Appendix G

Surface Water Assessment

Broken Hill Battery Energy Storage System Project

Surface Water Assessment

21-May-2021
Prepared for – AGL Energy Limited – ABN: 74 115 061 375

Broken Hill Battery Energy Storage System Project

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Client: AGL Energy Limited

ABN: 74 115 061 375

Prepared by

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21-May-2021

Job No.: 60619153

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Quality Information

Document Broken Hill Battery Energy Storage System Project

Ref REV0

Date 21-May-2021

Prepared by Dylan Bone

Reviewed by Nicky Lee

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	21-May-2021	Final	William Miles CEnvP IA Technical Director - Environment	

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Abbreviations

Abbreviation	Description
AECOM	AECOM Australia Pty Ltd
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AGL	AGL Energy Limited
ANZECC	*Australian and New Zealand Environment and Conservation Council*
ANZG	*Australian and New Zealand Guidelines for Fresh and Marine Water Quality*
APZ	Asset Protection Zone
ARMCANZ	*Agriculture and Resource Management Council of Australia and New Zealand*
BESS	Battery Energy Storage System
bgl	Below ground level
BoM	Bureau of Meteorology
Broken Hill LEP	*Broken Hill Local Environmental Plan 2013*
CEMP	Construction Environmental Management Plan
Council	Broken Hill Council
DEM	Digital Elevation Model
DCP	*Broken Hill Development Control Plan 2016*
DPIE	NSW Department of Planning, Industry and Environment (formerly the DPE)
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
ha	hectares
ISEPP	*State Environmental Planning Policy (Infrastructure) 2007*
km	kilometre
kV	kilovolt
LEP	*Broken Hill Local Environmental Plan 2013*
LGA	Local Government Area
m	metres
mm	millimetres
m^2	square metres
m^3	cubic metres
mg/L	milligram per litre
ML	megalitres
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
MW	megawatts
MWh	megawatt-hour
NEM	National Energy Market

Abbreviation	Description
NSW	New South Wales
OSD	On-site detention
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
PMF	Probable Maximum Flood
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
SSDA	SSD application
SWMP	Soil and Water Management Plan
WM Act	*Water Management Act 2000* (NSW)
WSUD	Water Sensitive Urban Design

Definitions

Term	Definition
Australian Height Datum (AHD)	The standard reference level used to express the relative height of various features. A height given in metres AHD is the height above mean sea level.
Annual Exceedance Probability (AEP)	The probability or likelihood of a storm event occurring or being exceeded within any given year.
Blue Book (the)	*Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and *Volumes 2A, 2B, 2C, 2D and 2E* (DECC, 2008).
Project (the)	The Project involves both the construction and operation of the BESS (the Site) and the transmission line connecting the BESS to the TransGrid Broken Hill substation.
Site (the)	The Site comprises the BESS which is contained within two lots located at 74-78 Pinnacles Place, Broken Hill (Lots 57 and 58 of DP 258288).
Project Area (the)	The Project Area includes both the Site and transmission corridor used to connect the Site to the TransGrid Broken Hill substation.

Executive Summary

AGL Energy Limited (AGL) is proposing to construct, operate and maintain a battery storage facility at Broken Hill (the Project). The Broken Hill Battery Energy Storage System (BESS) would provide a range of network services to augment the reliability of energy supply at Broken Hill. The proposed Project would provide storage and firming capacity to the National Energy Market (NEM), as well as additional services to assist grid stability, including frequency control ancillary services.

The proposed location of the BESS (the Site) is on two lots at 74 to 80 Pinnacles Place, Broken Hill NSW 2880 (Lots 57 and 58 of DP 258288). The Site is located approximately 120 metres (m) east of the TransGrid Broken Hill substation located at 76 Pinnacles Road, Broken Hill NSW 2880 (Lot 2 of DP 1102040). The Project would also involve the installation of a transmission connection between the Site and the TransGrid Broken Hill substation, which would traverse Lot 7302 DP1181129, being Crown Reserve. The Site and the transmission line corridor constitute the 'Project Area'.

The Project is classified as State Significant Development (SSD). As such, this technical report for surface water, flooding and water use has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs), which would assist the Department of Planning, Industry and Environment (DPIE) in their assessment of the Project's SSD application.

The assessment identifies the potential impacts on flooding, surface water and water use as a result of the proposed construction works and ongoing site operations. This report outlines the regulatory framework, highlights any relevant features of the existing environment, discusses the potential impacts from the Project and proposes mitigation and management measures, where appropriate.

Existing environment

Under existing conditions, the Project Area is almost entirely impervious and undeveloped. The Site is located within an industrial precinct that drains in a south-westerly direction towards the ephemeral drainage line located within Lot 7302 DP1181129, and the remaining portion of the Project Area (i.e. the transmission corridor) is located within Lot 7302 DP1181129. The ephemeral drainage line conveys flow in a southerly direction, feeding into Kelly's Creek (approximately 3.5 kilometres (km) south of the Site), which is part of the Murray-Darling Basin catchment.

The natural topography of the Site falls in a south-westerly direction such that any runoff generated by the Site would sheet towards Lot 7302 DP1181129. Floodwaters generated by upstream areas within the industrial precinct are intercepted by the road network of Pinnacles Place and diverted around the Site. The upstream drainage system prevents the Site from inundation due to floodwaters in all events up to and including a 1% annual exceedance probability (AEP) storm event. The AEP refers to the rarity and magnitude of an expected rainfall event. A 1% AEP storm event is considered to be a large and rare event, where there is only a 1% probability that such an event could occur during any given year.

The neighbouring properties also direct runoff towards Lot 7302 DP1181129 without flows encroaching on the Site. Therefore, management of stormwater at the Site only needs to rely on the management of runoff generated by the Site itself.

In its current state of development, the Site does not include any formal water quality treatment measures before discharging to the ephemeral drainage line. Bare soils across the Site are therefore exposed to the erosive effects of rainfall and runoff.

The remaining portion of the Project Area drains directly to the ephemeral drainage line and consists of land covered by denser and well-established vegetation. This provides some additional protection against erosion; however, there are still areas of exposed soils that would be susceptible to the erosive effects of rainfall and runoff.

Identified impacts

The proposed works during the construction and operational phases of the Project present some potential impacts on surface water, flooding and water use across the Project Area (the Site and the transmission line corridor connecting the BESS to the nearby TransGrid Broken Hill substation). The key potential changes and impacts identified as part of this assessment include:

- Construction works could disrupt the existing flow patterns and potentially direct runoff into adjacent properties
- Disturbed surfaces and stockpiles during construction that could increase the risk of sediment mobilisation and transportation via surface flows
- An increase in water and wastewater demands, as a result of increased personnel during both construction and operational phases of the Project
- An increase in impervious area, which would result in an increase in the total runoff generated by the Site. This could potentially overload existing downstream drainage infrastructure
- Concentrated flows moving through and discharging from the Site that have greater potential to scour the earth
- New pollutants introduced during both construction and operational phases of the Project, due to the soils mobilised during construction, new materials and machinery being used on-site, changes to the land use and ongoing operations at the Site
- Flooding along the ephemeral drainage line could coincide with construction works along the transmission line, which could present a safety risk to workers and could carry construction equipment and/or material downstream
- The potential for spills and leaks from the batteries that could make its way into water discharging to the receiving environment (refer to **Appendix I Preliminary Hazard Analysis)**.

The Project is not expected to have any impact on flooding during the construction and operation of the Site as it is protected from inundation from floodwaters in all events up to and including a 1% AEP storm event. While the wider Project Area (i.e. the transmission line) traverses the ephemeral drainage line, it would have negligible impact on flooding during ongoing operations as the transmission lines are likely to be set above ground.

Mitigation and management measures

To eliminate or minimise impacts, a number of mitigation and management measures would be implemented as part of the Project. Key measures include:

- Temporary drainage or drainage diversions to manage stormwater, direct flows around active construction areas, and prevent flow from encroaching onto the neighbouring properties
- A soil and water management plan would be developed in accordance with the principles and requirements outlined in *Managing Urban Stormwater: Soils and Construction - Volume 1* (Landcom, 2004) and *Volume 2A* (DECC, 2008) (Blue Book) to minimise the erosion potential and sediment production across the Site
- Accommodate for an increase in the demand for potable water and wastewater services as a result of increased personnel within the Project Area during construction and operational phases of the Project.
- The internal drainage system would be designed to control and manage increased flows in a manner that protects important Site infrastructure and prevents scouring at the Site
- Water Sensitive Urban Design (WSUD) measures, such as vegetated table drains and pervious surfaces, would be incorporated into the drainage design in order to treat surface water before discharging to the receiving environment
- Management measures would be in place to cease works when a severe weather warning is issued for the immediate area, and equipment would be secured accordingly, in order to mitigate the risks of flooding along the ephemeral drainage line during construction works
- The battery design would incorporate spill containment measures to prevent battery spillage from entering the Site drainage system or downstream waterways.

With the recommended mitigation and management measures in place, negligible impacts to surface water, flooding, and water use are expected as a result of the Project.

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned by AGL Energy Limited (AGL) to undertake an assessment of surface water, flooding and water use at the proposed Battery Energy Storage System (BESS) at Broken Hill, in Far West New South Wales (the Project).

This assessment identifies the potential impacts on flooding, surface water and water use as a result of the proposed construction works and site operations. This report outlines the regulatory framework, highlights any relevant features of the existing environment, discusses the potential impacts from the Project and proposes mitigation and management measures where appropriate.

1.1 Project overview

The Project includes the construction and operation of the BESS (the Site), the transmission line connecting the BESS to the nearby TransGrid Broken Hill substation – and works at the TransGrid Broken Hill substation to allow connection. These components are detailed in **Table 1-1**. The location and proposed layout of the Site, and the overall Project Area is shown in **Figure 1-1**.

Table 1-1 Project Area components

Component	Description	Location	Lot/s
BESS (the Site)	Land in the order of 0.8 ha, situated between Pinnacles Place and the Commons (Lot 7302 of DP 1181129), in which the BESS would be constructed and operated. The BESS would have a maximum active power of up to 50 MW and an energy range of up to 100 MWh.	74-78 Pinnacles Place, Broken Hill NSW	Lots 57 and 58 of DP 258288
Transmission Line	A transmission line providing a connection between the BESS and nearby TransGrid Broken Hill substation using a 22-kV powerline to connect into the 22-kV busbar at the substation. The transmission line would be located within a 20 m wide corridor.	Part Lot 7302 DP1181129	Part Lot 7302 DP1181129
TransGrid Broken Hill Substation	An existing 220 kV TransGrid substation, to which the BESS would connect into via the transmission line.	76 Pinnacles Road, Broken Hill NSW	Lot 2 of DP 1102040

The Site is zoned as IN1 – General Industrial under the *Broken Hill Local Environmental Plan 2013* (LEP), which is a prescribed industrial zone for electricity generating works under the *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP).

1.1.1 Elements of the Project

The following infrastructure is proposed as part of the Project:

- Lithium-ion (Li-ion) batteries inside battery enclosures
- Inverters
- Medium voltage transformers up to 22 kV
- Cabling and collector units
- Connection to an existing 22 kV electrical switchyard including minor works to connect the BESS to the TransGrid Broken Hill substation
- Temporary site office and then a permanent control and office building
- Asset Protection Zone (APZ)
- Site access, internal roads and car parking

- Drainage and stormwater management
- Other ancillary infrastructure including security fencing, lighting and CCTV.

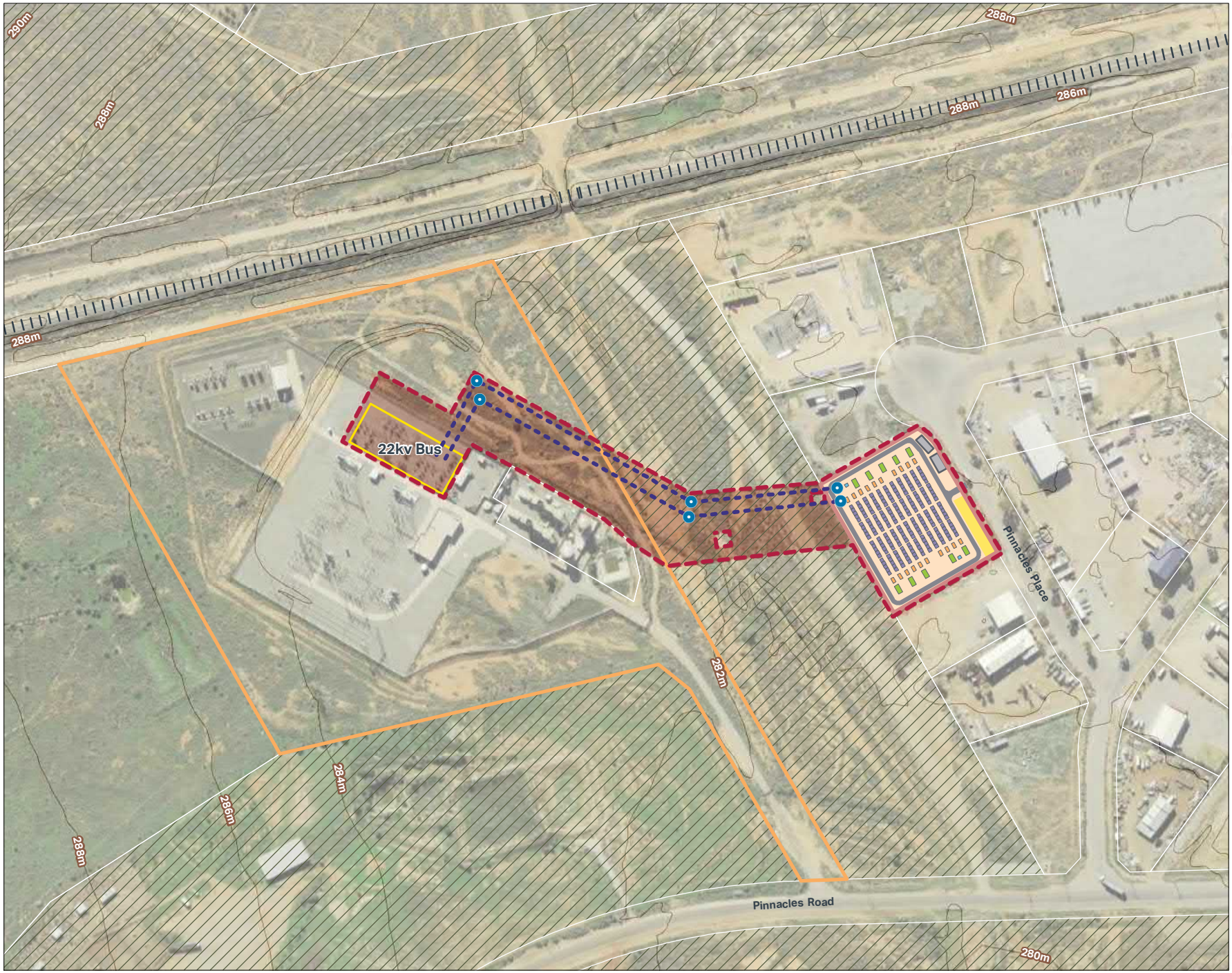
1.1.2 Construction works

It is estimated that construction of the Project would take up to 12 months to complete, starting in 2021.

Construction of the Project is expected to involve the following works:

- Enabling works
  - Site clearance activities
  - Installation of erosion and sediment controls and site fencing
  - Provision of construction power
  - Minor earthworks to form a level BESS pad, switchyard area and construction laydown areas, including potential import or export of fill as required
  - Development of site access to the sealed and unsealed road network adjacent to the Site (including Pinnacles Place)
  - Transportation of plant, equipment, materials and workforce to and from the site as required
- Civil, structural, mechanical and electrical works
  - Detailed excavation for site services, including stormwater drainage, water and electrical reticulation
  - Construction of foundations for BESS facilities
  - Structural works for BESS facilities
  - Construction of supporting structures and connection of site services, e.g. office building and associated amenities, workshop.
  - Delivery, installation and electrical fit-out of BESS
  - Construction of transmission connection between the Site and the TransGrid Broken Hill substation, including the landing gantry on Site and the 22 kV busbar at the TransGrid Broken Hill substation, installation of supporting structures and stringing the transmission line.
- Commissioning
  - Testing and commissioning activities
- Installation of landscaping Demobilisation
  - Rehabilitation of disturbed areas and landscaping, as necessary
  - Removal of temporary construction facilities and construction equipment.

A temporary laydown area would also be required on the Site during construction. Minor earthworks across this Site would also be required for site access and levelling the Site to ensure there is a suitable development footprint. Excavations within the Site would likely be to a maximum depth of 1.5 m. Excavations at other locations across the wider Project Area (i.e. along the transmission line corridor) would occur at the pole footings, up to a maximum depth of 3 m.



AECOM

N

0 50 100 m

Legend

- Project Area
- Site
- TransGrid Broken Hill Substation
- 22kV Bus
- Commons
- Railway
- Contour
- Indicative overhead transmission line
- Indicative transmission line pole

Site features

- Office building
- Battery
- Inverter
- Medium voltage auxillary switchboards
- Transformer
- Laydown area/operational parking area
- Access road
- Permeable surface

FIGURE 1-1:
PROJECT AREA

Source: © Department of Customer Service 2020

1.2 This report

The purpose of this impact assessment is to assess the potential surface water, flooding and water use impacts relating to the Project. In particular, it looks at the surrounding environment, assesses how and if the Project would impact on existing flooding, surface water drainage, and water use, then recognises whether any management and/or mitigation measures would be required to help minimise any potentially adverse impacts on the surrounding environment. In doing so, it aims to address the SEARs, which will assist the DPIE in their assessment of the Project's SSD application.

