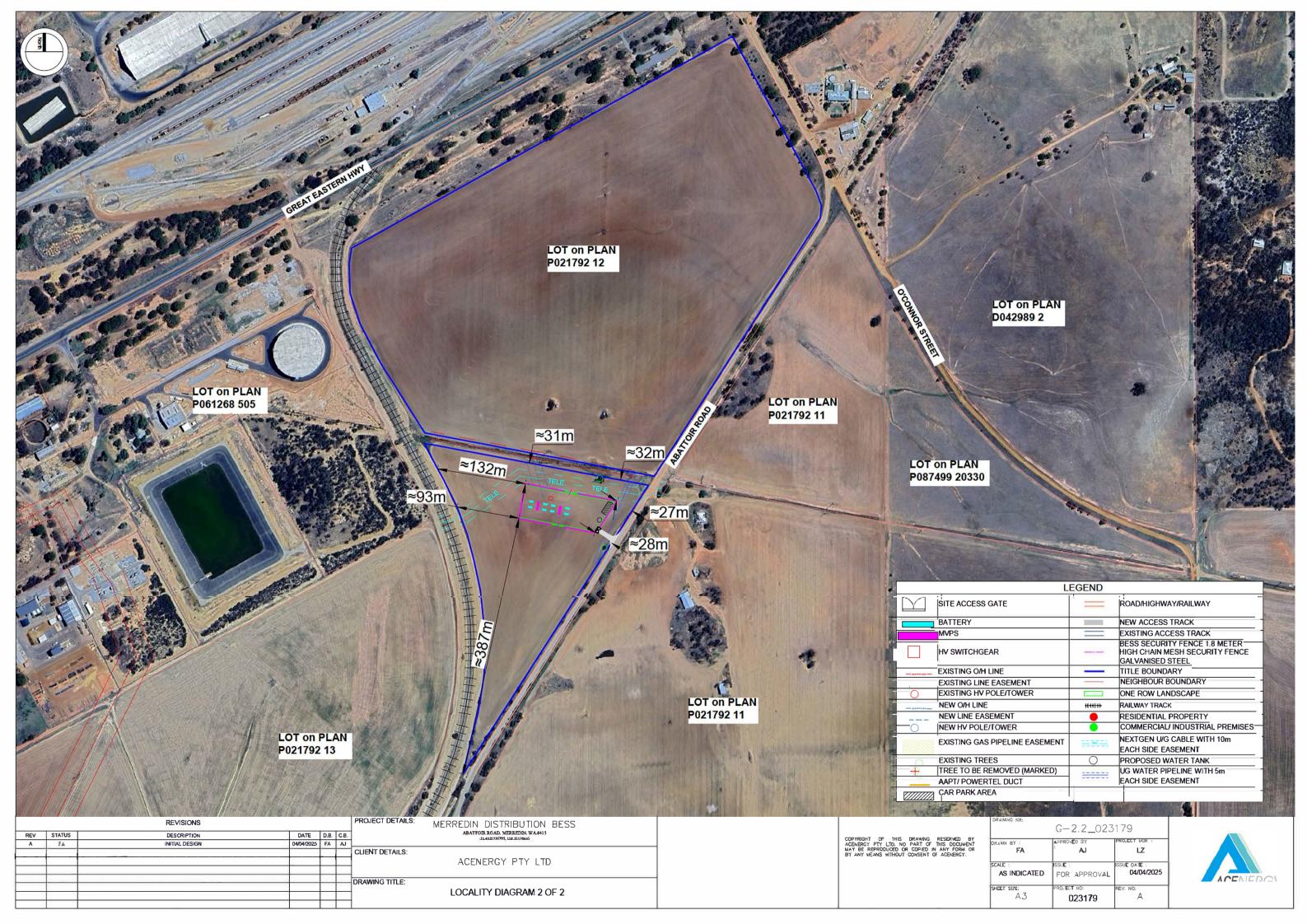


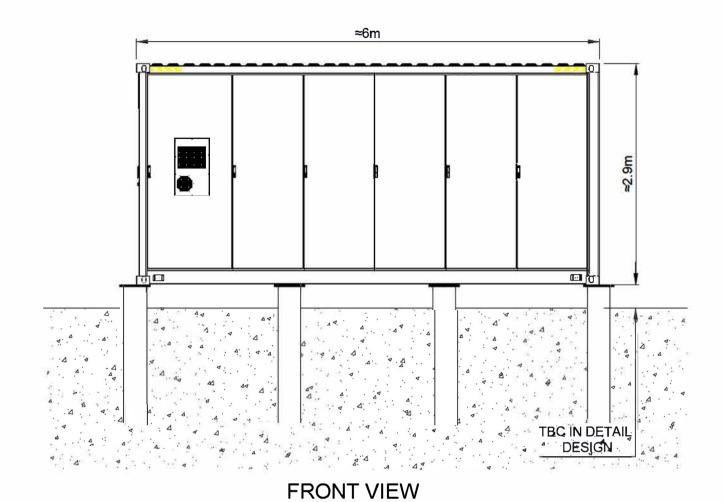
APPENDIX B DEVELOPMENT PLANS

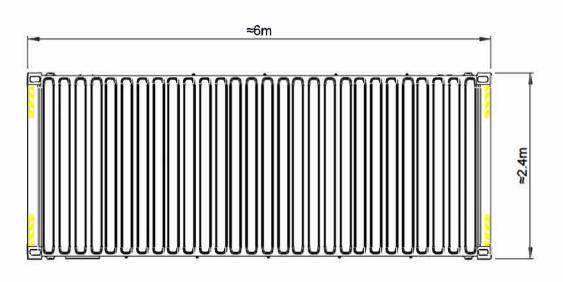


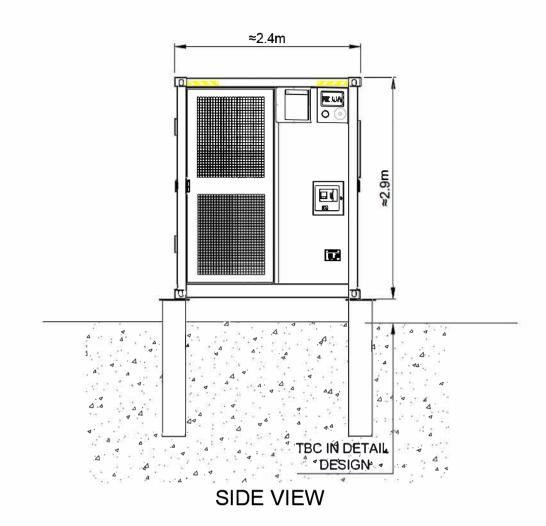














TYPICAL ENERGY STORAGE CONTAINER

REVISIONS				PROJECT DETAILS: MERREDIN DISTRIBUTION BESS		
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Α	FA	INITIAL ISSUE	01/04/2025	FA	AJ .	
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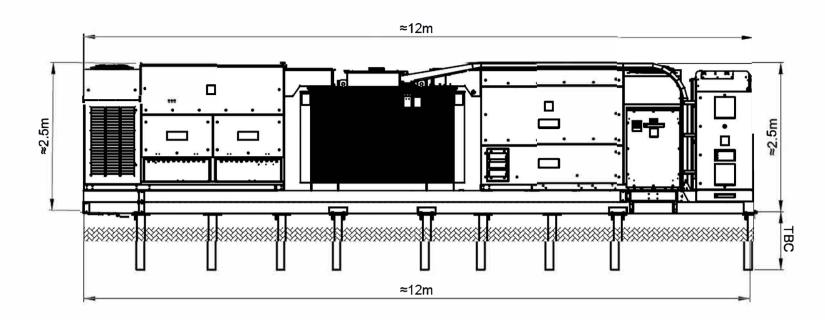
TOP VIEW

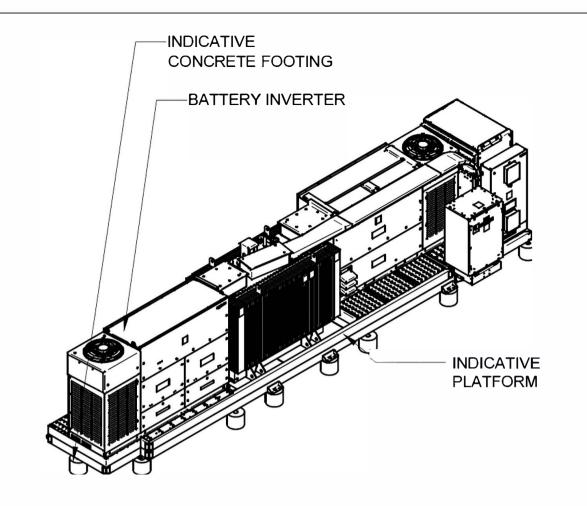
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AWING NR:	147	
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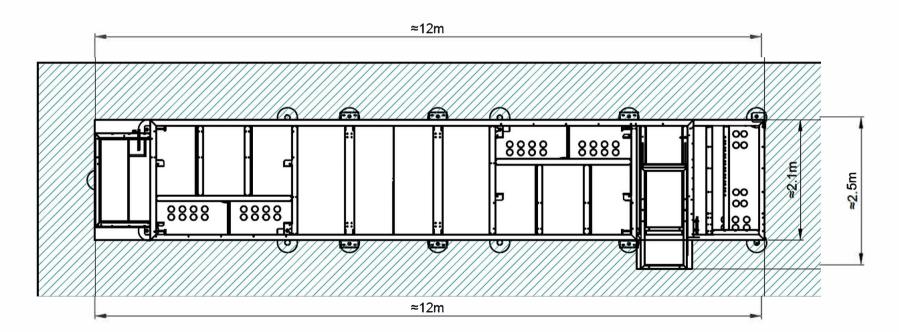


MVPS FRONT VIEW

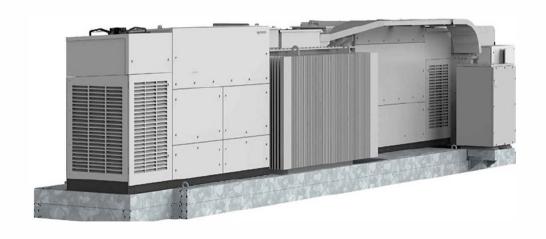




MVPS TOP VIEW



TYPICAL MVPS

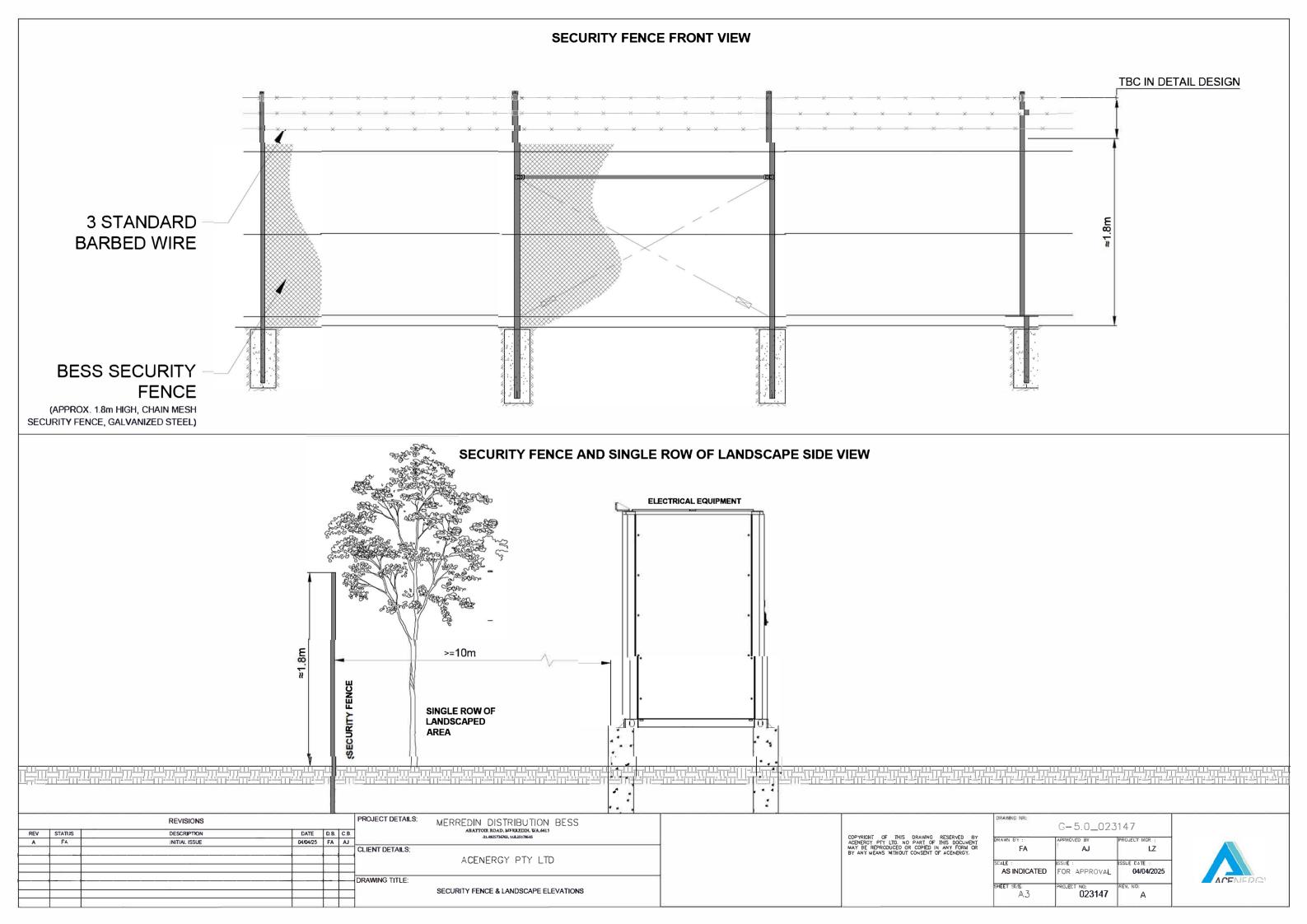


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RAWN BY:	APPROVED BY AJ	PROJECT MGR :
NO TSCALE	FOR APPROVAL	01/04/2025
HEET SIZE: A3	PROJECT NO: 023179	REV. NO:





APPENDIX C TRAFFIC IMPACT STATEMENT



1 May 2025

Jane Bai Senior Project Development Engineer ACENERGY Pty Ltd Level 3, 689 Burke Road Camberwell, VIC 3124 c/o

Re: Battery Energy Storage, Merredin – Transport Impact Statement

I am pleased to respond to your request to review the traffic impact and access arrangements for the proposed development at Abattoir Road in Merredin (the 'Site') - see Figure 1.

This assessment has been conducted in accordance with the Department of Planning, Lands and Heritage (DPLH) and Western Australian Planning Commission (WAPC) *Transport Impact Assessment Guidelines for Developments: Volume 4 -* Individual *Developments* (2016). The Guidelines promote a three-level assessment process, where the required level of assessment is dependent on the likely level of impact. The traffic generated by the Site has been determined to be less than 10 vehicle trips in the peak hour, which equates to a low impact. While no assessment is typically required where the impact is assessed as low, an abridged 'Transport Impact Statement' in accordance with Volume 4 Part B of the Guidelines has been prepared to confirm the proposals are safe and functional to support the Development Application (DA).

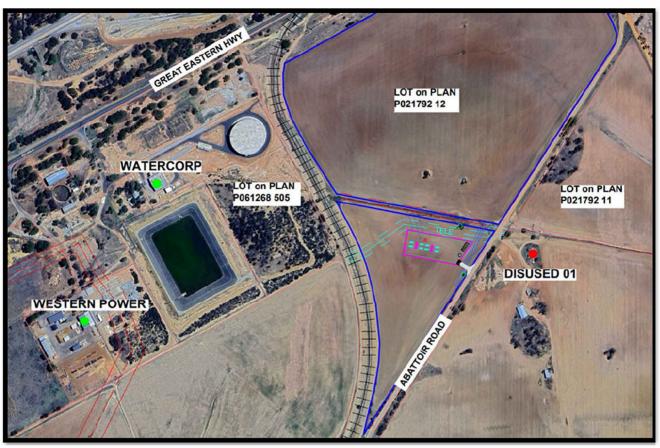
Site Overview

The property consists of an industrial battery energy storage facility at Lot 12 on Plan 21792 on Abattoir Road in Merredin, Western Australia.

These proposed buildings sit on a small parcel of land of approximately 6,500 m² on a 32.33 ha site.

An aerial image of the Site is shown in Figure 1. Additional site plans are given in Appendix A and B.

Figure 1 Existing subject site



Source: ACEnergy

Existing Road Network

The existing road network within the vicinity of the site is shown in Figure 2. This figure also illustrates the road hierarchy and history of road crashes in the surrounding area.

Table 1 summarises the characteristics of the adjacent road network.

Abattoir Road is a formed but unsealed road that runs 1.74 km south from O'Connor Street in Merredin. There is an unformed track at its end. It provides access to several other properties / farm paddocks in the vicinity of the Site.

O'Connor Street is an unsealed road that provides an existing connection between Great Eastern Highway and Abattoir Road and serves as access to several farm paddocks.

Table 1 - Road network characteristics

Road Name	Road Hierarchy	No. of Lanes (each way)	Posted Speed (km/h)
Abattoir Road	Access Road	1- lane unsealed	50
O'Connor Street	Access Road	1- lane unsealed	50

Source: MRWA Road Information Mapping System (April 2025)



Primary Distributor Regional Distributor Distributor A Distributor B Local Distributor Access Road Crashes (2020 - 2024) ▲ Fatal Hospital Medical PDO Major PD0 minor

Figure 2 Existing subject site

Source: Main Roads Road Information Mapping System

Existing Traffic Volumes

Existing traffic volume data in the area surrounding the Site is limited. Traffic volumes on O'Connor Street and Abattoir Road are estimated to be less than 50 vehicles per day and these roads are therefore operating well within their environmental traffic capacity.

The Development Proposal

The proposed development by ACEnergy involves the creation of a battery energy storage facility – a BESS plant. This plant requires 8 x 5 MWh 20' battery containers plus inverters / transformers, switchroom, HV kiosk and pole plus a water tank.

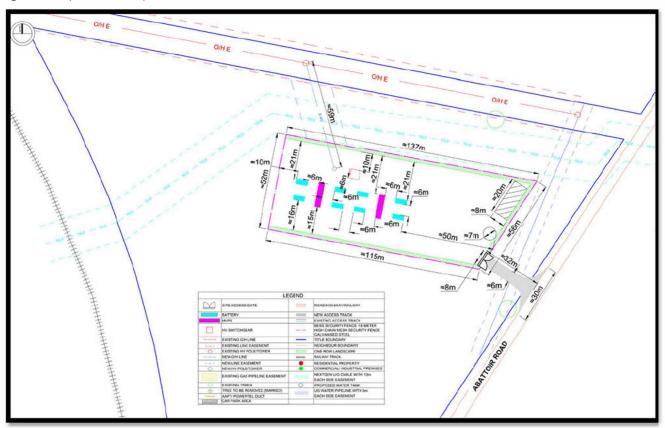
The busiest period for the development is forecast to be during construction. Afterwards, during the operation phase (involving a 27 + 27 yr lease), it will be run as an unmanned site, remotely monitored, that is visited only periodically, i.e. two light vehicles per fortnight for maintenance and service call outs subject to fluctuations driven by specific operational demands.

Proposed Site Access Arrangements

The site layout has been designed to optimise access and safety. Figure 3 shows the proposed access point to the development from Abattoir Road. This access includes a driveway primarily for access by cars, vans and small utilities for site maintenance purposes during normal operations.



Figure 3 Proposed site layout



Source: ACEnergy

Restricted Access Vehicle Movement

Figure 4 illustrates the existing approved Restricted Vehicle Access (RAV) network in the vicinity of the Site. The current approved RAV access network allows B-Doubles (RAV 4).

Table 4 - Maximum heavy vehicles allowed N2/N4

Maximum Truck Allowed	Dimensions
27.5 m B/A-Double (N2/4 Drive)	 Max width: 2.55 m Max length: 27.50 m Mass: 88.5 †

The proposed development has been designed to be accessed during construction by standard B-Double trucks up to a maximum length of 27.5 metres. The loaded container mass will be in the order of 45 t plus the truck tare weight. These weights and dimensions fall within the maximum allowed limits of the road network. Swept path analyses have been conducted, verifying that a N2/4 B-Double truck will be able to manoeuvre into and out of Abattoir Road to access the Site (see Appendix C).



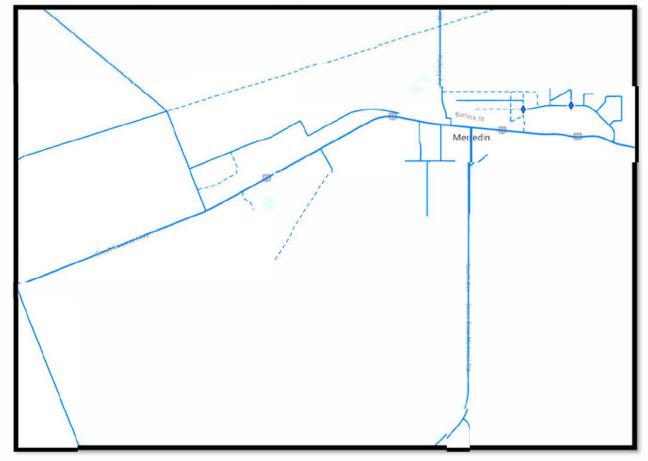


Figure 4 Main Roads Approved RAV Network (Suitable for 27.5m N2/4 B-Doubles and A-Doubles)

Source: Main Roads HVS Network Map (April 2025)

Crossover Design

A new crossover is proposed on the eastern side of the site on Abattoir Road (see Figure 3) to enable the forward entry, manoeuvring and exit for light vehicles. As a minimum this crossover shall be designed in accordance with the MRWA rural driveway requirements for light vehicles – one way (see Appendix D).

Trucks will only require access to the Site during construction. The driveway shall be installed prior to battery component delivery and installation.

Crash Risk Assessment

A review of the MRWA Reporting Centre was conducted to obtain traffic crash data for the immediate area of the Site, covering the period from 1 January 2020 to 31 December 2024. The search (see Figure 2) revealed no crashes on Abattoir Road or O'Connor Street during the specified timeframe.

Both Abattoir Road and O'Connor Street are formed unsealed roads with clear sight lines and low traffic volumes.

A sightline assessment of the Site and proposed access points was carried out, confirming that visibility from both directions meets the required minimum standards for safe ingress and egress, with no identified issues.



Operational Traffic

ACEnergy provided operational data derived from comparable facilities they currently manage. During operation the proposed development is projected to generate an average of one light vehicle trip per week subject to fluctuations driven by specific operational demands.

Construction Traffic

During construction it is forecast that traffic generated will be as follows:

- Max. No. trucks per hour: 1
- Max. No. light vehicles (cars/vans/utilities) per hour: 6

B-Double trucks will be required to move key BESS plant during construction due to tonnage carrying requirements. In addition, the development will accommodate movements by smaller light vehicles entering and exiting the facility.

The proposed construction work hours are 7 am to 7 pm Monday to Saturday. No construction work will occur on Sundays or Public Holidays.

Traffic Impact to Surrounding Network

During operation the proposed development is projected to generate an average of one light vehicle trip per week, which is considered negligible. It is therefore unlikely to have any material impact on the operation of the surrounding road network.

During construction there will be slightly higher volumes of traffic generated for an isolated period of time. Nonetheless, it is anticipated that less than 10 vehicle movements will occur in any one hour. In line with the WAPC Transport Impact Assessment Guidelines, Vol. 4 – Individual Developments, this volume qualifies as a 'low impact' on the surrounding network.

The intersection of Great Eastern Highway and O'Connor Street is expected to handle the additional projected traffic effectively. The WAPC guidelines specify that "any intersection would generally be considered to be materially affected if flows on any leg increase by more than 10% or any individual movement by 20%." Given the comparatively low volume of traffic generated by the development, the forecasted peak traffic increase is expected to fall below these thresholds, resulting in no material impact to the intersection.

In summary, the surrounding road network and access points are appropriately equipped to manage this level of traffic, supporting efficient and safe traffic flow within the area.

Parking Demand and Supply Requirements

There is sufficient space available so that all parking for operational needs can occur on Site.

Safe Vehicle Manoeuvres

Swept paths of vehicle movements were simulated and assessed, and illustrations are shown in Appendix C. In all cases vehicles can safely access and manoeuvre while operating in forward gear.

Pedestrian, Cycling and Public Transport Use

The Site is not well serviced by public transport, pedestrian or cycling facilities. The area is a regional farming area and therefore there are limited facilities available. The Site will have



a very low staff and contractor visitation rate, and all will access the site by car/utility post construction.

Conclusions

Based on the findings of our assessment, it is concluded that the proposed design for the Site fully satisfies the requirements for safe vehicular access and parking, and it is forecast to have negligible traffic impact on the surrounding road network.

Trucks are able to safely access the Site during construction, and during the operational phase only two light vehicles will visit the Site on average every fortnight to conduct general maintenance and call outs. Swept path simulations both within the Site and on the adjacent road network illustrate sufficient space for manoeuvrability including stopping and turning.

I trust our professional advice satisfies your requirements. If you have any questions, then please do not hesitate to contact me.

Yours sincerely

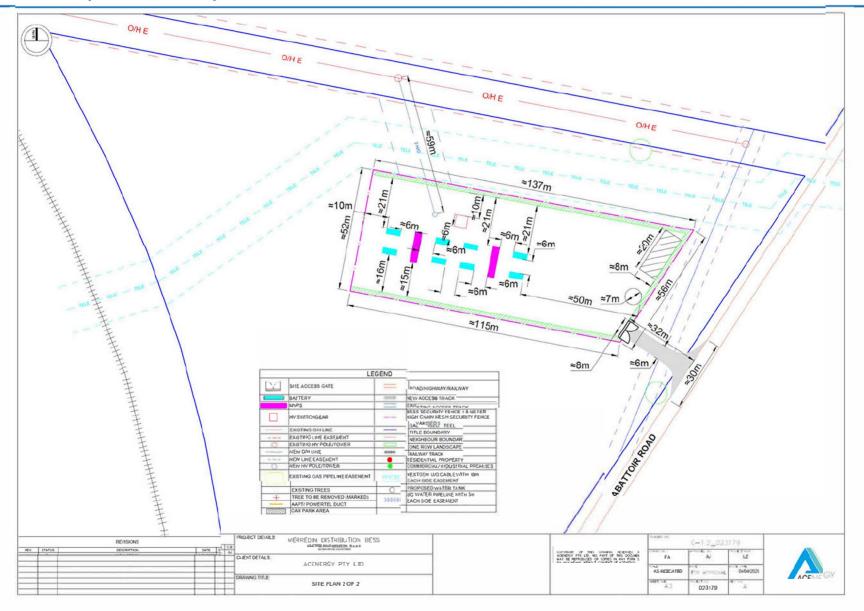


PETER DAMEN Managing Director Level 5 Design Pty Ltd

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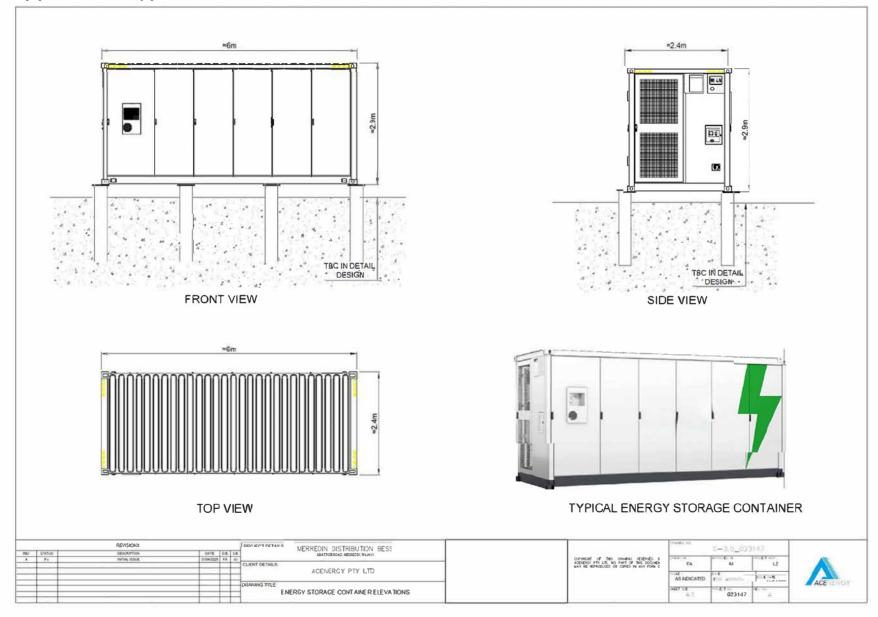


Appendix A: Proposed Site Layout





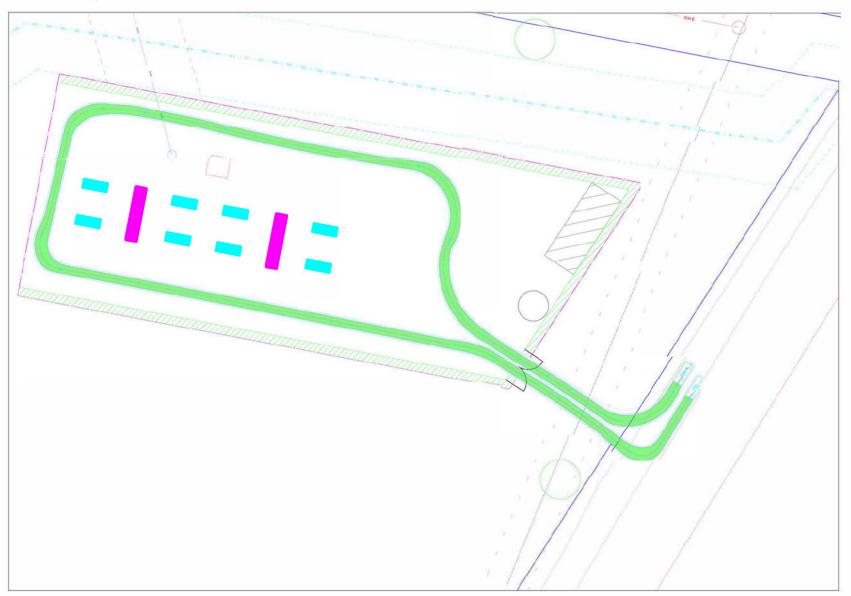
Appendix B: Typical Site Elevations





Appendix C: Swept Paths

Swept Paths B99 Car Site Entry and Exit to Abattoir Rd



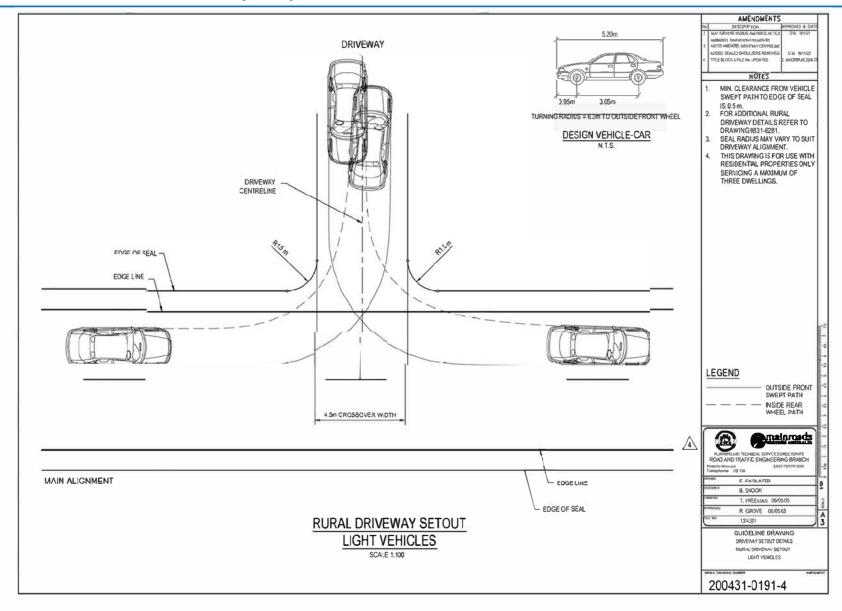


Swept Paths - 27.5 m B-Double Access Abattoir Rd





Appendix D: MRWA Rural Driveway Requirements





APPENDIX D ENVIRONMENTAL NOISE ASSESSMENT



BATTERY ENERGY STORAGE SYSTEM, MERREDIN ENVIRONMENTAL NOISE ASSESSMENT

Report 10.00875R-01 Prepared on 14/05/2025



AUSTRALIA

BATTERY ENERGY STORAGE SYSTEM, MERREDIN ENVIRONMENTAL NOISE ASSESSMENT



REPORT PREPARED BY

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PHONE (08) 6186 4122

EMAIL perth@acousticsconsultants.com.au

BASIS OF REPORT

This report has been prepared by Acoustics Consultants Australia (ACA) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with the Client. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

REFERENCE	DATE	STATUS / UPDATES	PREPARED	REVIEWED	AUTHORISED
10.00875R-01	15/04/2025	Draft	SS	MdlM	MdlM
10.00875R-01	13/05/2025	DA Application	SS	MdlM	
10.000/3R-01	13/03/2023	ра аррисаціон	33	IVIUIIVI	
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BATTERY ENERGY STORAGE SYSTEM, MERREDIN ENVIRONMENTAL NOISE ASSESSMENT



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AUSTRALIA

BATTERY ENERGY STORAGE SYSTEM, MERREDIN ENVIRONMENTAL NOISE ASSESSMENT

Report 10.00875R-01



EXECUTIVE SUMMARY

Acoustics Consultants Australia (ACA) has been appointed to provide acoustic consultancy services for a proposed battery energy storage system (BESS) site located at Lot 12 on Plan 21792 Abattoir Road, Merredin, WA 6415.

The proposal is located in a section of the lot that is approximately 6,500 m² in area. The BESS area comprises 8 containerised CATL EnerX 0.25P BESS units and two Ingecon battery inverter (MVPS) units for a 10 MW/40 MWh (4-hour storage configuration).

The Shire of Merredin has requested an acoustic report as part of the site's planning application in order to satisfy the requirements of the *WA Environmental Protection (Noise) Regulations 1997* (EPNR). ACA conducted a noise modelling assessment of the proposed site operations, in accordance with the EPNR, which identified the BESS and MVPS units' ventilation/cooling systems as the dominant noise source for the proposal. The manufacturers provided tested noise data with various mechanical cooling duty cycle modes (percentages), where 20% duty cycle would present the quietest noise emissions and 80% would generate the loudest mode.

The land around the project site is generally 'Rural Residential' with industrial use land within 250 m northwest of the site. Nine representative noise sensitive receivers were identified around the project site, including six rural residential dwellings (highly sensitive), a Western Power site and a Watercorp site (industrial). Noise criteria were calculated in accordance with the EPNR for each receiver type and the assigned noise levels were determined. It is noted that lots of vacant land are available around the site and this assessment comments on potential noise impacts on such lots should residential development is considered in the future.

A three-dimensional model was developed to predict noise levels at all nearby external receivers and consequently assess the predictions against the applicable noise criteria. Unit noise emission characteristics such as tonality and directivity, as well as meteorological and topographical conditions were considered.

The assessment results indicate:

- Compliance with the EPNR assigned noise levels at all industrial receivers, for all periods of the day with maximum duty cycle operation mode.
- Compliance with the EPNR assigned noise levels at all highly sensitive receivers:
 - o Running at maximum duty cycle for all days between 7am and 10pm; and
 - o Running at a reduced duty cycle for periods between 10pm and 7am the following day (or 9am for Sundays or public holidays),

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BATTERY ENERGY STORAGE SYSTEM, MERREDIN ENVIRONMENTAL NOISE ASSESSMENT



 With noise barriers 2.8 m high built around the BESS and MVPS compound, the predictions indicate compliance with the EPNR assigned noise levels at adjacent lots, should future residential development take place on such lots.

It is noted that the operation of the BESS and MVPS units, running at maximum duty cycle, either after 10pm or before 7am, is highly unlikely as temperatures in the project area would drop by at least 10 degrees Celsius during night-time in the worst-case scenario (winter). This means that maximum duty cycle ventilation of the units during night-time is unreasonable to assume. Thus, a 40%-50% duty cycle has been adopted in this assessment as a reasonable operational assumption.

As an overall note regarding compliance with EPNR, it is recommended that the following measures are applied:

- Where the BESS and MVPS units are required to operate during night-time, the units shall be programmed to limit the duty cycle to 40-50% between 10pm and 7am (or 9am on Sundays and public holidays), provided that the limiting does not affect performance of the unit;
- A 2.8m high noise barrier would prevent exceedances on potential future development within vacant adjacent rural lots. Details are further developed in the report;

Numerical noise assessment is presented in **Table 6** of the report and noise modelling contours are presented in **Appendix B**.

Where recommendations and assumptions adopted in this report are thoroughly followed, full compliance with the EPNR assigned noise levels is expected from the proposed BESS facility.

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1. INTRODUCTION

ACA has been commissioned to undertake an environmental noise assessment for a proposed battery energy storage system (BESS) site located at Lot 12 on Plan 21792 Abattoir Road, Merredin, WA 6415

The proposal is a battery energy storage system (BESS). The BESS comprises 8 containerised CATL EnerX 0.25P BESS units and two Medium Voltage Power Stations (MVPS) Ingecon battery inverter units for a 10 MW/40 MWh (4-hour storage configuration). The site will also feature a switchyard and associated ancillary spaces.

Noise associated with the new BESS and MVPS units has been identified as a potential source of impact to nearby noise sensitive receivers. The site is within close proximity to a number of rural residential premises.

The Shire of Merredin requires an acoustic report as part of the project's planning application. Noise emissions associated with the new BESS and MVPS units has been determined to quantify their potential impact.

The acoustic report shall include the assessment of noise emissions generated by the site operations in accordance with the EPNR.

The key stages of the noise assessment detailed in this report are as follows:

- Identification of the primary sources of noise associated with the project proposal and the nearest noise sensitive receivers;
- Noise assessment conducted based on a three-dimensional noise prediction model; and
- Noise mitigation measures identified and detailed to minimise potential impacts.

The methodology and standards used to conduct the assessment, as well as the numerical assessment results are presented in the following sections of this report.

Acoustic terms used in this report are defined in the Glossary of Appendix A.

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BACKGROUND INFORMATION

The Shire of Merredin requires an acoustic report as part of the site's planning application in order to satisfy the statutory requirements. The purpose of the acoustic report is to address environmental noise emissions associated with the addition of eight BESS and two MVPS units and its potential impact on nearby noise sensitive premises.

2.1. Location

The site is located in the South West Merredin locality within an area primarily of rural nature. The site is immediately bound by undeveloped land to the south, east and north, a Western Power and WaterCorp facilities are located to the west and further north railway stow roads and industrial land.

2.2. Nosie Sensitive Receivers

The nearest identified noise sensitive receivers are existing residential dwellings mainly to the east and south. Some of the dwellings have been identified by the developer as 'disused', nonetheless, assessment has been carried out taking into consideration such dwellings. **Figure 1** presents an annotated aerial view of the site in relation to the nearest sensitive receivers and wider site context.

Figure 1 Site location and nearest identified noise sensitive receivers



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Details of the nearest identified noise sensitive receivers are presented in Table 1.

Table 1 Nearest identified noise sensitive receivers

Noise sensitive receiver	Receiver details / EPNR classification	
R1	Residential dwelling / Noise sensitive premises: highly sensitive area	
R2	Residential dwelling / Noise sensitive premises: highly sensitive area	
R3	Residential dwelling / Noise sensitive premises: highly sensitive area	
R4	Commercial	
R5	Industrial (Western Power)	
R6	Industrial (Water Corp)	
R7	Commercial	
R8	Commercial	

Should noise be controlled to minimise impacts at the receivers listed above, it is considered that levels would also be suitably controlled at receivers further away due to increased distance attenuation and shielding from other buildings.

2.3. Operations and Site Description

The project proposal comprises a battery energy storage system site and associated ancillary equipment. The BESS area comprises eight containerised CATL EnerX 0.25P BESS units and two Ingecon battery inverter (MVPS) units for a 10 MW/40 MWh (4-hour storage configuration).

Noise emissions produced by all the units depend largely on the duty cycle required by their cooling systems. The CATL EnerX 0.25P BESS units also have an option for further sound reduction 'Sound Cover', which reduces approximately 5 dB of noise breakout.

Figure 2a presents the site plan of the development and **Figure 2b** presents the proposed BASS and MVPS units.

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Figure 2a Overall plant layout (Drawing no. SIPL-BD-SAT-DWG-0002 version 03 28/01/2025)

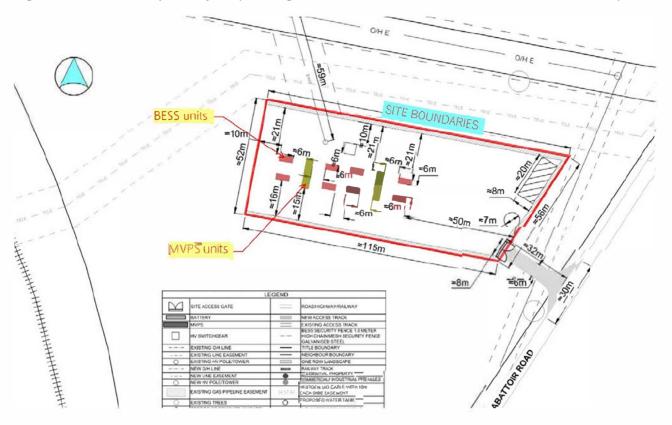


Figure 2b BESS: CATL EnerC +306 (Left) / MVPS: Ingecon C690 (Right)



ACA understands the BESS units operate continuously, and therefore, the hours of operation will fall within the day and night-time period as defined by the EPNR Noise Regulations (**Section 3**).

2.4. Operational Scenarios

The BESS unit's thermal system fans can operate at various duty cycles A worst-case noise level pertains to the maximum thermal system operation i.e. rated at 79.5%. The duty cycles will alternate based on ambient temperature i.e. a lower duty cycle is expected during the night-time period when the ambient temperature decreases.

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Scenario 1: The following 'Night-time' operational scenario has been considered for assessment purposes:

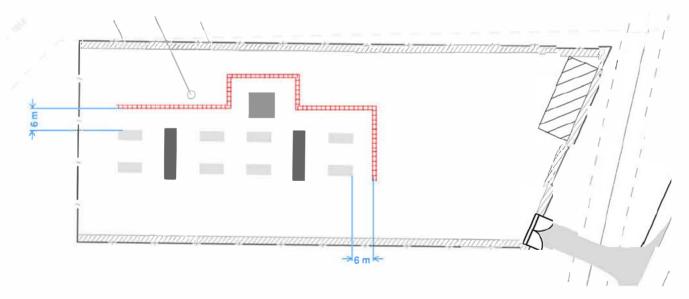
- Noise emissions generated by all BESS units operating simultaneously at 'medium' (50%) duty cycle.
- Noise emissions generated by all MVPS units operating simultaneously at 'medium' (CONF 1 setting, 50% generation, 50% fans) duty cycle.

Scenario 2: Worst-case 'Daytime' operational scenario has been considered:

- Noise emissions generated by all BESS units operating simultaneously at a 'maximum' (79.5%) duty cycle.
- Noise emissions generated by all MVPS units operating simultaneously at a 'maximum' (CONF 4 setting, 100% generation, 100% fans) duty cycle.

Further, an iteration of the scenarios described above has been tested with and without noise barriers as defined in **Figure 3**. The noise barriers tested are 2.8 m high and with either a minimum surface density of 20 kg/m^2 or certified for a sound reduction index of R_w 30 dB.

Figure 3 Noise barriers



BESS units will operate continuously over all periods, the above scenarios will be assessed under the L_{A10} metric.

2.5. Site Meteorological Conditions

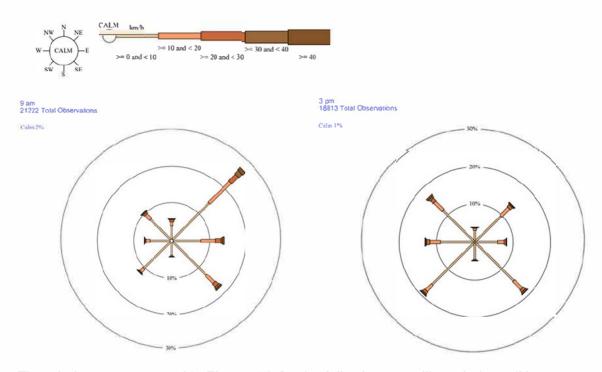
Long-term wind statistics data for a location nearest to the site (Merredin) was extracted from the BOM website. Wind roses are presented in **Figure 4**.

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Figure 4 Wind roses (annual): Merredin





The wind roses presented in **Figure 4** infer the following prevailing wind conditions:

- Morning wind is predominantly north-easterly with wind speeds less than 20 km/h observed 20-30 % of the time.
- Afternoon wind is predominantly southerly and south-westerly, with wind speeds less than 20 km/h observed 50 % of the time (southerly).

For distances of 250 m to 1 km (i.e. between source and receiver) typically a 2 dB increase can be applied. For noise assessment purposes, considering the sensitive receivers are located all around the site, a correction of + 2 dB will be applied to assessment results to account for downwind conditions.

In all cases, the following are also considered:

- Temperature 10 °C
- Relative Humidity 70%

Precipitation has a negligible effect on noise propagation. Inversions may occur during the night-time period i.e the air at a higher level is warmer than ground level. This can give the effect of noise 'carrying' over distance. Therefore, noise levels during the night-time at noise sensitive premises may be slightly higher than predicted for further receiver. During the daytime, a 'lapse' condition may occur, whereby the air is warmer near the earth's surface but gets cooler at higher altitude. At a certain distance, sound waves can bend upwards, thereby reducing noise levels. Therefore, predicted noise levels during the daytime at noise sensitive premises may be slightly lower than predicted.

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NOISE CRITERIA

Criteria have been determined in accordance with the Western Australia *Environmental Protection* (Noise) Regulations 1997 (EPNR).

3.1. WA Environmental Protection (Noise) Regulations 1997

Noise emissions from commercial/industrial premises received at nearby sensitive receivers are covered by state noise policy in the form of the EPNR. To achieve compliance with this policy, noise levels at nearby receivers are not to exceed defined limits. These limits are determined from consideration of prevailing background noise levels and 'influencing factors' that consider the level of commercial and industrial zoning in the locality.

The influencing factor considers zoning and road traffic volumes surrounding the sensitive receiver of interest, within 100 m and 450 m radii. Given the rural setting of the locality, the influencing factor calculated and nominated for highly sensitive receivers in this project is 0 dB. Therefore, no adjustment has been made to the baseline WA EPNR assigned noise levels. A summary of the applicable outdoor noise criteria is provided in the following table.

Table 2 WA EPNR Assigned Noise Levels

Type of premises receiving	Time of day	Assigned	Level (dB)	
noise		L _{A10}	L _{A1}	L _{Amax}
Noise sensitive premises: highly sensitive area	0700 to 1900 hours Monday to Saturday	45	55	65
	0900 to 1900 hours Sunday and public holidays	40	50	65
	1900 to 2200 hours All days	40	50	55
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35	45	55
Noise sensitive premises: any area other than highly sensitive area	All hours	60	7 5	80
Commercial premises	All hours	60	7 5	80
Industrial premises (other than Kwinana Industrial Area)	All hours	65	80	90

A series of adjustments must be added to the noise source levels if noise received at nearby sensitive premises cannot reasonably be free of intrusive characteristics of tonality, modulation and impulsiveness, and the adjusted level must comply with the assigned level. Definition of these terms (tonality, modulation and impulsiveness) can be read from Regulation 9(1) of the EPNR. **Table 3** summarises the adjustments, as defined by the Regulations.

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 Table 3
 Noise character adjustments



Adjustment where noise emission is not music		Adjustment where noise emission is music		
Where tonality is present	Where modulation is present	Where impulsiveness is present	Where impulsiveness is not present	Where impulsiveness is present
+5 dB	+5 dB	+10 dB	+10 dB	+15 dB

From review of the noise data provided by the BESS and MVPS manufacturers, it was found that both units are tonal and 5 dB noise character adjustment will be applicable for all noise emissions from the project. Conversely, for assessment purposes, this noise study has been conducted with assigned noise levels 5 dB more stringent than those of **Table 2** to allow for the tonal noise sources.

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4. ASSESSMENT

The assessment has been conducted based on the following steps:

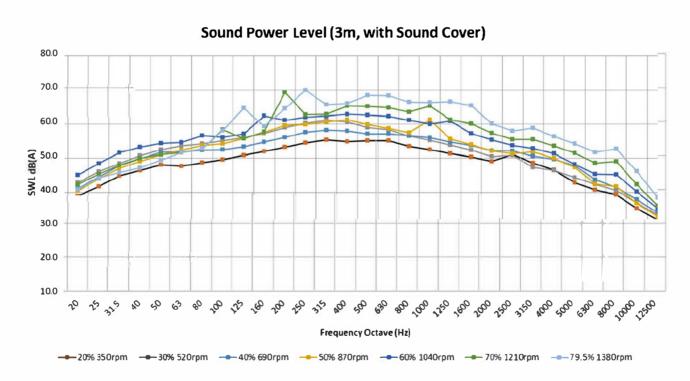
- A review of the product documentation, product sound data information and plant layout drawing to determine noise source location, sound power levels, noise directivity etc;
- 3D computer-aided noise modelling to predict resulting levels at nearby external receivers;
 and
- Assessment of predictions against the applicable noise criteria.

4.1. Source Noise Levels

ACA reviewed the product sound data documentation¹, which details the measurement methodology and resulting noise levels. All noise level testing was conducted in accordance with ISO3744.

The following chart summarises the measured sound power level of the unit "with sound cover".

Figure 5 Sound Power Levels for various duty cycle % – BESS



Third octave band sound power levels corresponding to the relevant duty cycle (i.e. 79.5% and 50%) have been inputted into the model.

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¹ BESS: CATL Test Report, No CAIT-VI-240659-E, Version 1.0, dated, 31/08/2024 MVPS: Ingecon Sun 3Power C Series Acoustic Emission, dated 12/03/2024

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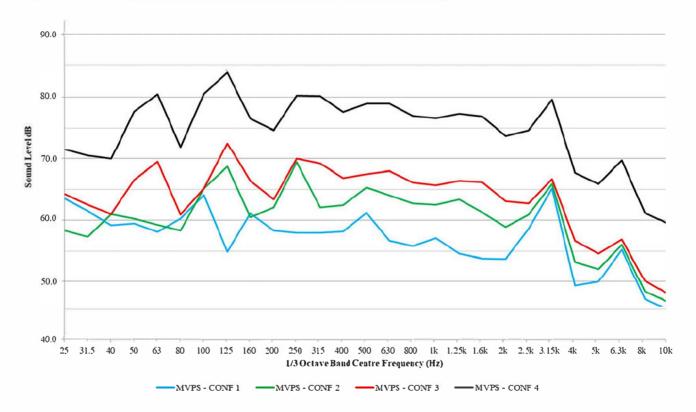
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Noise data for the MVPS unit, extracted from the manufacturer testing documentation, is summarised below.

Figure 6 Sound Power Levels for various configurations – MVPS

Configuration	Sound level at 2 m (dBA)	Sound level at 5 m (dBA)	Sound level at 10 m (dBA)
Configuration 1	63.7	55.7	49.7
Configuration 2	67.7	59.7	53.7
Configuration 3	70.7	62.7	56.7
Configuration 4	71.0	63.0	57.0



The BESS containers and MVPS units assessed in this report are based on preliminary product specifications. Should final equipment selections vary prior to construction, these will need to be confirmed with the acoustic consultant to ensure that the operational noise levels remain consistent with the outcomes presented in this assessment.

4.2. Noise Modelling

Geometry from the site and surroundings, surfaces, existing buildings, barriers and sound sources from the site were modelled using internationally recognised noise prediction algorithms. A three-dimensional noise model was developed using SoundPLAN Essential V5.1. An adaptation of the

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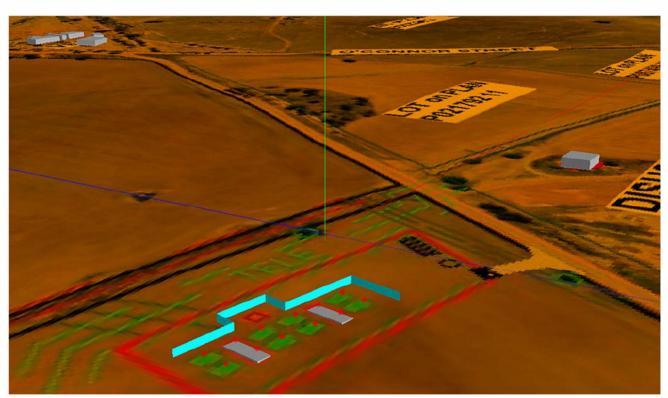
algorithm contained within ISO 9613:1996 *Acoustics – Attenuation of sound during propagation outdoors* was used in this instance².

The following items are considered:

- Three-dimensional location, height and orientation;
- shielding/reflection effects due to surrounding structures (such as awnings, parapets and roofs);
- meteorological/thermal effects; and
- ground absorption has been set at 0.5 (0 meaning reflective and 1 being absorptive).

Figure 7 presents 3D imagery of the noise model, including the point of assessment (receivers) and the key noise generating sources.

Figure 7 3D imagery of noise model



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² ISO 9613-2:1996 has since been superseded by ISO 9613-2:2024, however, SoundPLAN Essential V5.1 utilises the former.

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4.2.1. Modelling Scenarios

The noise modelling scenario described in **Section 2.4** is:

- Scenario 1 'Night-time': Noise emissions generated by all units operating simultaneously at 50% duty cycle (L_{A10} assessment).
 - Iteration 1: Scenario 1 No noise barrier
 - Iteration 2: Scenario 1A Including noise barrier
- Scenario 2A 'Daytime': Noise emissions generated by all BESS units operating simultaneously at maximum duty cycle (L_{A10} assessment).
 - Iteration 1: Scenario 1 No noise barrier
 - ➤ Iteration 2: Scenario 1A Including noise barrier

4.2.2. Results

Noise contour maps have been generated in SoundPLAN Essential V5.1 and are presented in **Appendix B**. The results from the noise model at the external receivers are presented in **Table 4**. A wind correction of + 2 dB has also been applied.

Table 4 Receiver noise level predictions

Receiver	Predicted Noise Levels (L _{A10})			
	Scenario 1: Night-time without barriers	Scenario 1A: Night-time with barriers	Scenario 2: Daytime without barriers	Scenario 2A: Daytime with barriers
R1	< 20 dB	< 20 dB	< 20 dB	< 20 dB
R2	< 20 dB	< 20 dB	< 20 dB	< 20 dB
R3	32 dB	27 dB	38 dB	35 dE
R4	< 20 dB	< 20 dB	22 dB	< 20 dB
R5	< 20 dB	< 20 dB	24 dB	26 dB
R6	< 20 dB	< 20 dB	24 dB	26 dB
R7	< 20 dB	< 20 dB	20 dB	23 dB
R8	< 20 dB	< 20 dB	22 dB	25 dB

4.3. Assessment and Discussion

The results presented above have been assessed against the EPNR calculated assigned noise level criteria (**Section 3**) and are presented in **Table 5**. These are for the scenarios with noise barriers.

It is considered that the noise prediction results are representative of a 'worst case' scenario and it is expected that in reality, noise levels would typically be less than that predicted for the majority of receivers.

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Table 5 Assessment of results



Scenario	Receiver	Resultant noise at receiver (dB)	Worst-case adjusted noise criterion (dB)	Difference (dB)
'Daytime'	R1	L _{A10} < 20 dB	La10 35	-15
Between 0700 to 2200	R2	La10 < 20 dB		-15
hours	R3	L _{A10} 35		-
	R4	L _{A10} < 20 dB		-15
	R5	L _{A 10} 26 dB		-9
	R6	L _{A10} 26 dB		-9
	R7	L _{A10} 23 dB		-12
	R8	L _{A10} 25 dB		-10
Night-time	R1	L _{A10} < 20 dB	La10 30	-10
Between 2200 hours	R2	L _{A10} < 20 dB		-10
to 0700	R3	L _{A10} 27 dB		-3
house any	R4	L _{A10} < 20 dB		-10
day, or 0900 hours	R5	L _{A10} < 20 dB		-10
Sunday and	R6	L _{A10} < 20 dB		-10
public holidays	R7	L _{A10} < 20 dB		-10
Holldays	R8	L _{A10} < 20 dB		-10

The assessment results indicate full compliance of the EPNR when operational conditions are adjusted to the basis of this noise study.

4.4. Recommendations

It is noted that the assessment considers reasonably worst-case operational conditions. The developer, as appropriate and based on final design and manufacturer capability, will be required to implement the following noise mitigation measures:

- Treating the source:
 - Adjustment of cooling system loads or operational settings. It is understood there is the ability to firmware-limit the fan duty cycle to mitigate the effects of noise, as long as the limiting does not affect performance of the unit. It is recommended that the units are limited up to the 50% duty cycle during the night-time in order to achieve compliance with the EPNR; and
 - > Use of manufacturer-supplied noise reduction kits or acoustic treatment solutions.

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Treating the path:

Installation of noise walls. A 2.8 m high noise barrier with a minimum surface density of 20 kg/m² has been considered for full compliance conditions at all noise sensitive dwellings and receivers and within all vacant lots with potential to be developed as residential in the future.

For the majority of the time, noise emitted by the BESS and MVPS unit(s) would be much lower. The above measures will be confirmed and incorporated into the final project design to maintain compliance with relevant noise criteria.

The noise contours of Scenarios 1A and 2A shown in **Appendix B** provide noise predictions at surrounding land; it is observed that, with noise barriers in place, noise levels <u>at the boundary of the adjacent lots</u> to the north, east and south are within the adjusted/worst-case L_{A10} 30 dB mark for night-time and L_{A10} 35 dB mark for daytime, and thus, compliant with the EPNR requirements.

Further, Scenario 1 noise contours (**Appendix B**) show the effect of no barriers, where a zone of compliance for worst-case night-time is delimited by the 30-32 dB contour zone. It should be noted that this zone applies in the presence of a highly sensitive buildings (a residential dwelling) and this zone does not apply for extended outdoor areas of residential lots or non-habitable buildings such as sheds or the like.

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APPENDICES

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APPENDIX A: Glossary of Acoustic Terms



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1 Sound Level or Noise Level

Sound consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. Noise is often used to refer to unwanted sound.

The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable range by using logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level.

The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x 10⁻⁵ Pa.

2 "A" Weighted Sound Levels

The overall level of a sound is usually expressed in terms of dB(A), which is measured using a sound level meter with an "A-weighting" filter. This is an electronic filter with a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dB(A) is a good measure of the loudness of that sound. Different sources having the same dB(A) level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB(A) change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels:

Typical noise levels and subjective scale

Sound Pressure Level dB(A)	Noise Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely loud
110	Grinding on steel	
100	Loud car horn at 3 m	Very loud
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (e.g. B, C and D) are less commonly used than A-weighting in environmental acoustics. Sound Levels measured without any weighting are referred to as "linear" and the units are expressed as dB(Lin) or dB.

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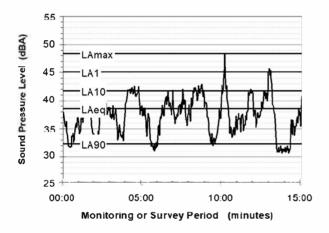
3 Sound Power Level

The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units, and these may be identified by the symbols SWL or Lw. The Sound Power definitions expressed in dB are typically referenced to the acoustic energy unit 10⁻¹² W.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN} , where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time.

The following figure presents a hypothetical 15-minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{A1} The noise level exceeded for 1% of the 15-minute interval.

La₁₀ The noise level exceeded for 10% of the 15-minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

L_{Aeq} The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

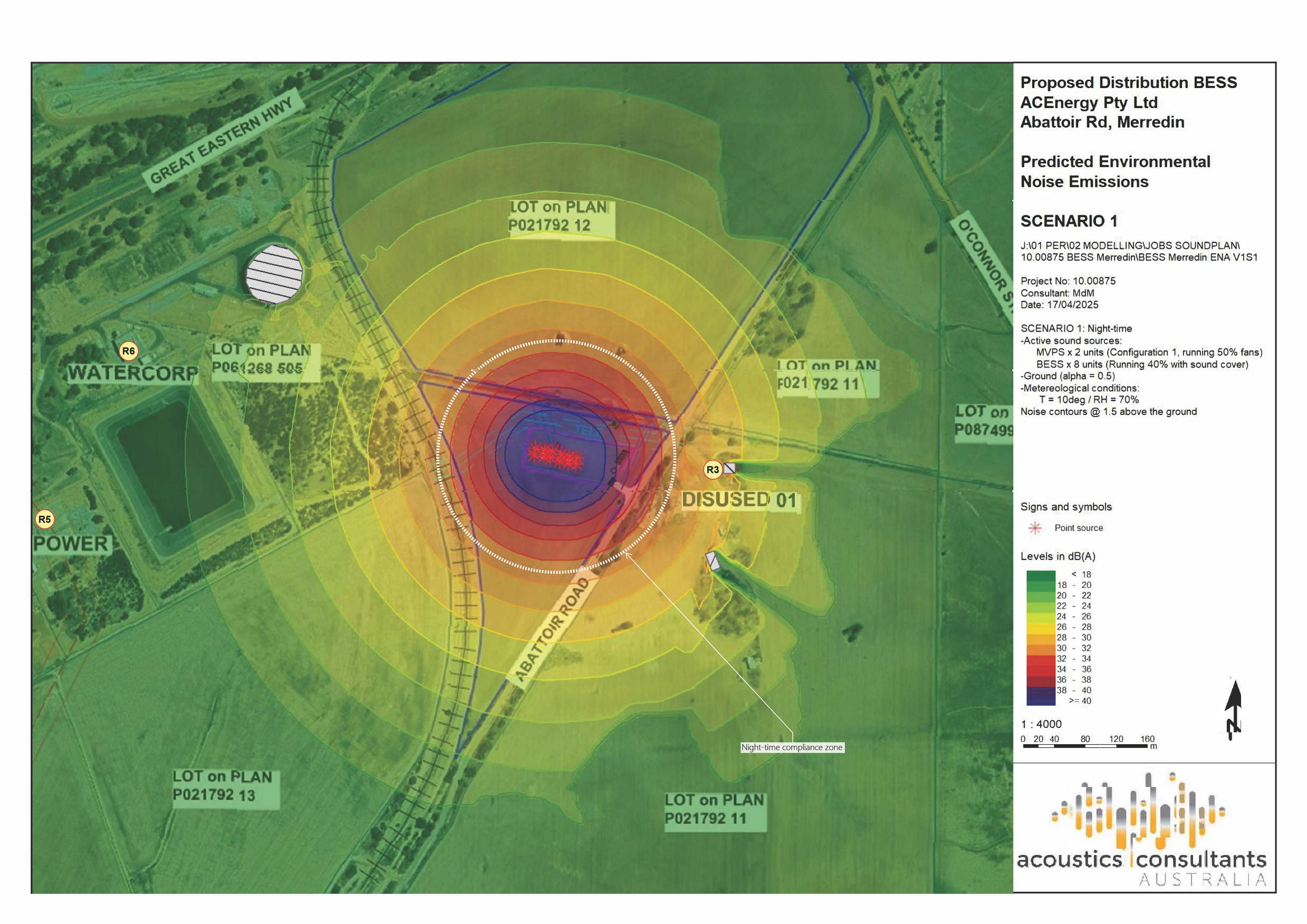
When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. Standardised methods are available for determining these representative levels. Different jurisdictions would choose to define their own preferred Standard.