1.2.1 Secretary's Environmental Assessment Requirements

Table 1-2 sets out the SEARs relevant to this technical report: surface water, flooding and water use, and identifies where the requirements have been addressed in this report.

Table 1-2 SEARs for surface water, flooding and water use

SEARs requirement	Addressed
An assessment of the likely impacts of the development (including flooding) on surface water and groundwater resources and measures proposed to monitor, reduce and mitigate these impacts	**Section 4.1, 4.2** and **5.2**[1]
Details of water requirements and supply arrangements for construction and operation	**Section 4.1.5** and **4.2.5**
A description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with *Managing Urban Stormwater: Soils & Construction* (Landcom, 2004)	**Section 4.1.4, 4.2.4** and **5.2**

Notes:

[1] Potential impacts to groundwater resources have been addressed in the Detailed Site Investigation and Assessment Report (AECOM, 2021a). This report includes a summary of the groundwater impacts identified.

In addition to the above requirements, it was suggested as part of Agency inputs into the SEARs that quantitative flood modelling should be conducted to appropriately size any drainage infrastructure and assess the flooding impacts at the Site. However, as the Site is located at the top of the catchment – where there is no upstream floodwaters contributing to water moving through the Site – there is unlikely to be any major flooding issues and it is therefore not considered necessary to undertake quantitative flood modelling. Further justification as to why flood modelling has not been undertaken is provided in **Section 3.5** of this report.

In addition to the above requirements, there are several relevant legislations, policies and guidelines that have been acknowledged as part of this assessment. These are discussed in **Section 2.2** of this report.

1.2.2 Report structure

The report structure is as follows:

- **Section 1.0:** provides an overview of the Project and the purpose of this assessment;
- **Section 2.0:** contains the assessment methodology and legislative requirements;
- **Section 3.0:** provides an overview of the existing environment;
- **Section 4.0:** contains the impact assessment;
- **Section 5.0:** contains the recommended mitigation and management measures;
- **Section 6.0:** summarises the approach and findings of this assessment; and
- **Section 7.0:** contains the references cited in this report.

2.0 Assessment methodology

2.1 Overview

The adopted approach for assessing the potential impacts on surface water, flooding and water use included:

- A desktop review and analysis of existing information to characterise the existing environment, identify surface water receptors, existing flood behaviours and drainage infrastructure
- Consideration of the location of the Project Area in the context of surrounding catchment areas and potential sensitivity and influence on downstream waterways
- Identification of key topographical features such as likely overland flow paths and low/sag points around the Project Area
- Assessment of potential construction and operational impacts relating to flooding, drainage and surface water, including drainage modelling
- Identification of appropriate mitigation and management measures to mitigate potential impacts on the environment.

The assessment draws on a number of data sources and reference documents, which included:

- Project information, including the latest site layout plan and contours within the area
- Elevation data in the form of a Digital Elevation Model (DEM) at a resolution of 1 m, obtained from the NSW Government Spatial Services
- The Urban Stormwater Master Plan for Broken Hill (Tonkin, 2006).

In addition to the above methodology and background information, a Concept Stormwater Management Plan was prepared for the Site by AECOM (2021) which has been used to inform this impact assessment. A copy of this report is provided in **Appendix A**. The Concept Stormwater Management Plan looks at the surface water requirements at the Site in terms of OSD for managing peak discharge flows and WSUD measures for treating surface water runoff.

The flooding assessment involved defining the upstream catchment areas contributing to flows moving through or around the Site, estimating peak flows generated by these catchments and assessing whether the capacity of the surrounding drainage system is capable of conveying the 1% AEP flows without risking inundation of the Site.

2.2 Legislation, policies and guidelines

2.2.1 Relevant legislation

The relevant legislation used to assess the impacts of the Project are described below.

Water Management Act

The *Water Management Act 2000* (NSW) (WM Act) is a key piece of legislation that establishes a framework for the management of water in NSW and contains provisions for the licensing of water access and use. The WM Act creates:

- Mechanisms for protecting and restoring water sources and their dependent ecosystems
- Improved access rights to water
- Partnership arrangements between the community and the Government for water management.

One such mechanism is a Water Sharing Plan, which is a legal document prepared under the WMA Act. It establishes rules for sharing water between the environmental needs of natural water sources and water users, and also between different types of water uses such as town supply, rural domestic, stock watering, industry and irrigation. The Project is within the jurisdiction of the Water Sharing Plan for the Barwon, Darling and West region, covering a large area of western NSW.

Section 91 of the WM Act relates to activity approvals and defines two types of approvals: controlled activity approvals and aquifer interference approvals. Certain activities are considered controlled activities when carried out on waterfront land, which is defined as land located within 40 m of the banks of a river, lake or estuary. Since the Project is located within proximity to an ephemeral drainage line that feeds into Kelly's Creek (approximately 3.5 km south of the Site), it is considered to be a controlled activity.

However, under Section 4.41 of the *Environmental Planning and Assessment Act 1979* it specifies authorisations that are not required for SSDs such as the Project. This includes various approvals under the WM Act, including an activity approval listed under Section 91 (described above). It is also stated under Schedule 4 of the *Water Management (General) Regulation 2018* (NSW) that the extraction of less than 3 ML/year from groundwater sources can be undertaken without obtaining an aquifer interference approval. Approval requirements for aquifer interference have not yet commenced; however, during the construction phase of the Project, approval may still be required should construction works intercept groundwater (e.g. during excavation and/or benching) and require more than 3 ML/year. Groundwater investigations completed at the Site suggest that the Project is unlikely to intercept groundwater.

Aquifer Interference Policy

The *Aquifer Interference Policy 2012* explains the requirements of the WM Act relating to the water licensing and assessment processes for aquifer interference activities. However, as mentioned above, it unlikely that the Project would require the extraction of more than 3 ML/year from groundwater sources and would therefore not require an approval for aquifer interference.

Guidelines for Controlled Activities on Waterfront Land

The *Guidelines for Controlled Activities on Waterfront Land 2018* administers the requirements of the WM Act to ensure that minimal harm will be done to waterfront land as a consequence of carrying out the proposed controlled activity. However, authorisations required as part of these guidelines, and the WM Act, are not required as the Project is a SSD. Nonetheless, the Project does still aim to minimise disturbance and harm to the waterfront land.

Protection of the Environment Operations Act

The *Protection of the Environment Operations Act 1997* aims to protect, restore and enhance the quality of the environment, such that the Project has the need to maintain an ecologically sustainable development. Section 148 of the Act requires immediate notification of pollution incidents causing or threatening material harm to the environment to the relevant authority.

Local Government Act

The *Local Government Act 1993* contains a requirement under Clause 68 to gain approval from local council for carrying out stormwater drainage and water supply works.

2.2.2 Council requirements

The Project is located within the Broken Hill City Council (Council), and there are a number of relevant requirements for stormwater management that are included within the *Broken Hill Development Control Plan 2016* (DCP) and *Broken Hill Stormwater Drainage Systems Policy 1995*. As the Project is SSD, the requirements of Council's DCP and Stormwater Drainage Systems Policy do not apply. However, the relevant sections of the DCP and Stormwater Drainage Systems Policy have still been considered as a guide for stormwater management at the Site and to ensure the Project is consistent with Council's expectations for the area.

The requirements that are relevant to the management of stormwater at the Site include, but are not limited to:

- The new development and associated works must not adversely impact flooding at the neighbouring properties or downstream locations
- Finished floor levels must be set at least 300 millimetres (mm) above the 1% AEP flood level

- WSUD measures must be incorporated into any new development for the retention and re-use of surface water. In particular, the collection, storage and re-use of roof water, and the treatment of runoff from paved surfaces using swales, or other treatment measures, is recommended
- OSD must be provided where the development increases the total impervious area. The OSD storage must be designed to limit the post-development discharge to pre-development discharge rates in both the 20% and 1% AEP storm events
- Where practicable, the new development should aim to minimise the amount of impervious area at the site and direct surface runoff to landscaped areas, soakage trenches, or possible aquifer recharge systems
- A major/minor drainage system shall be implemented and shall have a combined capacity capable of containing the 1% AEP flows generated by the site.

2.2.3 Relevant policies and guidelines

Key guidelines referenced in this assessment include:

- *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and *Volume 2A* (DECC, 2008) (the 'Blue Book')
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018)
- *NSW MUSIC Modelling Guidelines* (Greater Sydney Local Land Services, 2015)
- *Australian Rainfall and Runoff* (Commonwealth of Australia, 2019)
- *Australian Rainfall and Runoff* (Engineers Australia, 1987).

These guidelines are described below.

Managing Urban Stormwater: Soils and Construction

The principles for the management of soil and water, in order to minimise the amount of erosion and sediment production occurring at any development site, particularly during construction works, are documented in this publication, otherwise known as 'the Blue Book'. The Blue Book and these management principles have been accounted for in the mitigation and management measures developed for the Project.

Guidelines for Fresh and Marine Water Quality

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG)* were developed to provide a nationally consistent approach to water quality management based on the principle of ecological sustainable development of water resources. The guidelines contain a set of tools for the assessment and management of water quality across a range of water resource types based on designated environmental values. The *ANZG* are ambient water quality guidelines, appropriate for the assessment of water quality discharging from the Site.

Since the Project is located within the Murray-Darling Basin catchment, it is subject to the water quality objectives for this regional drainage division. However, the *ANZG* have not yet defined default guideline values for physical and chemical stressors across this drainage division and therefore recommend that the values set out in the *Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture* and *Resource Management Council of Australia and New Zealand (ARMCANZ) (2000)* guidelines are adopted.

Table 2-1 outlines the pollutant indicators and trigger values for upland rivers within the Murray-Darling Basin. Management of surface water generated by the Site should ensure that the concentration of pollutants leaving the Site and draining to the ephemeral drainage line does not exceed these trigger values.

Table 2-1 ANZG pollutant target concentrations

Pollutant	Target concentration (mg/L)
Total Phosphorous (TP)	0.02
Total Nitrogen (TN)	0.25

NSW MUSIC Modelling Guidelines

The *NSW MUSIC Modelling Guidelines* provides guidance for model set up and use within eWater's Model for Urban Stormwater Improvement Conceptualisation (MUSIC), which is an industry standard software that is used to simulate pollutant production and water quality treatment across a catchment. While these guidelines were developed for catchments within the Greater Sydney area, they are still applicable to catchments across the rural regions of NSW. They are also the recommended guidelines for catchments located within Council areas that do not have a standard approach for MUSIC modelling.

Australian Rainfall and Runoff

Australian Rainfall and Runoff (Commonwealth of Australia, 2019) (ARR) is the primary technical publication for hydrological estimates and design considerations. The latest issue was finalised in 2019 and was the result of a number of years of updates to the previous version of *Australian Rainfall and Runoff* (Engineers Australia, 1987). Hydrological calculations that were completed as part of this assessment were undertaken in accordance with the ARR guidelines.

3.0 Existing environment

3.1 General

The Site is located within an industrial precinct bounded by the railway line to the north, Kanandah Road to the east, Pinnacles Road to the south, and Lot 7302 of DP 1181129 to the west. While the Site itself has little in the way of current infrastructure, other properties within the industrial precinct predominantly comprise buildings and hardstand surfaces. Other industrial premises have very limited drainage infrastructure and do not have any formal stormwater detention or retention systems in place. The road network servicing the industrial precinct also has very limited underground drainage infrastructure such that drainage of stormwater runoff predominantly relies on the use of overland flow paths, such as the road network, to direct flows towards the nearest watercourse or drainage line.

Outside of the industrial precinct, and at other areas included within the Project Area, there is a significant amount of open space with sparse vegetation – particularly across Lot 7302 DP1181129.

The location of the Project – in Broken Hill, NSW – is considered to be an arid region. Rainfall records over a period of 130 years (from 1890 to 2020), that were obtained from the Bureau of Meteorology (BoM), show that Broken Hill experiences average annual rainfall of 227 mm.

3.2 Catchment

The existing Site is located adjacent to an ephemeral drainage line within Lot 7302 DP1181129 immediately west of the Site. The Site slopes towards the rear of the property, in a south-westerly direction – away from Pinnacles Place and towards Lot 7302 DP1181129. There is an unsealed vehicle access road that runs along the western side of the Site, situated between the Site and the ephemeral drainage line. This road catches any runoff coming from the Site (and neighbouring properties) and carries it in a southerly direction, before eventually draining directly into the ephemeral drain where the unsealed access road meets Pinnacles Road.

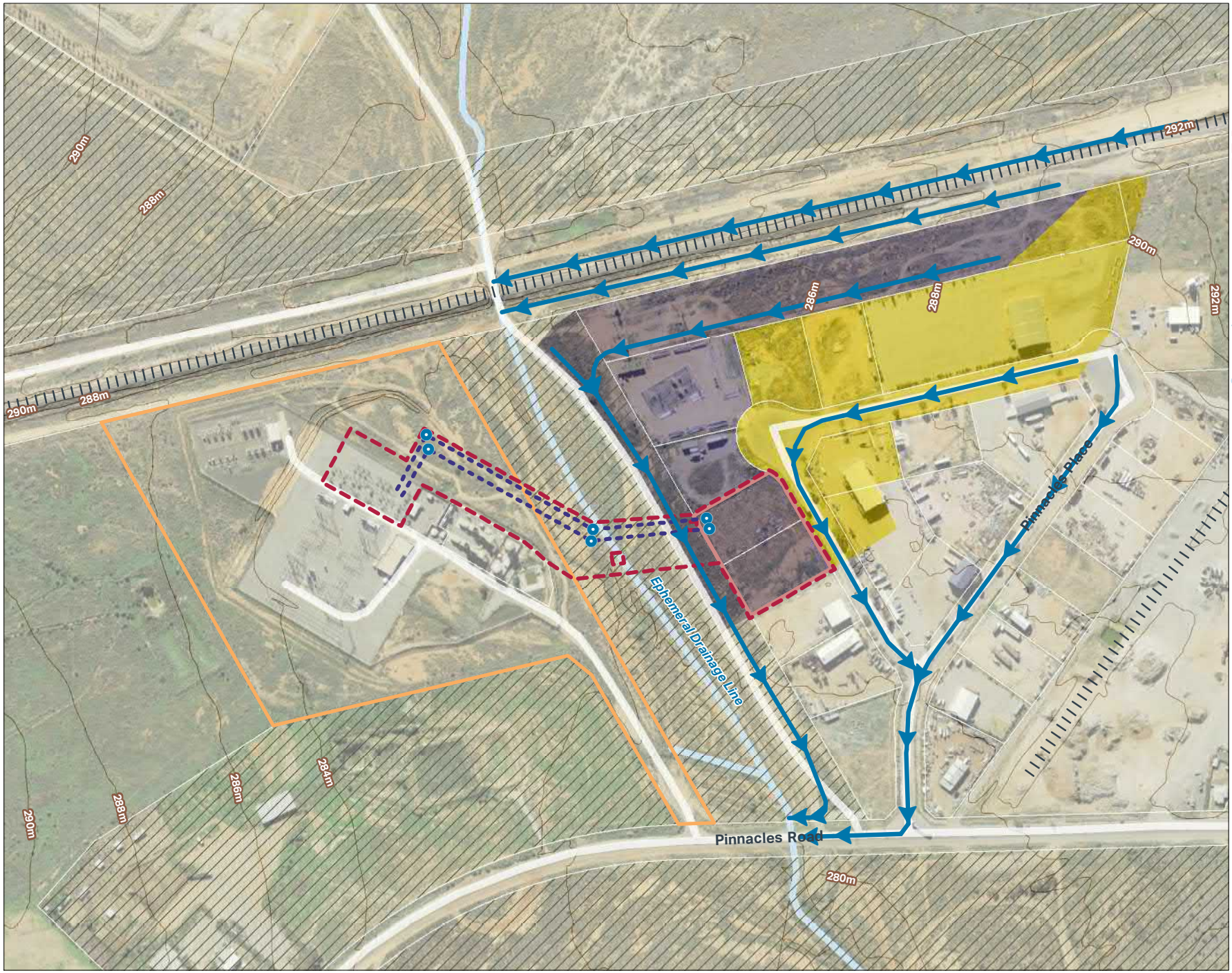
Flow within the ephemeral drainage line then passes through a culvert crossing under Pinnacles Road and heads south, eventually joining into Kelly's Creek (approximately 3.5 km south of the Site), which later feeds into Pine Creek, approximately 11 km south of the Site.

The railway line north of the industrial precinct is elevated above the surrounding land, by up to 4 m at some locations, and acts as a barrier to upstream flows moving in a southerly direction towards the industrial precinct. Flow approaching the railway line is captured by the longitudinal drain along the railway line and is directed around the industrial precinct, towards the ephemeral drainage line that runs past the Site.

The industrial precinct drains in a south-westerly direction towards the ephemeral drainage line. Flows coming from areas upstream of the Site are captured by the local road network around Pinnacles Place, which then directs flow towards Pinnacle Road before discharging to the ephemeral drainage line. This prevents any upstream flows from moving through the Site.