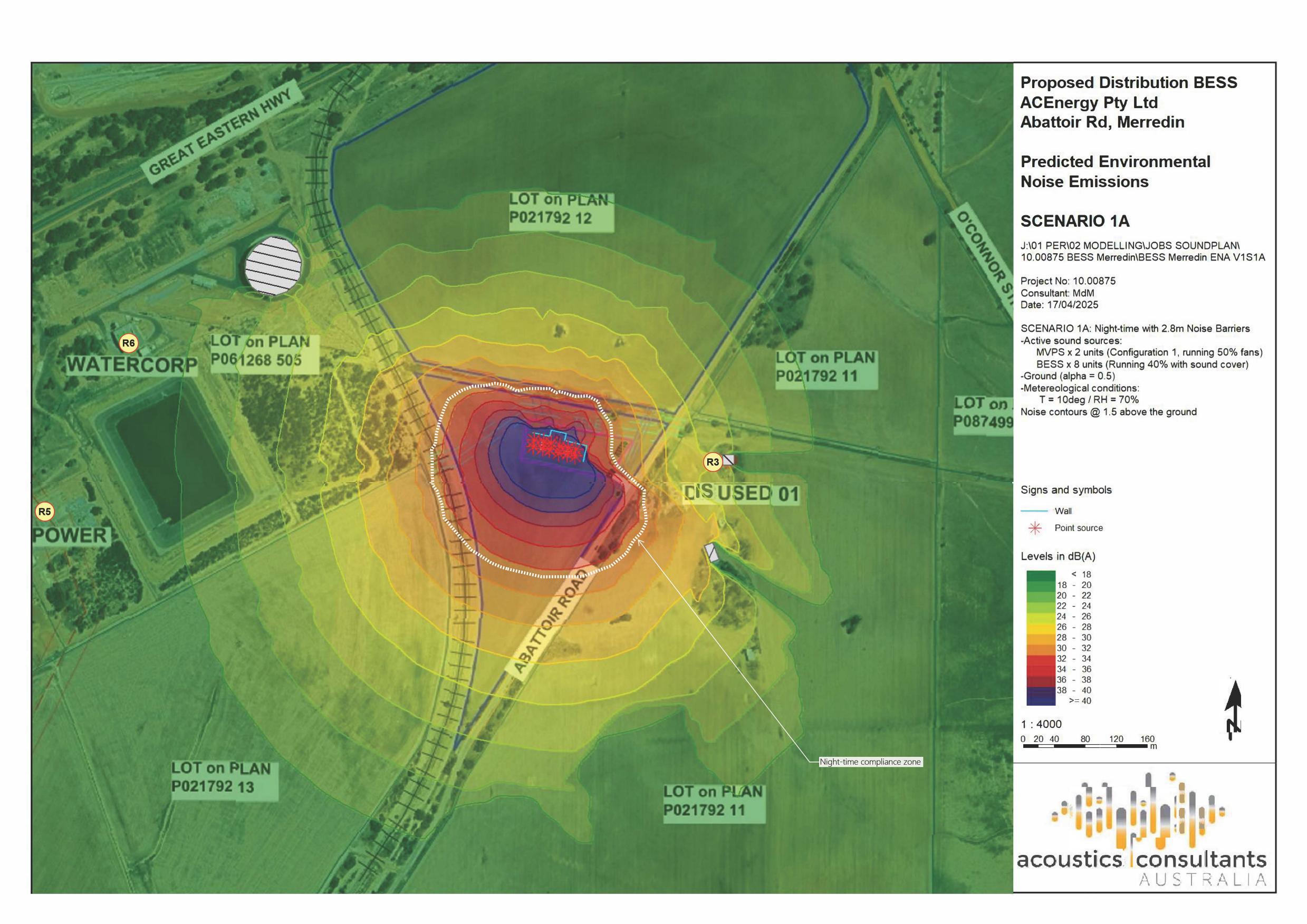
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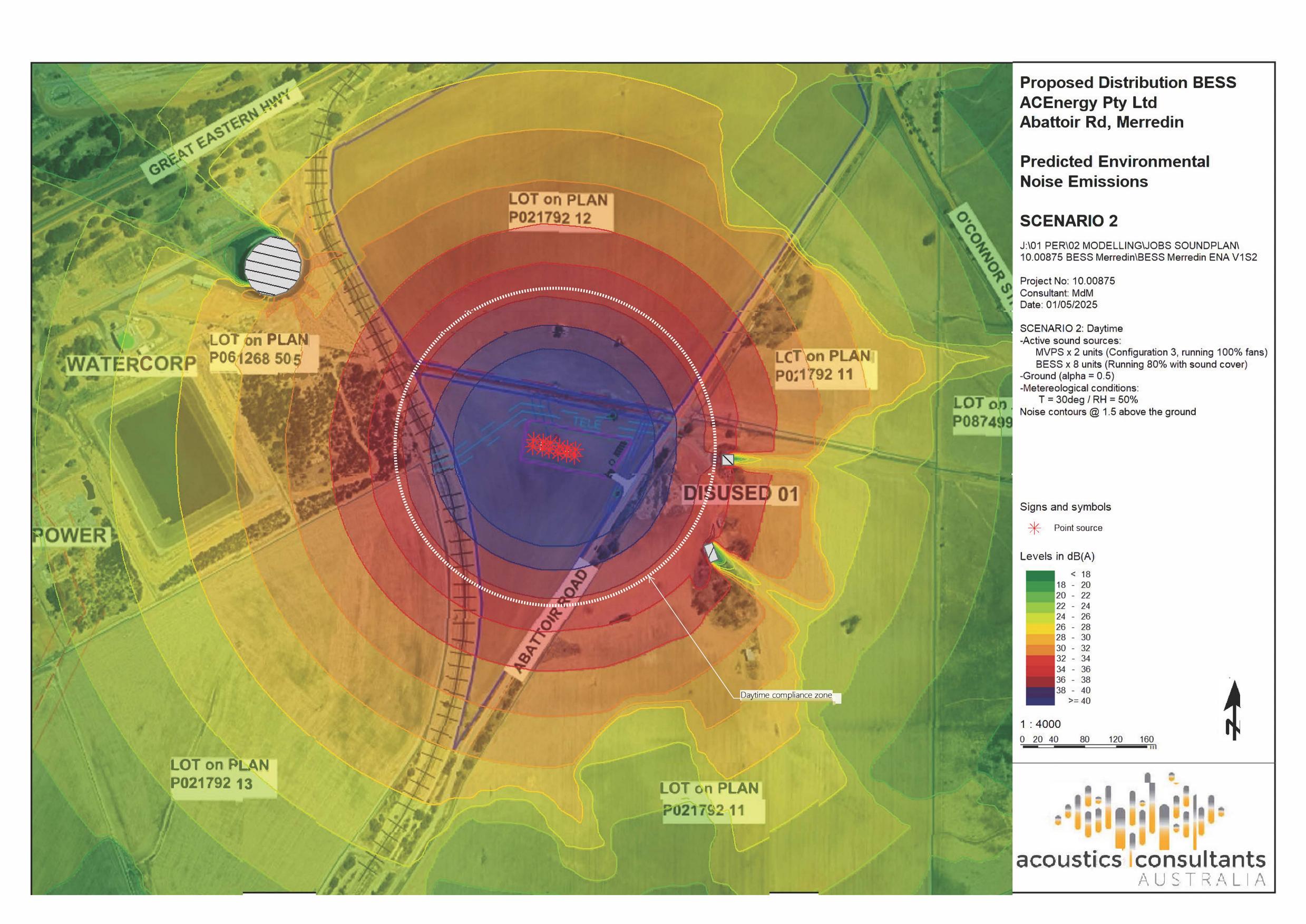
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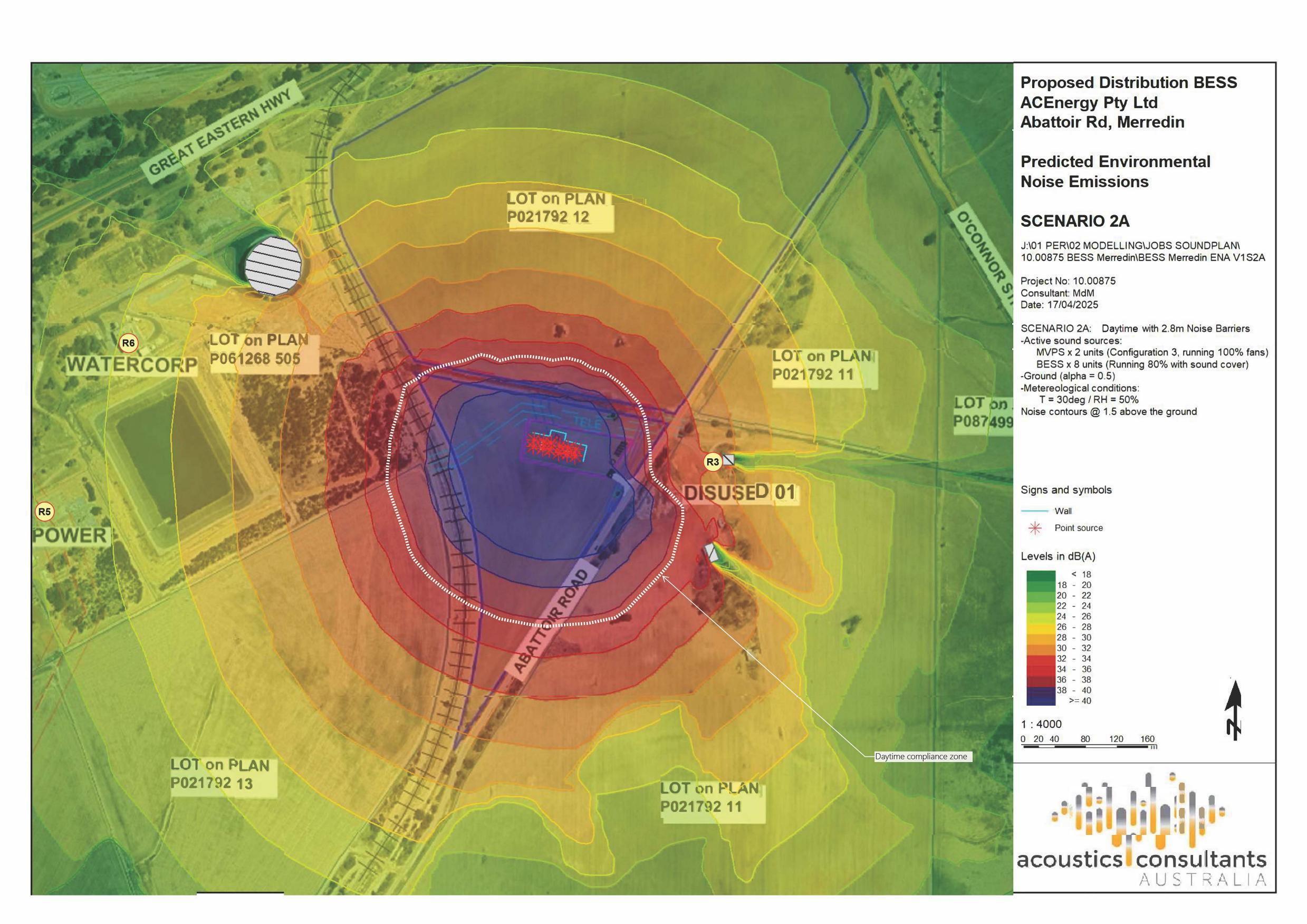
APPENDIX B: NOISE MODELLING CONTOURS











APPENDIX E BUSHFIRE ATTACK LEVEL ASSESSMENT



(08) 6162 8980 PO Box 437, Leederville, WA 6903 enquiries@westenv.com.au

Bushfire Attack Level (BAL) Assessment Report

Site details

Address: Lot on P021792 12

Suburb: Merredin State: Western Australia

Local Government Area: Shire of Merredin

Description of Building Works: Construction of a Battery Energy Storage System

Report details				
Project number	A25.098	Report version	0	
Report date		13/05/2025		
Author	Bridie Farrar		Daniel Panickar BPAD L3 37802	
	Bushfire Consultant	Review	BPAD Bushfüre Planning & Design Accredited Practitioner Level 3	

Site Context

Acenergy Pty Ltd. are seeking to progress a Development Application (DA) to support the development of a Battery Energy Storage System (BESS) on a portion of Lot on P021792 12, which is being leased to Acenergy by the landholder (hereafter referred to as the subject site; Figure 1).

The subject site is not within a designated bushfire prone area on the Western Australia Map of Bush Fire Prone Areas (DFES, 2024); however, the Shire of Merredin (the Shire) have requested a bushfire risk assessment be undertaken to support the development. Given the short timeframe for preparation and lodgement of the DA, Western Environmental Approvals Pty Ltd (WEPL) have been engaged to undertake this assessment, with a focus on the appropriate siting of proposed assets. WEPL have prepared this Bushfire Attack Level (BAL) report as a preliminary bushfire assessment in lieu of a full Bushfire Management Plan (BMP). A BMP and assessment against the Country Fire Authority's (CFA) Design Guidelines and Model Requirements for Renewable Energy Facilities Version 4 (the CFA Guidelines; 2023) will be prepared, if requested as a condition of development approval by the Shire.

Due to the short timeframe associated with DA lodgement, a preliminary desktop assessment of the BESS was undertaken for the purpose of determining the BAL in accordance with *Australian Standard AS 3959: 2018 Construction of Buildings in Bushfire Prone Areas* (AS 3959: 2018; SA, 2018) Simplified Procedure (Method 1). A detailed site assessment will be undertaken in the event that the Shire requests a BMP be prepared as a condition of development approval.

A Method 2 Bushfire Attack Level (BAL) calculation has also been undertaken in line with the methodology set out in AS 3959: 2018 (SA, 2018) to ensure that the proposed assets will be sited in areas where the radiant heat flux from a potential bushfire will not exceed 10 kW/m² (see Appendix A for calculations). Required separation distances between proposed assets and each Plot in this BAL assessment were calculated, with the resulting setback distances adopted as vegetation management areas required for the site. The Method 2 BAL calculations were undertaken solely to determine the setback required to achieve the required radiant heat flux.

The 10 kW/m² radiant heat flux threshold is widely adopted as being sufficient to significantly reduce the risk of radiant heat from the surrounding vegetation igniting the proposed assets within the site, in line with general guidance in the CFA Guidelines. Ultimately, this also implies that the resultant separation distances between the proposed BESS and classified vegetation will reduce the likelihood of bushfire ignition resulting from the functioning of the BESS. The separation distances prescribed around these assets is 22 m in width as a minimum, well exceeding the 10 m recommended by the Western Australian Planning Commission (WAPC) for Renewable Energy Facilities in Bushfire Prone Areas (*Position Statement: Renewable energy facilities; Department of Planning, Lands and Heritage; WAPC; 2020*).

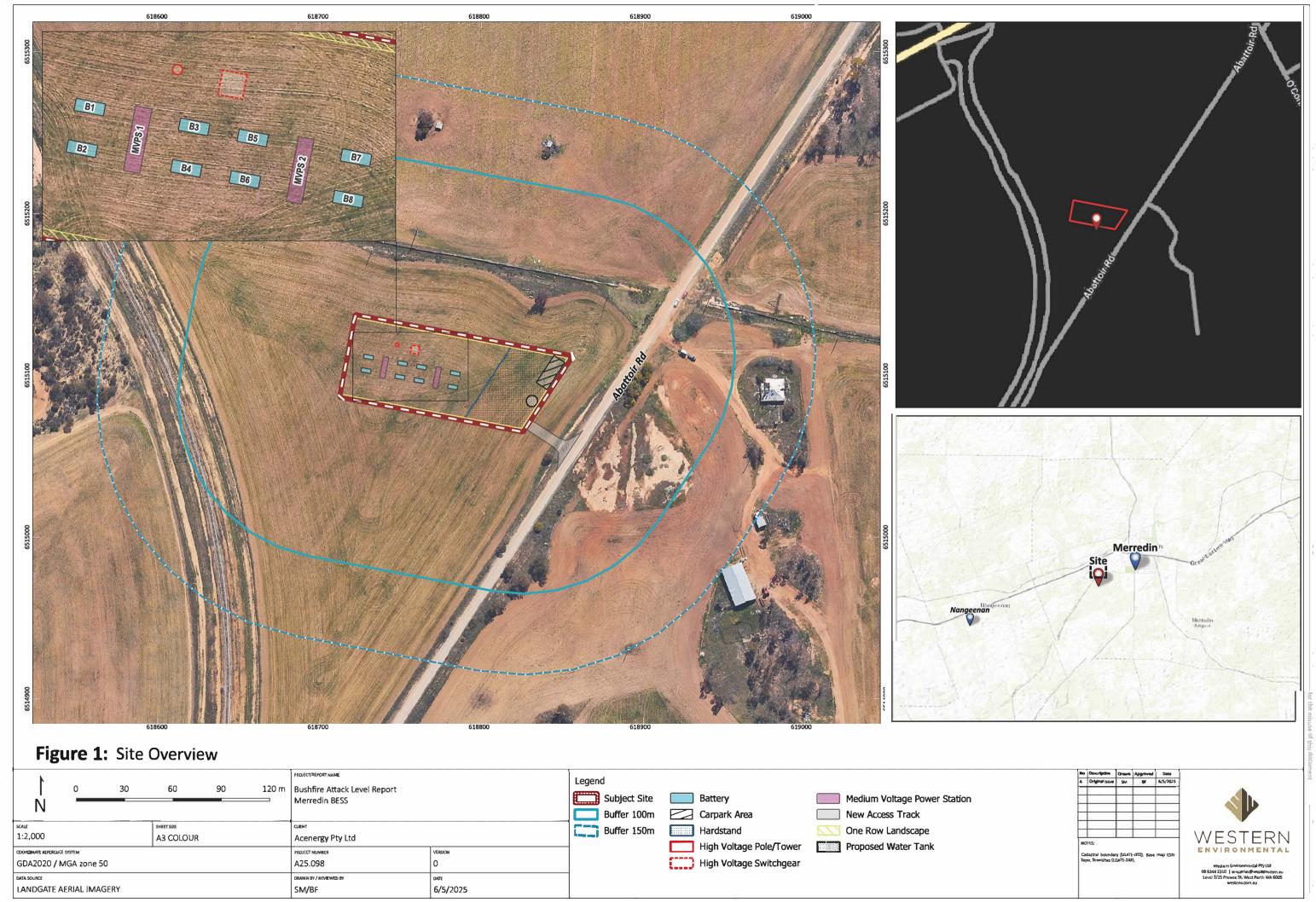
Vegetation Classification

All vegetation within 100 m of the BESS was classified in accordance with Clause 2.2.3 of AS 3959: 2018 based on publicly available aerial imagery and Google Streetview imagery. Each distinguishable vegetation class with the potential to determine the BAL is identified in Table 1 and presented in Figure 2.

A portion of vegetation which directly abuts the subject site has been excluded as low-threat vegetation. This vegetation will be managed in perpetuity to ensure that the radiant heat flux exposure for the renewable energy assets does not exceed 10 kW/m² at a flame temperature of 1090 K. The landholder agreement confirming this arrangement is contained within Appendix B.

Table 1: Vegetation Classification

Plot	Vegetation classification	Effective slope
1	Class G Grassland	Downslope >0 to 5 degrees
2	Class G Grassland	All upslopes and flat land (0 degrees)
3	Excluded - clause 2.2.3.2 (e)	
4	Excluded - clause 2.2.3.2 (f)	:=



2m Contours (DPIRD-072)

2m

____ 10m

Excluded AS 3959: 2018 2.2.3.2 (e)

Excluded AS 3959: 2018 2.2.3.2 (f)

A25.098

SM/BF

6/5/2025

GDA2020 / MGA zone 50

LA NOSANTEAERIAL IMAGERY

Relevant Fire Danger Index

The Fire Danger Index for this site has been determined in accordance with Table 2.1 of AS 3959: 2018 and is presented in Table 2.

Table 2: Fire Danger Index (FDI)

Relevant Fire Danger Index				
FDI 40 □ Table 2.4.5	FDI 50 □ Table 2 4 4	FDI 80 ✓ Table 2.4.3	FDI 100 □ Table 2.4.2	

Potential Bushfire Impacts

The potential bushfire impact to the site / proposed development from each of the identified vegetation plots are identified below in Table 3.

Appendix A contains the Method 2 BAL assessment calculations, using a flame temperature of 1090 K.

Table 3: Method 1 BAL Calculation (BAL Contours)

Vegetation		Effective	Separation distances required (m)					
Plot	Plot classification	slope	BAL-FZ	BAL-40	BAL-29	BAL-19	BAL-12.5	10 kW/m² @ 1090 K
1	Class G Grassland	Downslope >0 to 5 degrees	<7	7 - <9	9 - <14	14 - <20	20 - <50	25
2	Class G Grassland	All upslopes and flat land (0 degrees)	<6	6 - <8	8 - <12	12 - <17	17 - <50	22
3	Excluded - clause 2.2.3.2 (e)	-		No sepa	ration dista	nces requii	red - BAL-LO\	W
4	Excluded - clause 2.2.3.2 (f)) =)		No sepa	ration dista	nces requii	red - BAL-LO\	W

Determined Bushfire Attack Level (BAL)

The determined Bushfire Attack Level (highest BAL) for the proposed works has been determined in accordance with Clause 2.2.6 of AS 3959: 2018 relevant data from the site assessment shown in Figure 3 and Table 4.

Following the clearing of the site and Vegetation Management Area for development, and maintenance of these areas as non-vegetated areas or low threat vegetation, all batteries and Medium Voltage Power Stations (MVPS) will be sited in areas with a radiant heat flux not exceeding 10 kW/m² as depicted in Figure 3.

Table 4: BAL Assessment Summary

Proposed Building/Asset	Plot Most Affecting BAL Rating	Separation Distance	BAL Rating
Battery 1	Plot 1	25 m	BAL-12.5
Battery 2	Plot 1	25 m	BAL-12.5
Battery 3	Plot 2	23 m	BAL-12.5
Battery 4	Plot 2	22 m	BAL-12.5
Battery 5	Plot 2	23 m	BAL-12.5
Battery 6	Plot 2	22 m	BAL-12.5
Battery 7	Plot 2	23 m	BAL-12.5
Battery 8	Plot 2	22 m	BAL-12.5
MVPS 1	Plot 2	22 m	BAL-12.5
MVPS 2	Plot 2	22 m	BAL-12.5

Note: This BAL rating is based on the information current at the date of this document and is valid for 12 months.

Conclusion

The proposed BESS is sited appropriately to ensure that the radiant heat exposure of renewable energy assets during a bushfire is reduced so that it does not exceed 10 kW/m² at a flame temperature of 1090 K. This siting of renewable energy assets is also designed to reduce the potential for a fire originating from this infrastructure to spread to surrounding vegetation, igniting a bushfire. This method is considered best practice in Western Australia.

A full assessment of the BESS facility against the Guidelines and the CFA Guidelines will be undertaken if the Shire requests this as a condition of development approval. The facility has the ability to meet the requirements of each of these documents and is recommended for approval on the condition that a BMP is prepared which includes an assessment of the facility against the CFA Guidelines to ensure a design is created which reduces the risk to facility operators, responding firefighters and the surrounding community.

References

Country Fire Authority (CFA). (2023). *Design Guidelines and Model Requirements: Renewable Energy Facilities Version 4*. Government of Victoria.

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

Appendix A Method 2 BAL Calculations



NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 6/05/2025 **Assessment Date:** 12/03/2025

Site Street Address: Merredin BESS,

Assessor: Daniel Panickar; Western Environmental

Local Government Area: WA Alpine Area: No

Equations Used

Transmissivity: Fuss and Hammins, 2002 Flame Length: RFS PBP, 2001/Vesta/Catchpole

Rate of Fire Spread: Noble et al., 1980

Radiant Heat: Drysdale, 1985; Sullivan et al., 2003; Tan et al., 2005

Peak Elevation of Receiver: Tan et al., 2005

Peak Flame Angle: Tan et al., 2005

Run Description: Grassland 5 degrees

Vegetation Information

Vegetation Type:GrasslandVegetation Group:Grassland

Vegetation Slope: 5 Degrees Vegetation Slope Type: Downslope

Surface Fuel Load(t/ha): 4.5 Overall Fuel Load(t/ha): 4.5

Vegetation Height(m): 0 Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees Site Slope Type: Downslope

Elevation of Receiver(m): 3 APZ/Separation(m): 25

Fire Inputs

Veg./Flame Width(m): 100 Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95 Relative Humidity(%): 25
Heat of Combustion(kJ/kg) 18600 Ambient Temp(K): 308
Moisture Factor: 5 FDI: 110

Program Outputs

Level of Construction: BAL 12.5 Peak Elevation of Receiver(m): 4.02 Flame Angle (degrees): Radiant Heat(kW/m2): 9.76 79 **Maximum View Factor:** 0.157 Flame Length(m): 8.17 Inner Protection Area(m): Rate Of Spread (km/h): 20.19 25 Outer Protection Area(m): 0 0.819 **Transmissivity:**

Fire Intensity(kW/m): 46945

BAL Thresholds

BAL-40: BAL-29: BAL-19: BAL-12.5: 10 kw/m2: Elevation of Receiver:

Asset Protection Zone(m): 7 10 14 21 34 3

Run Description: Grassland Flat

Vegetation Information

Vegetation Type:GrasslandVegetation Group:Grassland

Vegetation Slope: 0 Degrees **Vegetation Slope Type:** Downslope

Surface Fuel Load(t/ha): 4.5 Overall Fuel Load(t/ha): 4.5

Vegetation Height(m): 0 Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees Site Slope Type: Downslope

Elevation of Receiver(m): 3 APZ/Separation(m): 22

Fire Inputs

Veg./Flame Width(m): 100 Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95 Relative Humidity(%): 25
Heat of Combustion(kJ/kg) 18600 Ambient Temp(K): 308
Moisture Factor: 5 FDI: 110

Program Outputs

Level of Construction: BAL 12.5 Peak Elevation of Receiver(m): 3.38 Flame Angle (degrees): Radiant Heat(kW/m2): 9.55 80 **Maximum View Factor:** 0.152 Flame Length(m): 6.87 Rate Of Spread (km/h): 14.3 Inner Protection Area(m): 22 0.827 Outer Protection Area(m): 0 **Transmissivity:** Fire Intensity(kW/m): 33248

BAL Thresholds

BAL-40: BAL-29: BAL-19: BAL-12.5: 10 kw/m2: Elevation of Receiver:

Asset Protection Zone(m): 6 8 12 18 30 3

Appendix B: Landholder Vegetation Management Agreement



Outlook

RE: Merredin Distribution BESS - Vegetation Management

Hi Jane,

Thank you for your business cooperation.

We understand the request of Vegetation Management for the fire control. We shall let our farm lease do it accordingly. If any cost is required, I shall let our farm lease contact you directly.

Would you have any queries on above please do not hesitate to contact me by E-mail at your convenience.

Thank you and Best regards

Mike Lee (Shi Li)
Managing Director
Sunshine United Developments Pty Ltd
34 Lionel Street, Naval Base, WA 6165

From: Jane bai . Sent: Tuesday, May 13, 2025 9:22 AM To: Mike (Shi) Lee

Subject: Fw: Merredin Distribution BESS - Vegetation Management

From: Jane bai

Sent: Tuesday, May 6, 2025 2:17 PM

To: Mike (Shi) Lee

Cc: Bai Xue; Ron lk; Leo Purssell Subject: Merredin Distribution BESS - Vegetation Management

Hi Mike,

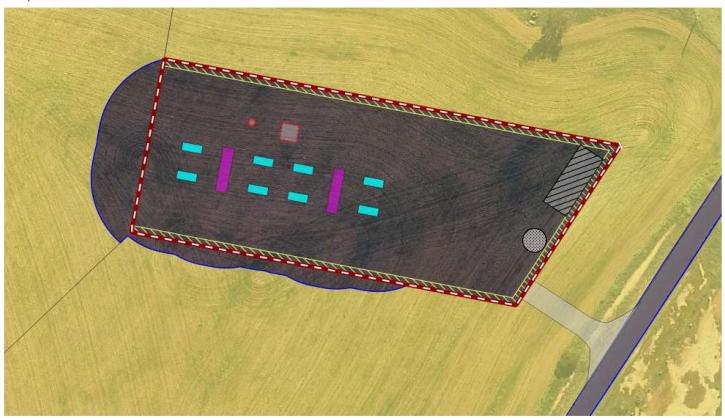
Hope you are doing well.

As part of the Merredin BESS project on Lot 12 DP21792, we are required to implement an Asset Protection Zone (APZ) for fire safety compliance. This includes maintaining specific vegetation conditions both within and immediately outside the project lease area (compound).

To meet these requirements, we kindly seek your approval for **ACEnergy** to carry out vegetation management during the operational stage **at our own cost** in the following areas outside the leased boundary:

- Up to 15 metres west of the project compound
- Up to 6 metres south of the project compound

Please refer to the area of vegetation management outside the leased boundary:



The main requirement is that grass within these APZ areas must be maintained at a height of 100 mm or less at all times, though other vegetation management conditions as set out in the attached guideline will also be followed.

We will source local suppliers to undertake this work, including Mr. and Ms. Pursell, if applicable and available.

We would be grateful for your written approval allowing ACEnergy to access and maintain these areas for the purpose of APZ compliance throughout the life of the project. Please don't hesitate to let us know if you would like to discuss this further or have any concerns.

Thank you.

Best Regards,

Jane Bai | Senior Project Development Engineer



^{*}Important Note: The details of any projects being developed by ACEnergy are confidential. They must not be distributed to any third party without the written consent of ACEnergy.

Appendix C Additional Information / Advisory Notes

This assessment was undertaken as per AS 3959: 2018. It is important that the current version of AS 3959, is consulted for construction purposes.

This BAL rating is based on the information current at the date of this letter and is valid for 12 months from the date of this letter.

Bushfire Attack Level (BAL) as set out in the Australian Standard 3959 Construction of Buildings in Bushfire-Prone Areas (AS 3959), as referenced in the Building Code of Australia.

Bushfire Attack Level (BAL)	Classified vegetation within 100 m of the site and radiant heat flux exposure thresholds	Description of predicted bush fire attack and levels of exposure	Construction Section as per AS 3959
BAL-LOW		There is insufficient risk to warrant specific construction requirements.	4
BAL-12.5	≤12.5 kW/m²	Ember attack	3 and 5
BAL-19	>12.5 kW/m² ≤19 kW/m²	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing radiant heat flux.	3 and 6
BAL-29	>19 kW/m² ≤29 kW/m²	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing radiant heat flux	3 and 7
BAL-40	>29 kW/m² ≤40 kW/m²	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing radiant heat flux with the increased likelihood of exposure to flames.	3 and 8
BAL-FZ	>40 kW/m²	Direct exposure to flames from fire front in addition to radiant heat flux and ember attack	3 and 9

Source: "AS 3959: 2018 Construction of buildings in bushfire-prone areas" published by Standards Australia, Sydney.

APPENDIX F LANDSCAPE CONCEPT PLAN



1 30/4/2025 APPROVAL ISSUE

Issue Date Issue Note

Structural Engineer:

Project Managers

ACEnergy Pty Ltd

IMPORTANT NOTE RE CLARIFICATION:
Tenderers/Contractors are advised to contact this office to confirm/clarify any aspect of the works, incl. any details of the contract documents (incl. this plan) of which they are uncertain. No claim will be accepted on account of failure to do so. IF IN DOUBT ... ASK.

This plan shall be read in conjunction with the ACEnergy Pty Ltd MERREDIN D-BESS drawings.

Revision Note

MERREDIN D-BESS

Abattoir Road Merredin Western Australia

Overview/Context Plan

Sheet 1 of 4 Local Authority Shire of Merredin

1:4,000 @ A1; 1:8,000 @ A3

Date 22 Apr 2025 Drawing # Rev

25728

ground**control**

Ground Control Landscape Architecture Pty Ltd

ABN 53 776 078 327

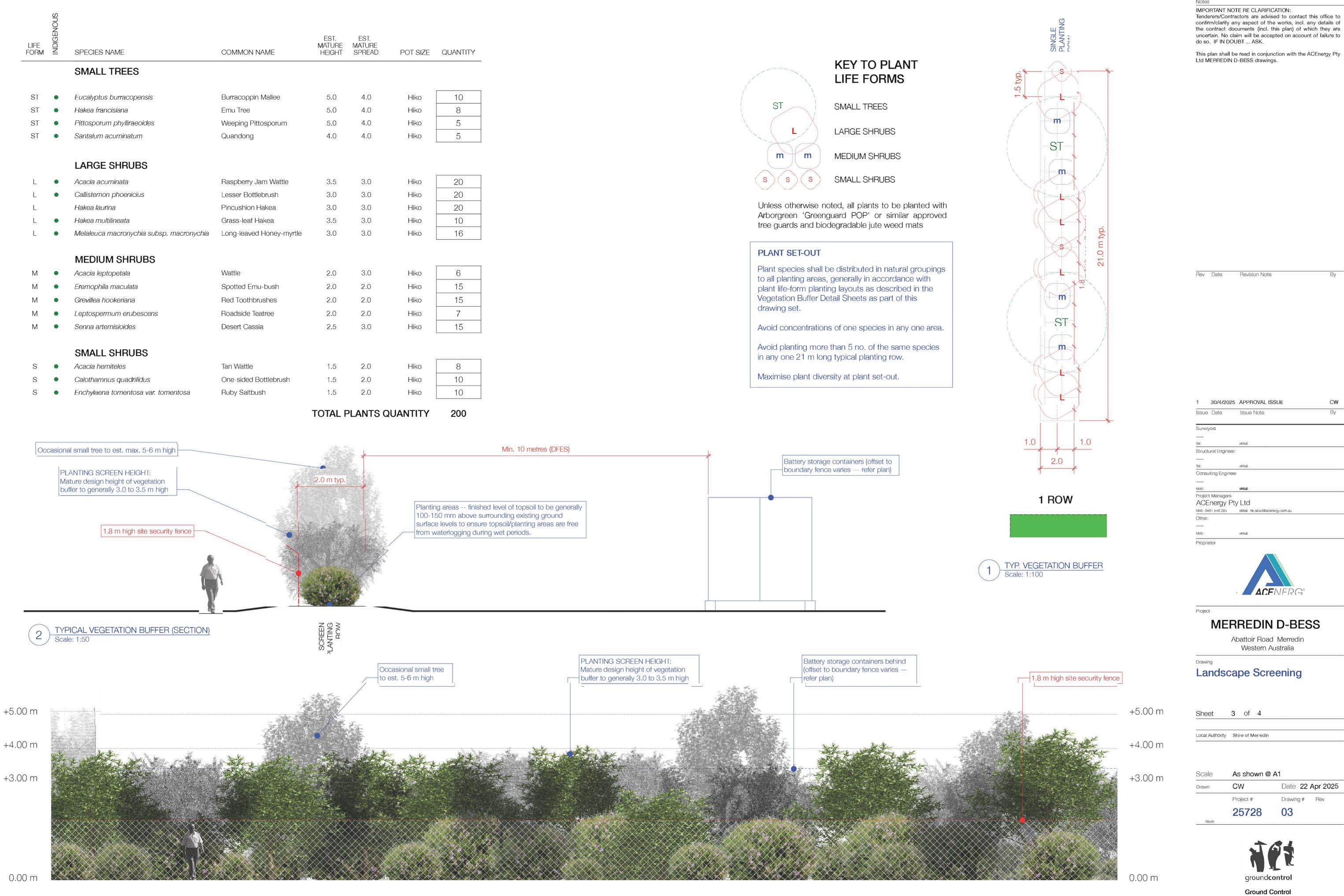
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TYPICAL VEGETATION BUFFER (EXTERNAL ELEVATION)
Scale: 1:50

APPROVAL ISSUE - 30 April 2025

Landscape Architecture Pty Ltd

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LANDSCAPE WORKS CONSTRUCTION NOTES:

1 WORKS BY CIVIL/OTHERS

All construction & civil works incl. demolition, building works, bulk earthworks, drainage infrastructure, road pavements, site electrical & battery facilities & associated infrastructure, fencing and other related works.

The civil contractor will ensure the following minimum depths of site topsoil are provided for the landscape works:

• Planting areas -- min. 150 mm depth site topsoil.

• Finished level of topsoil to be generally 100-150 mm above surrounding existing ground surface levels to ensure topsoil/planting areas are free from waterlogging during wet periods.

2 INSURANCES

Provide certificates of currency for Public Liability Insurance (min. \$20M) and Workcover insurance (min. \$20M) to the Superintendent prior to commencing works. Each certificate of currency shall note the Proprietor as an interested party.

3 ROAD OPENING PERMIT

Apply to the responsible authority for a road opening permit (if required), incl. the payment of all fees and charges re same. An approved copy of the approved road opening permit shall also be provided to the Superintendent prior to works commencing on site.

4 LANDSCAPE PRE-COMMENCEMENT MEETING

The Contractor shall Initiate, coordinate and attend a pre-commencement meeting with Council, Proprietor & Superintendent, incl. achieving compliance with all Council & specified requirements, checklists, insurances, approvals, etc.

5 TRAFFIC MANAGEMENT

If required, prepare and submit to the responsible authority a traffic management plan to their satisfaction, incl. the payment of all fees and charges re same. An approved copy of this plan shall also be provided to the Superintendent prior to works commencing on site. Implement approved traffic management plan during the duration of the Works on site.

6 LOCATE EXISTING SERVICES

Locate all existing services prior to commencing works, contacting Dial Before You Dig, the project civil engineers/contractor and/or the relevant authorities re same as required. Identify all overhead services prior to commencing works.

7 SET OUT THE WORKS

Accurately set the works out as per the documentation set.

8 SOIL TESTING & AMELIORATION

Undertake soil sampling & testing from an approved ag. soil testing laboratory, incl. seeking recommendations for fertilising & ameliorating planting zone to improve soil pH, NPK balance, trace elements, etc., including the addition of organic matter to improve structure and/or water-holding capacity. Any recommended adjustments must be made to improve the soil conditions for native tree & shrub planting.

9 PLANTING AREAS PREPARATION -- INITIAL

These works to be done ideally in LATE FEBRUARY/MARCH of the planting year:

- Eradicate broadleaf, woody and noxious weeds from all planting areas using selective, non-residual herbicides. Manual removal of larger woody weeds may be required -- inspect site to confirm extent.
- Rip along planting line to 2.0 m wide to min. 300 mm depth with a Yeomans/Keyline plough with tynes at max. 750 mm centres to break up/aerate natural subgrade and to relieve compaction, grade & level.
- Apply fertilisers and additives at rates recommended by soil test results.
- Cultivate planting lines to break up soil clods and provide an appropriate planting medium.
- DO NOT WORK WET SOIL. Remove any deleterious material brought to the surface, consolidate soil and grade surface to even grades, free of any depressions or undulations.
- Apply Amgrow Wettasoil Professional Granular or similar approved soil wetting agent (applied at manufacturer's recommended rates) to any soils showing evidence of non-wetting.

10 PLANTING AREAS PREPARATION -- SECONDARY

These works to be done ideally in APRIL/MAY of the planting year:

- Eradicate broadleaf, woody and noxious weeds from all planting areas using selective, non-residual herbicides. Manual removal of larger woody weeds may be required.
- Re-cultivate planting lines to break up soil clods and provide an appropriate planting medium.
- DO NOT WORK WET SOIL. Remove any deleterious material brought to the surface, consolidate soil and grade surface to even grades, free of any depressions or undulations.
- Apply Amgrow Wettasoil Professional Granular or similar approved soil wetting agent (applied at manufacturer's recommended rates) to any soils showing evidence of non-wetting.

11 PLANT SUPPLY

All plants shall be healthy, free from any pests or diseases, be attractive, well grown and well formed plant specimens and shall have a healthy, well formed root system commensurate in size with the foliage mass (root systems must not be pot bound). Plant container sizes shall be as listed in the detail planting schedule, but shall be min. hiko, ViroTube or 50 mm round/square pot size.

The planting contractor shall inspect all plants on delivery to site and shall certify in writing to the Superintendent that all plants supplied are as described above and are accepted by the planting contractor for planting in this project.

12 PLANTING

Set out plants as documented. Individual holes are to be dug (tree planter, mini-auger, etc.) in the prepared planting areas of sufficient size to easily accommodate the plant's root system and relieve any polishing. Create broad, shallow watering bowl to ALL plants to facilitate effective watering (min. 5 litre capacity). All plants shall be watered-in immediately after planting and at such times during the Contract period as is required to maintain growth free of water stress. Planting medium must be moist - do not plant into dry soil. Handle and plant all plants at all times in accordance with best horticultural practice.

13 FERTILISING

Refer maintenance section.

14 WEED MATS/MULCHING

Supply & install to each plant a 600 x 600 mm TreeMax or similar approved jute weed mat. Installation strictly to manufacturer's recommendations. Supply & spread min. 75 mm depth x min. 600 mmØ approved organic mulch to each plant.

15 TREE/PLANT GUARDS

Supply & install to each plant Arborgreen 'Greenguard POP' 450 x 200 mm (sides): Code: 'GRGRDPOP-TRI' or similar approved 100% biodegradable tree guard, incl. 1 no. x 25 x 25 x 750 mm HWD stake per guard to all plants. Ensure stake extends min. 300 mm into ground. Installation strictly to manufacturer's recommendations.

16 GRASSING (IF REQUIRED)

Some areas of grass seeding may be required and will be directed and quantified by the Superintendent.

Do not sow seed in periods of extreme heat, cold or wet, or where wind velocities are excessive unless otherwise approved. Seed mix shall be as follows:

- TURF-TYPE REGENERATING PERENNIAL RYEGRASS 95% by count
- TURF-TYPE TALL FESCUE 3% by cour
- SUB CLOVER
 WHITE CLOVER
 1% by count
 1% by count

Seeding rate shall be min. 30 gms per m2. Apply seed evenly – seed application shall be via direct drilling or by other approved methods. Seeding shall be programmed when there is a period of anticipated weather conditions (i.e. rain) that will provide the best chance for germination of grass seed. Any areas affected by heavy rain, wind removing seed or other cause shall be re-seeded as specified to achieve an even cover of grass.

Slash grass when growth height has reached 100 mm or otherwise as directed by Superintendent. Should all the areas not require cutting at one time, complete all further cuts as necessary until 100% of the area has achieved successful coverage and all areas have received at least first cut.

17 PRACTICAL COMPLETION COORDINATION

The Contractor shall Initiate, coordinate and attend a Practical Completion meeting with Council, Proprietor & Superintendent, incl. achieving compliance with all Council & specified requirements, checklists, insurances, approvals, etc. NOTE: Min. 3 no. working days notice is required for a Practical Completion meeting.

18 LANDSCAPE ESTABLISHMENT MAINTENANCE PERIOD

Maintain the contract works from the Date of Practical Completion to the Date of Final Completion/hand-over.

Maintenance shall include care of the contract area by accepted horticultural practices, and rectification of any defects that become apparent during this period. Maintenance tasks to be carried out during the maintenance period shall include, but shall not be limited to, slashing, watering as required, weed control, pest & disease control & management, tree/plant guard adjustment/replacement as required, rubbish removal.

WEED CONTROL - PLANTED AREAS:

In planted areas, poison all broadleaf, noxious & woody weeds as they appear. Slashable grasses are to be retained generally between planting rows. Selective herbicides shall be nominated by the Contractor and approved by the Superintendent prior to use. Non-selective herbicide shall be Monsanto 'Roundup BIACTIVE' glyphosate-based herbicide -- standard 'Roundup' is NOT to be used. NO OTHER HERBICIDE SHALL BE USED WITHOUT PRIOR APPROVAL. All herbicide applications shall use NuFarm 'Spraymate or similar approved marker dye admixture and shall be handled and applied strictly according to manufacturer's recommendations, recommended rates and directions.

GRASS MANAGEMENT - PLANTED AREAS:

Slash all areas between plants in rows and min. 1.5 m along all outside edges of all planting zones on a regular basis to maintain grass height to max. 100 mm. Slashing shall comply with all local Council and DFES guidelines re grass heights.

JUTE MAT, MULCH & TREE/PLANT GUARDS:

Maintain jute mat, mulch and tree/plant tree guards for first two summers minimum, repair and replace as required during this period.

PLANT REPLACEMENT:

Replace any failing, failed or dead plants during the maintenance period. The Superintendent and the Contractor will inspect the full planting areas at the end of each summer and will identify the number and species of plants that are failing, have failed/died. The Contractor shall replace all such plants identified.

WATERING:

The Contractor shall ensure all plants planted/maintained under this contract receive adequate (but not excessive) watering to maintain optimum growth and health. Watering shall be localised to each plant, not broad spraying across the entire planting area, to limit weed/grass growth between planting rows.

Watering shall be either manually via watercart/hose as required OR via a drip irrigation system, using Netafim 'UniRAM AS' inline dripline @ 1.6 LPH with emitter spacing of 400 mm -- one surface dripline per planting row. Drip irrigation system to be designed by an accredited irrigation designer and connect to an available clean water source, incl. filtration at source.

All plants shall be watered as required for at least the FIRST TWO SUMMERS to aid in establishment of healthy root systems and foliage growth, with further waterings if required during late spring and/or early autumn or at any other time of the year based on prevailing climatic conditions. Further waterings may be needed beyond this minimum establishment watering should prevailing climatic conditions deteriorate with potential to lead to deterioration of plant growth, health or plant deaths (e.g. severe drought, El Niño conditions, etc.).

WETTING AGENT:

Apply Amgrow Wettasoil Professional Granular or similar approved soil wetting agent (applied at manufacturer's recommended rates) to any soils showing evidence of non-wetting.

FERTILISING:

All plants (excluding Proteacea family) shall be fertilised with Scotts 'Osmocote® Plus Trace Elements: Native Gardens' (NPK 21.8: 0.7: 7.2) or similar approved at the manufacturer's recommended rates. Fertiliser shall be locally spread on soil surface around plants during planting operations. If unsure which plants are in the Proteacea family – ASK.

Allow for one fertiliser application in Year 1 and second application in Year 2.

PESTS & DISEASES:

Regularly monitor all plants grasses planted/maintained under this contract for evidence of pest and/or disease attack -- identify and treat any/all problems arising.

RABBITS, HARES, KANGAROOS, ETC.:

Identify any predation by rabbits, hares and other pests with potential to damage or destroy the landscape works under this contract. Take all necessary steps, within local authority regulations and/or guidelines, to limit or eradicate predation. Maintain all tree guards in good condition to limit rabbit/hare/kangaroo/other damage to plants with installed guards.

Notes

IMPORTANT NOTE RE CLARIFICATION:
Tenderers/Contractors are advised to contact this office to confirm/clarify any aspect of the works, incl. any details of the contract documents (incl. this plan) of which they are uncertain. No claim will be accepted on account of failure to do so. IF IN DOUBT ... ASK.

This plan shall be read in conjunction with the ACEnergy Pty Ltd MERREDIN D-BESS drawings.

Surveyors

Tel: eMail:
Structural Engineer:

Tel: eMail:
Consulting Engineer

Mob: eMail:
Project Managers
ACEnergy Pty Ltd
Mob: 0461 546 284 eMail: hk.sicad@acenergy.com.au

Other:

Mob: eMail:

1 30/4/2025 APPROVAL ISSUE

CW

Revision Note



Projec

MERREDIN D-BESS

Abattoir Road Merredin Western Australia

Landscape Specification Notes

Sheet

Local Authority Shire of Merredin

4 of 4

Scale N.T.S.

Drawn CW Date 22 Apr 2025

Project # Drawing # Rev

25728 04



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Landscape Architecture Pty Ltd

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APPENDIX G STORMWATER DRAINAGE STRATEGY



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DOCUMENT AUTHORISATION					
Revision	Revision Date	Proposal Details			
А	28/03/25	Issued for Initial Client Review			
В	06/05/25	Updated for Revised Client Layout			
С	14/05/25	Amended to Suit Client Comments			
Prepared By		Reviewed By		Authorised By	
G. Kleyweg	GK	C. Kleyweg	СК	C. Kleyweg	СК



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1. PREMISE STORMWATER DRAINAGE STRATEGY

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1.1 Location

Table 1 - Location Information - Lot 12 Abattoir Rd. Merredin

Lot Number	Area	Road Name	Suburb	Locality (Shire, City, etc.)
12	32.33ha*	Abattoir Road	Merredin	Shire of Merredin

*Note: 32.33ha is the whole area of Lot 12 Abattoir Road. However, the catchment areas being modelled do not include the entirety of the lot due to drainage only needing to be provided for the Distributed Battery Energy Storage System (D-BESS) as shown in the report and drainage calculations.



Figure 1 - Proposed Development Area Lot 12 Abattoir Road, Merredin

The subject site is surrounded by farmland and existing rural development.



The north-east corner of the land is proposed to be developed to operate a Distributed Battery Energy Storage System (D-BESS). The rest of the land does not currently have plans for development.

The following points are pertinent to the development of the subject landholdings: -

- The land is presently zoned as Farmland
- There are no nominated wetlands on the subject landholdings. There is an existing swale along the northern boundary of the subject site draining to the west. This swale acts to protect the site from large volumes of overland flow from upstream catchments.
- The area is considered "flood-prone" in the 1% ARI event due to being within 300m of the 1 in 100 AEP Floodplain Development Control Area. This is shown in the figure below and will be further explained in the following section 1.2 Stormwater Drainage Strategy.



FPM 1 in 100 (1%) AEP Floodplain Development Control Area (DWER-003)

Yes

No

Figure 2 - 1 in 100 AEP Floodplain Development Control Area - Lot 12 Abattoir Road, Merredin

In this Stormwater Drainage Strategy, we have nominated overland flow control measures to protect the proposed development area, and we have set levels for critical infrastructure to ensure an appropriate 0.15m clearance to 1% AEP flood levels as they traverse the site. Swale storage is calculated in accordance with the commentary in the following sections.



1.2 Stormwater Drainage Strategy

The Stormwater Drainage Strategy for the Study Area is for the natural overland flow paths to flow into a strategically placed catch drain which will lead to a swale that has been designed to accommodate the difference between the pre- and post-development 1 in 100-year flows. This difference in pre- and post-development flows is effectively the proposed flexible pavement layers over the 6,500m² pad area for the proposed installation of critical infrastructure for the BESS project.

While developing, it is crucial to not impact any pre-development flows. This drainage strategy has been designed with this in mind, and the proposed drainage will flow in the direction of existing flow patterns.

A portion of the lot to the east of the Study Area naturally flows toward the site. This has been shown on our Major Catchment Plan drawing which accompanies this report. This catchment will therefore sheet flow towards the subject site and across Abattoir Road. This area is shown in cyan blue below which would impact the proposed works area.

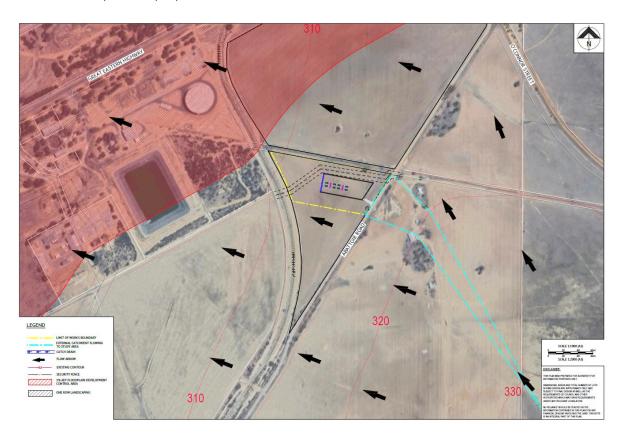


Figure 3 - Major Catchment Plan

As explained in Section 1.1 Location and in the above Major Catchment Plan, the Study Area is adjacent to a 'flood-prone' area due to being within 300m of the 1 in 100 AEPI Floodplain Development Control Area. This Floodplain Development Control Area is shown hatched in red. The subject site offers strong continual slopes from regional highpoints around RL 332 to the southeast. These gradients lessen further to the west of the site as evidenced by the red shaded area which has the higher likelihood of inundation in major storm events. Therefore, a simple strategy of diverting the upstream catchment around the proposed BESS hardstand and infrastructure, and the provision of a suitably sized catch basin at the western, or downstream end of the BESS hardstand is suitable.

The image below shows the general overland flow across the site, and the proposed drainage strategy to be implemented within the proposed pad for the BESS infrastructure. 135mm depth swales are to be located within the landscape buffers. This low flow swale should be located centrally within the landscape buffers with vegetation planted off centre to allow the swale to function for the critical storm events.

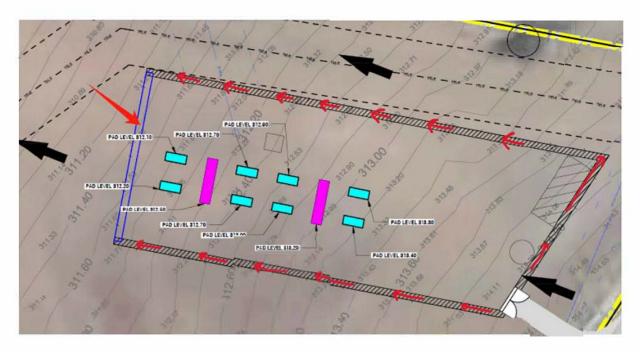


Figure 4 - Drainage Strategy - Lot 12 Abattoir Road, Merredin

As nominated earlier, we believe the pad level should be elevated a minimum of 150mm above the existing levels of the site. This would enable a simple overland flow of pre-development flows to continue around the proposed hardstand and infrastructure.

Does the location have suitable flow-paths for existing overland flow?	YES. The subject site is grading toward the west and north-west, away from the proposed hardstand and infrastructure that is to be developed.
Can infiltration drainage techniques be used?	NO. Desktop reviews and site photos received from the client have been used to determine the infiltration of the Study Area. A value of 0.5m/day has been utilised which is conservatively low, however the presence of gravel / gravelly clays on the site leads us to believe that the soil isn't suitable for infiltration techniques and therefore a low permeability should be used in our calculations.
Do existing stormwater drainage systems exist in site vicinity?	YES.

There is an existing 0.6H x 1.85W drain to the west of the Study Area as well as an existing swale that runs along the north of the Study Area. This existing swale helps protect the site from larger upstream catchment flows, hence the external catchment shown in our Major Catchment Plan is isolated and thin. The majority of the upstream catchment through the subject landholding does not impact the proposed 6,500m² building pad.

1.2.1 DEFINE INFORMATION REQUIREMENTS

The following information has been sourced as part of this study, and utilised in determining the Desktop Stormwater Drainage Study: -

- Aerial Imagery Reviewed from Google Maps
- Existing Rainfall Data for Merredin The Bureau of Meteorology keeps detailed information for a range of centres in Australia.

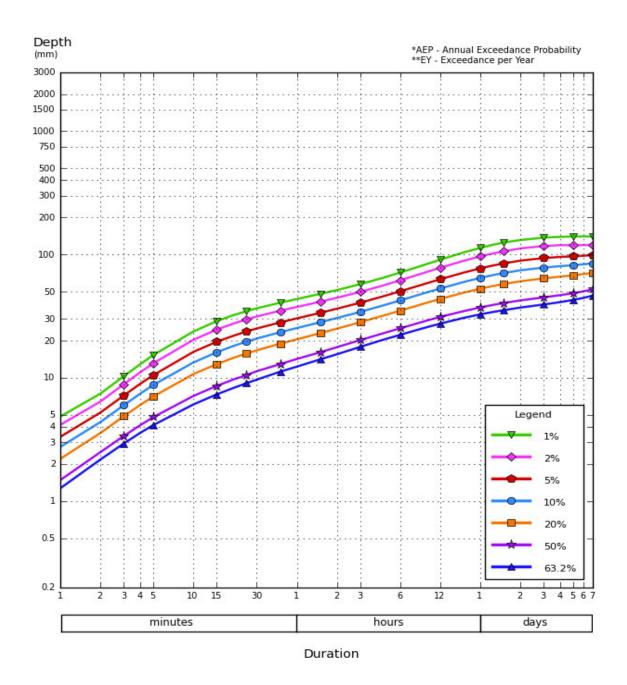
The following table is taken from the Bureau of Meteorology and shows detailed rainfall statistics for the nearest major station at Merredin, with statistics collated since 1903.

Table 2 – Average Monthly Rainfall Statistics

Month	*Mean Monthly Rainfall (mm)
January	14.5
February	15.7
March	21.4
April	22.8
May	40.0
June	48.5
July	50.0
August	39.4
September	25.3
October	18.5
November	15.2
December	13.7
Annual	325.0

Ref: Monthly Rainfall - 010092 - Bureau of Meteorology

The IFD chart below is taken from the Bureau of Meteorology for Merredin (Ref: <u>Rainfall IFD Data System:</u> <u>Water Information: Bureau of Meteorology</u>



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Figure 5 – Bureau of Meteorology IFD Chart – Merredin



1.2.2 POST DEVELOPMENT COEFFICIENTS OF RUNOFF

The following table provides the detail of runoff coefficients used in the stormwater drainage modelling for this Desktop Stormwater Review: -

Table 3 – Proposed Post-Development Runoff Coefficients

63.2% A EP	18.1% AEF	1% AEP
0.50*	0.50*	0.60*

^{*}NOTE: These coefficients have been used for the area that is proposed to be developed (within the security fence). The rest of the Study Area has been kept at the pre-development coefficient of 0.2 for all calculations.

1.2.3 DETAILED HYDROLOGICAL ANALYSIS – POST DEVELOPMENT

Premise have run a series of design checks to satisfy the Shire of Merredin's requirements that the differences between the pre- and post-development storm events are managed for storm events falling on the proposed BESS infrastructure pad. Our first analysis is to use a synthetic hydrograph to determine appropriate basin storage on the western edge of the proposed BESS infrastructure pad. The critical design elements are: -

Table 4 - Critical Design Elements for the Proposed 1% AEP Storage

Item	Notes
Basin Measurements	50m x 2m
Side Slopes	1 in 3
Basin I.L.	311.0m AHD
Coefficient of Runoff	0.5 (clay / gravelly clay / gravels)
Mannings Coefficient of Runoff (n)	Grass = 0.03 Compacted limestone / road base = 0.025

On the following pages are tables showing the synthetic hydrograph outputs for the 1% AEP.

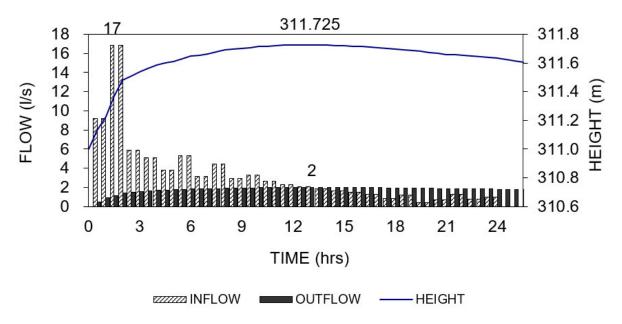


Figure 6 - Inflow-Outflow 100Yr 24Hr Event

The following graph shows the relationship between outflow, storage and height. The outflow in this example is infiltration into the soil. The model is conservative in that it doesn't allow for evaporation from wind or solar energy.

OUTFLOW & STORAGE vs HEIGHT

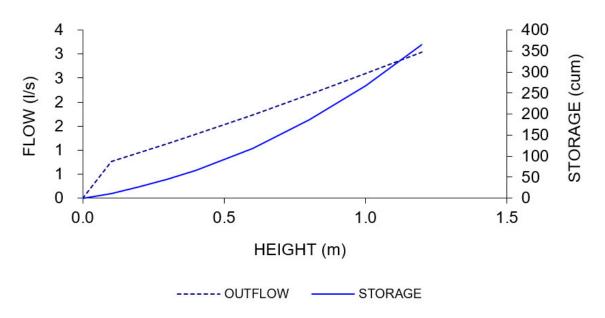


Figure 7 – Outflow and Storage vs Height (100Yr 24Hr)

FLOW WEIGHTED DETENTION TIME

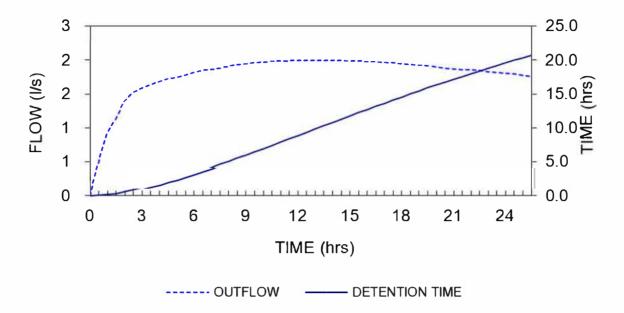


Figure 8 - 1% AEP Hydrograph (24 Hr)

The basin has been designed to accommodate the 1% AEP event shown in the graphs above. This means the design is robust for all storm events, and the catch drain system will protect the proposed BESS infrastructure pad from all external catchments.

The total area of the site is 32.33ha, however the contributing catchment at 26,567m² and 6500m² denoted as the proposed BESS Infrastructure Pad area. The remainder of the site will be left undeveloped and is therefore outside of the calculations presented in this report.

Premise have run a series of design checks utilising a set of drainage spreadsheets. The table below is based on: -

- Soil infiltration rate of 0.5m/day.
- Design Retention Volume = 164m3 for the 1% AEP.
- The proposed swale will have a depth of 0.725m for the 1% AEP and will then allow overtopping to maintain pre-development flows.

Table 5 – 1%, 18.1% and 63.2% AEP Drainage Calculations

Catchment Calculation	Equivalent Area (ha)	Time (hrs)	Catch Swale IL	Depth (m)	Storage Volume Required (m³	T.W.L
-		Lot 12 A	battoir Road	d, Merredin		-
1% AEP	0.260	24	311.00	0.725	161	311.725m
18.1% AEP	0.195	12	311.00	0.313	47	311.313m
63.2% AEP	0.195	6	311.00	0.179	23	311.179m



1.2.4 MANAGEMENT OF OVERLAND FLOWS AND FLOW DEPTH CALCULATIONS

The second phase of the drainage design is to review the likely depth of flows across the proposed BESS Infrastructure Pad to ensure critical infrastructure is stored above the likely sheet flows for each storm. Premise personnel have developed drainage calculations utilising the rational method and 2016 IFD charts and rainfall data from the Bureau of Meteorology for Merredin. To determine catchment depth of flow characteristics over a total catchment, we have broken the catchment into nodes in accordance with standard drainage design principles. The nodes in the drainage catchment are shown in the Major Catchment Diagram below: -



At each of the nodes, we have determined the following: -

- The terrain slope
- The Mannings n coefficient
- Total length of catchment
- Total area of the catchment
- Time of concentration
- Rainfall intensity for the appropriate storm duration

The outputs we then measure at each point in the catchment are the depth of flow and the velocity of that flow. These outputs allow us to set the critical infrastructure 150mm above the 1% AEP sheet flow.



Table 6 - Sheet Flow and Depth of Flow Calculations (1% AEP)

Catchment Node	Depth of Flow (mm)	Side Slopes	Flow Width (m)	Mannings 'n'	Slope (%)	Time of Concentr ation (min)	Flow Velocity (l/sec)
Ch 0.0	n.a.	3%	n.a.	0.025	n.a.	0	n.a.
Ch 710	13	3%	20.0	0.025	2.4	39.42	68.9
Ch 740	100	1 in 3	1.1	0.025	2.43	40.22	71.8
Ch 870	135	1 in 3	1.31	0.03	2.38	44.62	127.3
Sheet Flow	12	1%	50	0.025	1.97	13.96	128.9

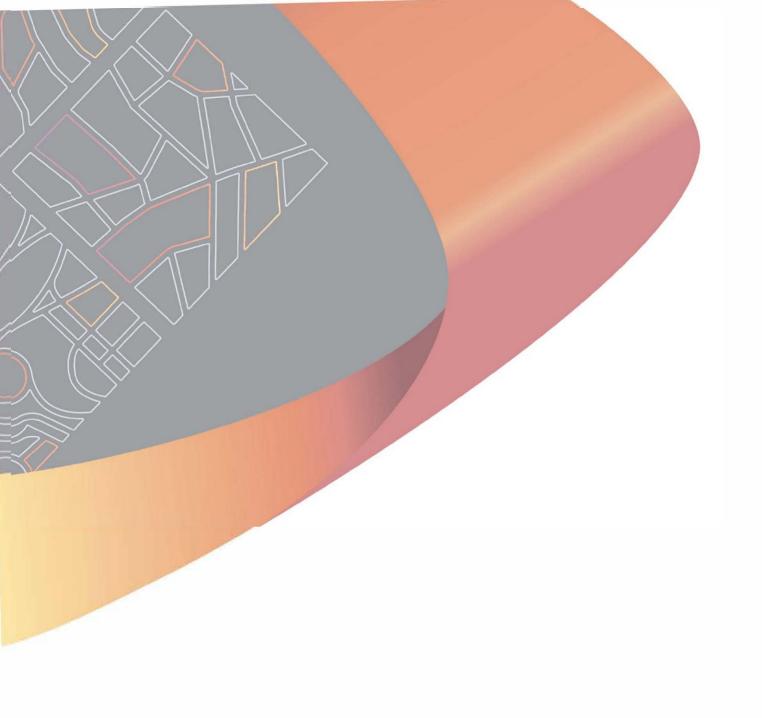
The calculations from Ch 0.0 to CH 870 above enable Premise to confirm diversion swales can form part of the landscaping along the edges of the BESS Infrastructure Pad. The depth of flow in these swales is insignificant at a maximum of 135mm.

The sheet flow calculation in dark red in the last row of Table 6 above is a calculation showing the depth of sheet flow in the 1% AEP across the BESS Infrastructure Pad. This calculated depth at 12mm confirms the 150mm minimum clearance above proposed pad levels is sufficient to protect infrastructure.

1.2.5 SUMMARY

The drainage calculations above and attached in the appendices show that the drainage system is robust. Therefore, Premise believe that this drainage strategy will adequately manage flood risk while keeping pre-development flows to their natural flow paths.