The upstream catchment contributing to flow within Pinnacles Place, as it moves past the Site, is in the order of 4.8 ha. The approximate extent of this catchment is illustrated in **Figure 3-1.**

There is also a small catchment area, in the order of 4.9 ha, on the downstream side of Pinnacles Place, which contributes to flow moving in a southerly direction along the eastern side of the unsealed access road as it passes the Site. None of the flows generated by this catchment are directed through the Site, with the exception of runoff generated by the Site itself. Both of the neighbouring properties (north and south of the Site) also fall in a westerly direction towards the ephemeral drainage line, without directing runoff onto the Site.



AECOM

N

0 50 100 m

Legend

- Project Area
- Site
- TransGrid Broken Hill substation
- Commons
- Catchment contributing to flow along Pinnacles Place
- Catchment contributing to flow along Crown Land access road
- Flow direction
- Railway
- Ephemeral watercourse
- Contour
- Indicative overhead transmission line
- Indicative transmission line pole

FIGURE 3-1:

EXISTING DRAINAGE AND CATCHMENTS

Source: © Department of Customer Service 2020

The only way for upstream flows (i.e. flows generated by external areas) to encroach on the Site is if flows from the upstream catchment were to exceed the capacity of the road reserve in Pinnacles Place and spill into the Site. However, if flows generated by the upstream catchment were large enough to exceed the capacity of the road reserve, it is likely that most of these spilled flows would overtop the kerb and property boundaries at the north-western corner of Pinnacles Place, as opposed to the section of road passing in front of the Site, which would direct overflows through the northmost properties first. The possibility of flows spilling out of the road reserve and into the Site is considered a low risk and has been assessed in more detail in **Section 3.5** of this report.

The catchment contributing to flow along the ephemeral drainage line as it passes through the transmission line corridor (i.e. the remaining portion of the Project Area) is estimated to be in the order of 2.7 km^2 and extends up to Wills Street. The Broken Hill Community Recycling Centre is located at the top of this catchment and incorporates a number of basins and low-lying areas which would provide some storage and attenuation of flows before they enter the ephemeral drainage line. The time of concentration for peak flows generated by this larger catchment is not likely to coincide with the time of concentration for peak flows generated by local catchments draining around the Site.

3.3 Receiving environment

Runoff from the Site and wider Project Area contributes to flow within the ephemeral drainage line, Kelly's Creek and eventually Pine Creek. There is a lack of information on the existing capacity, water quality and any sensitivities along these watercourses.

Review of aerial imagery has shown there to be some vegetation along the banks and invert of the creek line. It also appears as though it is an ephemeral drainage system for its entire length, up until Pine Creek discharges into Kudgee Lake.

3.4 Current site stormwater management

As stated in **Section 3.1**, the Site predominantly comprises cleared land with no formal drainage infrastructure in place. There are unlikely to be any external flows draining through the Site, and any runoff generated by the Site itself would move as overland sheet flow towards Lot 7302 DP1181129 and ephemeral drainage line.

Runoff generated by the remaining portion of the Project Area drains directly to the ephemeral drainage line via existing overland flow paths.

3.5 Existing flood risk

To assess the potential for floodwaters encroaching on the Site, peak flows generated by the catchment contributing to flow moving past the Site, along Pinnacles Place, were estimated for various storm events. The estimated flows within Pinnacles Place were then compared to the hydraulic capacity of the road reserve, to determine if and under what circumstances these flows would spill out of the road reserve and encroach on the Site.

DRAINS modelling was used to estimate the peak flow generated by the upstream catchment. The amount of runoff generated by the catchment was calculated using an ILSAX type hydrological model and using the loss parameters that were adopted for the *Broken Hill Urban Stormwater Master Plan* (Tonkin, 2006). The adopted values are summarised in **Table 3-1**.

Table 3-1 Adopted hydrological loss parameters

Parameter	Adopted value
Initial depression storage for impervious areas	1 mm
Initial depression storage for pervious areas	35 mm
Continuing loss for pervious areas	3 mm/hr

The model was set up using the latest rainfall depths and temporal patterns that were obtained from the BoM. In accordance with the latest (2019) ARR recommendations, the model was run for an ensemble of storm events (varied temporal patterns for each storm duration) and the median peak flow for each storm duration was adopted.

It is estimated that the upstream catchment (4.8 ha) would generate a peak flow in the order of 1.0 m^3/s in a 1% AEP storm event, and 0.6 m^3/s in a 5% AEP storm event.

It has been assumed, based on a review of aerial imagery and site photos, that the road is approximately 13 m wide with upright barrier kerbs (150 mm high). The contours indicated that the section of road passing in front of the Site has a longitudinal grade of approximately 1.0%.

Figure 3-2 shows a photo of the wide, kerbed road as it passes in front of the Site.

Figure 3-2 Pinnacles Place in front of the Site (on the left side)

Based on these assumptions, it is estimated from Manning's calculations that the road has the capacity to convey 0.6 m^3/s contained by the kerbs and 1.9 m^3/s contained by the full road reserve (i.e. including the verge area). On this basis, it is likely that flows would begin to overtop the kerb line in events larger than a 5% AEP storm event; however, the road reserve still has the ability to contain all of the 1% AEP flows without risking inundation of the adjacent properties. Therefore, it is extremely unlikely (or rare) that flows moving along Pinnacles Place would encroach on the Site.

The road capacity calculations are provided in **Appendix B**.

It should be noted that storm events larger than a 1% AEP event, such as the probable maximum flood (PMF), have not been assessed as it is unlikely that such events would impact important infrastructure at the Site for the following reasons:

- The road reserve passing in front of the Site still has some additional hydraulic capacity to convey flows larger than the 1% AEP flows.
- If flows were to spill out of the road reserve, they would move through the two properties immediately north of the Site as these properties align directly with flows moving in a westerly direction along Pinnacles Place.
- The proposed development is likely to incorporate a road network that would direct any incoming flows around important infrastructure, located at the centre of the Site, and discharge to Lot 7302 DP1181129.

Runoff discharging from the Site would contribute to flow moving along the catch drain that runs along the eastern side of the unsealed road within Lot 7302 DP1181129. It is expected that the Site would not be impacted by backwater effects caused by flow within this catch drain as flow exceeding the capacity of this drain would overtop the unsealed road and head towards the ephemeral drainage line before it ever floods back into the Site. The crest of the unsealed road (i.e. the spill point) is more than 500 mm lower than existing surface levels across the Site.

Based on the above findings, the Site is not likely to be impacted by flooding and quantitative flood modelling has therefore not been undertaken.

The remaining portion of the Project Area consists of the transmission line corridor which traverses the ephemeral drainage line located within Lot 7302 DP1181129. While the drainage line is dry for most of the year, it will be subject to flooding during storm events. Due to the pervious nature of the upstream catchment, it is likely that all flow generated by the catchment can be contained within Lot 7302 DP1181129 being 120 m wide. Therefore, floodwaters coming from the large upstream catchment would not impact the Site.

3.6 Groundwater

An assessment of historical groundwater records in proximity to the Project Area and recent bore logs undertaken within the Site was completed as part of the Detailed Site Investigation and Assessment Report (AECOM, 2021a).

The review of historical groundwater levels within a 1 km radius of the Project Area identified that standing groundwater levels could be as close as 2 m below ground level (bgl) but could also be as deep as 20 m bgl.

The soil logs undertaken at the Site ranged from 3 to 8 m deep, no groundwater was encountered, and there were no observations of moisture in the soil and bedrock. Therefore, is was assumed that groundwater levels are well (greater than 8 m) below surface levels across the Project Area.

3.7 Stormwater runoff quality

The existing Site and wider Project Area does not include any formal water quality treatment measures before discharging to the ephemeral drainage line.

A significant portion of existing surfaces across the Site are bare and vulnerable to the effects of scouring due to rainfall and runoff. There is some sparse vegetation across the Site, which would provide some slight protection against erosion; however, there are no formal erosion protection measures across the existing Site. Runoff generated by the Site is therefore likely to mobilise sediments and transport this sediment into the receiving environment.

The remaining portion of the Project Area, the transmission line which traverses Lot 7302 DP1181129, has a denser and well-established sparse vegetative cover. Further detail on the vegetation within and surrounding the Project Area is provided in **Chapter 8.0 Biodiversity**. This would provide greater protection against the erosive effects of rainfall and runoff; however, there are still some areas of exposed soils that would be susceptible to erosion and contribute to the transportation of sediments in waterways.

3.8 Water use and wastewater management

As mentioned in **Section 2.2.1**, the Project Area is subject to the Water Sharing Plan for the Barwon, Darling and West region

The Site is currently only used for the storage of equipment and therefore has limited demand for potable water and wastewater services. An existing water main runs along Pinnacles Place, with a single water hydrant located in front of the Site. There is also an existing sewer main that runs along the rear (western) boundary of the Site with connection points in both parcels of land (i.e. Lots 57 and 58 of DP 258288).

There are currently no requirements for water or wastewater services within the remaining portion of the Project Area (i.e. within Lot 7302 DP1181129), nor are there any existing water or wastewater mains servicing this land.

4.0 Impact assessment

The following sections assess the potential impacts on surface water, flooding and water use during the construction and operational phases of the Project. The impact assessment below is based on the methodology outlined in **Section 2.0** of this report and uses the Concept Stormwater Management Plan provided in **Appendix A** as the basis for stormwater management at the Site.

4.1 Construction phase

4.1.1 Surface water drainage

Construction works required for the Project have the potential to impact overland flow paths moving through the Site and wider Project Area as it evolves over time. This has the potential to cause a minor redistribution of some surface flows generated by the Project Area. The disruption of existing flow paths is likely to occur as a result of earthworks, and the potential impacts could include:

- Localised ponding occurring at new areas across the Site and impacting works
- Earthworks causing runoff to move as concentrated flows, as opposed to existing runoff moving as sheet flow, which has the potential to scour out the earth and mobilise sediment
- Earthworks directing concentrated flows into the neighbouring properties which could potentially create drainage/flooding issues within these properties.

As the Site is developed, it would increase the impervious area which may increase runoff. This has the potential to overload existing drainage systems, such as the catch drain along the eastern side of the unsealed access road in Lot 7302 DP1181129. If stormwater runoff is not managed appropriately, any increased runoff could be directed into adjacent properties.

Due to the small size of the Project Area, in the context of the wider catchment draining to the ephemeral drainage line, the redistribution and possible increase of flows during construction is not expected to significantly affect the performance of downstream drainage infrastructure. **Section 5.0** includes mitigation measures to ensure the risk of this occurring is minimised.

4.1.2 Flooding

As per the existing flood risk assessment provided in **Section 3.5** of this report, the Site is not likely to be impacted by flooding in all events up to and including a 1% AEP storm event. As there is not likely to be any floodwaters moving through the Site, the construction works contained within the Site are not likely to impact on flood behaviour.

Conversely, construction works at other locations across the Project Area (i.e. along the transmission line corridor) would occur within Lot 7302 DP1181129 and ephemeral drainage line. While the drainage line is generally dry most of the year, there is potential for the upstream catchment to generate large flows during a high intensity rainfall event which would be directed to the ephemeral drainage line and could result in flooding along the drainage line. If such an event were to occur, this could lead to large floodwaters moving through the construction site.

Flooding along the ephemeral drainage line during construction works would present a safety hazard to construction personnel, cause damage or loss of materials and equipment and could potentially lead to materials being washed off-site which could potentially block drainage infrastructure and/or have environmental impacts.

Since the construction period for works along the transmission line corridor would only be a few weeks, scheduled during a dry period of the year, it is extremely unlikely that a flood event along the ephemeral drainage line would coincide with construction works. It is however necessary that precautionary measures are taken. Any impact would be adequately managed through the mitigation and management measures identified in **Section 5.0**. Careful planning for safety and evacuation procedures specific to working in a watercourse would need to be prepared as part of the construction works. The location of site equipment and materials, such as stockpiles, would also need to be considered during construction and detailed design phases.

4.1.3 Groundwater

Excavations during construction works would be in the range of 1.5 m deep across the Site and 3.0 m deep for pole footings at other locations across the Project Area. Bore logs that were undertaken within the Project Area (refer **Section 3.6**) indicated that groundwater levels are likely to be greater than 8.0 m below surface level. On this basis, it is unlikely that groundwater would be encountered during construction and therefore it is not likely there will be any impact on existing groundwater conditions.

4.1.4 Water quality

The potential impacts caused by construction works that could potentially result in a low quality of stormwater runoff leaving the Site and wider Project Area include:

- Earthworks associated with site preparation, levelling, piling and trenching resulting in a large area of disturbed surfaces and loose soils (e.g. at stockpiles) that could increase the amount of sediment and nutrients being mobilised and transported downstream via stormwater runoff
- Earthworks and changes to the Site resulting in concentrated flows, as opposed to sheet flow, that have more potential to scour the earth and increase sediment loads carried by surface waters
- The contamination of surface waters due to accidental spillages of fuel, lubricants, effluent and other chemicals and materials used during construction
- Vehicle movement across the construction site which could loosen soils and transport sediment into the waterways either by runoff carrying sediment from loosened soils or through sediments attached to the vehicles traversing the ephemeral drainage line
- Dewatering open excavations following periods of rainfall, which may contain sediments and other pollutants mobilised by the rainfall.

Where sediments are mobilised from construction areas and allowed to enter the receiving waterways, there is the potential to adversely impact water quality by increasing turbidity, lowering dissolved oxygen levels, increasing nutrients and increasing pollutants.

The impacts to the receiving watercourses are considered to be negligible with the implementation of standard mitigation and management measures described in **Section 5.0**.

4.1.5 Water use and wastewater

The number of workers/occupants on the Site and across the Project Area would be at its largest during the construction phase of the Project. To accommodate these workers, there would likely be some temporary office facilities. This would require a temporary increase in the demand for potable water, a temporary increase in the amount of wastewater to be disposed, and would alter the existing water supply arrangements .

4.2 Operational phase

4.2.1 Surface water drainage

Under existing conditions, the Site is almost entirely pervious. The proposed layout of the Site would increase the impervious area which would in turn, increase the runoff generated by the Site. Areas that would contribute to an increase in pervious area include:

- Concrete pads for supporting the inverter, transformer and batteries
- The access/internal roads around the perimeter of the Site
- Office buildings
- The car parking area

The Concept Stormwater Management Plan prepared by AECOM (2021) (refer **Appendix A**) indicates that the impervious area would likely increase from 0% to 40%, which would increase the site discharge from 150 L/s to 345 L/s in a 1% AEP storm event. This increase in runoff has the potential to slightly alter the performance of drainage systems immediately downstream of the Site, such as the

catch drain along the eastern side of the unsealed road in Lot 7302 DP1181129 and the downstream culvert crossings. This small increase in runoff, in comparison to the peak flows generated by the wider catchment draining to the ephemeral drainage line, would, however, have minimal impact on the performance of the broader downstream drainage system.

It is a recommendation of Council (outlined in the DCP) that new developments incorporate OSD to limit post-development discharge rates to the pre-development flows. This strategy aims to protect downstream drainage systems and the receiving environment from the cumulative effect caused by multiple upstream developments. Due to the scale of the Site (0.8 ha) relative to the size of the upstream catchment (2.7 km^2), incorporating an OSD system is not likely to provide much improvement in downstream flooding.

The Concept Stormwater Management Plan indicated that, should post-development discharge rates need to be limited to pre-development rates, it is likely that a volume in the order of 240 m^3 would be required for OSD storage. An appropriate location for the OSD system would be identified during detailed design.

The small increase in runoff and changes to the overland flow patterns would also be managed by the proposed Site drainage system. As per the Concept Stormwater Management Plan, this would consist of the battery storage pads draining to table drains and culverts that direct flow around the perimeter of the Site, along the internal road network, subject to detailed design. These table drains and culverts would convey flow towards the OSD basin before discharging to Lot 7302 DP1181129.

The remaining portion of the Project Area (i.e. along the transmission line corridor) would not impact on surface water drainage, as the transmission lines are likely to be set above ground and transmission line poles would have a negligible impact on surface water drainage within the area.

4.2.2 Flooding

As discussed in **Section 4.1.2** for the construction phase of the Project, the Site would not be affected by flooding under both pre- and post-development conditions. Therefore, the proposed works would not impact existing flooding regimes or adversely impact flooding at downstream or neighbouring properties. The neighbouring sites (to the north and south) do not, under existing conditions, direct surface water into the Site; therefore, raising levels within the Site would not impact on flooding/drainage at these properties.

While the Site is expected to be protected from flooding in all events up to and including the 1% AEP storm event, there is a slight possibility that larger, less frequent storm events such as the PMF could spill onto the Site. To manage the risks of PMF floodwaters moving through the Site, the office buildings and concrete pads for supporting the inverters, transformers and batteries would be elevated above the ground (on concrete pads) in order to protect them from floodwater impacts. The road network within the Site would also direct any floodwaters around the central battery storage area.

Along the transmission line, there may be poles that encounter floodwaters moving along the ephemeral drainage line. Due to the small width of these poles, relative to the full width of the ephemeral drainage line, it is expected that they would only create a slight obstruction to flows moving in a southerly direction. Floodwaters would easily be directed around the poles, without having an impact on flood levels. The transmission line would therefore have minimal impact on floodwaters within the area.

4.2.3 Groundwater

The Project is not expected to have any interaction with groundwater and therefore is not likely to have an impact on groundwater.