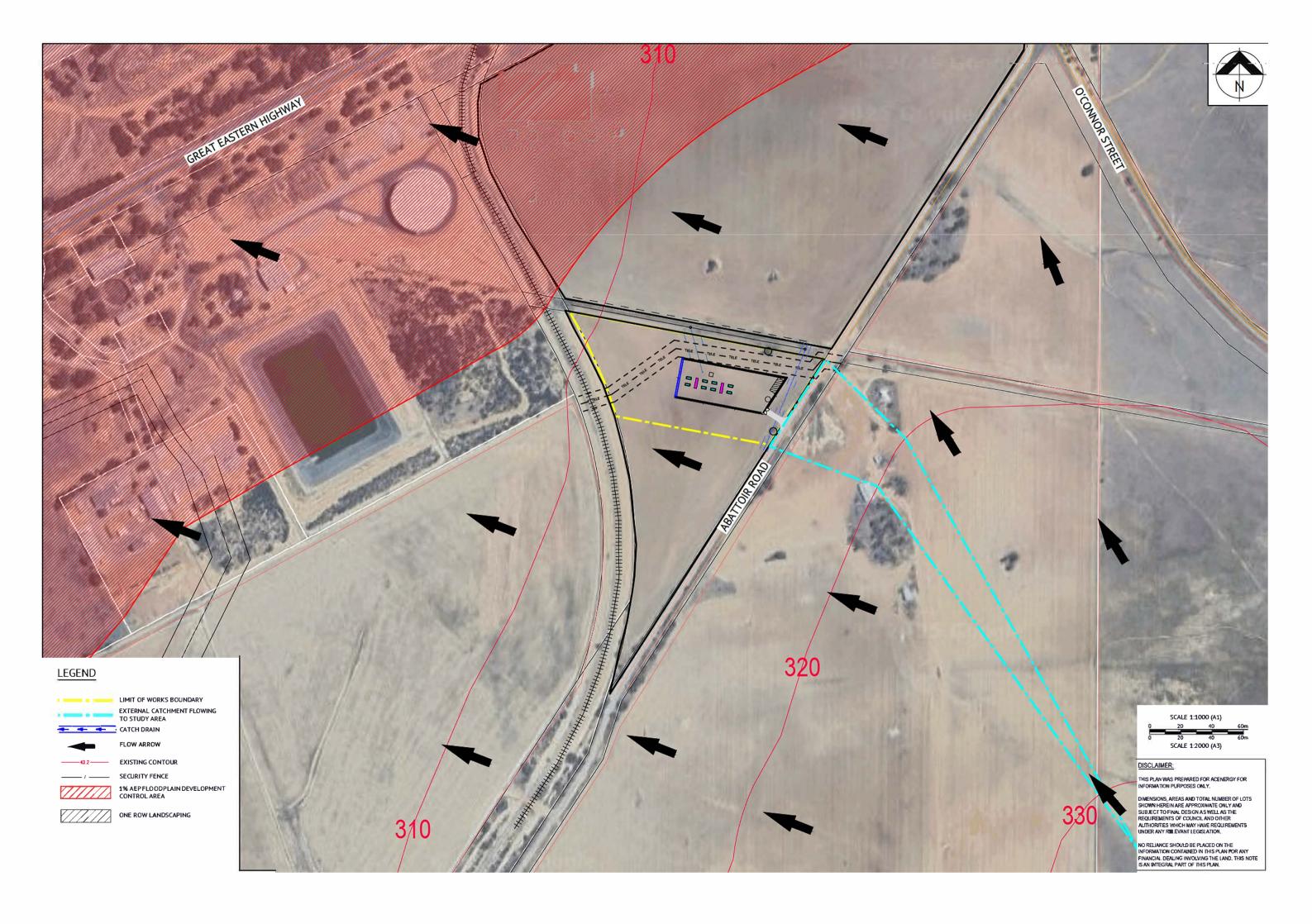
As mentioned earlier in this report, we believe it is prudent that upon topsoil stripping, the Contractor provides a finished surface level for the BESS Infrastructure Pad that is 150mm above the existing surface level.

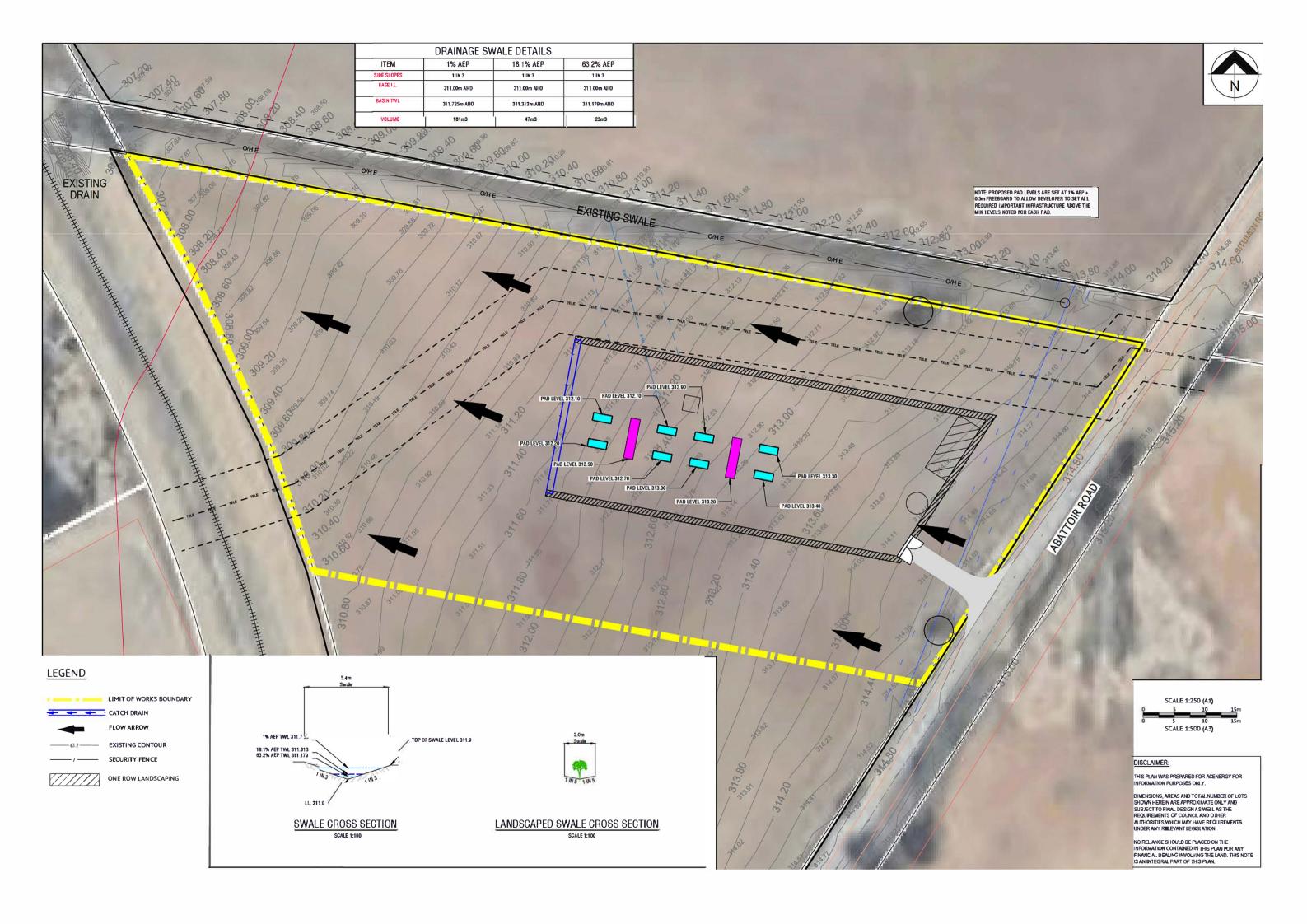




<u>Appendix A</u>

ENGINEERING DRAWINGS





<u>Appendix B</u>

DRAINAGE CALCULATIONS



PRE AND POST-DEVELOPMENT OVERLAND FLOW CHARACTERISTICS 1:1 year ARI

PROJECT: P003016 Merredin BESS Stormwater

DATE: \$/05/2025

Start CH0.00 - Merredin BESS Top of Catchment

Ragional Method	PRE DEV	POST DEV	Notes 3.6438
Catchrount area overland - m ²	0	0	Total Merredin Cathbrient = 2.6567 bz
Razioff Conflictment - %	20	20	Purnoff Coefficient for Gracs = 0.03
Catchrount area Lots - m ²	0	0	
Razoff Conficient - %	20	20	
Catchroent area Verge - m²	0	0	
Russoff Confficient - %	20	20	
lorpervious area - Itt ²	D	ъ	
Langth of everland flow - m	710	710	
Cattebrownt top R1	332.0	332.0	
Cattabrount Base RL	315.00	315.00	
Ground slope to extrem S	0.024	0.024	
Overland Flow Time - min	35 34	35.34	Kinematic Wave Eqn (Manning's n) - grass 0.025
Time Upstream - mis	0.00	0.00	
Total Overland Flow Time - min	35.34	35,34	
lebesity - :em/hr	19.0	19.0	Refer IFD Table
Flow - Gres/sec	0.0	0.0	
Flow - 677's	0.00	0.00	

FLOWRATE WITHIN EXISTING OPEN CHANNEL ORAIN - MANNING FORMULA (CHO.00)

Depth of flow	LH bank slope %	RH bank slope %	Base width m	Flow width m	Marxing's n	Flow section area a	Wetted perimeter P	Hydrautic radius a/p=r	Channel Siope S %	Channel Flow Q m ^y sec	Flow Velocity m/sec
0	16.67	16.67	0.50	0.500	0.025	0.00	0.50	0.00	0.7	0.00	#D(V/O!
		n for	excavated eart	h drains with sh	ort grass, few w	reeds				0.00	

CH 710.0m - Open Drain

Rational Method	PRE DEV	POST DEV		
Carchroent area overland - m²	20000	20000	fi .	
Russoff Confficient - %	20	20	Calculated Average Runoff Coefficient	
Catchount area Lots - m2	0	0	Carbon Notae Later Control	
Rapport Confinement - %	20	20		
Carchronnt area Main Drain - m²	0	0		
Remoff Confficient - %	20	20		
l opervioes area - m²	4000	4000		
Laugth of overland flow - m	710	710		
Catchroent top R1.	332.0	332.0		
Catchronnt Base RL	315.00	315.00		
Ground slope to extvert S	0.024	0.024		
Overland Flow Time - min	39.42	39.42	Kinematic Wave Eqn (Manning's n)	
Time Upstream - mis	0.00	0.00		
Total Overland Flow Time - min	39.42	39.42		
lenesity - meu/ar	17.0	17.0	Refer IFD Table	
How - litrus/sec	18.9	18.9		
Flow - m ³ /s	0.02	0.02		

FLOWRATE ACROSS EXISTING LAND - 20m WIDE SHEET FLOW CALCULATION

Depth of flow	LH bank slope	RH bank slope	Base width	Flow width	Manning's	Flow section area	Wetted perimeter	Hydraulic radius	Charriel Slope	Charmel Flow	Flow Velocity
THE	- %	%	m	m		a	Р	a/p=r	S %	Q m ³ /sec	m/sec
6	3.00	3.00	20.00	20.400	0.030	0.12	20.40	0.01	2.3944	0.02	0.2
		n for	excavated eart	h drains with s	ort mass few w	eeds				0.02	

CH 740.0m - Open Drain, Channel Away from Development Area (Western Side of Abattoir Road)

TO.OM Open Diam, enginerane	,		on old of Pariton House	
cal Method	PRE DEV	POST DEV		
rount area overland - m²	20500	20500		
Conflicient - %	20	20	Calculated Average Runoff Coefficient	
ent area Lots - 1112	0	0	Tanana and the River Communication	
Cofficient - %	20	20		
oust area Main Orain - m²	0	0		
Conflicient - %	20	20		
¹ m - sers 200k	4100	4100		
f evertand flow - m	740	740		
ment top R1.	332.0	332.0		
ent Base RL	314.00	314.00		
siope to extvert S	0.024	0.024		
d Flow Time - min	40.22	40.22	Kinemat	tic Wave Eqn (Manning's n)
Jpstream - mie	0.00	0.00		
Overland Flow Time - min	40.22	40.22		
ty - ध्वराऽ/विर	17.0	17.0	Refer IFD Table	
itres/sec	19.4	17.0 19.4	TROID II D Talke	
नरेड	0.00	0.02		

FLOWRATE WITHIN THE EXISTING OPEN CHANNEL DRAIN - MANNING FORMULA

Depth of flow	LH bank slope %	RH bank slope %	Base width m	Flow width m	Manuing's n	section area	perimeter perimeter	nyourainec radius a/p=r	Slope S %	Flow Q m³/sec	Velocity m/sec
55	33.33	33.33	0.50	0.830	0.030	0.04	0.85	0.04	2.4324	0.02	0.6
		n for	excavated eart	h drains with sh	ort grass, few w	eeds				0.00	

CH 870.0m - Western end of BESS

Rational Method	PRE DEV	POST DEV
Caretroest area overland - m²	28500	20000
Runoff Conficient - %	20	20
Catchrount area Lots - m ²	0	8500
Razioff Conflictment - %	20	80
Cauchrount area Main Drain - m²	0	0
Rapoff Conficient - %	20	20
l <i>o</i> quervious area - m²	5600	7900
Laugth of overland flow - m	870	870
Catebroent top RL	332.0	3320
Catchronnt Base RL	311.30	311.30
Ground slope to extvert S	0.024	0.024
Overland Flow Time - min	44.62	44.62
Time Upsveren - mis	0.00	0.00
Total Overland Flow Time - min	41.62	46.02
labosity - resulter	16.0	16.0
	10.0	10.0

3MD ATE MITH	THE EXISTING OPE	NI CHANNEL DO AIN	MANNING FOR	MIII A								
OWRATE WITHII	THE EXISTING OPE	N CHANNEL DRAIN	- MANNING FOR	RWULA		Flow	Wetted	Hydraulic	Channel	Channel	Flow	
Depth of flow	LH bank slope	RH bank slope	Base width	Flow width	Manning's	section area	perimeter	radius	Slope	Flow	Velocity	
mm	%	%	m	m	n	а	. р	a/p = r	s %	Q m³/sec	m/sec	
75	33.33	33.33	0.50	0.950	0.030	0.05	0.97	0.06	2.3793	0.04	0.8	
		n for	excavated eart	h drains with sh	ort grass, few w	eeds				0.04		
x Culvert Sizing	Check - Analysis fo	r Comparative Purp	oses Only								HGL Calculations	
OX CIII VERT EI OW	ANALYSIS - MANNING	FORMULA									TIGE Galculations	
DA GOLVEIN TEOM	TABLETOID INDIGNICA	OIIIIOD1			Flow	Wetted	Hydraulic	Culvert Flow	Culvert Flow	Flow	Entry	Ben
Cub	ert size	Number of	HGL slope	44				•	•			Los
		Mailibal of	nar siobe	Manning's	section area	perimeter	radius	Q	Q	Velocity	head loss	
Width mm	Depth mm	Culverts	%	n	a	. P	а/р = г	u m³/s	litres/sec	m/sec	m	m
				n 0.012		•		m³/s 0.21	litres/sec 206			m
Width mm	Depth mm	Culverts	%	n	a	. P	а/р = г	m³/s	litres/sec	m/sec	m	m 0.10
Width mm 300	Depth mm 300	Culverts	%	n 0.012	a	. P	а/р = г	m³/s 0.21	litres/sec 206	m/sec	m	m
Width mm 300	Depth mm 300	Culverts	%	n 0.012	a	. P	а/р = г	m³/s 0.21	litres/sec 206	m/sec	m	m
Width mm 300	Depth mm 300	Culverts	%	n 0.012	a	. P	а/р = г	m³/s 0.21	litres/sec 206	m/sec	m	m
Width mm 300 ircular Pipe Chec	Depth mm 300 k Sizing Check	Culverts 1	%	n 0.012	a	. P	а/р = г	m³/s 0.21	litres/sec 206	m/sec	m	m
Width mm 300 ircular Pipe Chec	Depth mm 300	Culverts 1	%	n 0.012	a	. P	а/р = г	m³/s 0.21	litres/sec 206	m/sec	m	m
Width mm 300 Fircular Pipe Chec	Depth mm 300 k Sizing Check	Culverts 1	%	n 0.012 n for concrete pipe	a 0.090	р 1.2	a/p = r 0.0750	m³/s 0.21 0.035	litres/sec 206 35.11	m/sec 2.286	m	m
Width mm 300 Fircular Pipe Chec	Depth mm 300 k Sizing Check w Analysis - Mannii	Culverts 1	% · 2.38	n 0.012 n for concrete pipe	a 0.090 Wetted	p 1.2 Hydraulic	a/p = r 0.0750 Culvert Flow	m ² /s 0.21 0.035	Iltres/sec 206 35.11	m/sec 2.286	m	m
Width mm 300 Circular Pipe Chec OUND CULVERT FLC Culvert size Depth mm 375	Depth mm 300 k Sizing Check W ANALYSIS - MANNII Number of Culverts	Culverts 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	% 2.38 Manning's	n 0.012 n for concrete pipe	a 0.090 Wetted perimeter	p 1.2 Hydraulic radius	a/p = r 0.0750 Culvert Flow Q	m ⁰ /s 0.21 0.035 Culvert Flow Q	litres/sec 206 35.11	m/sec 2.286 Entry head loss	m	m
Width mm 300 Circular Pipe Chec OUND CULVERT FLC Culvert size Depth mm 375 ead Loss Calculations	Depth mm 300 k Sizing Check W ANALYSIS - MANNII Number of Culverts	Culverts 1 1 IG FORMULA HGL slope %	% 2.38 Manning's	n 0.012 n for concrete pipe	a 0.090 Wetted perimeter p	p 1.2 Hydraulic radius a/p = r	a/p = r 0.0750 Culvert Flow Q m³/s	m ⁹ /s 0.21 0.035 Culvert Flow Q litres/sec	litres/sec 206 35.11 Flow Velocity m/sec	m/sec 2.286 Entry head loss m	m	m
Width mm 300 Circular Pipe Chec OUND CULVERT FLC Culvert size Depth mm	Depth mm 300 k Sizing Check W ANALYSIS - MANNI Number of Culverts 1	Culverts 1 1 IG FORMULA HGL slope %	% 2.38 Manning's	n 0.012 n for concrete pipe	a 0.090 Wetted perimeter p	p 1.2 Hydraulic radius a/p = r	a/p = r 0.0750 Culvert Flow Q m³/s 0.29	m ⁹ /s 0.21 0.035 Culvert Flow Q litres/sec	litres/sec 206 35.11 Flow Velocity m/sec	m/sec 2.286 Entry head loss m	m	m

V DRAIN FLOW ANALYSIS - MANNING FORMULA



PRE AND POST-DEVELOPMENT OVERLAND FLOW CHARACTERISTICS 1:5 year ARI

PROJECT: P003016 Merredin BESS Stormwater

DATE: 5/95/202

Start Cl(0.00 - Merredin BBGS Top of Catchment

Rational Market Catalogue area over b		PRE DEV	POST DEV		Helia							
Remail Confisions - %		20	20		Total Marrodia Catal Runoff Coefficient fo							
Continues area Lets -	ro ^c	0	0									
Remail Confisions - %		20	20									
Remail Conflicient - %		20	0 20									
propertions near - us.		0	0									
Longth of everland flo	w · m	710	710									
Continue top RL Continue Base RL		332.0	332.0 315.00									
Ground shope to earlie	et S	0.024	0.024	1								
Overland Flow Term -		35.34	35.34					Kinematie Wave E	Eqn (Manning's n) -	grass	0.025	
Time Upst can - min		0.00	0.00									
Total Overland Flow Ti	- -	35.34 32.0	35.34	Rotor BFD Table								
Interestly - percent Plane - Octobilism		0.0	0.0	1400 AD 1300								
Flow - mY2		0.00	0.00									
H.OWKATE WITHIN	EXISTING OPEN CHA	ANNEL UKABN - MAZ	WHING PORMUL	∆(C2:00.000)		Flow	Wetted	Hydraulic	Clarel	Charmel	Flow	
Depth of flow	LH brank all ope	Rid bank alope	Base width	Flow width	Manuing's	eaction area	pertmeter	radius	Skope	Flow	Velocity	
nm	%	%	m	m	n	9	P	a/p = r	5%	QIII*/sec	m/sec	
0	16.67	16.67	0.50	0.500	0.025	0.00	0.50	0.00	0.7	0.00	#DIVIO!	
		n tor	excavated eart	n dramswith s	hortgræs, few w	eeds				0.00	i.	
CH 710.0m - Open	Drain											
Rational Markey Condensate area growth		PRE DEV	POST DEV									
Carlinat area overb		20000 20	20000 20									
Continued area Lets -	m ^e	0			Calculated Average	Sunoff Coefficient						
Remail Conflicient - %		20	20									
Continuent area lifeir I Romanii Conflicient - %		0	0									
productions may - mg		20 4000	20 4000									
Leagth of everland flo	w - m	710	710									
Canada Sup RL Canada Rhose RL		332.0 315.00	332.0 315.00									
Ground shope to eafer		0.024	315.00 0.024									
Overland Flow Time •		39.42	39.42					Kinematie Wave E	iqn (Manning's n)		0.03	
Timo Upot cam - min		0.00	0.00									
Total Overhand Flow Ti	-	39.42	39.42									
Plow - Ozwa/see		29.0 32.2	29.0 32.2	Refer IFD Table								
Flow - mYs		2.00	0.00									
EL CHARATE ACROS	S EXISTING LAND - 2	20m Water 1 at a 1	OW CALCIE AT	TION								
I.Omorization	O CHOIRD LAID	LONI VIEL CIALLY I	LOW ONLOWS			Flow	Wetted	Hydrausic	Chammal	Charmel	Flow	
Depth of flow	LH bank alope	Ril bank alope	Base width	Flow width	Manning's	section area	bertweter	radius	Slope	Flow	Velocity	
8	3.00		m	m	n	a 0.16	P 20.53	a/p=r 0.01	2.3944	Q m*fsec 0.03	m/sec 0.2	
	200	3.00	20.00	20.533	0.030		20.55	0.01	2,3944	0.03	0.2	
Rained Method Cataloguet 2012 overla Ramifi Cateloguet - %		20000 20	20000 20		Calculated Average	Rossell Conflictions						
Contract and lets -	m ^c	0	0		Calculated Average	Sundf Lorthorni						
Remail Conflicter - %		20 0	20 0									
Remail Confisions - %		20	20									
palmaniam may - 102		¥100	4100									
Longth of evertued flo	w - m	740 IS2.0	740 332.0									
Canada Sap RL Canada Sana RL		14.00	314.00									
Ground slope to calve Overland Flow Time •	et S	1024	0.024 40.22					P	Eqn (Manning's n)		0.03	
Timo Upsteam - min		0.00	0.00					Variety of A 1/6 i	cdu (manumè a u)		0.00	
Total Overhand Flow Ti	ingo - min	40.22	40.22,									
many - myle		29.0	29.0	Refer IFD Table								
Flow - Ozes/see Flow - mYs		33.0	33.0									
FI.OWRATE WITHEN	THE EXISTING OPE	N CHANNEL DRAIN	MANNENG FOR	AJU		Ete-			-	Ob	D=::	
236.0022	LH bank alope	Rif bank alops	Base width	Flow width	Manulogra	Flow section area	Wetted perimeter	Hydraulic radius	Creavel Slope	Charmel	Flow Velocity	
Depth of flow	*	*		m	n	a	P	a/p=r	S %_	Q III*/bec	rofteec	
65	33.33	33.33	0.50	0.890	0.030	0.05	0.91	0.05	2.4320	0.03	0.7	
		n for	excavated eart	h drains with s	hort grass, few w	eeds				0.03	I	
CI 1 870.0m - West	en and of RFSS											
11860	414 41 8644											
الماسا الماسا		PRE DEV	POST DEV									
Carlesont area overla Rameli Confesiont - %		25500 20	20000 20									
Contract and Late -	m [£]	0	6500		Calculated Scarcon	Remail Confirment						
Result Confesions - %		20	80									
Continuent area Main I Rossell Conflicient - %		0	0									
primariono mar - m²		20 5300	20 7900									
Longth of evertured flo	w - m	870	870									
Continue top RL Continue Bose RL		332.0	332.0									
Ground shope to eather		311.30	311.30									
Overland Flow Time •		44.0E 0.00	44.62 0.00					Kinematie Wase E	Eqn (Manning's n)		0.03	
Timo Upstream - min Total Overtand Flow Ti		0.00 44.62	0.00 44.62									
Total Overtand Flow Ti Intendity - province		27.0		Refer IFD Table								
Flow - Bares/see		39.8	59.3									
Flow - m7s		0.04	0.06									
FI.OWRATE WITHEN	THE EXIST ING OPE	N CHANNEL DRAIN	MANNING FOR	MULA								
						Flow	Wetted	Hydraulic	Charrel	Charmel	Flow	
Depth of flow com	LH brank alope	Riil Dank alopa %	Base width	Flow width m	(Maren) right	eection area	perimeter	radius. a/p=r	Slope 5 %	Cill*/sec	Velocity	
95	33.33	33,33	0.50	m 1.070	0.030	9 0.07	P 1,10	avp=r 0.07	2,3793	0.06	0.9	
		Sitter			hort grace, few w			3.01	2.07.50	0.06		
Roy Culture Ci	Check - Analysis for	r Commodie II	angae fluib									
_	-		~oos UMY								HGL Caleston	
OX CULVERT FLOW	SHINKEN - SIEYLANA	FORMULA								_		
	ert sio	Number of	HGL slope	ووضطنا	Dow section area.	Westerd perimutar	متلحد شراط دمیشده	Culvert Flow Q	Culvert Flow	Flow Vedenity	Entry head less	Bond Less

Width mm	Depth mm	Culverts	%	n	а	P	a/p = r	m³/s	litres/sec	m/sec	m	m	m	m
300	300	1	2.38	0.012	0.090	1.2	0.0750	0.21	206	2.286	0.266	0.107	0.186	#REF!
				n for concrete pipe				0.059	59.25					
Circular Pipe Check	Sizing Check													
ROUND CULVERT FLO	W ANALYSIS - MANNI	NG FORMULA												
				Flow	Wetted	Hydraulic	Culvert Flow	Culvert Flow	Flow	Entry				
Culvert size	Number of	HGL slope	Manning's	section area	perimeter	radius	Q	Q	Velocity	head loss				
Depth mm	Culverts	%	n	a	P	a/p = r	mª/s	litres/sec	m/sec	m				
375	1	2.379	0.012	0.110	1.2	0.0938	0.29	293	2.65	0.359				
Head Loss Calculations							0.05925							
hl = k (Vo2/2g)														
Vo - outlet pipe velocity														
2g = 2 x 9.81m/sec2														
Loss (m) = k (V12 -	V22)/2a													
, , ,	, ,													
V DRAIN FLOW ANALY	SIS - MANNING FORM	ÍULA												
					Flow	Wetted	Hydraulic	V drain	V drain	V drain	V drain			
Depth of flow	Left side	Right side	Flow width	Manning's	section area	perimeter	radius	8	Q	Q	Velocity			
mm	%	%	m	n	a	. D	a/p = r	%	m³/s	litres/sec	m/sec			
160	33.33	33.33	0.960	0.03	0.0768	1.0120	0.0759	2.379	0.07	71	0.92			
_			-											



PRE AND POST-DEVELOPMENT OVERLAND FLOW CHARACTERISTICS 1:10 year ARI

PROJECT: P003016 Merredin BESS Stormwater

DATE: 5/95/2021

Start Cl(0.00 - Merredin BBGS Top of Catchment

Rational Machinel Continuous area overhand - m ²								
Cappening Start GARAGES - Wg	PRE DEV	POST DEV	Heles					
Remail Conflicient - %	20	20	Total Marrodo Catalanani = 2.5567 Runoff Coefficient for Grass = 0.03					
Combinated area Lets - ref	0	0						
Remail Conflicient - % Confinent area Verse - or	20	20						
Remail Confisions - %	20	0 20						
pubmiciono mer - m ₂	0	0						
Leagth of everland flow - m	710 332.0	710 332.0						
Condenses Base RL	415 00	315.00						
Ground shope to earliest S	35.34	0.024					0.025	
Overland Flow Term - min Time Upstream - min	35.34 0.00	35.39 0.00			Kinematie Wave E	qn (Manning's n) - grass	0.025	
Tetal Overtand Flow Time - min	35.34	35.31						
transfer - profes	39.0	39.0 Refer IFD To	čla					
Flow - Ocros/see	0.0	0.0						
FI.OWRATE WITHIN EXISTING OPEN CHA			Flow		Hydraulic	Charmel Charmel	Flow	
Depth of flow LH bank alope	Riibankalope %	Base width Flow w	idth Maeilog'e eadfon: n a	area pertmetar P	autban 1=qka	Skopa Flow 5% Quiffeec	Welocity	
0 16.67	16.67	0.50 0.50			0.00	0.7 0.00	WDIV/OI	
	n for e	excavated earth drains w	rith short grass, few weeds			0.00	l.	
CH 710.0m - Open Drain								
Radinari Mathari	PRE DEV	POST DEV						
Carbon and control out	20000	20000						
Remail Conflicient - %	20	20	Calculated Average Runoff Coeffic	ient				
Combinent area Lets - m ² Remail Confisiont - %	20	20						
Combinant area Main Drain - m²	0	0						
Remail Confisions - % Impurvious area - m²	20	20						
Leagth of everband flow - m	4000 710	4000 710						
Condenses top RL. Condenses Base RL.	332.0	332.0						
Condensed Base RL Ground above to enforct S	315.00 0.024	315.00 0.024						
Overland Flow Time - min	39.42	39.42			Kinematie Wave E	qn (Manning's n)	0.03	
Timo Upstream - min	0.00	0.00						
Total Overtage Flow Time - min	39.42	39.42						
Flow - Mixed/see	36.5 40.6	36.5 Refer IFD T 40.6	able					
Plee - mYs	0.04	200						
FILOWRATE ACROSS EXISTING LAND - 2	Om WIDE SHEET FL	OW CALCULATION			100000000		-	
Depth of flow LH bank slope	Riil bank alope	Base width Flow v	Flow width Manning's section:	Wetted area perimetar	Hydraulic radius	Charmel Charmel Slope Flow	Flow Velocity	
m %	- 3	Th m	n a	P	a/p=r	S % Q m*feec	rotesc	
9 3.00	3.00	20.00 20.6		20.60	0.01	2.394 0.04	0.2	
	n for	avezustad aseth desincu	with chart arces fow woods					
CH 740.0m - Open Drain, Chamnel Awa	y from Developmen	nt Area (Western Side of	Abathoir Road)					
Rational Markey	PRE DEV	POST DEV						
California area evertani - m²	20000	20000						
Remail Conflicient - % Considerant area Lets - m²	20	20	Calculated Average Runoff Coeffic	ent				
Remail Confisions - %	20	20						
Combinent area Main Drain - m ² Remail Conflicient - %	0 20	0 20						
Improvious area - m²	4100	4100						
Longto of evertand flow - m	740 5320	740						
Continues top RL Continues Bose RL								
Capitanest Stree FL	314.00	314.00						
Ground shope to eather t S	314.00	0.024						
Ground shipe to earliest S Overland How Time - min	314.00 0.024 40.22	0.024 40.22			Kinematie Wave E	qn (Manning's n)	0.03	
Ground above to outwet S Overland How Time - min Time Upstream - min	31400 0.024 40.22 0.00	0.024 40.22 0.00			Kinematie Wave E	qn (Manning's n)	0.03	
Ground shops to eashert S Overland How Time - min Time Upstream - min Time Upstream - min Total Overland How Time - min Intellight - mryler	314.00 0.024 40.22 0.00 40.22	0.024 40.22 0.00 40.22	žie		Kinematie Wave E	qn (Manning's n)	0.03	
Ground stope to enforct S OverSand Flow Time - min Time Upstream - min Total OverSand Flow Time - min	314-00 0.024 40-22 0.00 40-22 36.0 41.0	0.024 40.22 0.00 40.22 36.0 Refer IFD T	žile		Kinematie Wave E	qn (Manning's n)	0.03	
Ground alope to solves 15 Overfault Flow Tumo - min Timo Uperbrane - min Total Overband Flow Timo - min Total Overband Flow Timo - min Indianally - movile Flow - Ground-solve Flow - min's	314-00 0.024 40-22 0.00 40-22 36.0 41.0	0.024 40.22 0.00 40.22 36.0 Refer IFD T	ižia		Κινοιαιτόο Wzve E	gn (Manning's n)	0.05	
Crossed shops to earliest 5 Overhand Reve Tisse - min Tisse Updrawn - min Total Overhand Flow Tisse - min Intell Overhand Flow Tisse - min Intell Overhand Flow Tisse - min Intell Control San Flow - Garcel San F	314:00 0.024 40:22 0.00 40:22 36:0 41:0	0.024 40.22 0.00 40.22 36.0 Refer IFD T 41.0	Flow		Hydraud c	Charres Charres	Flow	
Ground shipe to entwert 5 Overland Flow Time - min Time Upstream - min Tatal Overland Flow Time - min Intelled - movther Flow - Growten Flow - Growten	314-00 0.024 40-22 0.00 40-22 36.0 41.0	0.024 40.22 0.00 40.22 36.0 Refer IFD T	Flow	area pertmetar	Hlydraullic radius	Charrel Charnel Slope Flow	Flow Velocity	
Fround ships to softwal S Overhald New Times - usin Time Updatesas - usin Total Overhald Flow Times - usin Intellige - usin/flow Flow - Sava-Sava Flow - alva Overhald Flow Time - Destricts Overhald Flow Life Destricts O	314:00 0.024 40:22 0.00 40:22 36:0 41:0 0.00 41:0 0.00 Rt Blank alops	0.024 40.22 0.00 40.22 36.0 Refer IFD T 41.0	Flow ficth Manning's section. na	area perimetar P	Hydraud c	Charrel Charrel Slope Flow	Flow	
Ground alope to edited 15 Overhall Rev Time - usin Time Updates - usin Total Overhall Rev Time - min Intell Overhall Rev Time - min Intell Overhall Rev Time - min Intellige - min Rev - editable Flow - editable Flow - editable Flow - editable Oppth of flow	314.00 0.024 40.22 0.00 40.22 36.0 41.0 0.00 8 CHANNEL DRAIN RH Bank slope 33.33	0.024 40.22 0.00 40.22 36.0 Refer IFD T 41.0 11.0 AAAPenNS FORMULA Base width Flows m 0.055 0.955	Flow foldh Manning's section: n section:	area pertmetar P	Hydraulic radius alp≕r	Charrel Charnel Slope Flow S % QuiMec	Flow Velocity rolled	
Eround shop to solve 15 Overhall Rev Time - min Time Updream - min Total Overhall Flow Time - min Intel	314.00 0.024 40.22 0.00 40.22 36.0 41.0 0.00 8 CHANNEL DRAIN RH Bank slope 33.33	0.024 40.22 0.00 40.22 36.0 Refer IFD T 41.0 11.0 AAAPenNS FORMULA Base width Flows m 0.055 0.955	Flow fidth Massiling's section. n a 0 0,030 0.05	area pertmetar P	Hydraulic radius alp≕r	Charmel Charmel Stops Flow 5.% Q III/Noc 2,4326 0.0.04	Flow Velocity rolled	
Crossed slope to ealther IS Overhand Reve Times - min Times Upperhans - min Tated Overhand Reve Times - min Reve - may - Overhand Common - min Tell Overhand Reversal - min Tell Overhand Reversal - min Tell Overhand Common - min Te	314:00 0.024 40:22 0.00 40:22 36:0 41:0 10:04:04:04:05:05:06:06:06:06:06:06:06:06:06:06:06:06:06:	0.024 40.22 56.0 Refer IFD T 41.0 MANAGEMENT FORMUL A Base widdth ro ro 0.501 0.95 excavated earth drains w	Flow fidth Massiling's section. n a 0 0,030 0.05	area pertmetar P	Hydraulic radius alp≕r	Charmel Charmel Stops Flow 5.% Q III/Noc 2,4326 0.0.04	Flow Velocity rolled	
Crowd shops to solve 15 Overtical Rev Time - sin Time Upstream - min Total Overtical Rev Time - min Intel Overtical Rev Time - min Intel Overtical Rev Time - min Intel Rev Time - m	314.00 0.024 40.22 0.00 40.22 36.0 41.0 0.00 8 CHANNEL DRAIN RH Bank slope 33.33	0.024 40.22 0.00 40.22 36.0 Refer IFD T 41.0 11.0 AAAPenNS FORMULA Base width Flows m 0.055 0.955	Flow fidth Massiling's section. n a 0 0,030 0.05	area pertmetar P	Hydraulic radius alp≕r	Charmel Charmel Stops Flow 5.% Q III/Noc 2,4326 0.0.04	Flow Velocity rolled	
Crowd shop to enther IS Overhald Flore Time - vins Time Updates - vins Flore - days FLOWRATE WITHIN THE EXISTING OPEN Ought of flow Lith bank stope ran 75 33.333 CII 870.0m - Western and of BESS Rational Machine Canthoner area overhand - m² Ramel Canthoner - %	314-00 0.024 40-22 0.00 40-22 36.0 41.0 10 CHAMMEL DRAIM - Rill bank silops % 33.3.33 n for e	0.024 40.22 56.0 Refer IFD T 41.0 AAAPeleNS FORMULA Base width m Base width r D Caract Dev 20000 20	Flow fidth Massiling's section. n a 0 0,030 0.05	ants perirmeter P 0.97	Hydraulic radius alp≕r	Charmel Charmel Stops Flow 5.% Q III/Noc 2,4326 0.0.04	Flow Velocity rolled	
Crowd shops to enther IS Overhand Flow Time - min Time Upstream - min Tatal Overhand Flow Times - min Interest Overhand Flow Times - min Interest Overhand Flow Times - min Interest overhands Flow - min Oughth of Time Lith bank all open TIM TIS 33.33 CII 870.0m - Western end of BESS Radiand Machand Canthounit area overhand - mil Ramel Confisions - % Continuous area overhand - mil Ramel Confisions - %	314-00 0.024 40.22 0.00 40.22 \$6.0 40.22 \$6.0 41.0 Ann CHANNEL DRAIN-I Rit bank slope 5, 5, 33.33 n for e	0.024 40.22 36.0 Refer IFD T 41.0 ANAMMOR FORMUL A Base width roun 0.552 0.55 xccavated earth drains w POST DEV 20000 20 6500	fidth Massings eaction. 0.030 0.05 Uith short græs, few weeds	ants perirmeter P 0.97	Hydraulic radius alp≕r	Charmel Charmel Stops Flow 5.% Q III/Noc 2,4326 0.0.04	Flow Velocity rolled	
Crossed shope to enther IS Overhand Flow Time - min Time Updates - min Tated Overhand Flow Times - min Tated Overhand Flow Times - min Tated Overhand Flow Times - min Enthumity - marrie Flow - min Ought of flow Lith bank alope ram % 75 33.33 CII 870.0m - Western end of BESS Radiand Machand Canthounitz area overhand - mil Ramel Confisions - % Canthounitz mars overhand - mil Ramel Confisions - %	314-00 0.024 40-22 0.00 40-22 36.0 41.0 41.0 81 CHANNEL DRAIN-I Rif bank stops 5 33.33 n for e	0.024 40.22 56.0 Refer IFD T 41.0 Ann MANMON FORMULA Base widdh m ROSS 0.55 CXCAVAREd earth Grains is FOST DEV 20000 20 6600 00	fidth Massings eaction. 0.030 0.05 Uith short græs, few weeds	ants perirmeter P 0.97	Hydraulic radius alp≕r	Charmel Charmel Stops Flow 5.% Q III/Noc 2,4326 0.0.04	Flow Velocity rolled	
Crowd shops to softwal S Overhand Piece Times - sins Time Updateses - min Tated Overhand Flow Times - min Intell Overhand - min Intell Confidence - Min Intellect - mi	314-00 0.024 40-22 0.00 40-22 36.0 41.0 41.10 Riff bank slope 5 33.33 n for e	0.024 40.22 36.0 Refer IFD T 41.0 ANAISMENT FORMUL A Begon width no m 0.550 0.55 Cxcavaled earth drains w POST DEV 20000 20 6500 60 0	fidth Massing's section as 0.050 0.050 11th short græs, few weeds	ants perirmeter P 0.97	Hydraulic radius alp≕r	Charmel Charmel Stops Flow 5.% Q III/Noc 2,4326 0.0.04	Flow Velocity rolled	
CHI BYOLON - Western and of SESS Resided Water and Children - Western Resident Resid	31400 0.024 40.22 0.00 40.22 36.0 41.0 0.00 10.00	0.024 40.22 55.0 55.0 75.0 75.0 75.0 75.0 75.0 75.0	fidth Massing's section as 0.050 0.050 11th short græs, few weeds	ants perirmeter P 0.97	Hydraulic radius alp≕r	Charmel Charmel Stops Flow 5.% Q III/Noc 2,4326 0.0.04	Flow Velocity rolled	
Crowd shops to enther IS Overhand Frow Time - usin Time Upstream - usin Tated Overhand Frow Times - usin Interest Overhand Frow Times - usin Interest Overhand Frow Times - usin Interest Overhand Tree Editives OPEN Ought of flow	314-00 0.024 40-22 0.00 40-22 36.0 41.0 41.10 Riff bank slope 5 33.33 n for e	0.024 40.22 36.0 Refer IFD T 41.0 ANAISMENT FORMUL A Begon width no m 0.550 0.55 Cxcavaled earth drains w POST DEV 20000 20 6500 60 0	fidth Massing's section as 0.050 0.050 11th short græs, few weeds	ants perirmeter P 0.97	Hydraulic radius alp≕r	Charmel Charmel Stops Flow 5.% Q III/Noc 2,4326 0.0.04	Flow Velocity rolled	
CHI BYOLONG THE STORY AND A ST	314-00 0.024 40-22 0.00 40-22 36.0 41.0 41.10 REF bank slope 5 33.33 n fore PRE DEV 25500 20 0 20 0 20 500 570	0.024 40.22 36.0 40.22 36.0 Refer IFD T 41.0 ANAI-MANING FORMALIA Base widdth TO USST 0.95 SECONVALED earth drains w POST DEV 20000 20 6500 60 0 0 20 79000 870	fidth Massing's section as 0.050 0.050 11th short græs, few weeds	ants perirmeter P 0.97	Hydraulic radius alp≕r	Charmel Charmel Stops Flow 5.% Q III/Noc 2,4326 0.0.04	Flow Velocity rolled	
Ground shope to enfore 15 From July 20 Fro	314-00 0.024 40-22 0.00 40-22 36.0 41.0 40-22 36.0 41.0 Rif bank slope 5 33.33 n for e PRE DEV 25500 20 0 20 0 20 570 332.0 311.30 41.66	0.024 40.22 56.0 76.10 7	fidth Massing's section as 0.050 0.050 11th short græs, few weeds	ants perirmeter P 0.97	Hydraulic radius alp≕r	Charmell Charmel Stops Flow Gurhac 2.4326 0.04	Flow Velocity rolled	
Crisian John to enther IS Overhand Peer Times - min Time Updates - min	314.00 0.024 40.22 0.00 40.22 \$6.0 41.0 ACHAMMEL DRAIM - Rill bank silops % 33.3.33 n for e PRE DEV 25.000 0 0 0 0 0 10 0 0 0 11.30 11.30 0.00	0.024 40.22 55.0 Refer IPO T 41.0 41.0 41.0 41.0 41.0 41.0 41.0 41.0	fidth Massing's section as 0.050 0.050 11th short græs, few weeds	ants perirmeter P 0.97	Hydraudic radius abj≕r 0.06	Charmell Charmel Stops Flow Gurhac 2.4326 0.04	Flow Velocity rohac 0.8	
Crowd shops to solve IS Overhald Flow Time - usin Time Updream - usin Flow - alva Flow - alva Ought of flow LH bank dispe TIM TIME EQSTIME OPEN Ought of flow LH bank dispe TIME TIME AND	314-00 0.024 40.22 0.00 40.22 36.0 41.0 81.0 81.0 81.0 81.0 81.0 81.0 81.0 8	0.024 40.22 40.20 0.00 40.22 36.0 Refer IFO T 41.0 A A A A A A A A A A A A A A A A A A A	idth Massings section a 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.	ants perirmeter P 0.97	Hydraudic radius abj≕r 0.06	Charmell Charmel Stops Flow Gurhac 2.4326 0.04	Flow Velocity rohac 0.8	
Ground shope to enform 15 Overhand Prev Time - min Time Updateson Prev - may's FILOWRATE WITHIN THE EQSTIME OPEN Ought of flow	314-00 0.024 40.22 0.00 40.22 36.0 41.0 0.014 0.022 36.0 41.0 0.014 0.01	0.024 40.22 0.00 40.22 35.0 Refer IFD T 41.0 Refer IFD T 41.0 Refer IFD T 70.95 0.95 20.00	idth Massings section a 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.	ants perirmeter P 0.97	Hydraudic radius abj≕r 0.06	Charmell Charmel Stops Flow Gurhac 2.4326 0.04	Flow Velocity rohac 0.8	
Ground shope to enform 15 Overhand Prev Time - min Time Updateson Prev - may's FILOWRATE WITHIN THE EQSTIME OPEN Ought of flow	314.00 0.024 40.22 0.00 40.22 \$6.0 41.0 41.0 Rit bank siops % 33.3.33 n for e FME DEV 25500 20 0 20 20 20 20 20 20 41.82 33.0	0.024 40.22 58.0 Refer IFD T 41.0 AMANWANG FORMULA Base width m 0.501 0.592 202 0.593 870 832.0 \$11.30 44.82 8.66 FD T 8.60 8.66 FD T 8.60 8.66 FD T 8.60 8.60 8.60 8.60 8.60 8.60 8.60 8.6	idth Massings section a 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.	ants perirmeter P 0.97	Hydraudic radius abj≕r 0.06	Charmell Charmel Stops Flow Gurhac 2.4326 0.04	Flow Velocity rohac 0.8	
Crowd shops to solve IS Overhall Flow Time - unin Time Updream - min Tatel Overhall Flow Time - min Tatel Overhall Flow Time - min Flow - Graylose Flow - gaylo Ought of flow LH bank stope ram - % 75 33.33 CII 870.0m - Westlern end of 8ESS Relinant Market Cantinent area overhand - min Remail Confisions - % Confi	314.00 0.024 40.22 0.00 40.22 36.0 41.0 40.22 36.0 41.0 61.0 61.0 61.0 61.0 61.0 61.0 61.0 6	0.024 40.22 0.00 40.22 35.0 11.0 AMANMING FORMULA Base width romm 0.95 202 2000 200 600 600 600 600 600 600 60	idth Mauring's section, a 0 (0.30) 0.05 Film short grass, few weeds Columbial & some Rundi Coeffee	area portradur P 0.97	Hydraudic radium alp=r 0.06	Charmel Stops Flow Quirhac O.04 U.04	Flow Velocity rohec 0.8	
Fround shope to enform IS Overhand Prov Times - min Time Updatemen - min Tated Overhand Frow Times - min Interforman - min Tated Overhand Frow Times - min Interforman - min Frow - min Frow - min Frow - min Frow - min Overhand Frow Times Times - min Tim	314-00 0.024 40-22 0.00 40-22 36.0 41.0 41.0 8 CHANNEL DRAIN- Rif bank stope 5 5 33.33 n for e PNE DEV 25500 20 0 20 0 20 531.39 41.62 0.00 41.62 33.00 41.62 33.00 41.62 33.00 41.62 33.00 41.62 41.64 61.	0.024 40.22 56.0 76.0 76.0 76.0 76.0 76.0 76.0 76.0 7	idth Massing's section, a 0 0.030 0.05 Film short grass, few weeds Charlest Europe Rinell Coeffee	portrandur P P 0.97	Hydraudic radius alp=r 0.06 Kinematie Wave E Hydraudic radius	Charmel Charmel Stops 5 % Quinhac 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.0	Flow Velocity roles 0.8	
Crowd shop to exhect 5 Overhall Flore Time - sins Time Updream - min Time Overhall Flore Time - min Time Overhall Flore Time - min Time	314-00 0.024 40.22 0.00 40.22 \$5.0 41.0 41.0 41.0 41.0 41.0 41.0 41.0 41	0.024 40.22 0.00 40.22 35.0 Refer IFD T 35.0 Refer IFD T 41.0 0.05 Excavated earth drains w 0.05 20 20 20 20 20 311.30 44.82 0.07 72.4 0.07 72.4 0.07 MANNAMES FORMULA Base width Flow w m MANNAMES FORMULA Base width Flow w m	idth Massing's section a 0.050	area perforabar P 0.97	Hydraudic radius ab = r 0.06 Knessorie Wave E radius ab = r	Channel Stops Flow Gurhacc Channel Stops Gurhacc St. Channel Stops Flow Gurhacc St. Channel Stops Flow Gurhacc St.	Flow Velocity rohace 0.8 0.8 Elow Velocity rohace	
Ground shipe to edited 5 Overhall Rev Time - sins Time Upstream - min Total Overhall Rev Time - min Intell Confidence - % Confidence area destinate - % Confidence area destinate - % Confidence area destinate - % Intell Confidence - % Intellection - Min Intellection -	314-00 0.024 40 22 0.00 40 22 36.0 41.0 41.0 Rif bank alopa 5 33.33 n for e PRE DEV 25500 20 0 20 0 20 0 20 40 22 40 40 40 40 40 40 40 40 40 40 40 40 40	0.024 40.22 40.20 40.20 35.0 Refer IFD T 41.0 Refer IFD T 41.0 Refer IFD T 6.50 Refer IFD T 70 Refer IFD T 71 Refer IFD T 72 Refer IFD T 72 Refer IFD T 73 Refer IFD T 74 Refer IFD T 75 R	idth Massing's section a 0.050	area perforabar P 0.97	Hydraudic radius alp=r 0.06 Kinematie Wave E Hydraudic radius	Charmel Charmel Stops 5 % Quinhac 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.0	Flow Velocity roles 0.8	
Ground ships to edward 5 Overhand New Time - sim Time Upstream - min Total Overhand Flow Time - min The Upstream - min Total Overhand Flow Time - min The Control of the Co	314-00 0.024 40 22 0.00 40 22 36.0 41.0 41.0 Rif bank alope 5 33.33 n for e PRE DEV 25500 20 0 20 0 20 0 20 41.0 41.0 41.6 41.6 41.6 41.6 41.6 41.6 41.6 41.6	0.024 40.22 40.20 40.20 35.0 Refer IFD T 41.0 Refer IFD T 41.0 Refer IFD T 6.50 Refer IFD T 70 Refer IFD T 71 Refer IFD T 72 Refer IFD T 72 Refer IFD T 73 Refer IFD T 74 Refer IFD T 75 R	idth Massing's exciton a 0 0.05 O 0.030 0.05 Film short grass, few weeds Coloridad Europe Rendii Colfee Massing's exciton a 0 0.05	area perforabar P 0.97	Hydraudic radius ab = r 0.06 Knessorie Wave E radius ab = r	Charmel Stops 9 Charmel Stops 9 Charmel Pilow 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.0	Flow Velocity rohace 0.8 0.8 Elow Velocity rohace	
Fround ships to softwal 5 Overhand Rev Times — sins Time Upothrome — min Time Control — min Time Upothrome — min Time — min Time Upothrome — min Time — min Ti	314.00 0.024 40.22 0.00 40.22 36.0 41.0 40.22 36.0 41.0 40.23 36.0 41.0 40.22 36.0 41.0 40.22 36.0 40.22 36.0 40.22 33.33 6 fore PPE DEV 25.00 20 20 20 20 20 311.30 41.02 41	0.024 40.22 58.0 Refer IFO T 58.0 Refer IFO T 61.0 Refer	idth Massing's exciton a 0 0.05 O 0.030 0.05 Film short grass, few weeds Coloridad Europe Rendii Colfee Massing's exciton a 0 0.05	area perforabar P 0.97	Hydraudic radius ab = r 0.06 Knessorie Wave E radius ab = r	Charmel Stops 9 Charmel Stops 9 Charmel Pilow 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.0	Flow Velocity rotace 0.8	
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Width mm 300	Depth mm 300	Culverts 1	% 2.38	n 0.012 n for concrete pipe	a 0.090	p 1.2	a/p = r 0.0750	m³/s 0.21 0.072	Iltres/sec 206 72.42	m/sec 2.286	m 0.266	m 0.107	m 0.186	m #REF!
Circular Pipe Check	Sizing Check													
ROUND CULVERT FLO Cuivert size Depth mm	W ANALYSIS - MANNII Number of Culverts	NG FORMULA HGL slope %	Manning's n	Flow section area a	Wetted perimeter p	Hydraulic radius a/p = r	Cuivert Flow Q m³/s	Culvert Flow Q Iltres/sec	Flow Velocity m/sec	Entry head loss m				
375 Head Loss Calculations h1 = k (Vo2/2g) Vo - outlet pipe velocity 2g = 2 x 9.81 m/sec2 Loss (m) = k (V12 -	1 V22)/2g	2.379	0.012	0.110	1.2	0.0938	0.29 0.072416667	293	2.65	0.359				
V DRAIN FLOW ANALY Depth of flow mm 160	rsis - Manning Form Left side % 33.33	Right side % 33.33	Flow width m 0.960	Manning's n 0.03	Flow section area a 0.0768	Wetted perimeter p 1.0120	Hydraulic radius a/p = r 0.0759	V drain S % 2.379	V drain Q m³/s 0.07	V drain Q litres/sec 71	V drain Velocity m/sec 0.92			



PRE AND POST-DEVELOPMENT OVERLAND FLOW CHARACTERISTICS 1:20 year ARI

PROJECT: P003016 Merredin BESS Stormwater

DATE: 5/95/202

Start Cl(0.00 - Merredin BBGS Top of Catchment

Rational Markey Catalogue area overhand - m ²	PRE DEV	POST DEV		Hotes Total Marrodio Catala							
Result Confining - %	20	20		Runoff Coefficient for							
Combanet area Lets - rof	0	0									
Remail Conflicient - % Combinent area Verse - pri	20	20 0									
Result Confinient - %	20	20									
transvious area - m² Leagth of evertand flow - m	710	710									
Catalances top FL	332.0	332.0									
Consistency River RI, Ground shope to enforce S	915 00	315.00 0.024									
Overland Flow Term - min	35.34	35.34					Kingeaztie Wave E	qn (Manning's n) - q	grass	0.025	
Timo Upstram - min	0.00	0.00									
Total Overhand Row Time - min	35.34 46.0	35.34 48.0 F	Rotor BFD Table								
Flow - Street/2009	0.0	0.0									
Flow - m/Y2	0.00	0.00									
PE.OWRATE WITHIN EXISTING OPEN CH	AMNEL DRAIN - MAN	NING FORMALA	(Ct10.00)							Section 2	
Depth of flow LH bank alope	Rill bank alops	Base width	Flow width	Mareringte	Flow eaction area	Wetted perimeter	Hydraulic radius	Charrell Slope	Charmel Flow	Flow Velocity	
nvn %	% .	m	m	n -	a	P	a/p=r	5%	Quiffsec	m/sec	
D 16.67	16.67	0.50	0.500	0.025	0.00	0.50	000	0.7	0.00	#DIV/0!	
	птоге	excavated earth	oranewith a	hort grass, few we	:08				0.00	it.	
CH 710.0m - Open Drain											
Rating Makes	PRE DEV	POST DEV									
Canada area overhand - mi ²	20000	20000									
Remail Conflicient - % Confinent area Lets - cof	20	20		Calculated Average F	anolf Coefficient						
Remail Confining - %	20	20									
Combinent area Main Drain - m ² Remail Conflicient - %	0	0									
pubmicioni sura - mg	20 4000	20 4000									
Leagth of everband flow - m Continuent top RL	710	710									
Constant Stree Fil.	332.0 315.00	332.0 315.00									
Ground above to univert S	0.024	0.024					es				
Overtand Flow Time - min Time Unstream - min	39.42	39.42 0.00					Kinematic Wave E	qn (Mannang's n)		0.03	
Total Overhand Flow Time - min	39.42	39.42									
hitmaily - provier	43.0	43.0	Refer IFD Table								
Flow - @zeo/≥m Flow - mYs	47.8	47.8									
FI.OWRATE ACROSS EXISTING LAND -	Man Marine et EEE F. Co.	OH CALCIE AT	m								
71.OMICATE ACRESS EXISTING LAND.	ZUIT WILDE STREET FL	OWCALCINAL	ion .		Flow	Wetted	Hydrausic	Channel	Charmel	Flow	
Depth of flowr LH bank alope	Riil bank alope %	Base width	Flow width	Manning's	eaction area a	perimeter P	a/p = r	Stope 3 %	Flow Qm*fsec	Velocity	
10 3.00	3.00	20.00	m 20.667	0.030	0.20	20.67	0.01	2.3944	0.05	0.2	
		Contract Con		hort grace faw wa	ade				0.05	ř.	
01.740.4- 0- D- 01- 14-			. 6°4 . 4 45	- B B							
CH 740.0m - Open Drain, Chamnel Awa	y mom neveropmen	K Area (Western	2 2 100 OI NO SEE	oer Koadj							
Rational Markey	PRE DEV	POST DEV									
Carried - m2	20000	20000									
	20	20									
Remail Conflicient - % Continuent area Lets - cof	20 0	20 0		Calculated Average F	moff Coefficient						
Continuent area Lets - cof Remail Conflicient - %	0 20	0 20		Calculated Average F	anoff Coefficient						
Continues area Lets - m²	0 20 0 20	0		Calculated Average F	anaff Coefficient						
Catalament area Lots - cof Remell Conflicient - % Catalament area Main Drain - m ² Remell Conflicient - % brownvious area - m ²	0 20 0 20	0 20 0 20 4100		Calculated Average F	anall Coefficient						
Continuent area Lets - m ² Remoff Confinient - m ² Remoff Confinient - 7 ² Remoff Confinient	0 20 0 20 1100 740	0 20 0 20 4100 740 332.0		Calculated Average F	matt Coefficient						
Continuent awa Lets - or Remark Conflicient - or Remark - or Remar	0 20 0 20 1100 740 532,0 14,00	0 20 0 20 4100 740 332.0 314.00		Calculated Average F	unoff Coefficient						
Continuer awa Lets - or Ream? Confinent - %. Continuer awa Main Drain - m? Ream? Confinent - %. Inquiries awa - m? Length of overhald flow - m. Continuer to Pt. Continuer Bone Pt. Continuer Bone Pt. Continuer Bone Pt. Continuer Bone Pt.	0 20 0 20 1100 740	0 20 0 20 4100 740 332.0		Calculated Auerana P	unoff Coefficient		Κάτφαιστέο W2/16 E	ga (Manning'a n)		0.03	
Confinent availatis - of Resett Confinent - 5 Confinent availation Drain - m2 Resett Confinent - 5 Important availation - 7 Important - 7 Confinent top III. Confinent top III. Confinent Drain III. Confinent Drain III. Confinent Store IV. Time Updates - min Time Updates - min	0 20 0 20 1100 740 32.6 14.00 1.024 10.22	0 20 0 20 4100 740 332,0 314,00 0,024 40,22 0,00		Calculated Auerana P	andif Coefficient		Κόπφαιστόο W21/6 E	qn (Manning'a n)		0.03	
Confuser availate - of Ramiff Confusion - % Confuser availabile Drain - m? Ramiff Confusion - % beyond on available of or Longth of worked flow - m Confusion - to pt. The Confusion - to the confusion - to pt. The Updates - mine Tatal Overhand Flow Time - mine Total Overhand Flow Time - mine	0 20 0 20 1100 740 532.0 14.00 1.024 10.22	0 20 4100 740 332,0 314,00 6,024 40,22 0,00		Calculated Average F	andf Coefficient		Клюшато Wave E	qn (Manning's n)		0.03	
Continues awai nets - or Raumif Confinient - % Continues awai Main Drain - m? Remail Confinient - % Inspirations awai - or Longle of worked flow - m Continues the PR. Continues The PR. Continues The PR. Continues The PR. Continues The PR. Continues The PR. Continues The PR. The Updates - min Total Overhand Flow Time - min Internal Overhand Flow Time - min Internal Coverhand Flow Time - min Internal Coverha	0 20 0 20 1100 746 132.6 14.00 1024 10.22 43.0 40.22	0 20 0 20 4100 740 332.6 314.00 0.024 40.22 0.00 40.23, 43.0	Refer IFO Table	Calculated Auerona F	anell Coefficient		Коловиято Wave E	qa (Manning's n)		0.03	
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Continues availates of Ramiff Confinent, % Continues availation Drain - m ² Ramiff Confinent, % Improvious availation Provinent See See See See See See See Se	0 20 0 20 1100 790 102,0 1,024 10,22 0,00 40,22 43,0 12,0 12,0 12,0 12,0 12,0 12,0 12,0 12	0 20 0 20 1100 740 332.8 314.00 0.024 40.22 0.00 40.22 43.8 49.0 0.00 MANNENG FORM	IUI.A		Flow	Wettad owi (nucha	Nydraulic	Clarel	Channel Flow	Flow	
Combinant availatis - of Real of Combination - % Combinant availability - % Combinant availability - % beyond the second fore - on Combinant availability - on Combinant availability - on Combinant availability - on Combinant availability - on Combinant - on Com	0 20 0 20 1100 746 1000 746 1000 746 1000 1000 1000 1000 1000 1000 1000 10	0 20 8 20 4100 740 3328 31400 0.024 40.22 0.00 40.25 43.9 49.0 0.05 MANNERS FORM	IULA Flow width m	Massings n	Flow eaction area	pertmeter P	Hydrauffc radius alp≕r	Charrell Slope S %	Flow	Flow Velocity rotatic	
Combinate awa Lets - of Combinate awa Letin Orain - m? Combinate awa Letin Orain - m? Remail Coefficient - % Inogit of overband flow - m Combinate to PI. Combinate Pi.	0 20 0 20 11:00 740 15:00 16:00 17:00 16:0	0 20 0 20 0 20 41100 740 332.5 331.00 0.024 40.22 0.00 40.25, 43.0 0.06 MAJNOR FORM	NULA Flow width m 1.010	Manufogra 9 8,000	Flow section area a 0.06	pertmeter	Hydraudic radius	Creavel Slopa	Plow Quirffaec 0.05	Flow Velocity	
Combinate awa Lets - ref Remit Confliction: "S Combinate awa Lebin Drain - m2 Remit Confliction: "S Inspection awas - ref Lectured or worked fiver - re Combinate they fit. Drawnal slope to service five re Combinate they fit. Drawnal slope to service in S Downstand fiver to service in S Total Ownstand fiver to make it is Total Ownstand fiver to make in in Total Ownstand fiver to time - min Total Ownstand fiver to make - min Total Ownstand fiver to min Total Ownstand f	0 20 0 20 11:00 740 15:00 16:00 17:00 16:0	0 20 0 20 0 20 41100 740 332.5 331.00 0.024 40.22 0.00 40.25, 43.0 0.06 MAJNOR FORM	NULA Flow width m 1.010	Massings n	Flow section area a 0.06	pertmeter P	Hydrauffc radius alp≕r	Charrell Slope S %	Flow	Flow Velocity rotatic	
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Combinate and Lets - of Remail Confinence - % Combinate and Lets of Drain - mill Remail Confinence - % Experience area - Lets of Drain - mill Remail Confinence - % Experience area - of Lets of overhead Remail Remail Confinence - Market - Southead Remail Remail Confinence - min State Overhead Remail Rem	0 20 0 20 100 1746 182.0	0 20 0 20 4100 740 22 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NULA Flow width m 1.010	Manufings n 0.030 nort græs, few we	Flow eaction area a 0.06 eds	pertmeter P	Hydrauffc radius alp≕r	Charrent Stops 5 % 2.4336	Plow Quirffaec 0.05	Flow Velocity rotatic	
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Combinate awa Lets - of Combinate awa Lets - of Combinate awa Lets of Crisis - or Combinate awa Lets of Crisis - or Longis of everband flow - or Combinate to pf II. Combinate Combinate II. Combinate III. C	0 20 0 20 1100 1100 1100 1100 1100 1100	0 20 0 0 20 0 1740 1750 1750 1750 1750 1750 1750 1750 175	HULA Flow width m 1.010 or drains with si	Manufings n 0.030 nort græs few we	Flow eaction area a 0.06 eds	pertmeter P	Hydraudic radius alp = r 0.06	Charrent Stops 5 % 2.4336	Plow Quirffaec 0.05	Flow Velocity rother 0.8	
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Width mm	Depth mm	Culverts	- %	n	a	P	a/p = r	m³/s	litres/sec	m/sec	m	m	m	m
300	300	1	2.38	0.012	0.090	1.2	0.0750	0.21	206	2.286	0.266	0.107	0.186	#REF!
				n for concrete pipe				0.088	87.78					
Circular Pipe Check	Sizing Check													
ROUND CULVERT FLOW	W ANALYSIS - MANNII	NG FORMULA												
				Flow	Wetted	Hydraulic	Culvert Flow	Culvert Flow	Flow	Entry				
Culvert size	Number of	HGL slope	Manning's	section area	perimeter	radius	Q	Q	Velocity	head loss				
Depth mm	Culverts	%	n	a	P	a/p = r	mª/s	litres/sec	m/sec	m				
375	1	2.379	0.012	0.110	1.2	0.0938	0.29	293	2.65	0.359				
Head Loss Calculations							0.087777778							
hl = k (Vo2/2g)														
Vo - outlet pipe velocity														
2g = 2 x 9.81m/sec2														
Loss (m) = k (V12 - \	V22)/2g													
	, ,													
V DRAIN FLOW ANALYS	SIS - MANNING FORM	ULA												
					Flow	Wetted	Hydraulic	V drain	V drain	V drain	V drain			
			Flow width	Manning's	section area	perimeter		8		Q				
mm			, m	n	a	P		%						
160														
Depth of flow mm 160	Left side % 33.33	Right side % 33.33	Flow width m 0.960	Manning's n 0.03	section area a 0.0768	perimeter p 1.0120	radius a/p = r 0.0759	8 % 2.379	Q m³/s 0.07	Q Iltres/sec 71	Velocity m/sec 0.92			