4.2.4 Water quality

Introducing more impermeable surfaces across the Site would help to reduce the potential for sediment and nutrient mobilisation. However, the proposed operations may introduce a number of additional pollutants and other opportunities for sediment mobilisation. Some of the key sources of pollutant generation at the Site could include:

- Vehicle by-products, such as oils and grease, as they traffic the Site or park on-site
- General litter introduced through workers

- Hazardous substances from a battery spill/leak
- New site layout concentrating flows which may increase the risk of scour and sediment mobilisation
- Raindrop and rill erosion on the pervious surfaces surrounding the batteries pervious surfaces due to the surface not having a protective cover or having insufficient compaction.

The MUSIC modelling undertaken as part of the Concept Stormwater Management Plan (AECOM, 2021b, refer **Appendix A)** shows that the proposed network of vegetated table drains is capable of providing the required treatment in order to meet the ANZG requirements outlined in **Table 2-1**. The water quality impacts to the receiving watercourses are therefore considered to be negligible with the proposed stormwater management measures in place.

However, it is, important that these potential sources of pollutants are mitigated and managed through the measures described in **Section 5.0**. This would help to further reduce the risk of increasing the pollutant load leaving the Site and also reduce the risk of blockage within the Site's drainage system.

Some of the prevention measures included in the Concept Stormwater Management Plan are as follows:

- The design of the battery enclosures would incorporate spill containment measures to protect the receiving environment from leaks or spills from the batteries
- Concentrated flows discharging from the OSD basin would discharge to some form of heavy-duty (e.g. rock) scour protection or energy dissipator to prevent these discharge flows from scouring the earth at the outlet.

The remaining portion of the Project Area, along the transmission line, would have negligible impact on the water quality within downstream waterways as there are no ongoing operations within this area. Any maintenance works along the transmission line would be undertaken in a manner that minimises the disturbance to local vegetation and soils.

4.2.5 Water use and wastewater

Typically the Site would be unmanned for the majority of the time. When staff are required to be on-site, there is only likely to be three personnel at any given time, and it is not expected that any personnel would be on-site for the entire day.

Since the Site was previously undeveloped and had limited demand for water use and wastewater, this increase in on-site personnel is likely to increase these demands. Connection to the existing water main within Pinnacles Place and the existing sewer main at the western end of the Site would need to be established in order to service these demands. However, this increase in water and wastewater demands would be minimal and would not have an impact on the performance of the existing water and sewer mains.

In addition, as the Site is located in an area that has been subdivided for industrial use it would be expected the servicing for this land would have accounted for its future development. Indeed it is likely that the expected potable and wastewater provision for this land under this subdivision would have been greater than the demand expected from the Project.

There is no additional demand for potable water and wastewater services at other locations across the Project Area.

5.0 Management and mitigation measures

5.1 Overview

This section describes the environmental management approach for surface water, flooding and water use during construction and operational phases of the Project. It includes a compilation of the performance outcomes as well as the mitigation and management measures, including those that are proposed in the Concept Stormwater Management Plan prepared by AECOM (2021b) – refer **Appendix A**.

The mitigation and management measures described would be included as part of the Construction Environmental Management Plan (CEMP) for the Project.

5.2 Mitigation and management measures

The impacts identified in **Section 4.0** of this report, and the mitigation and management measures that would be implemented to minimise the effects on the receiving environment during the construction and operational phases of the Project are summarised in **Table 5-1**.

Table 5-1 Mitigation and management measures

Ref	Mitigation and management measures	Timing
SW1	A Soil and Water Management Plan (SWMP) would be included as part of the CEMP. This SWMP would be prepared in accordance with *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and would include the following: • plans for temporary drainage or drainage diversions to be implemented during construction to control concentrated flows, avoid impeding stormwater flows, ensure flows are not directed onto adjacent properties and construction is not impacted by site runoff. • erosion and sediment control measures to minimise the erosion potential and sediment production across the Project Area. • measures to cease works within Lot 7302 DP1181129 and secure equipment when a severe weather warning is issued for the immediate area • details of potable water requirements.	Construction
SW2	The Site drainage system would: • be designed to cater for an increase in flows generated by the Site to limit post-development flows to pre-development flows in all events up to and including a 1% AEP storm event. • incorporate water sensitive urban design features such as vegetated swales and pervious areas, where possible, to treat stormwater runoff generated by the Site in order to meet the water quality targets outlined in the ANZG guidelines. This would reduce the amount of pollutants generated through Site operations, such as general litter, vehicle by-products, sediments and nutrients, leaving the Site and entering the receiving environment. • include heavy-duty scour protection (e.g. rock) or an energy dissipator would be installed on-site and at the Site's stormwater discharge point to reduce the	Operation

Ref	Mitigation and management measures	Timing
	risk of scouring and the transport of sediment downstream. The design for stormwater management system at the Site would be discussed with Broken Hill City Council prior to being finalised.	
SW3	Site buildings would incorporate a roof drainage system, designed in accordance with Australian Standards, that safely discharges roof runoff to the Site's surface water drainage system and rainwater tanks to prevent roof runoff from eroding soils.	Operation
SW4	The battery design would incorporate spill containment measures to prevent battery spillage from entering the Site drainage system or downstream waterways.	Operation
SW5	The requirement for additional measures to protect the transmission line poles from floodwaters within Lot 7302 DP1181129 would be determined during detailed design.	Operation
SW6	Maintenance works along the transmission line would be undertaken in a manner that minimises the disturbance to soils and local vegetation.	Operation
SW7	The office buildings, inverters, transformers and batteries would be elevated above surface level on concrete pads to protect them from potential floodwater impacts.	Operation

6.0 Summary

An impact assessment for surface water, flooding and water use has been carried out for the Project.

This assessment involved a desktop review of the existing environment to identify surface water receptors and the existing flood and drainage behaviour of the Site. Identification of any construction and operational impacts of the Project, and establishing the appropriate mitigation and management measures to eliminate or minimise any adverse impacts.

Under existing conditions, the Project Area was almost entirely impervious and undeveloped such that stormwater flows generated by the area sheeted across the bare surface and discharged to the ephemeral drainage line within Lot 7302 DP1181129. The Site does not receive any additional flows from the neighbouring properties, nor is it subject to flooding in all events up to and including a 1% AEP storm event.

The key potential changes and impacts resulting from the Project include:

- Construction works could disrupt the existing flow patterns and potentially direct runoff into adjacent properties
- Disturbed surfaces and stockpiles during construction that could increase the risk of sediment mobilisation and transportation via surface flows
- An increase in water and wastewater demands, and alterations to the water supply arrangements, as a result of increased personnel during both construction and operational phases of the Project
- An increase in impervious area, which would result in an increase in the total runoff generated by the Site. This could potentially overload existing downstream drainage infrastructure
- Concentrated flows moving through and discharging from the Site that have greater potential to scour the earth
- New pollutants introduced during both construction and operational phases of the Project, due to the soils mobilised during construction, new materials and machinery being used on-site, changes to the land use and ongoing operations at the Site
- Flooding along the ephemeral drainage line could coincide with construction works along the transmission line, which could present a safety risk to workers and could carry construction equipment and/or material downstream
- The potential for spills and leaks from the batteries which would introduce hazardous substances that could make its way into water discharging to the receiving environment.

A number of mitigation and management measures were identified as part of this assessment to address the above impacts. These include:

- Temporary drainage or drainage diversions to manage stormwater, direct flows around active construction areas, and prevent flow from encroaching on the neighbouring properties
- A soil and water management plan would be developed, in accordance with the Blue Book (Landcom, 2004), to minimise the erosion potential and sediment production across the Project Area
- Accommodate for an increase in the demand for potable water and wastewater services, and establish a connection to the existing water and sewer mains adjacent to the Site, as a result of increased personnel within the Project Area during construction and operational phases of the Project
- It is possible that some OSD might be required to reduce peak flows leaving the Site and to help maintain existing drainage conditions downstream of the Site
- The internal drainage system would be designed to control and manage increased flows in a manner that protects important Site infrastructure and prevents scouring at the Site

- Water sensitive urban design (WSUD) measures, such as vegetated table drains and pervious surfaces, would be incorporated into the drainage design in order to treat surface water before discharging to the receiving environment
- Management measures would be in place to cease works when a severe weather warning is issued for the immediate area, and equipment would be secured accordingly, to mitigate the risks of flooding along the ephemeral drainage line during construction works
- The battery design would incorporate spill containment measures to prevent any battery spillage from entering the Site drainage system or downstream waterways.

With the recommended mitigation and management measures in place, negligible impacts to surface water, flooding, and water use are expected as a result of the Project.

7.0 References

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Appendix A

Concept stormwater management plan

AECOM Imagine it. Delivered.

AGL Energy Limited
26-Mar-2021

Broken Hill Battery Energy Storage System Project

Stormwater management design

Revision 1 – 26-Mar-2021
Prepared for – AGL Energy Limited – ABN: 74 115 061 375

Broken Hill Battery Energy Storage System Project

Stormwater management design

Client: AGL Energy Limited

ABN: 74 115 061 375

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26-Mar-2021

Job No.: 60619153

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Quality Information

Document Broken Hill Battery Energy Storage System Project

Ref REV 1

Date 26-Mar-2021

Prepared by Jacob Briant

Reviewed by Todd Pulbrook

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
1	26-Mar-2021	Final	Rachel O'Hara Associate Director	

Table of Contents

1.0 Introduction

This Stormwater management design has been prepared by AECOM for the Broken Hill Battery Energy Storage Project (the Project). The Project is located within the Broken Hill City Council (Council) area. Where relevant, appropriate design criteria have been outlined.

This stormwater management design identifies the peak stormwater discharge pre and post development and outlines appropriate detention requirements. Stormwater quality control methods have also been identified and designed to ensure alignment with the relevant stormwater quality requirements.

This information would be utilised by AGL to inform ongoing design development for the Project.

2.0 Design criteria

This stormwater management design has been developed in accordance with the criteria outlined in **Table 1**.

There are a number relevant requirements for stormwater management that are included within the Broken Hill Development Control Plan 2016 (DCP) and Broken Hill Stormwater Drainage Systems Policy 1995. As the Project is SSD, the requirements of Council's DCP and Stormwater Drainage Systems Policy do not apply. However, the relevant sections of the DCP and Stormwater Drainage Systems Policy have still been considered as a guide for stormwater management at the Site and to ensure the Project is consistent with Council's expectations for the area. The appropriateness of this criteria will be discussed with Broken Hill City Council through the next stages of design development.

Table 1 Relevant design criteria summary

Design guideline	Design criteria	Reference
Broken Hill City Council **Stormwater Drainage Systems Policy 1995**	All drainage designs will be examined to ensure that safety, environment, and maintenance factors are considered. No particular requirements have been specified because of the individual nature of most drainage works. Action in accordance with the guidelines detailed in Australian Rainfall and Runoff will be satisfactory.	Clause 10
Broken Hill City Council **Broken Hill Development Control Plan 2016**	New development must include Water Sensitive Urban Design (WSUD) features allowing for the retention and re-use of stormwater, and in particular the collection, storage and reuse of runoff from rooves, and treatment of runoff from paved and carpark areas using swales or other appropriate devices. Where new development will result in an increase in impervious site coverage, on-site stormwater detention structures/techniques must be provided to limit the post-development peak discharge rate of stormwater from the site (including roof and ground surface runoff) to the predevelopment peak flow rate during both the 5 year and 100 year ARI events.	Section 3.1
Australian and New Zealand Environment and Conservation Council **Australian and New Zealand Guidelines**	Required concentration values for Total Phosphorous and Total Nitrogen content for South-East Australia	Table 3.3.2

Design guideline	Design criteria	Reference
for Fresh and Marine Water Quality 2000		
Greater Sydney Local Land Services **NSW MUSIC Modelling Guidelines**	In the absence of local stormwater quality modelling guidelines, the Greater Sydney guidelines have been adopted for the application of stormwater quality modelling software. Use of MUSIC software is considered industry standard. Within NSW, it is recommended that MUSIC be applied for assessing stormwater quantity and quality impacts of a proposed development in circumstances where the total proposed development area exceeds 2500 m2.	Clause 1.2

3.0 Existing site and drainage conditions

3.1 Location

The Site is located at 76 and 84 Pinnacles Place, on the south-west outskirts of Broken Hill, NSW. As shown in **Figure 1**, the Site occupies Lots 57 and 58 of DP258288.

Figure 1 Site Location

The Site fronts Pinnacles Place road reserve to the east, land classified as Commons to the west and private property on both north and south property boundaries. There is a vehicle access to Pinnacle

Place and an informal vehicle access track to the Commons. The Commons (Lot 7302 on DP1181129) includes an ephemeral drainage line draining in a north to south direction.

3.2 Topography and existing drainage

The Site is approximately 7,700m^2, with the Site naturally sloping down towards the south-west. LiDAR topographical data sourced from *Intergovernmental Committee on Surveying and Mapping* (https://elevation.fsdf.org.au/) identifies levels varying from RL 288m AHD at the Northern boundary of the site, to RL 287m AHD at the south-west corner, with slope of approximately 1%.

There is no existing drainage infrastructure on the Site. All stormwater currently flows across the Site and discharges to either the neighbouring lots, or the Commons to the south-west. There are no current stormwater quality treatment devices used on the Site.

4.0 Proposed development

The proposed development is a Battery Energy Storage System, connected to the TransGrid Broken Hill substation, as seen below in **Figure 2**. The Site will comprise:

- 2 small office buildings
- Multiple batteries, inverters and transformers positioned on separate hardstands
- An access road surrounding the hardstand and connecting to Pinnacles Road
- Laydown/operational parking area.

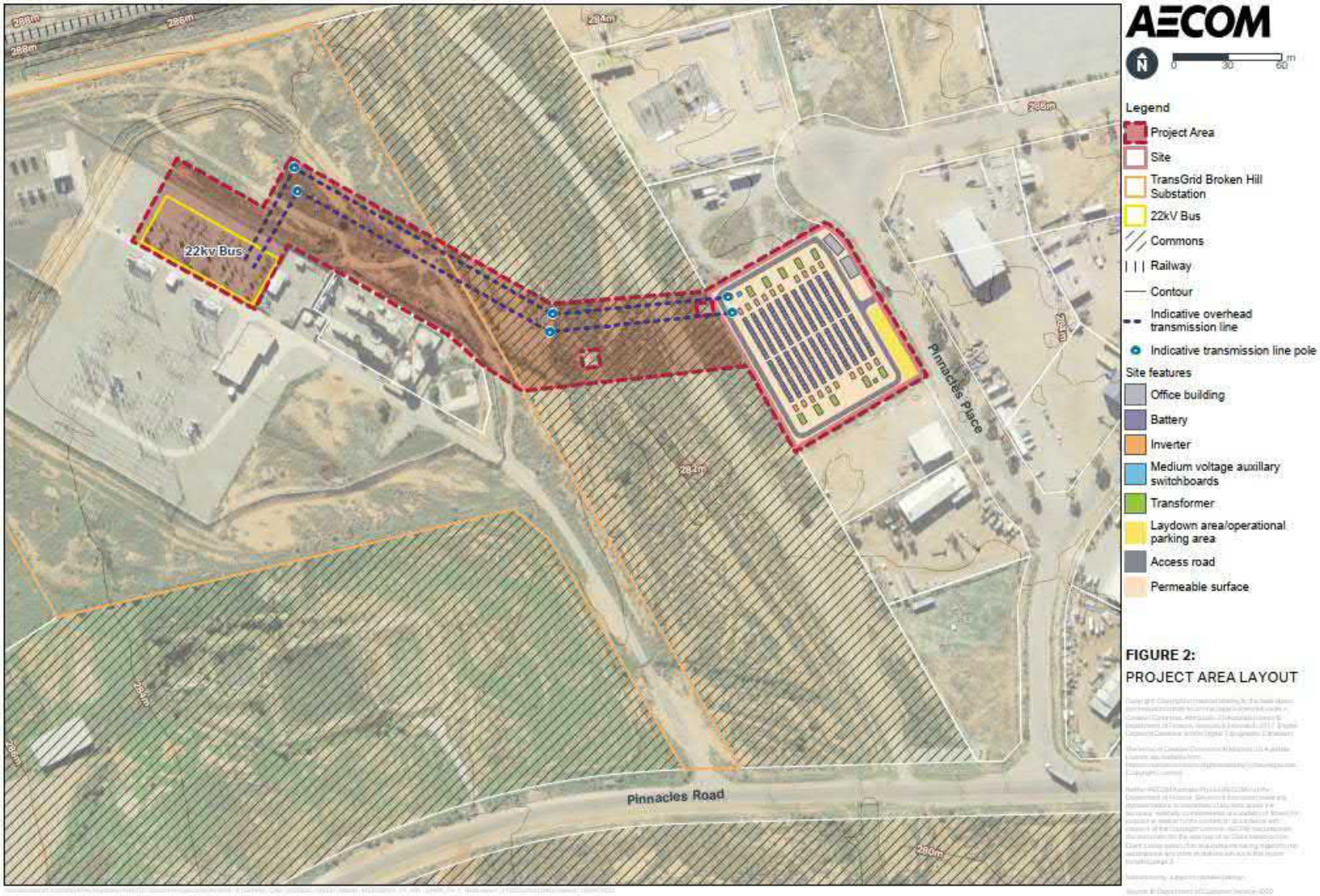


FIGURE 2:
PROJECT AREA LAYOUT

Figure 2 Project Area layout

5.0 Stormwater quantity

5.1 Peak discharge

To calculate the peak stormwater discharge, the Rational Method outlined in Australian Rainfall and Runoff (ARR) was followed. An intensity-frequency-duration (IFD) table for the Site was obtained from the Bureau of Meteorology (BOM). The existing area was compared to the proposed development in terms of impervious area, as shown below in **Table 2**. The proposed impervious areas were calculated using the reference project; Hume Power Station, Battery Energy Storage System as a guide. This reference project indicated the inverter, transformer and batteries are all located on a concrete slab. The internal circulation roadway and buildings are also impervious. These areas represent approximately 40% of the total site coverage. This reference Project Drawings are contained in **Appendix A.**

Table 2 Impervious area comparison

	Existing	Developed
Fraction impervious (f_i)	0.0	0.39

Using the f_i values above, as well as the 10-year 1-hour event rainfall intensity ($^1I_{10}$) of 30.7 mm/hr (BoM), the following design parameters were obtained.