PRE AND POST-DEVELOPMENT OVERLAND FLOW CHARACTERISTICS 1:50 year ARI

PROJECT: P003016 Merredin BESS Stormwater

DATE: 5/95/2025

Start CI (0.00 - Merredin BBGS Top of Gatchment

Rational Markey		PRE DEV	POST DEV		Hetes						
Catholic area overhal - m² Ramii Confinint - %	١	20	20		Total Merrodio Catalana Runoff Coefficient for I						
Combinent area Lats - ref		0	0								
Remail Conflicient - % Combinent area Verge - mil		20 0	20								
Remail Conflicient - %		20	20								
Impervious area - m² Leagth of everland flow - m		710	710								
Comment top RL Comment Rase RL		332.0	332.0								
Ground above to enforce t		0.024	0.024								
Overland Flow Term - min		2234	35.31					Kinematic Wave	Eqn (Manning's n) - g	rass	0.025
Time Upstram - min Total Overtand Row Time - mi	_	0.00 55.34	0.00 35.34								
hamily - myler		58.0		oter IFD Table							
Flow - Marus/2000 Flow - MP2		0.0	0.00								
PI.OWRATE WITHIN EXST	TING OPEN CHAM	NEL DRAIN - MAN	NING FORMALA	(CH0.00)		Flow	Wetted	Hydraulic	Charact	Charmel	Flow
Depth of flow LH	bank alope	Rid bank alops	Base width	Flow width	Mare ingre	eaction area	perimeter	radius	Stope	Flow	Velocity
ovn O	% 16.67	% 16.67	m 0.50	m 0.500	n 0.025	a 0.00	P 0.50	a#p=r 0.00	5 % 0.7	Q III ⁴ lsec 0.00	m/sec
0	10.07				v.u.ಎ lort græs, few wee		0.50	000	0.7	0.00	#DIVIO!
CH 710.0m - Open Drain											
الماعل الماعل		PRE DEV	POST DEV								
California area overland - m²	1	20000	20000								
Remail Conflicient - % Conflictent area Lets - m ²		20 0	20		Calculated Average Ru	anoff Coefficient					
Remail Conflicient - %		20	20								
Combinent area Main Drain - s Result Conflicient - %	m²	0	0								
beganvious area - m²		20 4000	20 6000								
Leagth of evertued flow - m Catalances top RL		710 332.0	710 332.0								
Calaborate Stone Fil.		315.00	315.00								
Ground shope to univert S Overland Flow Time - min		0.024 39.42	0.024 39.42					Kanania Wa-	Eqn (Manning's n)		0.03
Time Upstream - min		39.42 0.00	39.42 0.00								
Total Overhand Row Time - mi	-	39.42	39.42								
Flore - Octoo/See		54.0 60.0	54.0 F	Refer IFD Table							
Flow - mYs		0.00	0.00								
FI.OWRATE ACROSS EXIS	STING LAND - 20n	m WNDE SHEET FL	OW CALCULATE	ON							
Depth of flow LH	l bank slope	Rii bank alope	Base width			Flow section area	Wetted perimeter	Hydraulic	Chammel Slope	Charmel Flow	Flow Velocity
mm.	*	3	M	Flow width m	Manning's n	a	P	a/p=r	3%	Q m4sec	rofeec
15	3.00	3.00	20.00	21.000	0.030	0.31	21.00	0.01	2.394	0.09	0.3
		n for	atrea hateuenva	draine with d	hart aroce faw was					(1112)	
CH 740.0m - Open Drain,	. Chamnel Away f	trom Developme	et Area (Western	Side of Abase	oir Road)						
Rational Markey		PRE DEV	POST DEV	Side of Abase	oir Road)						
Rained Market Carbonal area overhand - mil		PRE DEV 20000	POST DEV 20000	side of Abatin							
Rained Marked Cathernet area overhand - m ² Remail Conflictions - % Cathernet area Lets - m ²		PRE DEV 20000 20 0	POST DEV 20000 20 0	Side of Abates	oir Road) Coloubted Average Ru	anall Coefficient					
Rational Machinal Catalhumat area overhand - mil Ramari Conflainat - % Catalhumat area Lets - mil Ramari Conflainat - % Catalhumat area Main Drain - m		PRE DEV 20000 20	POST DEV 20000 20	Side of Ab-2±10		anoff Coefficient					
Rational United on the Institute of the		PRE DEV 20000 20 0 20 0 20	POST DEV 20000 20 0 20 0 20 0 20	Side of Abase		andf Coefficient					
Ratimat Machant Cathemet area evolund - m² Remail Coefficient - % Cathemet area lets - m² Remail Coefficient - % Cathemet area letin Drain - 1 Remail Coefficient - % Leogh of worked flow - m		PRILE DEV 20000 200 0 20 0 20 0 20 1100 740	POST DEV 20000 20 0 20 0 20 0 20 4100 740	Side of Abate		unell Coefficient					
Rational Mathed Catalanust area overhand - m ² Roundi Conflavinet - % Catalanust area Lots - or ² Roundi Conflavinet - % Catalanust area Lots - or ² Roundi Conflavinet - % bryanvious area - m ² Loogh of overhand flow - m Catalanust on RI		PNE DEV 20000 20 0 20 0 20 0 20 1100 740 332.0	POST DEV 20000 20 0 20 0 20 0 20 4100 740 332,0	Side of Abatte		until Coefficient					
Rational Method Calaborat area overland - m ² Remark Coefficient - % Calaborat area Lets - set Remark Coefficient - % Calaborat area Lets (Drain - m Remark Coefficient - % Remark Coefficient - % Remark Coefficient - % Longity of overland flow - m Calaborate type (TL Calaborate State (TL Calaborate Sta		20000 20 0 20 0 20 0 20 0 20 0 20 1100 740 32.6 14.00	POST DEV 20000 20 0 20 0 20 4100 740 332,8 314,00 0,024	Side of Abatta		undf Corfficient					
Raised Method Chishmet area overland - mi- Reself Conflicient - % Continues area last - mi- Reself Conflicient - % Reself Conflicient - % Reself Conflicient - % Reself Conflicient - % Represent area - mi- Locydo of workend flow - mi Conflicient - top RL Chishmett Door RL Drownlade por select S Overland Rev Tiss - min		PNE DEV 20000 20 0 20 0 20 0 20 0 1100 740 132,0 144,00 1024	POST DEV 20000 20 0 20 0 20 0 20 4100 740 332,8 314,00 0,024 40,22	Side of Abase		andf Coefficient		Kinematie Wave	Eqn (Manning'≥ n)		0.05
Rational Method Calaborat area overland - m ² Remark Coefficient - % Calaborat area Lets - set Remark Coefficient - % Calaborat area Lets (Drain - m Remark Coefficient - % Remark Coefficient - % Remark Coefficient - % Longity of overland flow - m Calaborate type (TL Calaborate State (TL Calaborate Sta		20000 20 0 20 0 20 0 20 0 20 0 20 1100 740 32.6 14.00	POST DEV 20000 20 0 20 0 20 4100 740 332,8 314,00 0,024	Side of Abase		andf Corfficient		Kinematie Wave	Eqo (Manning's n)		0.03
Railword Marking Chathanut array coverhal or in Found's Conflictions - % Chathanut array Lets - or Chathanut array Lets - or Chathanut array Lets - or Length Conflictions - % Engeny for operation - % Engeny for operation - % Engeny for operating trop (IL Length of operating letter Length of operating le		PNE DEV 20000 20 0 0 20 0 0 20 0 100 0 740 152.0 144.00 1024 10222 0.00 40.22 54.0	POST DEV 20000 20 0 0 20 4100 740 332,5 314,00 0,024 40,22 0,00 40,22,5 54,6	Side of Abatin		andf Coefficient		Качевастве Wzve	Eqn (Manning's n)		0.03
Raincel Machine Challment area overhand - mi Femal Coefficient - % Challment area last - mi Femal Coefficient - % Challment area last - mi Femal Coefficient - % Department - Machine Challment - Bane RJ Devent - Lapse to andrest S Overhand Row Time - min Time Upstream - m		PRE DEV 20000 20 0 0 20 0 0 20 10 10 740 132.0 14.00 10.24 10.22 0.00	POST DEV 20000 20 8 20 9 20 9 4100 740 332,0 314,00 0,024 40,22 0,00			undf Coefficient		Kinemarke Wave	Eqo (Manning's a)		0.05
Rained Mehind on Promise of the Residence of the Residenc	-	PRE DEV 20000 20 0 20 0 20 0 20 1100 740 5220 1024 1022 1024 1022 54.0 61.5 0.06	POST DEV 20000 20 0 20 0 20 0 20 0 20 0 20 0 2	Refer IFD Table		andf Coefficient		Kinematie Wave	Eqn (Manning's n)		8.05
Rainard Machine Challmant area conclused - mi Fundif Coefficiente - % Challmant area Lots - ori Fundif Coefficiente - % Fundif Coefficiente - March 12 Fundificiente - March 2	E E E E E E E E E E E E E E E E E E E	PRE DEY 20000 0 0 20 0 20 0 1000 746 1022 1,004 1022 0,00 40,22 54,0 61,5 0,00 61,5 0 61,5 0 61,5 0 61,5 0 61,5 0 61,5 0 61,5 0 0 61,5 0 61,5 0 61,5 0 61,5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	POST DEV 20000 0 20 0 20 20 41100 740. 332.0 314.0 0.024 40.22 0.00 40.24, 54.0, 61.5 0.06	Refer FD Table	Calculated Average Re	Flow	Wettud	Nydraulic	Charrel	Channel	Flow
Residued Machine Challement areas constand - mi Resulf Conflicione - % Challement areas Lots - or Resulf Conflicione - % Challement areas Lots - or Resulf Conflicione - % Desputy or a sea - mi Longs of overland flow - no Challement Rose RI, Challement Rose RI Challement Rose RI Challement Rose RI Total Overband Flow Tisso - mi Intelled Overband Flow Tisso - mi Intelled Overband Flow Tisso - mi Rose - divolute Rose - divolute Rose RI Dopth of Rose LHI LHI LHI LINE LINE LHI LINE LINE LINE LINE LINE LINE LINE LIN	E E E E E E E E E E E E E E E E E E E	PRE DEV 20000 20 0 20 0 20 0 20 1100 740 5220 1024 1022 1024 1022 54.0 61.5 0.06	POST DEV 20000 20 0 20 0 20 0 20 0 20 0 20 0 2	Refer IFD Table			perimeter			Channel Flow	
Ratimat Marking Chathant area corchad - m Chathant area corchad - m Fumil Coefficient - % Chathant area last - or Chathant area last - or Chathant area last - lor Longli or Coefficient - % Improvious area - m Longli or overhand flow - m Chathante 20m PL Pl Chathant	EOSTING OPEN C	PRE DRY 20000 20 0 0 20 0 10 20 1100 740 832.0 44.00 40.22 54.0 61.5 0.06 HAARNEL DRAM - Rif bank alope % 33.33	POST DEV 20000 20 20 0 0 20 0 0 20 0 0 20 0 0 20 0 0 20 0 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Refer IFD Table ULI A Flow width III 1.070	Calculated Average Rd Materning's 0.0339	Flow section area a 0.07		Hydraudic radius	Cřesvel Slopa	Flow Qurfteec 0.06	Flow Velocity
Ratimal Marking Chathant area coverhal or in Found Configure - % Chathant area lets - or Length or overhand from - in Length or overhand from - in Chathante from PL Chathante from I The Upstram - min Total Overhand From Times - min To	sisis	PRE DRY 20000 20 0 0 20 0 10 20 1100 740 832.0 44.00 40.22 54.0 61.5 0.06 HAARNEL DRAM - Rif bank alope % 33.33	POST DEV 20000 20 20 0 0 20 0 0 20 0 0 20 0 0 20 0 0 20 0 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Refer IFD Table ULI A Flow width III 1.070	Calculated Averages Re	Flow section area a 0.07	perimeter P	Hydraudic radius ayp≕r	Charrell Sions S %	Flow Quiffaec	Flow Velocity rotec
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Railword Markhad Chathants areas overhand - or Chathants areas overhand - or Chathants areas less - or Chathants Brow File Chathants areas Teld Overhand Frow Times - mi Teld Overha	me ² DESTING OPEN C Dank at Ope % 33.33 d of 8833	PINE DEV 200000 20 0 20 0 20 0 20 1000 740 314000 314000 40.22 54.0 61.5 0.06 HEARINGEL DRAIN - RH Bank slope % 33.33 In for e	POST DEV 20000 20 0 20 0 20 20 0 100	Refer IFD Table ULI A Flow width III 1.070	Calculated Average Rd Materning's 0.0339	Flow section area a 0.07	perimeter P	Hydraudic radius ayp≕r	Charrell Sions S %	Flow Qurfteec 0.06	Flow Velocity rotec
Ratimal Markins Challman arous constant on a Challman arous constant on a Challman arous Lets - out Longth of everland from - in Longth of everland from - in Challman & Dan Ri, Challman & Dan Ri, Challman & Dan Ri, Challman & Dan Ri, Challman & Lets Ri,	me ² DESTING OPEN C Dank at Ope % 33.33 d of 8833	PRE DEV 200000 20 0 20 0 20 1100 746 182.0 14.00 1.024 10.02 61.5 61.5 61.5 61.5 61.5 7 74.0 74.0 74.0 74.0 74.0 74.0 74.0 74	POST DEV 20000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Refer IFD Table ULI A Flow width III 1.070	Calculated Average Re Material rays D. 0.0030 Out 1 grass, few week	Flow section area a 0.07 205	perimeter P	Hydraudic radius ayp≕r	Charrell Sions S %	Flow Qurfteec 0.06	Flow Velocity rotec
Ratimal Machine Challmant arous constant on in Fundif Coefficient - % Challmant arous Lest - or Fundif Coefficient - % Challmant arous Lest - or Fundif Coefficient - % Challmant arous Léais Drain - n Fundif Coefficient - % Longlis of overfand flow - n Challmant Rate RL Fundif Rev Time - min Lest One-hard Flow Time - mi Rate - direction Rev - environ	me ² DESTING OPEN C Dank at Ope % 33.33 d of 8833	PRE DEV 20000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	POST DEV 20000 20 0 20 0 20 0 20 0 20 0 20 0 2	Refer IFD Table ULI A Flow width III 1.070	Calculated Average Rd Materning's 0.0339	Flow section area a 0.07 205	perimeter P	Hydraudic radius ayp≕r	Charrell Sions S %	Flow Qurfteec 0.06	Flow Velocity rotec
Railword Markhad Chathants areas coverhand - or Remark Coefficients - % Chathants areas Lests - or Chathants areas Lests - or Chathants areas Lests - or Remark Coefficients - % Remark Coefficients - % Remark Coefficients - % Remark Coefficients - % Remark Coefficients - See Remark Coefficients - %	me ² DESTING OPEN CODEN AS 33.333 d of BESS	PRE DEV 20000 20 0 20 0 20 0 20 0 20 0 20 0 2	POST DEV 20000 20 20 20 20 20 20 20 20 20 20 20	Refer IFD Table ULI A Flow width III 1.070	Calculated Average Re Material rays D. 0.0030 Out 1 grass, few week	Flow section area a 0.07 205	perimeter P	Hydraudic radius ayp≕r	Charrell Sions S %	Flow Qurfteec 0.06	Flow Velocity rotec
Raincel Markind Chathant area coverhal - in Francis Configure - % Chathante area lets - or Chathante Bone File Chathante File Chathante File File Chathante Area Chathante Chathante Chathante Area Chathante area coverhal - in Chathante area coverhal - in Chathante area lets - or Chathante ar	me and a second	PRE DEV 20000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	POST DEV 20000 20 0 20 0 20 0 20 0 20 0 20 0 2	Refer IFD Table ULI A Flow width III 1.070	Calculated Average Re Material rays D. 0.0030 Out 1 grass, few week	Flow section area a 0.07 205	perimeter P	Hydraudic radius ayp≕r	Charrell Sions S %	Flow Qurfteec 0.06	Flow Velocity rotec
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Railword Markhad Chathannet arma roverhand - or Remark Coefficient - % Chathannet arma Lett - or Remark Coefficient - % Chathannet arma Lett - or Remark Coefficient - % Expensive on the Letter of the Remark Coefficient - % Improving arma - or Length of workford filter - or Chathannet those Rit. Chathannet Rose Rit. Chathannet Rose Rit. Chathannet Rose Rit. The Upstream - nim Total Overhard Flow Times - min Remark Coefficient - % Chathannet arma roverhard - or Remark Coefficient - % Chathannet arma Lett - or Chathannet arma Lett - or Chathannet Rose Rit. Chathannet Ros	EGSTING OPEN CO. State of the control of the contro	PIVE DEV 200000 20 0 20 0 20 0 20 0 20 0 20 0	POST DEV 20000 20 0 20 0 20 0 20 0 20 0 20 0 2	Refer IFD Table ULI A Flow width III 1.070	Calculated Average Re Material rays D. 0.0030 Out 1 grass, few week	Flow section area a 0.07 205	perimeter P	Hydraulic radius ap≐r 0.07	Charrell Slope 5 % 2.4326	Flow Qurftee 0.06	Flow Velocity rotate 0.9
Railword Markind Chathanus arms overhand - or Round Coefficient - % Chathanus arms Lets - or Round Coefficient - % Chathanus arms Lets - or Round Coefficient - % Experience - % Experienc	EGSTING OPEN CO. State of the control of the contro	PIVE DEV 200000 20 0 20 0 20 0 20 0 20 0 20 0	POST DEV 20000 20 0 20 0 20 0 1740 152.8 314.00 0.00 40.21, 54.0 61.5 10.05 10	Refer IFD Table ULI A Flow width III 1.070	Calculated Average Re Material rays D. 0.0030 Out 1 grass, few week	Flow section area a 0.07 205	perimeter P	Hydraulic radius ap≐r 0.07	Charrell Stops 5 % 2.4326	Flow Qurftee 0.06	Flow Velocity rotate 0.9
Ratimat Marking Challmant arous constant - in Fundif Coefficiant - % Challmant arous lasts - or Fundif Coefficiant - % Challmant arous lasts - or Fundif Coefficiant - % Challmant arous labia Darin - in Fundif Coefficiant - % Challmant arous labia Darin - in Fundif Coefficiant - % Challmant Ray II Fund - direct II Dopkin of Row Times - mi II Dopkin of Row II	EGSTING OPEN CO. State of the control of the contro	PRE DEV 20000 0 0 20 0 0 20 0 1000 1749 1826 1826 1826 1826 1826 1826 1826 1826	POST DEV 20000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Refer IFD Table UI.A Flow width n 1.070 d rains with a	Calculated Average Re Material rays D. 0.0030 Out 1 grass, few week	Flow section area a 0.07 205	perimeter P	Hydraulic radius ap≐r 0.07	Charrell Stops 5 % 2.4326	Flow Qurftee 0.06	Flow Velocity rotate 0.9
Ratimat Machina Challmant arous conclusion in Remark Confliciante - % Challmant arous Lets - or Remark Confliciante - % Challmant arous Lets - or Remark Confliciante - % Challmant arous Letia Drain - in Remark Confliciante - % Challmante Rate of Longit of overfand flow - on Challmante Rate of Longit of overfand flow - on Challmante Rate of Longit of overfand flow - on Challmante Rate of Longit of the Rate - division - on the Longit of the Rate - division - on the Longit of the Rate - division - on the Longit of the Rate - division - % Confliciante - Machina - on the Longitude - % Remark Confliciante	EDISTING OPEN C Sharek alope % 33,333 and of 8ESS	PINE DEV 20000 0 0 20 0 0 20 0 1100 744 0 122 144 0 0 22 0 0 0 0 155 0 0 0 0 0 0 0 0 0 0 0 0 0 0	POST DEV 20000 0 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0	Refer IFD Table UI.A Flow width m 1.070 Grains with 9	Calculated Average Re Material rays D. 0.0030 Out 1 grass, few week	Flow section area a 0.07 205	perimeter P	Hydraulic radius ap≐r 0.07	Charrell Stops 5 % 2.4326	Flow Qurftee 0.06	Flow Velocity rotate 0.9
Ratimat Marking Challmant arous constant - in Fundif Coefficiant - % Challmant arous lasts - or Fundif Coefficiant - % Challmant arous lasts - or Fundif Coefficiant - % Challmant arous labia Darin - in Fundif Coefficiant - % Challmant arous labia Darin - in Fundif Coefficiant - % Challmant Ray II Fund - direct II Dopkin of Row Times - mi II Dopkin of Row II	EDISTING OPEN C Sharek alope % 33,333 and of 8ESS	PINE DEV 20000 0 0 20 0 0 20 0 1100 744 0 122 144 0 0 22 0 0 0 0 155 0 0 0 0 0 0 0 0 0 0 0 0 0 0	POST DEV 20000 0 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0	Refer IFD Table UI.A Flow width m 1.070 Grains with 9	Calculated Average Re Material rays D. 0.0030 Out 1 grass, few week	Flow section area a 0.07 cc65	perimeter P	Hydraudic radius alp=r 0.07	Charrell Stops 5 % 2.4326	Flow Qurftee 0.06	Flow Velocity rotate 0.9
Railword Markhand Chathannet arma coverhand - or format Coefficient - % Chathannet arma Letts - or format Coefficient - % Chathannet arma Letts - or format Coefficient - % Expension arma - or format Coefficient - % Expension arma - or format Length of word marked tope 10. Chathannet Rose IR. Chathannet Ro	ma* DOSTING OPEN C Down's stope % 33.33 d of 8835 in DOSTING OPEN C Down's stope C DOWN's stope DOSTING OPEN C Down's stope	PIVE DEV 200000 20 0 20 0 20 0 20 1000 740 152.6 314.00 100.22 20 40.22 54.6 61.5 0.06 REARNEL DRAIN - RH Bank slope 4 33.33 11 for e PIVE DEV 25500 0 20 20 20 311.30 31.30 44.02 44.02 50.00 73.6 0.00 73.6 0.00 73.6 0.07	POST DEV 20000 20 0 0 20 0 0 20 0 0 0 0 0 0 0 0	Refer IFD Table U.A. Flow width 1.070 Grains with st	Millerings 1030 Ort grass, few wee	Flow section area a 0.07 costs	portrestur P 1.10	Hydraulic radius alp=r 0.07 Kinecarie Wave Hydraulic radius	Crammal Stops 5 % 2.4326	Flow Quirhout O.05 O.05 O.05 O.05 O.05 O.05 O.05 O.05	Flow Velocity robac 0.9
Rational Machinal Chathant arous coverhal - mi Framed Coefficient - % Chathants arous lates - or Framed Coefficient - % Chathants arous lates - or Framed Coefficient - % Chathants arous lates loris - i Framed Coefficient - % Chathants arous lates David - mi Chathants arous - mi Chathants arous - mi Trans Upstrams - min Total Overhard frow Time - mi Total Coefficient - % Combined arous overhard - mi Remed Coefficient - % Remed Coefficient - % Total Machinal Combined arous overhard - mi Remed Coefficient - % Total Coefficient - % Combined arous overhard frow - m Chathants Erica Fig. Lates arous them of min Time Upstrams - min Time Upstrams	EDUSTING OPEN C	PRE DEV 20000 20 0 20 0 20 0 1000 740 1002 1002 1002 1002 1002 1002 1002 10	POST DEV 20000 0 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0	Refer IFD Table UI.A Flow width m 1.070 drains with st	Materilogia Baselogia Custos Ort grass few wee	Flow section area a 0.07 cos	portmetur P 1.10	Hydraulic radius alp=r 0.07 Kineacris Ware	Charrel Stops S % 2.4336 Eqe (Manning': n)	Rior Qurfine 0.06 0.05	Flow Velocity rotate 0.9
Raincel Marking Chatherit area coverhal - in Fundif Conflaint - % Chatherit area (%	DESTING OPEN C bank at ope % 33.33 at of OFENS C bank at ope bank at ope bank at ope %	PIVE DEV 200000 20 0 20 0 20 0 20 1000 740 152.6 140.00 1004 10.22 20 0.00 40.22 54.0 61.5 0.06 65.5 0.06 65.5 0.06 67.6 67.6 67.6 67.6 67.6 67.6 67.6	POST DEV 20000 20 0 20 0 20 20 0 4100 740 20 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Refer IFD Table UI.A Flow width m 1.070 drains with st refer IFD Table UI.A Flow width m 1.250	Material Average Re Material of P 0.000 Charleted Average Re Material of P	Flow section area a 0.07	portmetur P 1.10	Hydraulic radius alp=r 0.07 Kinesorie Wave Hydraulic radius alp=r	Charrell Slope S % 2.4336 Eqn (Manning's n) Charrell Slope S %	Flow Q influe Q influ	Flow Velocity rotace 0.9 a.es

Box Culveri	t Sizina Check	 Analysis for 	Comparative Pur	nosas Oniv

		g Check - Analysis fo	•	rposes Only								HGL Calculations			Outlet Velocity = 2
	Cu	W ANALYSIS - MANNING ilvert size	Number of	HGL slope	Manning's	Flow section area	Wetted perimeter	Hydraulic radius	Culvert Flow Q	Culvert Flow Q	Flow Velocity	Entry head loss	Bend Loss	Pit Head Loss	Exit head loss
WI	ldth mm	Depth mm	Culverts	%	n	a	P	a/p = r	m³/s	litres/sec	m/sec	m	m	m	m
	300	300	1	2.38	0.012	0.090	1.2	0.0750	0.21	206	2.286	0.266	0.107	0.186	#REF!
					n for concrete pipe				0.110	109.72					

Outlet Velocity = 2

Circular Pipe Check Sizing Check

ROUND CULVERT FLOW ANALYSIS - MANNING FORMULA	
	ı

Culvert size Depth mm	Number of Culverts	HGL slope %	Manning's n	Flow section area a	Wetted perimeter P	Hydraulic radius a/p = r	Culvert Flow Q m³/s	Culvert Flow Q litres/sec	Flow Velocity m/sec	Entry head loss m	
375	1	2.379	0.012	0.110	1.2	0.0938	0.29	293	2.65	0.359	
Head Loss Calculation	s						0.109722222				
hl = k (Vo2/2g)											
Vo - outlet pipe veloci	ty										
2g = 2 x 9.81 m/sec2											
Loss (m) = k (V12	! - V22)/2g										

V DRAIN FLOW ANALYSIS - MANNING FORMULA

A DUVIN LEGAL VIV	LI 313 - MANNINI TURI	MOLA									
					Flow	Wetted	Hydraulic	V drain	V drain	V drain	V drain
Depth of flow	Left side	Right side	Flow width	Manning's	section area	perimeter	radius	8	Q	Q	Velocity
mm	%	%	m	n	a	p	a/p = r	%	m²/s	litres/sec	m/sec
160	33.33	33.33	0.960	0.03	0.0768	1 0120	0.0759	2 379	0.07	71	0.92



PRE AND POST-DEVELOPMENT OVERLAND FLOW CHARACTERISTICS 1:100 year ARI

PROJECT: P003016 Merredin BESS Stormwater

DATE: 5/05/2025

Start CH0.00 - Merredin BESS Top of Catchment

Rational Method		PRE DEV	POST DEV		Notes					
Catchment area overla		0	0		Total Merredin Catchment = 2.6567 ha					
Runoff Coefficient - % Catchment area Lots -		20 0	20 0		Runoff Coefficient for Grass = 0.03					
Runoff Coefficient - %	•	20	20							
Catchment area Verge Runoff Coefficient - %		0 20	0 20							
mpervious area - m²	•	0	0							
ength of overland flo	w - m	710	710							
Catchment top RL Catchment Base RL		332.0 315.00	332.0 315.00							
iround slope to culve		0.024	0.024							
Overland Flow Time -	min	35.34	35.34				Kinematic Wave I	Eqn (Manning's n) -	grass	0.025
'ime Upstream - min 'otal Overland Flow Ti	ll-	0.00 35.34	0.00 35.34							
rota: Overiand Flow 11 ntensity - mm/hr	ime - min	72.9	72.9	Refer IFD Table						
Flow - litres/sec		0.0	0.0							
Flow - m ³ /s	EXISTING OPEN CH	0.00	0.00	A (OLIO OO)						
Depth of flow	LH bank slope	RH bank slope	Base width	Flow width	Flow Manning's section area	Wetted perimeter	Hydraulic radius	Channel Slope	Channel Flow	Flow Velocity
mm	%	%	m	m	n a	, P	a/p = r	S %	Q m³/sec	m/sec
0	16.67	16.67	0.50	0.500	0.025 0.00	0.50	0.00	0.7	0.00	#DIV/0!
		n for	excavated earl	h drains with s	hort grass, few weeds				0.00	
H 710.0m - Open	Drain									
Rational Method		PRE DEV	POST DEV							
Catchment area overla Runoff Coefficient - %		20000 20	20000 20		Calculated Average Runoff Coefficient					
Catchment area Lots -	· m²	0	0							
Runoff Coefficient - % Catchment area Main I		20 0	20 0							
tunoff Coefficient - %		20	20							
mpervious area - m² ength of overland flo	w - m	4000 710	4000 710	ı						
atchment top RL	w III	332.0	332.0							
atchment Base RL		315.00	315.00							
Fround slope to culve Everland Flow Time -		0.024 39.42	0.024 39.42				Kinematic Wave	Eqn (Manning's n)		0.03
ime Upstream - min	-	0.00	0.00					. ,		2.50
otal Overland Flow Ti	ime - min	39.42	39.42							
ntensity - mm/hr low - litres/sec		62.0 68.9	62.0 68.9	Refer IFD Table						
low - m3/s		0.07	0.07							
	SS FYISTING I AND .	20m WIDE SHEET F	I OW CALCIII A	TION					Channel	-
LOWRATE ACROS	O EMOTING EMILE		LOW CALCULA	IION						Flow
Depth of flow	LH bank slope	RH bank slope	Base width	Flow width	Flow Manning's section area	Wetted perimeter	Hydraulic radius	Channel Slope	Flow	Velocity
										Velocity m/sec 0.3
Depth of flow mm	LH bank slope %	RH bank slope % 3.00	Base width m 20.00	Flow width m 20.867	Manning's section area	perimeter p	radius a/p = r	Slope S %	Flow Q m³/sec	m/sec
Depth of flow mm 13	LH bank slope %	RH bank slope % 3.00 n for	Base width m 20.00 excavated eart	Flow width m 20.867	Manning's section area n a a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r	Slope S %	Flow Q m³/sec 0.07	m/sec
Depth of flow mm 13 CH 740.0m - Open Rational Method	LH bank slope % 3.00 Drain, Channel Aw	RH bank slope % 3.00 n for ay from Developme	Base width m 20.00 excavated earl ent Area (Wester	Flow width m 20.867	Manning's section area n a a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r	Slope S %	Flow Q m³/sec 0.07	m/sec
Depth of flow mm 13 CH 740.0m - Open tational Method atchment area overla	LH bank slope % 3.00 Drain, Channel Aw	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500	Base width m 20.00 excavated eart ent Area (Weste POST DEV 20500	Flow width m 20.867	Manning's section area n a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r	Slope S %	Flow Q m³/sec 0.07	m/sec
Depth of flow mm 13 CH 740.0m - Open lational Method artchment area overlak unoff Coefficient - % latchment area Lots -	LH bank slope % 3.00 Drain, Channel Aw and - m² im²	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 20 0	Base width m 20.00 excaval ed early ont Area (Wester POST DEV 20500 20 0	Flow width m 20.867	Manning's section area n a a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r	Slope S %	Flow Q m³/sec 0.07	m/sec
Depth of flow mm 13 CH 740.0m - Open tational Method atchment area overlaunoff Coefficient - % atchment area Lot - 4 tatchment area Lot - 4 tunoff Coefficient	LH bank slope % 3.00 Drain, Channel Aw and - m² in m²	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 20 0 20	Base width m 20.00 excavated eart eart Area (Wester POST DEV 20500 20 0 20	Flow width m 20.867	Manning's section area n a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r	Slope S %	Flow Q m³/sec 0.07	m/sec
Depth of flow mm 13 13 13 14 740.0m - Open tatchment area overlaunoff Coefficient - % atchment area Lots - tunoff Coefficient - % atchment area Main i	LH bank slope % 3.00 Drain, Channel Aw and - m ² m ² Drain - m ²	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 0 0 0 0	Base width m 20.00 excavated earl ent Area (Weste POST DEV 20500 20 0 20 0 0	Flow width m 20.867	Manning's section area n a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r	Slope S %	Flow Q m³/sec 0.07	m/sec
Depth of flow mm 13 CH 740.0m - Open lettonal Method attainment area overlai unoff Coefficient - % lettorment area Main i unoff Coefficient - % lettorment area Main i unoff Coefficient - % mpervious area.	LH bank slope % 3.00 Drain, Channel Aw und - m² 6 m² 6 Drain - m²	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 20 0 20 0 20 4100	Base width m 20.00 excavated early ont Area (Wester POST DEV 20500 20 0 20 0 20 4100	Flow width m 20.867	Manning's section area n a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r	Slope S %	Flow Q m³/sec 0.07	m/sec
Depth of flow mm 13 2H 740.0m - Open tational Method atchiment area overlautoff Coefficient - % atchiment area lots - unoff Coefficient - % tatchiment area thomatic machinent area mpervious area - nº 4 ength of overland flo	LH bank slope % 3.00 Drain, Channel Aw und - m² 6 m² 6 Drain - m²	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 20 0 20 0 20 0 20	Base width m 20.00 excavated eart wint Area (Wester POST DEV 20500 20 0 20 0 20 4100 740	Flow width m 20.867	Manning's section area n a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r	Slope S %	Flow Q m³/sec 0.07	m/sec
Depth of flow mm 13 H 740.0m - Open stational Method atchment area overlaunoff Coefficient - % stachment resulted method in the flow of t	LH bank slope % 3.00 Drain, Channel Aw and - m ² 6 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 20 0 20 0 20 4100 740 332.0 314.00	Base width m 20.00 excavat ed earl ont Area (Wester POST DEV 20500 0 0 20 0 4100 740 332.0 314.00	Flow width m 20.867	Manning's section area n a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r	Slope S %	Flow Q m³/sec 0.07	m/sec
Depth of flow mm 13 2H 740.0m - Open lational Method stohment area oversitationer area lots - unoff Coefficient - % method stohment area with unoff Coefficient - % method overland fin stohment ran overland fin stohment top RL stohment Base RL iround slope to culve	LH bank slope % 3.00 Drain, Channel Aw and - m² m² brain - m² w - m w - m	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 20 0 20 4100 740 332.0 314.00 0.024	Base width m 20.00 excavated eart ont Area (Wester Post Dev 20500 20 0 20 41100 7440 332.0 314.00 0.024	Flow width m 20.867	Manning's section area n a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r 0.01	Slope S% 2.3944	Flow Q m³/sec 0.07	m/sec 0.3
Depth of flow mm 13 H 740.0m - Open Lational Method atchment area overlaunoff Coefficient - % stohment area thement area thement area thement area thement area thement area may be a more than the stohment area thement area thement area than thement area than thement area than thement to Bushment to Bushm	LH bank slope % 3.00 Drain, Channel Aw and - m² m² brain - m² w - m w - m	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 20 0 20 0 20 4100 740 332.0 314.00	Base width m 20.00 excavat ed earl ont Area (Wester POST DEV 20500 0 0 20 0 4100 740 332.0 314.00	Flow width m 20.867	Manning's section area n a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r 0.01	Slope S %	Flow Q m³/sec 0.07	m/sec
Depth of flow mm 13 13 CH 740.0m - Open tational Method atchiment area overal unorf Coefficient -% atchiment area label unorf Coefficient area Main in unorf Coefficient area Main un officient ar	LH bank slope % 3.00 Drain, Channel Aw and - m² 6 m² 6 Drain - m² 6 ww - m wt S min	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 20 0 20 4100 740 332.0 314.00 0.024 40.22	Base width m 20.00 excavated earter with Area (Wester POST DEV 20560 20 20 20 4100 740 332.0 314.00 0.024 40.22	Flow width m 20.867	Manning's section area n a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r 0.01	Slope S% 2.3944	Flow Q m³/sec 0.07	m/sec 0.3
Depth of flow mm 13 13 14 740.0m - Open lational Method atchiment area overlauturoff Coefficient -% atchiment area latin unorff Coefficient -% atchiment area Main lunorff Coefficient septiment area Main lunorff Coefficient septiment of coefficient septiment area Main lunorff Coefficient septiment of coefficient septiment area Main lunorff Coefficient area for such coefficient septiment of the maintain top RL incoment latin lunorff coefficient septiment top RL incoment latin lunorff coefficient septiment to particular more coefficient septiment lunorff coefficient septiment lunorff coefficient lunorff coefficient septiment lunorff coefficient lunorff coeffi	LH bank slope % 3.00 Drain, Channel Aw and - m² 6 m² 6 Drain - m² 6 ww - m wt S min	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 0 20 0 0 20 4100 740 332.0 314.00 0.024 40.22 0.00 40.22 63.0	Base width m 2000 excavated earth area (Weste POST DEV 20000 0 20 0 0 20 4100 740 332.0 314.00 0.024 40.22 0.00 40.22 63.0	Flow width m 20.867	Manning's section area n a 0.030 0.27 hort grass, few weeds	perimeter p	radius a/p = r 0.01	Slope S% 2.3944	Flow Q m³/sec 0.07	m/sec 0.3
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Depth of flow mm 13 2H 740.0m - Open tational Method atchement area overla unorf Coefficient - % atchement area in the management of the	LH bank slope % 3.00 Drain, Channel Aw and - m² is m² is m² is m² is m² is m² is min ITHE EXISTING OPE LH bank slope % 33.33 sern end of BESS and - m² is m²	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 20 0 0 20 0 0 20 4100 740 332.0 314.0 0.024 40.22 0.00 40.22 63.0 71.8 0.07 N CHANNEL DRAIN RH bank slope % 33.33 n for PRE DEV 26600 20 0 20 0 20 0 20 870 332.0 311.30 0.024 44.62 0.00 44.62 58.0 83.8 0.08	Base width m 20.00 excavated eart of Area (Weste POST DEV 200000 20 20 20 31 30 20 44 62 58 0 0.024 44 62 58 0 0.13	Flow width 20.867 h drains with s m Side of Abatt Refer IFD Table MULA Flow width 1.100 h drains with s	Manning's section area n 0.030 0.27 hort grass, few weeds Calculated Average Runoff Coefficient Manning's section area n 2 0.030 0.08 hort grass, few weeds Calculated Average Runoff Coefficient	Wetted perimeter p 1.13	radius a/p = r 0.01 Kinematic Wave I Hydraulic radius a/p = r 0.07	Slope S % 2.3944 Eqn (Manning's n) Channel Slope S % 2.4324	Flow Q m/sec 0.07 0.07 0.07	n/sec 0.3 0.03 Flow Velocity m/sec 0.9
Depth of flow mm 13 CH 740.0m - Open tational Method atchiment area overla unorf Coefficient -% atchiment area in the company of the company	LH bank slope % 3.00 Drain, Channel Aw and - m² im² im² im² im² im² im² im² imin ime - min I THE EXISTING OPE LH bank slope % 33.33 arn end of BESS and - m² im² im² im² im² im² im² im² im² im² i	RH bank slope % 3,00 n for ay from Developme PRE DEV 20500 20 0 20 4100 740 332.0 314,00 0,024 40.22 0,00 40.22 63.0 71.8 0,07 N CHANNEL DRAIN RH bank slope % 33.33 n for PRE DEV 26600 20 0 20 0 20 10 20 10 20 10 20 10 20 10 20 10 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	Base width 20.00 excavated earl 20.00 excavated ear	Flow width an 20.867 h drains with s m Side of Abatt Refer IFD Table MULA Flow width 1.100 h drains with s Refer IFD Table	Manning's section area n 0.030 0.27 hort grass, few weeds Calculated Average Runoff Coefficient Manning's section area n a 0.030 0.08 hort grass, few weeds Calculated Average Runoff Coefficient	Wetted perimeter p 1.1.13	radius a/p = r 0.01 Kinematic Wave l Hydraulic radius a/p = r 0.07 Kinematic Wave l	Slope S % 2.3944 Eqn (Manning's n) Channel Slope S % 2.4324	Flow Q m/sec 0.07 0.07 0.07 0.07	n/sec 0.3 Flow Velocity n/sec 0.9
Depth of flow min and a second a second and a second a second and a second and a second a	LH bank slope % 3.00 Drain, Channel Aw and - m² 6 m² 6 m² 6 m² 6 m² 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	RH bank slope % 3.00 n for ay from Developme PRE DEV 20500 20 0 0 0 20 0 0 20 4100 740 332.0 341.00 0.024 40.22 0.00 0 0.07 N CHANNEL DRAIN RH bank slope % 20 0 0 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0	Base width m 0.00 excavated eart of Area (Weste POST DEV 200000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Flow width 20.867 h drains with s m Side of Abatt Refer IFD Table MULA Flow width m 1.100 h drains with s	Manning's section area n 0.030 0.27 hort grass, few weeds Calculated Average Runoff Coefficient Manning's section area n 0.030 0.08 hort grass, few weeds Calculated Average Runoff Coefficient	Wetted perimeter P 1.13	radius a/p = r 0.01 Kinematic Wave I Hydraulic radius a/p = r 0.07	Slope S% 2.3944 Eqn (Manning's n) Channel Slope S% 2.4324	Flow Q m/sec 0.07 0.07 0.07 0.07 0.07 0.07 0.07 0.0	m/sec 0.3 0.03 Flow Velocity m/sec 0.9

Box Culvert Sizin	ng Check - Analysis fo	r Comparative Pur	poses Only											Outlet Velocity = 2
BOX CULVERT FLOW	W ANALYSIS - MANNING	FORMULA			Flow	Wetted	Hydraulic	Culvert Flow	Culvert Flow	Flow	HGL Calculations Entry	Bend	Pit	Exit
Width mm 300	ulvert size Depth mm 300	Number of Culverts	HGL slope % 2.38	Manning's n 0.012 n for concrete pipe	section area a 0.090	perimeter p 1.2	radius a/p = r 0.0750	Q m³/s 0.21 0.127	Q litres/sec 206 127.28	Velocity m/sec 2.286	head loss m 0.266	Loss m 0.107	Head Loss m 0.186	head loss m #REF!
Circular Pipe Che	eck Sizing Check			ii ioi oonololo pipo				0.127	127.20					
ROUND CULVERT F	LOW ANALYSIS - MANNI	ING FORMULA		Flow	Wetted	Hydraulic	Culvert Flow	Culvert Flow	Flow	Entry				
Culvert size Depth mm	Number of Culverts	HGL slope %	Manning's n	section area a	perimeter P	radius a/p = r	Q m³/s	Q litres/sec	Velocity m/sec	head loss m				
375 Head Loss Calculation hI = k (Vo2/2g) Vo - outlet pipe veloci 2g = 2 x 9.81m/sec2		2.379	0.012	0.110	1.2	0.0938	0.29 0.127277778	293	2.65	0.359				
Loss (m) = k (V12	, ,													
V DRAIN FLOW ANA	ALYSIS - MANNING FORM Left side	MULA Right side	Flow width	Manning's	Flow section area	Wetted perimeter	Hydraulic radius	V drain S	V drain Ω	V drain Q	V drain Velocity			
mm 160	% 33.33	% 33.33	m 0.960	n 0.03	0.0768	p 1.0120	a/p = r 0.0759	% 2.379	m³/s 0.07	litres/sec 71	m/sec 0.92			
CH 870.0m - Dep	pth of Flow Calculation	n (55m Wide BESS	Footprint)											
Rational Method Catchment area over Runoff Coefficient - Catchment area Lots Runoff Coefficient -	% s - m² %	PRE DEV 26500 20 0 20	908T DEV 0 20 6500 60		Calculated Average R	unoff Coefficient								
Catchment area Mai Runoff Coefficient - Impervious area - m Length of overland i Catchment top RL	· % n² flow - m	0 20 5300 870 332.0	0 20 3900 137 314.0	 										
Catchment Base RL Ground slope to cul Overland Flow Time Time Upstream - mi Total Overland Flow	ivert S 1 - min in	311.30 0.024 40.00 0.00 40.00	311.30 0.020 13.96 0.00 13.96					Kinematic Wave E	qn (Manning's n)		0.025			
intensity - mm/hr Flow - litres/sec Flow - m³/s		63.0 92.8 0.09	119.0 128.9 0.13	Refer IFD Table										
PLOWRATE ACRO	OSS EXISTING LAND -	50m WIDE SHEET F	LOW CALCULA	TION Flow width	Manning's	Flow section area	Wetted	Hydraulic radius	Channel Slope	Channel	Flow Velocity			
mm 10	% 3.00	% 3.00	m 50.00	m 50.667	n 0.025	a 0.50	p p 50.67	a/p = r 0.01	S % 1.9708	Q m³/sec 0.13	m/sec 0.3			
			n for excav	rated crushed lim	est one pad					0.13				

COMPENSATION BASIN CALCULATOR

Project: Lot 12 Abattoir Road, Merredin Job No. P003016 Client: **ACENERGY** Date 28/03/2025 DURATN INFLOW OUTFLOW VOLUME LEVEL RAINFALL WORST COMPENSATING BASIN DISCHARGE - Section 7.5.7 AR&R 1987 CASE 311 541 KELLERBERRIN 58 LOCATION 122 311.608 25.3 **EQUIV AREA (ha)** 0.260 3 40 133 311.641 19 1 6 26 311.696 100 151 11.8 DURATION (hrs) 24 12 28 2 158 311.717 74 24 RAINFALL (mm/hr) 4.59 PEAK 17 161 311.725 4.6 INFLOW VOL (cum) 286 INFLOW OUTFLOW VOLUME I FVFI 48 11 140 311.664 2.8 HYET PERIOD (hrs) 72 311.634 2.0 1.00 17 2 161 311.725 130 CALC PERIOD (hrs) 0.50 STORAGE & DISCHARGE HYETO WATER CULVERT ORIFICE INFILT'N CLOGGED RELATIONSHIPS LAKE TWL GRAPH INFLOW OUTFLOW VOLUME LEVEL DEPTH LEVEL VOLUME AREA FLOW PERIOD HRS (%) (I/s) (I/s) (cum) (m) (m) (cu m) (I/s) (m) (cu m) (sq m) (I/s) (I/s) (I/s) (I/s) 311 000 0.000 n 311 00 n 0.6 0.6 n 0 n n n 100 n 0.00 0.00 16 311.128 0.100 311.10 12 132 0.8 0.9 12 0.50 5.80 9 31 311 224 0.200 26 311 20 26 164 n n 0.9 1.3 1.00 5.80 59 311.368 0.300 44 311.30 44 197 0 1.8 1.1 3 4 1.50 10 60 17 87 95 311.479 0.400 66 311.40 66 119 231 n 0 1.3 1.7 2.4 2.00 10.60 311.509 0.600 119 311.60 300 3.8 5 6 7 8 2.50 3.70 6 5 102 311.538 0.800 186 2 311.80 186 373 0 0 2.2 5.6 109 2.6 7.8 3.00 3.70 311.562 1.000 268 312.00 268 448 3.50 4.00 3.20 3.20 115 118 311.585 311.599 5 4 1.200 365 312.20 365 526 0 0 3.0 10.4 4.50 2.40 122 311.610 **BASIN GEOMETRY** V = A*h + B*h^2 + C*h^3 2.40 10 5.00 129 311.629 11 12 5.50 6.00 3.35 5 135 311.648 311.655 Length (m) 50 100 Coefficient A 100 3.35 137 Width (m) Coefficient B 156 13 14 6.50 2 00 140 311.662 Side Slope (1 in) 3 Coefficient C 12 7.00 2.00 144 311.676 15 16 7.50 2.80 149 311.690 **OUTLET CULVERT PARAMETERS** SOIL PERMEABILITY PARAMETERS 8.00 2.80 151 311.695 Permeability Kt (m/d) 8.50 1.85 153 311.700 0.300 0.5 18 19 9.00 1.85 3 155 311.707 Culvert Fall (m) 0.080 Clogged Kc (m/d) 0.5 157 311.714 Culvert Length (m) Clogged Layer Thickness t (m) 20 21 22 10.00 2.05 158 311.718 Tailwater Depth (m) 0.300 3 2 No of Culverts Entrance Type (1-3) 11.00 1.65 160 311.723 23 24 11.50 1.45 161 311.725 4.00 12 00 1 45 161 311 725 Manning's n 0.011 25 12.50 1.30 2 2 161 311.725 26 27 13.00 1.30 1.15 2 161 311.724 311.723 **ORIFICE PLATE PARAMETERS** 13.50 160 28 29 14.00 1.15 2 2 160 311.722 Orifice Dia (m) 0.010 14.50 1.05 159 311.720 Orifice Coeff 1.00 30 31 15.00 15.50 1 05 158 157 311.717 311.715 Orifice CL depth (m 1.000 0.95 156 155 311.711 311.707 32 33 16.00 0.95 16.50 0.80 17.00 17.50 153 151 34 35 0.80 2 311.702 0.55 311.696 36 37 18.00 0.55 150 311.692 18.50 0.75 148 311.688 38 311.680 0.75 19.50 0.25 0 143 311.672 20.00 0.25 141 311.666 41 20.50 0.45 139 311.659 42 21.00 0.45 138 311.656 43 21.50 0.80 137 311.653 22.00 135 2 45 22.50 0.50 133 311.642 46 23.00 0.50 131 311.637 47 23 50 0.60 2 130 311.633 48 24.00 0.60 0 127 311.623 49 24 50 0.00 n 2 123 311.614 25.00 120 311.604 50 0.00 0 TOTAL Q 100 159 92

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TOTAL V

COMPENSATION BASIN CALCULATOR

Job No. P003016 Project: Lot 12 Abattoir Road, Merredin Client: **ACENERGY** Date: 28/03/2025 DURATN INFLOW OUTFLOW VOLUME LEVEL RAINFALL WORST COMPENSATING BASIN DISCHARGE - Section 7.5.7 AR&R 1987 CASE 311.245 KELLERBERRIN 311.274 LOCATION 26 40 11.8 **EQUIV AREA (ha)** 0.195 3 17 42 311.290 8.9 46 311.309 5.5 5 DURATION (hrs) 3.4 12 12 12 47 311.313 <= RAINFALL (mm/hr) PEAK 47 311.311 3.43 24 INFLOW VOL (cum) 80 INFLOW OUTFLOW VOLUME I FVFI 48 41 311.284 1.2 HYET PERIOD (hrs) 0.50 3 37 311.260 0.9 12 47 311.313 72 CALC PERIOD (hrs) STORAGE & DISCHARGE HYETO WATER **CULVERT ORIFICE** INFILT'N CLOGGED LAKE TWL RELATIONSHIPS GRAPH INFLOW OUTFLOW VOLUME LEVEL DEPTH LEVEL VOLUME AREA FLOW PERIOD HRS (%) (I/s) (I/s) (cum) (m) (m) (cu m) (I/s) (m) (cu m) (sq m) (I/s) (I/s) (I/s) (I/s) 311 000 0.000 n 311 00 0 0.6 0.6 n n n n n 100 n 0.00 0.00 311.047 0.100 311.10 12 132 0.8 0.9 12 0.25 6.90 10 311.090 0.200 26 311 20 26 164 n 0 0.9 1.3 0.50 6.90 311.161 0.300 311.30 44 197 0 1.8 0.75 13 50 12 31 33 311.224 311.237 0.400 66 311.40 66 231 0 1.3 1.7 2.4 1.00 13.50 0.600 119 311.60 119 300 3.8 36 36 1.25 4.25 311.251 0.800 186 2 311.80 186 373 0 0 2.2 5.6 4.25 2.6 1.50 311.256 1.000 268 312.00 268 448 7.8 2.15 2.15 37 39 311.260 311.269 1.75 2 1.200 365 312.20 365 526 3.0 10.4 2.00 41 42 9 10 2.25 3.35 311.279 **BASIN GEOMETRY** V = A*h + B*h^2 + C*h^3 2.50 3.35 311.286 43 44 44 11 12 2.75 2.75 311.292 Length (m) Coefficient A 100 3.00 2.75 311.296 Width (m) Coefficient B 156 13 3 25 2.10 311 300 Side Slope (1 in) Coefficient C 45 14 3.50 2.10 311.304 46 47 15 3.75 2.45 311.309 **OUTLET CULVERT PARAMETERS** SOIL PERMEABILITY PARAMETERS 16 4.00 311.311 2.45 4.25 1.85 47 311.313 Permeability Kt (m/d) 0.5 Clogged Kc (m/d) Clogged Layer Thickness t (m) 18 4.50 1.85 47 311.311 Culvert Fall (m) 0.080 0.5 19 0.80 46 311.309 Culvert Length (m) 20 21 22 5.00 0.80 46 311.307 Tailwater Depth (m) 0.300 No of Culverts Entrance Type (1-3) Inlet Loss Coeff 5.50 0.90 45 311.304 23 5.75 0.70 45 311.302 6.00 0.70 45 311 303 Manning's n 0.011 25 45 6.25 1.55 311.304 26 27 6.50 1 55 45 311.304 ORIFICE PLATE PARAMETERS 45 311.304 6.75 1.35 28 29 7.00 1.35 45 311.304 Orifice Dia (m) 0.010 45 311.303 7.25 1.15 Orifice Coeff 1.00 30 31 7.50 7.75 1.15 1.00 45 45 311.302 311.301 Orifice CL depth (m) 1.000 32 33 1.00 44 44 8.00 311.298 311.295 8.25 34 35 43 42 8.50 0.60 311.292 8.75 0.45 311.288 36 37 9.00 0.45 41 311.283 41 9.25 0.20 311.279 38 0.20 40 39 39 9.75 0.55 0 311.273 10.00 0.55 39 311.270 41 42 10.25 0.50 0 38 311.266 10.50 0.50 38 311.263 43 44 10.75 0.35 0 37 36 311.259 45 36 35 11.25 0.35 0 311.251 46 11.50 0.35 311.247 0.25 0.25 34 33 47 11.75 0 311.243 48 12.00 311.238 49 12 25 0.00 n 32 311 233 12.50 311.228 50 0.00 0 TOTAL Q 100 89 54

49

80

TOTAL V

COMPENSATION BASIN CALCULATOR

Job No. P003016 Project: Lot 12 Abattoir Road, Merredin Client: **ACENERGY** 28/03/2025 DURATN INFLOW OUTFLOW VOLUME LEVEL RAINFALL WORST COMPENSATING BASIN DISCHARGE - Section 7.5.7 AR&R 1987 CASE 311 147 16 15 KELLERBERRIN LOCATION 311.163 6.6 21 **EQUIV AREA (ha)** 0.195 3 10 22 311.170 5.0 23 ARI 6 311.179 DURATION (hrs) 12 23 311.175 1.9 RAINFALL (mm/hr) PEAK 21 311.163 3.11 24 1.2 INFLOW VOL (cum) 36 INFLOW OUTFLOW VOLUME I FVFI 48 3 2 20 311.156 0.7 HYET PERIOD (hrs) 0.50 311.179 72 15 0.5 6 23 311.122 CALC PERIOD (hrs) STORAGE & DISCHARGE HYETO WATER **CULVERT ORIFICE** INFILT'N CLOGGED LAKE TWL RELATIONSHIPS GRAPH INFLOW OUTFLOW VOLUME LEVEL DEPTH LEVEL VOLUME AREA FLOW PERIOD HRS (%) (I/s) (l/s) (cum) (m) (m) (cu m) (I/s) (m) (cu m) (sq m) (I/s) (I/s) (I/s) (I/s) 311 000 0.000 n 311 00 0 0.6 0.6 n n n n n 100 n 0.00 0.00 311.014 0.100 311.10 12 132 0.8 0.9 12 0.25 4 55 n 3 311 027 0.200 26 311 20 26 164 n 0 0.9 1.3 0.50 4.55 311.053 0.300 311.30 44 197 0 1.8 0 0.75 9.15 9.15 9 311.078 0.400 66 311.40 66 231 0 1.3 1.7 2.4 1.00 311.080 0.600 119 311.60 119 300 3.8 1.25 2.10 9 311.082 0.800 186 2 311.80 186 373 0 0 2.2 5.6 2.6 1.50 2.10 311.119 1.000 268 312.00 268 448 7.8 19 21 311.152 311.162 1.75 15.30 6 1.200 365 3 312.20 365 526 3.0 10.4 2.00 15.30 22 23 311.173 311.175 9 10 2.25 6.45 **BASIN GEOMETRY** V = A*h + B*h^2 + C*h^3 2.50 6.45 23 23 11 12 2.75 3.20 311.177 311.177 Length (m) Coefficient A 100 3.00 3.20 Width (m) Coefficient B 156 23 23 13 3 25 2.15 311.177 Side Slope (1 in) Coefficient C 14 3.50 2.15 311.178 23 23 15 3.75 2.65 311.179 **OUTLET CULVERT PARAMETERS** SOIL PERMEABILITY PARAMETERS 16 4.00 2.65 311.178 23 22 22 4.25 1.65 311.176 Permeability Kt (m/d) 0.5 311.173 311.171 Clogged Kc (m/d) Clogged Layer Thickness t (m) 18 4.50 1.65 0 Culvert Fall (m) 0.080 0.5 19 1.15 Culvert Length (m) 20 21 22 22 21 21 5.00 1.15 0 311.168 Tailwater Depth (m) 0.300 311.165 No of Culverts Entrance Type (1-3) Inlet Loss Coeff 5.50 0.95 0 311.161 23 24 5.75 0.70 20 311.157 6.00 0.70 n 19 311 152 Manning's n 0.011 25 6.25 0.00 19 311.147 26 27 6.50 0.00 n 18 17 311.142 311.137 ORIFICE PLATE PARAMETERS 6.75 0.00 28 29 7.00 0.00 n 16 311.132 Orifice Dia (m) 0.010 311.127 7.25 0.00 16 Orifice Coeff 1.00 30 31 7.50 7.75 0.00 15 14 311.122 311.117 Orifice CL depth (m) 1.000 32 33 0.00 8.00 13 13 311.112 8.25 311.107 34 35 311.103 311.098 8.50 0.00 12 8.75 0.00 0 11 36 37 9.00 0.00 11 10 311.092 311.087 9.25 0.00 0 38 0.00 311.082 39 9.75 0.00 0 311.077 10.00 0.00 311.073 41 42 10.25 0.00 0 8 7 311.068 10.50 0.00 311.064 43 44 10.75 0.00 0 0 311.061 0.00 311.057 45 11.25 0.00 0 0 6 6 311.054 46 11.50 0.00 0 311.051 0.00 47 11.75 0 0 311.048 6 5 5 48 311.045 12.00 49 12 25 0.00 0 n 311 043 12.50 0 311.040 50 0.00 0 TOTAL Q 100 40 35 TOTAL V 36

APPENDIX H BESS FIRE SAFETY FAQ

BESS Fire Safety FAQ

Merredin D-BESS

Rev.0

1. How does the proposed battery system mitigate fire risks?

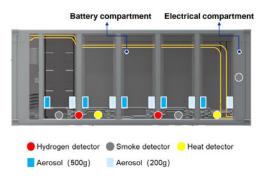
The battery system proposed by ACEnergy uses lithium-iron phosphate (LFP) chemistry, which is one of the safest lithium-ion battery types available. Unlike other battery chemistries, LFP batteries have a significantly lower risk of overheating and fire. This is because they are highly stable and do not easily enter thermal runaway—a rapid overheating reaction that can lead to fire or explosion.

The safety of the battery system has been tested under extreme conditions using the UL 9540A test, a recognised fire safety assessment for battery energy storage systems. The results confirm that the battery does not produce external flames, does not overheat nearby units, and does not pose an explosion risk. The containerised design and in-built fire suppression system further reduce fire risks by containing and extinguishing any potential fire within the unit.

Each battery container is equipped with smoke detectors, gas sensors, and temperature monitors to provide early warning of any issues. Please refer to the figure below as an example. If an abnormal condition is detected, the automatic fire suppression system activates to quickly contain and extinguish the fire within the container. This prevents the fire from spreading to other battery units or the surrounding area.

Ener C+ Product Overview - Fire Suppression System

- Detection system
- · Equipped with different types of detectors, such as smoke detector, heat detector and gas detector
- All detection signals are received and processed by the fire control panel, and the hydrogen (H₂) detector can be linked with the explosion-proof fan system.



No	Туре	Quantity	Configuration	Remarks		
1	Heat detector	2	Optional	Detection of temperature, in the battery compartment		
2	Smoke detector	2+1	Standard	Detection of smoke particles, two in the battery compartment, and one in the electrical compartment		
3	Hydrogen detector	2	Standard	Detection of hydrogen, in the battery compartment		
4	Fire control panel	1	Standard	Receive detector signals and control fire extinguishing system and explosion-proof system, in the electrical compartment		
5	Aerosol	12	Optional	In the battery compartment		

The Battery Management System (BMS) continuously monitors the temperature, voltage, and overall condition of each battery. This real-time monitoring allows for early detection of potential issues so that preventative action can be taken before a problem escalates. The system also includes an explosion-proof panel that safely disperses gases before they reach hazardous levels.

Testing has also shown that even if an LFP battery is physically damaged, such as by being punctured, it does not ignite. In rare cases where an LFP battery does catch fire, it primarily produces carbon dioxide, which helps slow combustion. These safety measures ensure that the battery system is designed to prevent, detect, and contain fire risks effectively.

2. How does the project mitigate risks of fire ignited from within a BESS container?

ACEnergy has adopted a comprehensive, multi-layered approach to reduce fire risks, including the unlikely event of a fire originating within a BESS container. Key design and planning measures include:

- Adequate separation distances: All battery containers and Medium Voltage Power Stations (MVPS) will be installed with sufficient spacing between units to minimise the risk of fire spreading between components.
- Asset Protection Zone (APZ): A managed APZ of up to 25 metres will be maintained around the BESS and MVPS equipment. This reduces the

likelihood of vegetation contributing to fire spread and supports safe fire response operations.

- Dedicated water supply: A water tank sized in accordance with the
 Department of Fire and Emergency Services (DFES WA) bushfire
 protection guidelines will be installed to support firefighting efforts should
 an incident occur.
- Emergency access: The project will establish a suitable access point from Abattoir Road, designed to allow safe and efficient entry and exit for emergency service vehicles.
- Fire management planning: ACEnergy is committed to preparing and submitting a Bushfire and Fire Management Plan prior to construction.
 This plan will address both bushfire threats and on-site fire response procedures in line with current regulatory requirements and DFES expectations.

These measures are designed to support prevention, containment, and safe response to any internal fire event, ensuring the protection of people, property, and the surrounding environment.

3. Has the BESS product undergone fire testing, and what standards does it meet?

Yes, the batteries have undergone extensive fire safety testing and meets stringent international safety standards to ensure protection against fire and thermal events. It is certified to IEC 62619 (battery safety), UL 9540A (thermal runaway fire testing), UL 9540 (BESS safety certification), and UL 1973 (battery performance and safety).

A large-scale burn test conducted by DNV, an internationally recognised testing body, confirmed that the selected BESS product can effectively contain fire within a single unit, preventing spread to adjacent units. Even when placed at the minimum allowable separation distance, neighbouring units remained below critical thermal runaway thresholds, demonstrating strong fire containment and safety measures.

These tests confirm that the BESS meets industry best practices for fire safety and reliability, ensuring compliance with both international and Australian regulatory requirements.

4. Do LFP batteries release toxic gases if they catch fire?

According to a full breakdown of the gases released in the UL9540A testing of the proposed battery system, and a declaration from the manufacturer CATL, the proposed battery products do not contain toxic and harmful substances prohibited by the EU, as defined under the EU Battery Regulation: (EU) 2023/1542.

With respect to the potential for long-term air quality impacts, the publicly available Report of Technical Findings Victorian Big Battery (VBB) Fire serves as a reference. Note that the VBB project employs Nickel Manganese Cobalt (NMC) lithium-ion batteries which share very similar off-gas components with the LFP lithium-ion batteries proposed in the Merredin D-BESS project, except for the release of oxygen. This document details the air monitoring performed by the Environment Protection Authority Victoria (EPA) by deploying two mobile air quality monitors within 2 km of the VBB site. Locations were chosen where there was potential to impact the local community. The data demonstrates that two hours after the fire event, the air quality in the surrounding area was "good" and no long-lasting air quality concerns arose from the fire event. Note that NMC lithium-ion batteries are generally considered more prone to thermal runaway effect than the LFP lithium-ion batteries, due to a lower thermal threshold and the release of oxygen that fuels combustion and accelerates thermal runaway during incidents of overcharging, overheating, or physical damage. In the worstcase scenario event, performed under UL 9540A module level fire testing, the products of combustion of a Megapack battery module (from the NMC lithiumion batteries used in the VBB) can include flammable and non-flammable gases. Based on those regulatory tests, the flammable gases were found to be below their Lower Flammable Limit (LFL) and would not pose a deflagration or explosion risk to first responders or the general public. The non-flammable gases were found to be comparable to the smoke encountered in a typical Class A structure fire and do not contain any unique or atypical gases beyond what is found in the combustion of modern combustible materials.