Table 3 Coefficient of runoff

ARI	Frequency factor (F_y)	Coefficient of runoff (C_y)	
		Existing	Developed
1 in 1-year ARI	0.8	0.32	0.62
1 in 2-year ARI	0.85	0.34	0.66
1 in 5-year ARI	0.95	0.38	0.74
1 in 10-year ARI	1	0.40	0.78
1 in 20-year ARI	1.05	0.42	0.82
1 in 50-year ARI	1.15	0.46	0.89
1 in 100-year ARI	1.2	0.48	0.93

With the parameters above, the peak discharge values were calculated using the Rational Method. The results are outlined below.

Table 4 Peak Discharge Results

	Existing peak flow rate (m^3/s)	Developed peak flow rate (m^3/s)	Peak flow rate difference (m^3/s)
1 in 1-year ARI	0.020	0.048	0.028
1 in 2-year ARI	0.026	0.062	0.036
1 in 5-year ARI	0.047	0.111	0.064
1 in 10-year ARI	0.064	0.151	0.087
1 in 20-year ARI	0.084	0.197	0.113

	Existing peak flow rate (m^3/s)	Developed peak flow rate (m^3/s)	Peak flow rate difference (m^3/s)
1 in 50-year ARI	0.118	0.278	0.160
1 in 100-year ARI	0.147	0.344	0.197

The results shown above indicate an increase of peak discharge flow from the Site post development. A detention system is proposed to ensure compliance with Broken Hill City Council requirements and mitigate the increase in peak flows to pre-development flow rates, as outlined in **Section 2.0**.

5.2 Stormwater drainage concept design layout

The Site was split into 4 sub-catchments (identified as C1 to C4) based on the existing site grading assuming minimal earthworks would be required as part of the Project. Each catchment follows the existing grade of the Site and drains to a table drain adjacent to the proposed circulation roadway internal of the Site, as shown below in **Figure 3**.

- The main battery area (Catchments C1 and C2) and the northern office buildings drain to table drains located on the inside of the access road. These drains follow the access road to the southern side of the Site, where they discharge through a culvert located under the access road and into the proposed detention basin.
- The carpark area (Catchment C3) discharges into a separate table drain to reduce the amount of water flowing across the access road. This drain discharges directly into the proposed detention basin without the need for an additional culvert.
- The small area to the west of the access road (Catchment C4) drains directly off the Site. As the area is both the smallest and most permeable catchment, there would be a negligible amount of discharge directly to the Commons and matches existing discharge conditions.
- Discharge from the Site would be from the detention basin. To avoid issues of scour/erosion due to concentrated flows, scour protection would be design and included in the next stage of design development.

Figure 3 Stormwater Concept Plan

All proposed table drains are V-shape cross sectional profile with a longitudinal slope of 1%, depth between 0.3 - 0.35m deep spanning 3.6 - 4.1m in width. The exact geometry of each drain would be determined during the detailed design phase, as will the size of the culvert.

5.3 Initial detention basin sizing

The detention basin was sized by calculating the required volume through four different methods (*Culp, Boyd, Carrol* and *Basha*). The largest volume was then multiplied by a time-ratio factor, which takes into account the different time of concentration values between existing and developed areas. This is a conservative approach to ensure sufficient detention volume allowed for the purpose of Site spatial planning and would be refined in the detailed design phase of the Project. The inflow and outflow values as well as the detention basin storage volume is shown below in **Table 5.**

Table 5 Initial Detention Sizing Results

Flood Event ARI year	Rainfall Intensity		Inflow Volume	Desired peak outflow	Storage Volume				
	Existing	Developed			Calculation Methods				Storage Volume
	[I] (mm/hr)	[I] (mm/hr)	[Vi] (m^3)	[Qo] (m^3/s)	CULP (m^3)	BOYD (m^3)	CARROL (m^3)	BASHA (m^3)	(m^3)
3mth	14.30	17.30	21	0.01					**21**
1	28.60	34.60	42	0.02	17	24	18	21	**33**
2	34.70	41.90	55	0.03	22	31	23	27	**43**
5	55.80	67.30	98	0.05	40	56	41	48	**76**
10	72.00	86.80	133	0.06	54	76	56	65	**104**
20	89.40	108.00	174	0.08	71	100	73	85	**136**
50	115.00	139.00	245	0.12	101	140	103	121	**192**
100	137.00	165.00	303	0.15	124	174	127	149	**237**

The detention basin would be located on the most downstream boundary of the Site, shown in **Figure 3.** Please note that the exact location and geometric configuration of the basin is to be confirmed during the detailed design phase.

6.0 Stormwater quality

6.1 Pollutant targets

As no site-specific pollutant targets have been set, and there are no specific guidelines from Broken Hill City Council, targets from Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC) have been used for this assessment.

Table 6 ANZECC Pollutant Targets

	Total Phosphorous	Total Nitrogen
Target Concentration (mg/L)	0.02	0.25

To evaluate the pollutant concentration levels generated from the site development, eWater's MUSIC software package has been used.

6.2 MUSIC pollutant simulation

As MUSIC design guidelines do not exist for the Broken Hill region, the NSW MUSIC Modelling Guidelines 2015 have been utilised. The rainfall data obtained from BoM was for an 8-year period between 1939 and 1947. Whilst this data is old, it is considered reasonable for use as it provides; consistent data over a long duration, it can be applied in 6minute time-step interval, and the data is used only to generate base flows not peak flows which are more critical with regards to current rainfall records. For the Project, the parameters in **Table 7** and **Table 8** have been adopted.

Table 7 MUSIC Model Runoff Generation Parameters

MUSIC Rainfall-Runoff Parameters	Commercial and Industrial
Rainfall threshold (mm)	1
Soil storage capacity (mm)	139
Initial storage (% capacity)	50
Field capacity (mm)	69
Infiltration capacity coefficient – a	360
Infiltration capacity coefficient - b	0.5
Initial depth (mm)	10
Daily recharge rate (%)	100
Daily baseflow rate (%)	50
Daily deep seepage rate (5)	0

Table 8 MUSIC Model Pollutant Export Parameters

Flow Type	TSS log^{10} values (log mg/L)		TP log^{10} values (log mg/L)		TN log^{10} values (log mg/L)	
	Mean	**Std Dev**	**Mean**	**Std Dev**	**Mean**	**Std Dev**
Baseflow	1.20	0.17	-0.85	0.19	0.11	0.12
Stormflow	2.15	0.32	-0.60	0.25	0.30	0.19

The catchments and table drains outlined in **Figure 3** were replicated in MUSIC to simulate the stormwater design network. The two office buildings at the northern side of the Site were inserted separately as each roof drains to a 1kL rainwater tank. Catchment size and fraction impervious values are summarised below.

Table 9 Catchment Node Summary

Catchment	Area (ha)	Fraction Impervious (Fi)	Treatment Device
Catchment 1	0.34	0.24	Table Drain 1
Catchment 2 (Open)	0.34	0.324	Table Drain 2
Catchment 2 (Roof 1)	0.006	1	Rainwater Tank 1, Table Drain 2
Catchment 2 (Roof 2)	0.007	1	Rainwater Tank 2, Table Drain 2
Catchment 3	0.07	0.69	Table Drain 3
Catchment 4	0.02	0	Nil

The proposed stormwater quality catchment and MUSIC treatment trains are visualised below.

Figure 4 MUSIC treatment train layout

The results of the MUSIC model show that the stormwater network meets all required quality objectives.

Table 10 MUSIC modelling results

Pollutant	Mean Concentration (mg/L)	Target Concentration (mg/L)	Objective Achieved (Yes/No)
Total phosphorous	0.0172	0.02	Yes
Total nitrogen	0.186	0.25	Yes

7.0 Spill containment

Batteries contain hazardous substances. As such, spill containment measures would be incorporated into the design of the battery enclosures to protect the site and downstream environment should there be a spillage on-site. A proprietary system is proposed to manage this spill containment. Therefore, no additional spill containment is required as part of the Stormwater Management – Concept Design for the Project.

Appendix A

Appendix A - Reference Project

Appendix A Appendix A - Reference Project

Appendix A. Revised design plans

GENERAL

G1. These drawings shall be read in conjunction with all other Consultants' drawings and specifications and with such other written instructions as shall be issued during the course of the contract. Any discrepancy on these drawings must be referred to the Engineer, Tim Gibney & Associates Pty Ltd for resolution prior to proceeding with the work.

G2. These drawings shall not be used for construction until issued as "issued for Construction" by this office.

G3. The Contractor and/or Sub-Contractors, are responsible for verifying all datum points, levels and dimensions including setout dimensions prior to commencing either on site construction or off site fabrication. All setout and overall dimension shall be obtained form the architectural drawings. DO NOT SCALE these drawings.

G4. All dimensions are in millimetres unless stated otherwise. All levels are expressed in metres.

G5. During construction, the Contractor shall be responsible for maintaining the structure and all excavations in a stable condition and ensuring no part is overstressed by construction activities.

G6. Workmanship and materials are to be in accordance with the relevant current SAA Codes, the Building Code of Australia, Occupational Health and Safety Regulations and the local statutory authorities requirements.

G7. The approval of any substitution by the Engineer is not an authorisation for an extra. Any extras involved must be taken up with the Engineer and/or Project Manager before work commences.

G8. No responsibility shall be taken unless the work is inspected and approved during construction. All inspections required shall be confirmed with the Engineer 24 hours in advance of time required (working days only included).

G9. Where additional construction loads such as mobile cranes etc. are to be imposed on the structure, the Contractor shall provide full details of the proposed temporary supports to the Engineer for approval, a minimum of 7 days prior to the proposed works commencing.

G10. The structural work on these drawings has been designed for the following live loads.

Area	Live Load
Roof	0.25 kPa
Dwelling	2 kPa
Carpark	3 kPa
Ramp	3 kPa
Balcony & Terrace	3 kPa

G11. The structure has been designed for the following wind load parameters.

Regional Basic Design Velocity (Vu)	45m/s
Terrain Category	3.0

G12. The roof structure has been designed for the roof loads as stated above only and no allowance has been made for any additional loads such as hoists, monorails and mechanical equipment unless such items are shown on the drawings.

G13. The structure has not been designed to resist earthquake loadings.

STRUCTURAL STEEL

S1. All work and materials shall be in accordance with AS4100.

S2. Fabrication and erection shall be in accordance with AS4100 and SAA/SNZ HB62

S3. Hot rolled and welded products shall be BHP – 300plus and plate shall be grade 250 material tubular members shall comply with AS1163 (uno).

S4. All welds shall be continuous fillet weld, size 6mm, GP category using E41xx/W40x consumables u.n.o.

S5. All welding shall be in accordance with AS1554.

S6. Bolts shall be M20 – 4.6/S u.n.o.

S7. Holding down bolts shall be M20 –4.6/S, galvanised u.n.o

S8. Connections not specifically detailed shall be in accordance with the appropriate connection detailed in the AISC standardised structural connections manual.

S9. All cleat plates and stiffeners shall be 10mm thick u.n.o.

S10. The ends of all tubular members shall be sealed with a 3mm plate u.n.o.

S11. Tubular members to be galvanised shall be adequately vented.

S12. Purlins and girts shall be in accordance with AS/NZS 4600, galvanised and installed in accordance with the manufacturer's recommendations.

S13. Before commencing fabrication 3 copies of the shop drawings shall be submitted to the engineer for review. This review does not remove the responsibility for the interpretation of the drawings, dimensional accuracy and the steel fabrication from the steel fabricator/builder.

S14. Camber shall be as noted on the drawings.

S15. Structural steel to be concrete encased shall be wrapped with SL41 mesh. The gap between the structural steel and the mesh and the external cover to the mesh shall be 25mm and 50mm respectively.

S16. All bolts and structural steel exposed to the weather shall be hot dip galvanised u.n.o.

S17. All steel lintels supporting masonry exposed to the weather shall be hot dip galvanised.

S18. Provide all necessary cleats and holes required to fix timber and other materials and finishes to the steelwork.

S19. Lintels shall not be propped during load application (u.n.o)

S20. Provide minimum 150mm end bearing and leveling grout for steelwork seated on masonry u.n.o.

S22. Protective coatings

Preparation	Class 2a abrasive blast	
First coat	Inorganic zinc silicate	125Dft
Second coat	Inorganic zinc silicate	125Dft
Third coat	Inorganic zinc silicate	125Dft
		Dft = dry film thickness

S23. Coatings damaged during transport and erection shall be made good.

CONCRETE

C1. All workmanship and materials shall be in accordance with AS 3600 and comply with AS1379.

C2. Cover (millimetres) to all reinforcement including fitments (excluding finishes) shall be as follows unless otherwise shown.

Element	Formed or Internal	Finished External	Surfaces Cast Against Ground
Footings	–	50	75
Bored or cast piers	–	50	75
Columns / Pedestals	40	40	50
Walls	30	40	50
Beams	30	40	50
Slabs	20	40	30

Where members have at least one face exposed to the weather or possible corrosive attack, this concrete requires a special tolerance for the above covers –0mm+10mm. Members may require extra cover for fire-rating purposes. This will be noted on drawings where applicable.

C3. Sizes of concrete members do not include thickness of applied finishes.

C4. Depth of beams are given first and include slab thickness.

C5. Beams and slab shall be poured together in one operation.

C6. No holes chases or embedment of pipes other than those shown on the Structural Drawings shall be made in concrete members without prior approval of the Engineer.

C7. Reinforcement is represented diagrammatically and not necessarily shown in true projection. Reinforcement is denoted by a symbol in accordance with AS 1302 for Bars and AS 1304 for Fabric.

C8. Splices in reinforcement shall be made only in the position as shown or as otherwise approved by the Engineer. Where lap length is not shown, it shall be sufficient to develop the full strength of the reinforcement. Laps to fabric shall be two transverse wires plus 100mm.

C9. Welding of reinforcement shall not be permitted without the approval of the Engineer.

C10. All reinforcement shall be supported in its correct position during concreting by approved bar chairs, spacers or support bars. For all external surfaces, provide fully plastic bar chairs, tie wire shall not be nailed to the forms, reinforcing bars shall not be used to keep forms apart and a through tie system shall be used to tie forms.

C11. Provide N12 distribution in bars at 450mm centres to all slab reinforcement except where shown otherwise. Lap bars 300mm at splices. Provide 2/N16 X 1200mm diagonal trimming bars in each face of member around openings.

C12. Camber – unless noted otherwise on the drawings, slabs shall be given a positive upward camber at mid-span of 3mm per 1000mm span. The method of cambering is to be agreed with the Engineer. Beams shall be cambered as shown on the drawings (negative cambering is not allowed).

C13. Formwork shall be designed and constructed in accordance with AS1509. Formwork shall remain in position for a minimum of 28 days after pouring of concrete unless written approval by the Engineer stating otherwise is obtained.

C14. Concrete grades shall be as follows.

Element	F'c (MPa)	Slump (mm)	Aggregate (mm)
Footings	25	75	20
Piers	32	75	20
Columns	40	75	20
Slabs / Beams	32	75	20
External Slabs/Beams – exposed to weather	32	75	20
Precast walls	32	75	20
Ground Slab –			
– office, residential	25	65	20
– warehouse, factory	32	75	20

External elements are those exposed to weather, rain and water penetration and are classified B1 unless noted otherwise. Concrete to be minimum grade 25 for footings and minimum grade 32 for all other elements.

C15. External concrete elements, Grade N32 minimum, shall meet the following requirements – minimum Portland Cement Content 330kg/m3 (No fly ash to be used) Maximum watercement ratio 0.5, shrinkage limit 600 micro-strain after 56 days, and chloride content to be restricted as per Clause 4.9 of AS3600. No other salt shall be added.

C16. Concrete must be moist cured by an approved method for seven days after pouring and curing must commence within 2 hours of placement.

C17. Additives must not be added to the concrete without the approval of the Engineer.

C18. Construction joints shall be properly formed and used only where shown or approved by the Engineer.

C19. All concrete shall be mechanically vibrated. The vibrators shall not be used to vibrate the forms nor shall they be used to spread the concrete.

C20. Concrete shall be separated from supporting masonry by two layers of malthoid (or an approved equivalent). For slabs on ground and paving, vertical faces of slabs, masonry walls and columns are to be separated by 12mm thick bituminous canite or similar.

C21. Provide a 20mm x 20mm chamfer to all visible junctions of concrete faces, except for precast panels which shall have a 12mm x 12mm chamfer. – Refer to Architects Drawings for further details.

C22. All props and formwork for beams and slabs shall be removed before construction of any masonry walls or partitions on the floor.

C23. All non load bearing walls shall be kept clear of the underside of slabs and beams by 20mm unless otherwise shown.

C24. Concrete shall be tested in accordance with AS1012. Allow for the cost of making tests in accordance with the requirements of AS1012.1 at the specified rate.

C25. Concrete may be rejected if it does not meet the requirements of AS3600-1994 Section 19 and related clauses.

CIVIL

GENERAL

C1. All levels shown are metric levels referred a nominal site datum.

C2. Pavement levels are finished levels throughout.

C3. Any existing pavement, kerb and channel, kerb or the like that is damaged during construction is to be reinstated to its original condition prior to the completion of works.

C4. All existing levels shown are to be confirmed on site. All earth batters are to be in the ratio of 1 to 4 or less unless noted otherwise.

C5. All vegetation and compressible top soil shall be removed from the paving area. The ground below the paving (prior to any compacted fill being placed) shall be proof rolled with a heavy duty roller. Any soft spots encountered shall be dug out and replaced. Excavated clay may be used as fill compacted in 150 mm maximum deep layers at 16% moisture content to achieve a compacted density of 90% AS1289 clause E.1.1 (standart compaction). The material to be used as fill shall be approved by the Engineer, prior to placement and compaction.

DRAINAGE

C6. All existing underground services are to be located prior to excavation for new pipe lines and no existing service shall be disconnected or disturbed without the approval of the Engineer.

C7. Pit covers to be light duty to approved detail unless noted otherwise.

C8. Stormwater drains suspended under slabs or along walls shall be to approved details.

C9. Any misalignments that may be solved by corbelling of pit walls may only be carried out with the written approval of the Engineer.

C10. All downpipe collector pipes shall be 150 diameter at a grade of 1 in 100 unless noted otherwise.

C11. All pipe junctions shall be made with a 45° joint.

C12. Class of Pipes:

a) Concrete Pipes (RC) shall conform to AS 1342 "Precast Concrete Drainage Pipes" and shall be Class X pipes with spigot and socket rubber ring joints.

b) Fibre Reinforced Cement Pipes (FRC) shall conform to AS 1342 "Precast Concrete Drainage Pipes" and shall be tested to the requirements of AS 1712 Appendix D "Asbestos Cement Sewer Pipes". All FRC pipes shall be Class X pipe with Adcol "V" ring joints. For pipe sizes greater than 300mm, alternative jointing may be permitted with the approval of the City Engineer.

c) Vitrified Clay Pipes (VC) shall conform to AS 1741 "Vitrified Clay Pipes" and shall be rubber ring jointed.

d) Unplasticised PVC Pipes (UPVC):

1. Within Property:

All UPVC Pipes shall conform to AS 2032 "Code of Practice for the installation of UPVC Pipes" Part 7 and shall be Class 6 sewer quality or heavy duty, stormwater, depending on the application. All jointing procedures shall conform to AS 2032 Part 3 and shall be either solvent welded or rubber ring joints.

2. Within Road Reserve:

All UPVC Pipes shall conform to AS 1260 "Unplasticised P.V.C. (U.P.V.C.) pipes and fittings for sewerage applications" Parts 1 to 5 and shall be Class S.H. pipes.

C12. Cover details:

Application	Cover required			UPVC Pipe
Not subject to vehicular loading	150 mm	300 mm	150 mm	Heavy duty stormwater
Subject to vehicular loading				
i) within road reserve	(1)	500 mm (2)	(1) & (3)	Sewer
ii) sealed roadway	(1)	600 mm (2)	(1) & (3)	Sewer
Under building slabs	(1)	600 mm	150 mm	Sewer

Notes:

1. Cover shall be a minimum of 150mm below the underside of slab or 500mm below the level of sealed pavements.
2. If the required cover is not obtainable, pipes in areas not subject to construction vehicle loading may be encased in 100mm of concrete.
3. The whole drain is to be encased in 100mm of concrete.

C13. All drainage pipes are to be laid in a 50mm minimum depth, layer of crushed rock.

C14. All drainage excavations are to be backfilled with a suitable material. Under sealed pavements and building slabs, this shall be 20mm, class 2A crushed rock.

SLAB ON GROUND AND FOOTINGS

F1. All relevant codes and regulations must be complied with including AS2870 and AS3600

F2. All grass roots, vegetation and compressible topsoil must be removed from the area of the slab.

F3. Prior to any compacted filling being placed the ground below the slab shall be proof rolled with a 3 tonne sheepsfoot roller compactor. Any "soft spots" encountered shall be dug out and replaced with compacted crushed rock in accordance with AS2870.

F4. Polythene membrane under slab is to be 0.2mm thick branded as concrete underlay, continuous, lapped 200mm minimum where required and taped at laps, punctures and service and pipe penetrations. Membrane to extend under all slabs, beams and thickenings cast against the ground.

F5. Where surface silts and sands may become unworkable during the wet winter months, allowance shall be made for the immediate placement of a granular working surface of at least 200mm thick.

F6. Excavations near the building edge shall be backfilled in such a manner to prevent ready access of water to the foundations.

F7. The ground surrounding the slab shall have its surface at least 150mm below the slab surface and be sloped away from the slab edge so that surface water will be run via impermeable spoon drains to suitable drainage points.

F8. Soil Classification for the site is: "CLASS A"
Site classification to AS2870 Residential Slabs & Footings to be confirmed on site by the builder. Refer to Geotechnical Investigation No. ADL2018-0245AB Rev0 CMW GEOSCIENCES

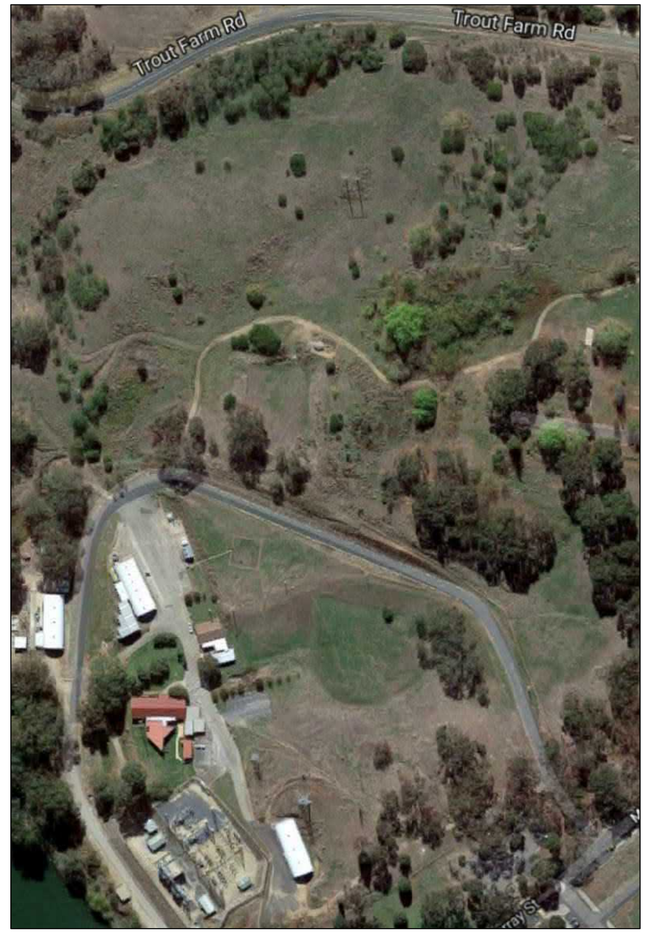
F9. Hot water heating pipes may be embedded in the slab if the thickness is increased by 25mm and layed on SL52 mesh.

F10. Termite protection shall be provided as required by the local Authority.

F11. Owners must recognise their responsibilities noted in AS2870 and in more detail in the CSIRO publication "Guide to homeowners on foundation maintenance and footing performance"

F12. All excavations should be carefully inspected by a competent person and this office contacted immediately if conditions other than those described in the soil report are encountered or any filling is found.

SHEET SCHEDULE	
HUM\BUA00801-03	TITLE SHEET
HUM\BUA00802-03	SITE CONTEXT PLAN
HUM\BUA00803-03	B.E.S.S SITE LAYOUT
HUM\BUA00804-03	ACCESS ROAD PLAN
HUM\BUA00805-03	ACCESS ROAD PLAN CONTINUED
HUM\BUA00806-03	CABLE RUN ACCESS ROAD
HUM\BUA00807-03	CABLE RUN SWITCHYARD
HUM\BUA00811-03	B.E.S.S SITE DRAINAGE PLAN
HUM\BUA00812-03	B.E.S.S SITE DRAINAGE PLAN CONTINUED
HUM\BUA00821-03	B.E.S.S SITE FOOTING PLAN
HUM\BUA00822-03	B.E.S.S SITE FOOTING PLAN CONTINUED
HUM\BUA00831-03	CABLE RUN PLAN AND DETAILS
HUM\BUA00841-03	SWITCHROOM DETAILS
HUM\BUA00842-03	RELAY ROOM DETAILS
HUM\BUA00843-03	INVERTER DETAILS
HUM\BUA00844-03	TRANSFORMER DETAILS
HUM\BUA00845-03	BATTERY CUBE DETAILS
HUM\BUA00846-03	AUX TRANS/DC/TELCO DOX DETAILS
HUM\BUA00851-03	CIVIL DETAILS
HUM\BUA00861-03	FENCE DETAILS
HUM\BUA00871-03	EROSION AND SEDIMENT CONTROL PLAN
HUM\BUA00881-03	WATER TANK DETAILS



north

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
01	FIRST ISSUE	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	24/08/20
02	FBG BOX ADDITION	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	28/08/20
03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

Meridian.

HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM TITLE SHEET

FOLDER:		DISTRIBUTION:	
DRAWING:	HUM\BAU00801		
COMPANY:	MERIDIAN ENERGY		
NUMBER:		ISSUE:	03

LEGEND

- FENCE LINE
- BAU1 SYSTEM
- BAU2 SYSTEM
- DATA CABLES
- BATTER
- SEDIMENT FENCE
- ACCESS ROAD
- DRAINAGE CHANNEL
- DRAINAGE PIPES
- NATURAL WATER COURSE
- EASEMENT
- UNDISTURBED NATURAL GROUND
- EXISTING WETLANDS
- TREES TO REMAIN
- TREES TO BE REMOVED

BOUNDARY

SEDIMENT FENCE

HARDSTAND LAYDOWN AREA

FALL

ENERGY DISSIPATER

TOPSOIL STOCKPILE

ENERGY DISSIPATER

SEDIMENT FENCE

SEDIMENT FENCE

SEDIMENT FENCE

10,000L WT

10,000L WT

30253

31942

69134

56606

13059

63742

4800 4800 4800 4800 4800 4800 4800

BATTERIES

INVERTER

DC

T/X

2060

1500

FBG

AUX T/X

1200

#150 FRCP PIPE

#225 FRCP PIPE

#375 FRCP PIPE

#450 FRCP PIPE

DUCT

RELAY ROOM

SWALE DRAIN 1:100

X 192.94

X 193.25

X 193.32

X 193.69

X 194.00

X 194.63

EXISTING GROUND COVER TO BE UNDISTURBED

EXISTING GROUND COVER TO BE UNDISTURBED

WATER COURSE

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
01	FIRST ISSUE	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	24/08/20
02	FBG BOX ADDITION	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	28/08/20
03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

Meridian.

HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM B.E.S.S SITE LAYOUT

FOLDER:	DISTRIBUTION:
DRAWING:	HUM\BAU00803
COMPANY:	MERIDIAN ENERGY
NUMBER:	ISSUE: 03

01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20

A B C D E F G H J K L M N

BOUNDARY

SEDIMENT FENCE

ENERGY DISSIPATER

TOPSOIL STOCKPILE

ENERGY DISSIPATER

ENERGY DISSIPATER

SEDIMENT FENCE

SEDIMENT FENCE

SEDIMENT FENCE

FALL

FALL

FALL

FALL

185.00

184.50

184.00

183.40

181.57

192.94

193.32

193.69

4800 4800 4800 4800 4800 4800 4800

SWALE DRAIN 1:100

SWALE DRAIN 1:100

56606

250m3
SEDIMENT POND

RE-GRADE EX-TRACK

RE-GRADE EX-TRACK

CULVERT B

RIP RAP

RIP RAP

PROPOSED CABLE TRENCH LINE

NATURAL WATER COURSE

EXISTING GROUND COVER
TO BE UNDISTURBED

EXISTING WETLANDS
TO BE UNDISTURBED

VEHICLE ACCESS TRACK

SEWERAGE TANK

GRAVEL LINED
ROAD SURFACE

HOLLOW-BEARING
TREE TO REMAIN

LEGEND

FENCE LINE	EASEMENT
BAU1 SYSTEM	UNDISTURBED NATURAL GROUND
BAU2 SYSTEM	EXISTING WETLANDS
DATA CABLES	TREES TO REMAIN
BATTER	TREES TO BE REMOVED
SEDIMENT FENCE	
ACCESS ROAD	
DRAINAGE CHANNEL	
DRAINAGE PIPES	
NATURAL WATER COURSE	

north

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

Meridian.

HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM ACCESS ROAD PLAN

FOLDER:

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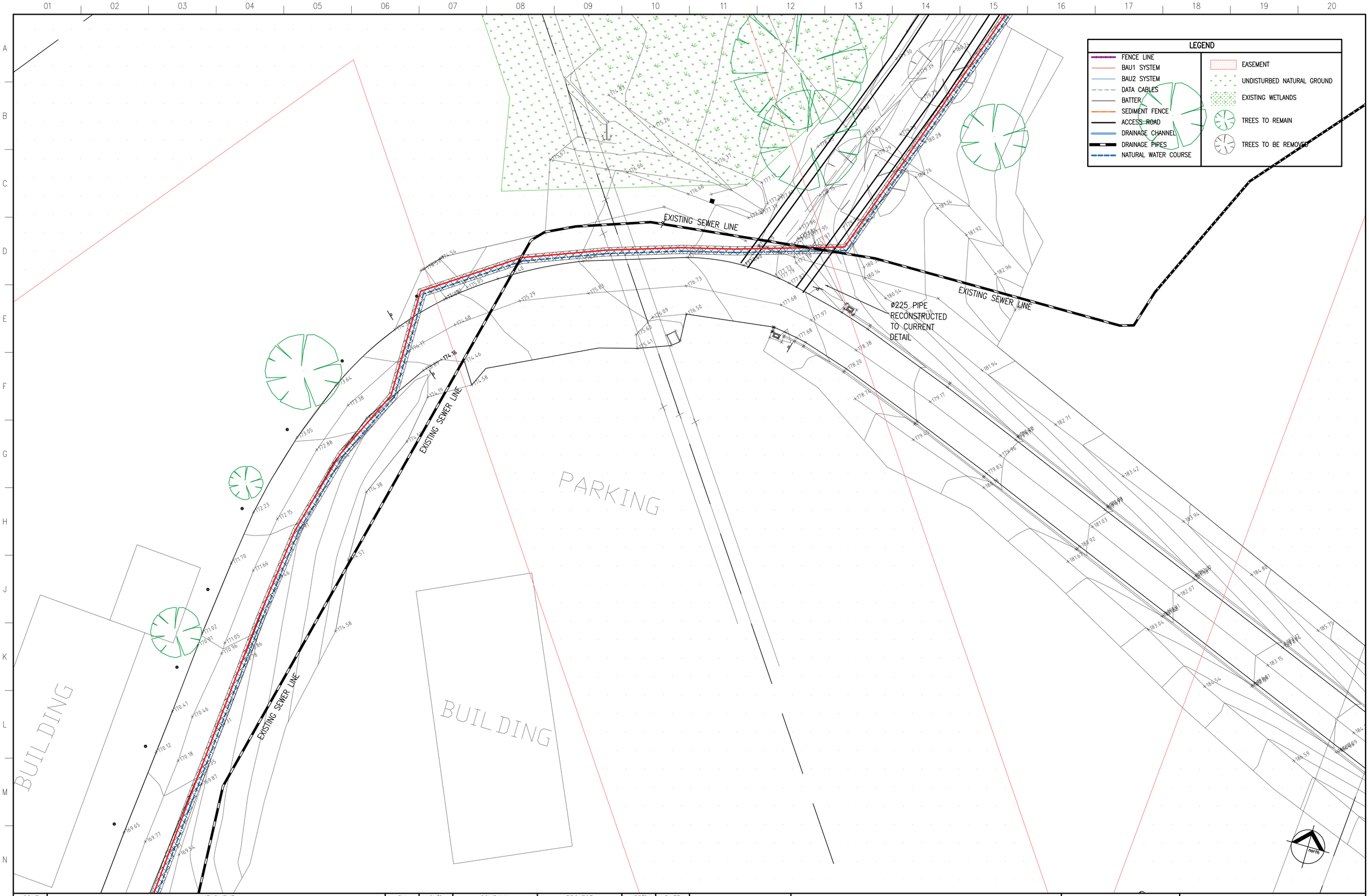
DRAWING: HUM\BAU00804

COMPANY: MERIDIAN ENERGY

NUMBER:

ISSUE: 03



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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
ACCESS ROAD PLAN CONTINUED

FOLDER:	DISTRIBUTION:
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NUMBER:	ISSUE: 03

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
01	FIRST ISSUE	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	24/08/20
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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
CABLE RUN ACCESS ROAD

FOLDER:	DISTRIBUTION:
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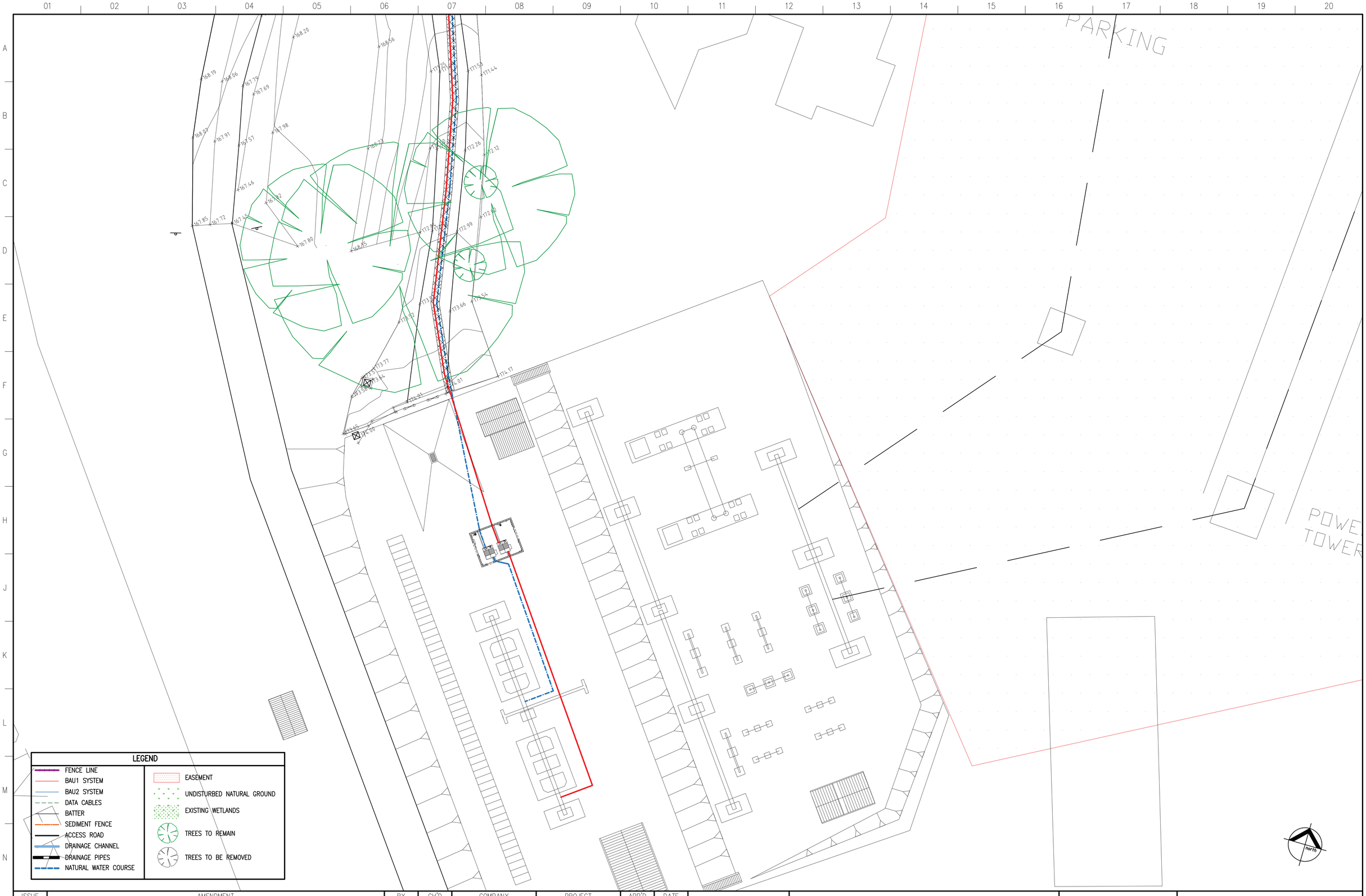
COMPANY:	MERIDIAN ENERGY
NUMBER:	ISSUE: 03



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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
CABLE RUN SWITCHYARD

FOLDER:
DISTRIBUTION:
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COMPANY: MERIDIAN ENERGY
NUMBER:
ISSUE: 03

01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20

A B C D E F G H J K L M N

LEGEND

- FENCE LINE
- BAU1 SYSTEM
- BAU2 SYSTEM
- DATA CABLES
- BATTER
- SEDIMENT FENCE
- ACCESS ROAD
- DRAINAGE CHANNEL
- DRAINAGE PIPES
- NATURAL WATER COURSE
- EASEMENT
- UNDISTURBED NATURAL GROUND
- EXISTING WETLANDS
- TREES TO REMAIN
- TREES TO BE REMOVED

30253

SWALE DRAIN 1:100

SWALE DRAIN 1:100

SWALE DRAIN 1:100

63242

69134

Ø225 FRCP PIPE

Ø225 FRCP PIPE

Ø150 FRCP PIPE

CULVERT 'A'

10,000L WT

10,000L WT

188.68

188.51

north

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
01	FIRST ISSUE	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	24/08/20
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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM B.E.S.S SITE DRAINAGE PLAN

FOLDER: | DISTRIBUTION:

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COMPANY: MERIDIAN ENERGY

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01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20

A B C D E F G H J K L M N

AREA

69134

ø225 FRCP PIPE

CULVERT 'A'

ø150 FRCP PIPE

ø225 FRCP PIPE

SWALE DRAIN 1:100

SWALE DRAIN 1:100

SWALE DRAIN 1:100

13050

56606

197 196 195 194 193

LEGEND

- FENCE LINE
- BAU1 SYSTEM
- BAU2 SYSTEM
- DATA CABLES
- BATTER
- SEDIMENT FENCE
- ACCESS ROAD
- DRAINAGE CHANNEL
- DRAINAGE PIPES
- NATURAL WATER COURSE
- EASEMENT
- UNDISTURBED NATURAL GROUND
- EXISTING WETLANDS
- TREES TO REMAIN
- TREES TO BE REMOVED

north

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
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HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
B.E.S.S SITE DRAINAGE PLAN CONTINUED

FOLDER: | DISTRIBUTION:

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COMPANY: MERIDIAN ENERGY

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01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20

A B C D E F G H J K L M N

30253

31942

X 192.94

X 193.32

X 193.69

X 193.25

X 193.63

X 194.00

+188.10

+187.61

+188.68

+187.43

+188.53

189 190 191 192 193 194 195 196 197

LEGEND

FENCE LINE	EASEMENT
BAU1 SYSTEM	UNDISTURBED NATURAL GROUND
BAU2 SYSTEM	EXISTING WETLANDS
DATA CABLES	TREES TO REMAIN
BATTER	TREES TO BE REMOVED
SEDIMENT FENCE	LIGHT POST & FLOODLAMP
ACCESS ROAD	
DRAINAGE CHANNEL	
DRAINAGE PIPES	
NATURAL WATER COURSE	

10,000L WT

10,000L WT

D AREA

69134

North

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM B.E.S.S SITE FOOTING PLAN

FOLDER: | DISTRIBUTION:

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COMPANY: MERIDIAN ENERGY

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AREA

69134

X 193.25

X 193.63

X 194.00

X 192.94

X 193.32

X 193.69

56606

13050

197

196

195

194

193

LEGEND

FENCE LINE	EASEMENT
BAU1 SYSTEM	UNDISTURBED NATURAL GROUND
BAU2 SYSTEM	EXISTING WETLANDS
DATA CABLES	TREES TO REMAIN
BATTER	TREES TO BE REMOVED
SEDIMENT FENCE	LIGHT POST & FLOODLAMP
ACCESS ROAD	
DRAINAGE CHANNEL	
DRAINAGE PIPES	
NATURAL WATER COURSE	

north

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
B.E.S.S SITE FOOTING PLAN CONTINUED

FOLDER:

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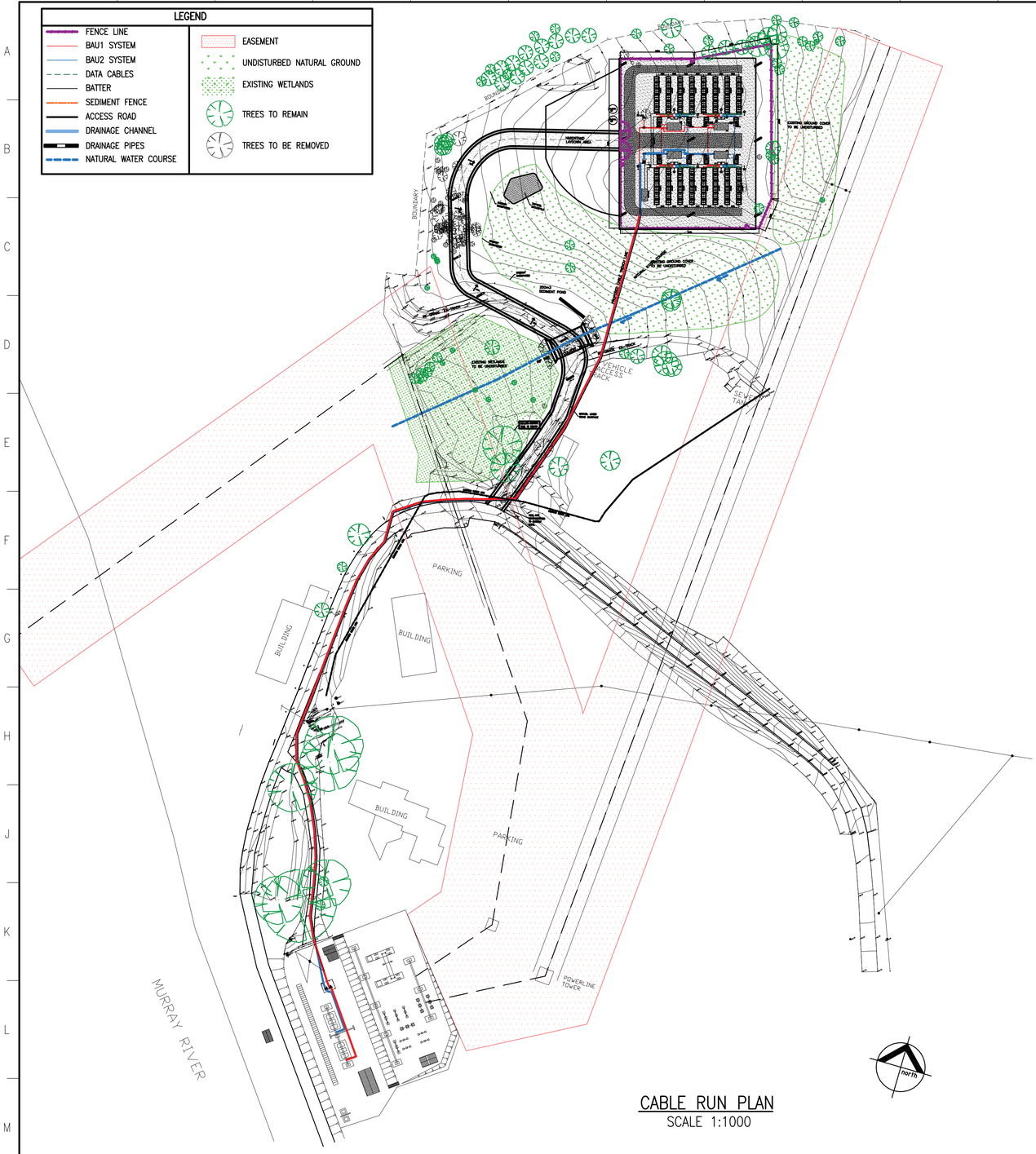
COMPANY: MERIDIAN ENERGY

NUMBER:

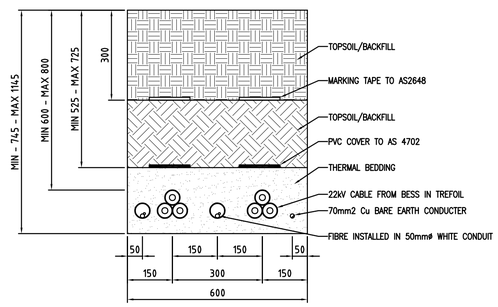
ISSUE: 03



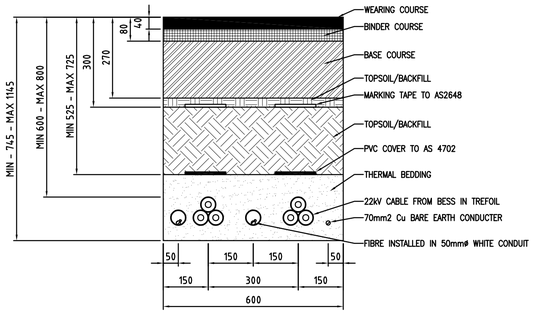
CABLE RUN PLAN
SCALE 1:1000

NOTES:

1. TRENCHES EXCAVATED FOR THE DIRECT BURIAL OF CABLES SHALL BE CAREFULLY CLEARED OF ROCKS PRIOR TO THE LAYING OF THE CABLE. CABLES SHALL BE BEDDED IN THERMAL BEDDING OF NOT LESS THAN 50mm THICK. AFTER LAYING THE CABLE, THE SAME THERMAL BEDDING MATERIAL SHALL BE INSTALLED OVER THE CABLE TO A MINIMUM THICKNESS OF 75mm ABOVE THE CABLE (NOTE BEDDING REQUIREMENTS)
2. THERMAL BEDDING SHALL HAVE A MINIMUM FULLY DRIED OUT TR VALUE OF 1.2km/W AT MINIMUM 85% COMPACTION, CARE SHALL BE TAKEN WHEN COMPACTING BEDDING SO THAT THE CABLE IS NOT DAMAGED.
3. SAND SHALL BE A WELL–GRADED MIXTURE WITH NO PARTICLE SIZE GREATER THAN 5mm. A GRADING CURVE SHALL BE SUPPLIED FROM THE QUARRY WHICH SHOULD INDICATE AN EVEN GRADING OF PARTICLE SIZES DOWN TO VERY FINE.
4. WASHED OR GRADED SANDS SHALL NOT BE USED.
5. ROCKS AND SHARP OBJECTS SHALL BE REMOVED FROM SUB SOIL PRIOR TO BACKFILL.
6. THE DRY THERMAL RESISTIVITY OF THE PROPOSED MIXTURE SHALL BE MEASURED PRIOR TO USE.
7. THE BACKFILL SHALL HAVE A DRY DENSITY OF APPROXIMATELY 1900 kg/m
8. BACKFILLING TO 85% SHALL BE DONE IN LAYERS NOT EXCEEDING 200mm AND EACH LAYER SHALL BE COMPACTED BEFORE THE NEXT LAYER IS APPLIED.
9. CUT CABLES THAT ARE NOT IMMEDIATELY JOINED SHALL BE CAPPED TO PREVENT MOISTURE INGRESS.
10. THE CABLE & FOC MANUFACTURES SPECIFIED MAXIMUM BENDING RADII AND PULLING TENSIONS SHALL BE ADHERED TO AT ALL TIMES.
11. CABLE CROSSINGS MUST BE AVOIDED, HOWEVER IF A CROSSING IS PRACTICALLY UNAVOIDABLE, CABLES SHALL BE CROSSED PERPENDICULAR TO EACH OTHER WITH SUFFICIENT GAP BETWEEN THEM TO PREVENT DERATING.
12. ALL CABLES COPPER WIRE SCREENS SHALL BE BONDED AT BOTH ENDS.



TYPICAL CABLE TRENCH DETAILS



CABLE TRENCH UNDER ROAD DETAILS

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
01	FIRST ISSUE	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	24/08/20
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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM CABLE RUN PLAN AND DETAILS

FOLDER: | DISTRIBUTION:
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COMPANY: MERIDIAN ENERGY
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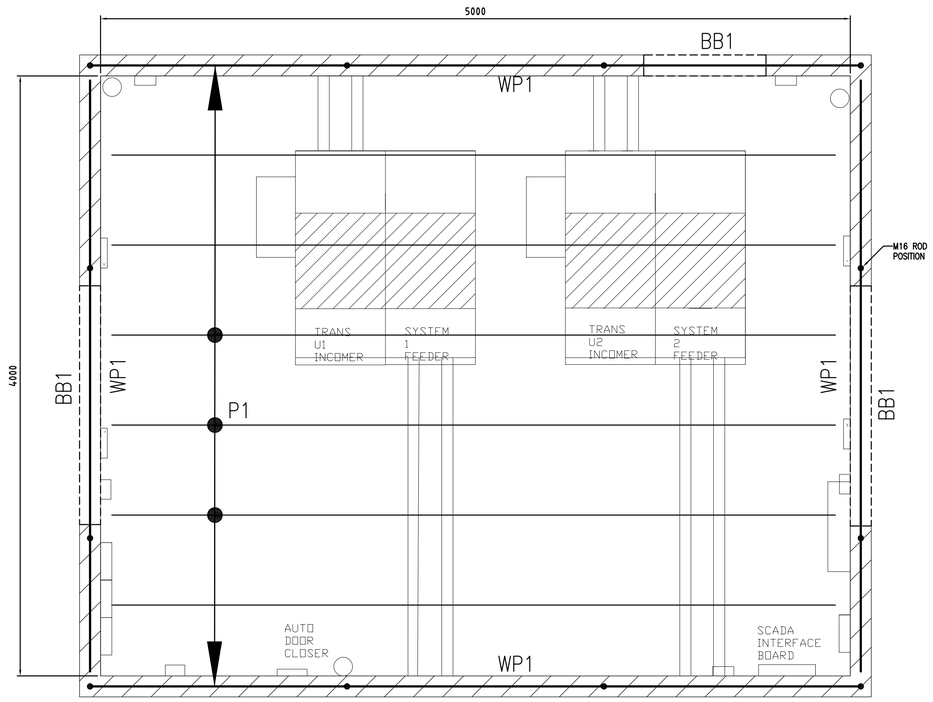
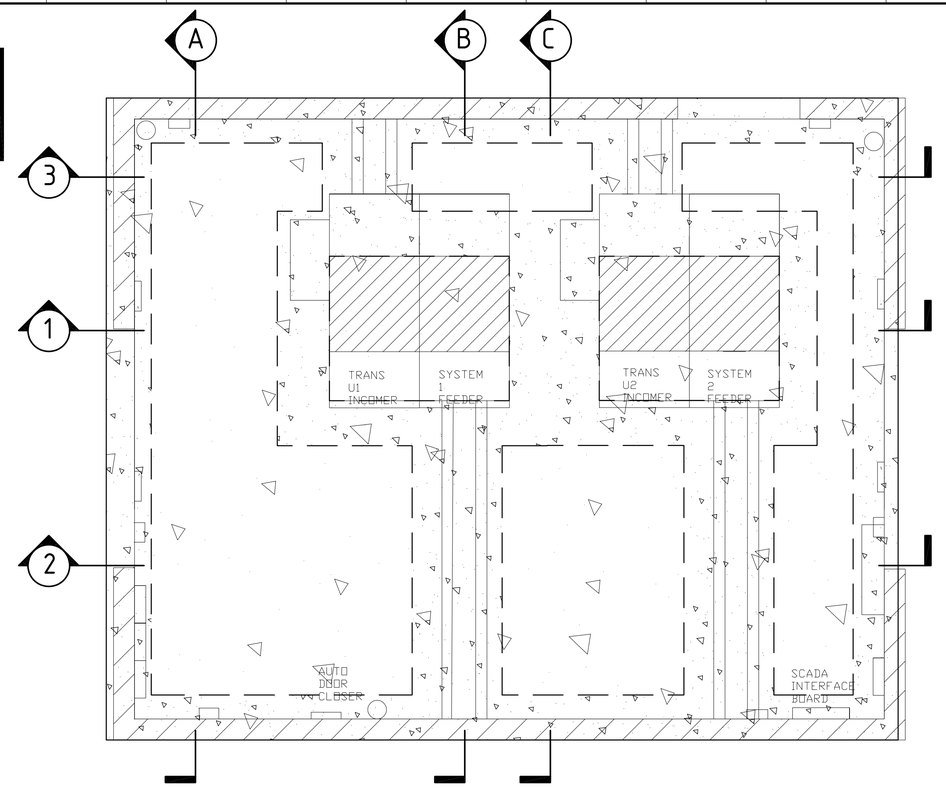
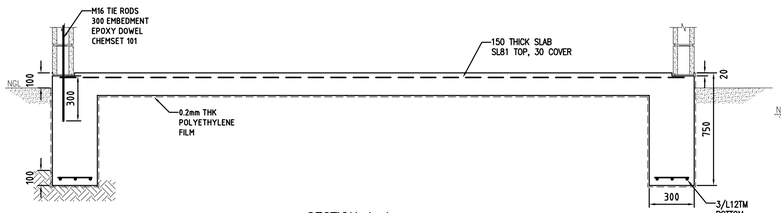


SWITCHROOM ROOF PLAN
SCALE 1:20

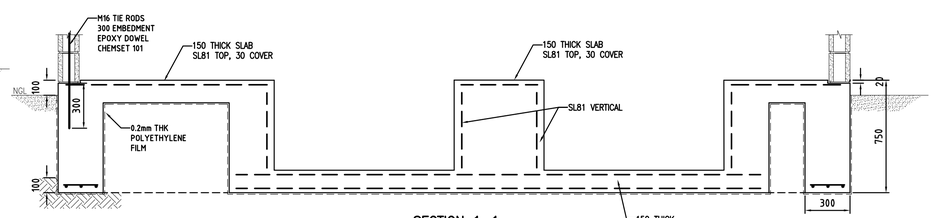
FOUNDING NOTE:
FOOTINGS TO BE FOUNDED 100mm MIN INTO STIFF NATURAL CLAY OR BETTER WITH BEARING CAPACITY OF 100 kPa MIN. BLINDING CONCRETE MAY BE USED TO OBTAIN THIS. DESIGN ENGINEER TO INSPECT FOOTINGS PRIOR TO POUR.



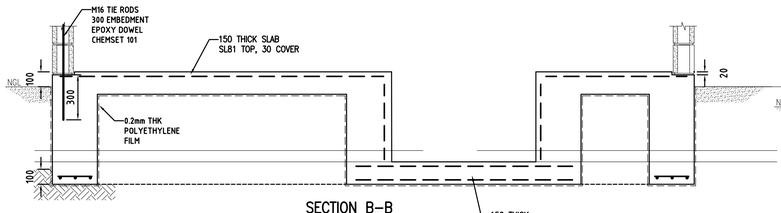
SWITCHROOM SLAB PLAN
SCALE 1:20



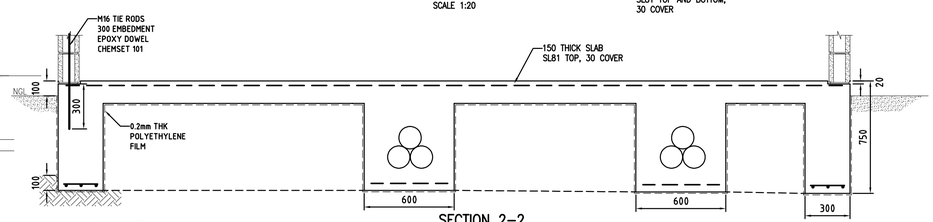
SECTION A–A
SCALE 1:20



SECTION 1–1
SCALE 1:20



SECTION B–B
SCALE 1:20



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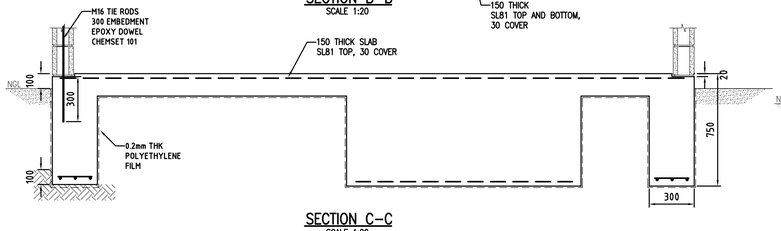

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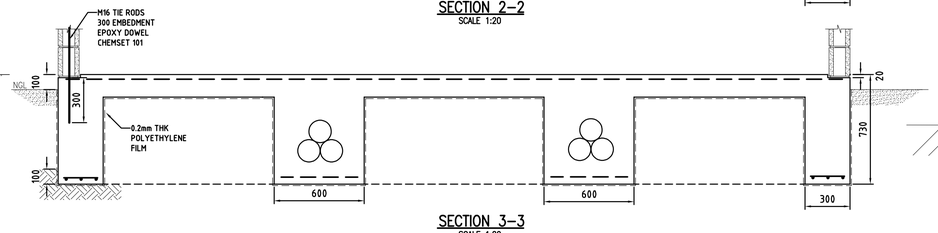
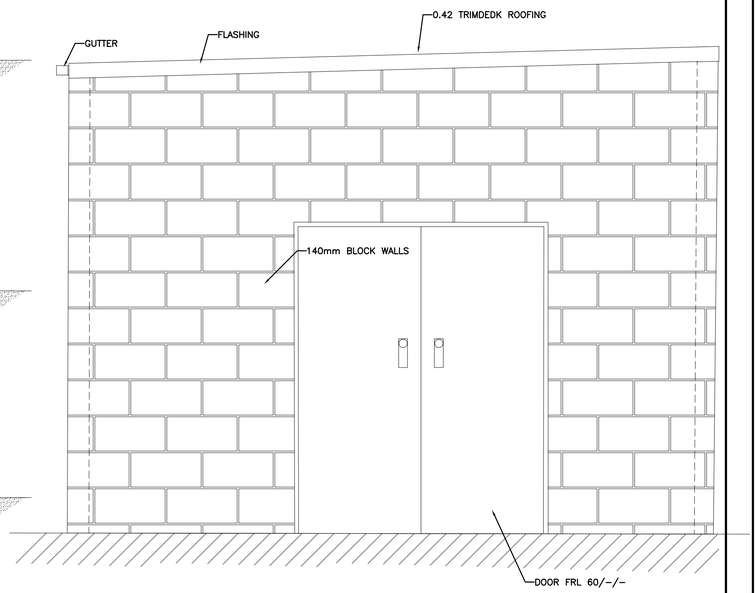
SCALE 1:20



SECTION 3–3
SCALE 1:20



SWITCHROOM ELEVATION
SCALE 1:20

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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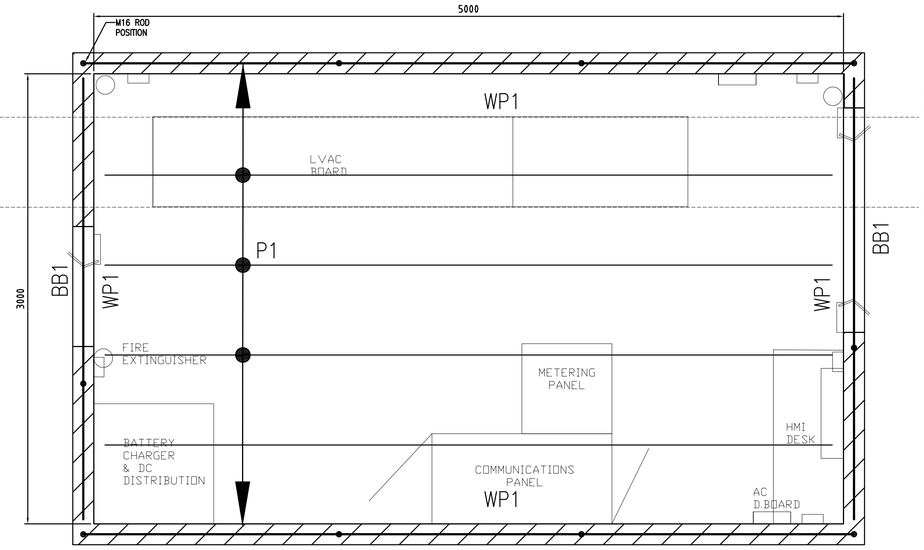
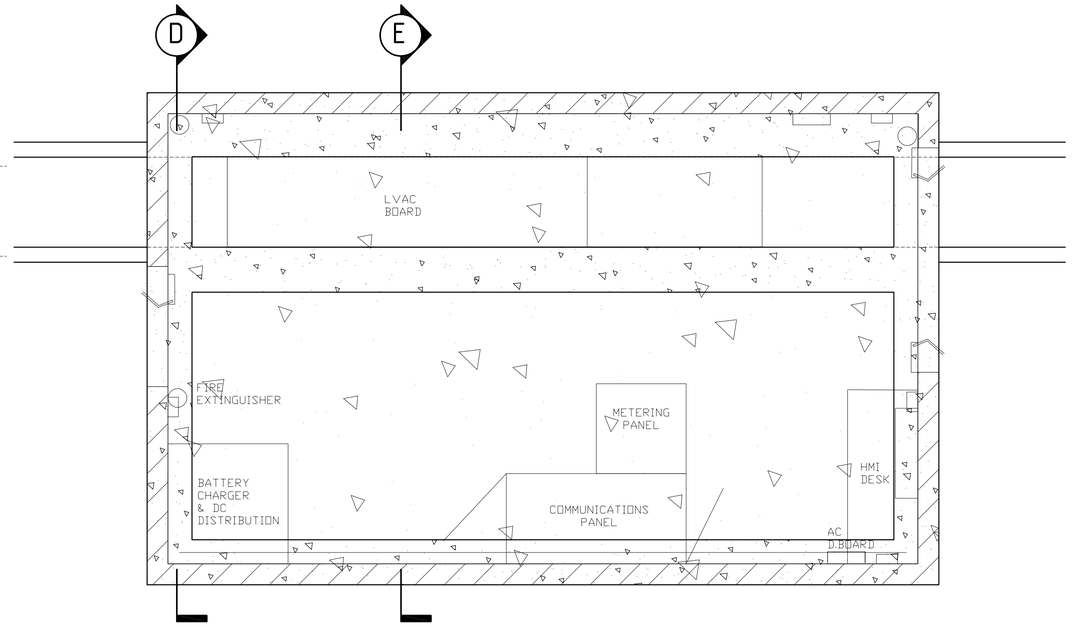
HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM SWITCHROOM DETAILS

FOLDER:
DISTRIBUTION:
DRAWING: HUM\BAU00841
COMPANY: MERIDIAN ENERGY
NUMBER:
ISSUE: 03

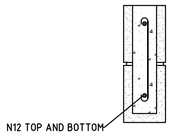


RELAY ROOM ROOF PLAN
SCALE. 1:20

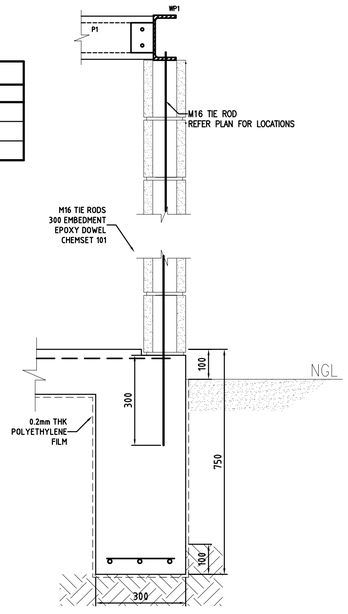


RELAY ROOM FOOTING PLAN
SCALE. 1:20

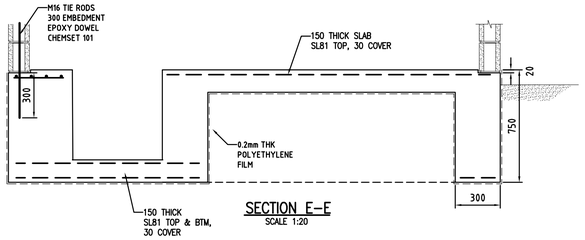
MEMBER SCHEDULE		
Mark	SIZE	DESCRIPTION
BB1	REFER DETAIL	BOND BEAM
P1	C15019	PURLIN @ 600cts
WP1	150UB15	WALL PLATE



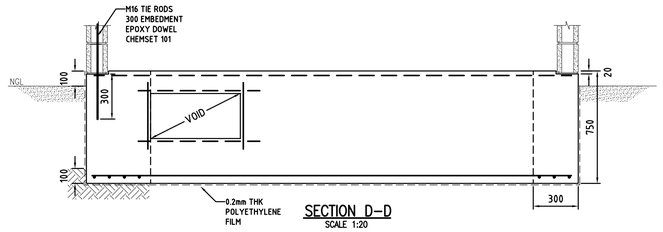
BB1 DETAIL



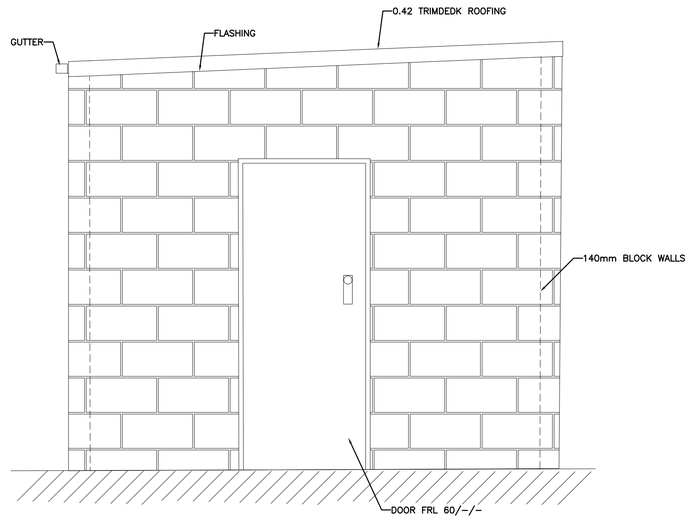
WALL TIE DOWN DETAILS



SECTION E-E
SCALE 1:20



SECTION D-D
SCALE 1:20



RELAY ROOM ELEVATION
SCALE 1:20

FOUNDING NOTE:
FOOTINGS TO BE FOUNDED 100mm MIN INTO STIFF NATURAL CLAY OR BETTER WITH BEARING CAPACITY OF 100 kPa MIN. BLINDING CONCRETE MAY BE USED TO OBTAIN THIS. DESIGN ENGINEER TO INSPECT FOOTINGS PRIOR TO POUR.

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
01	FIRST ISSUE	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	24/08/20
02	FBG BOX ADDITION	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	28/08/20
03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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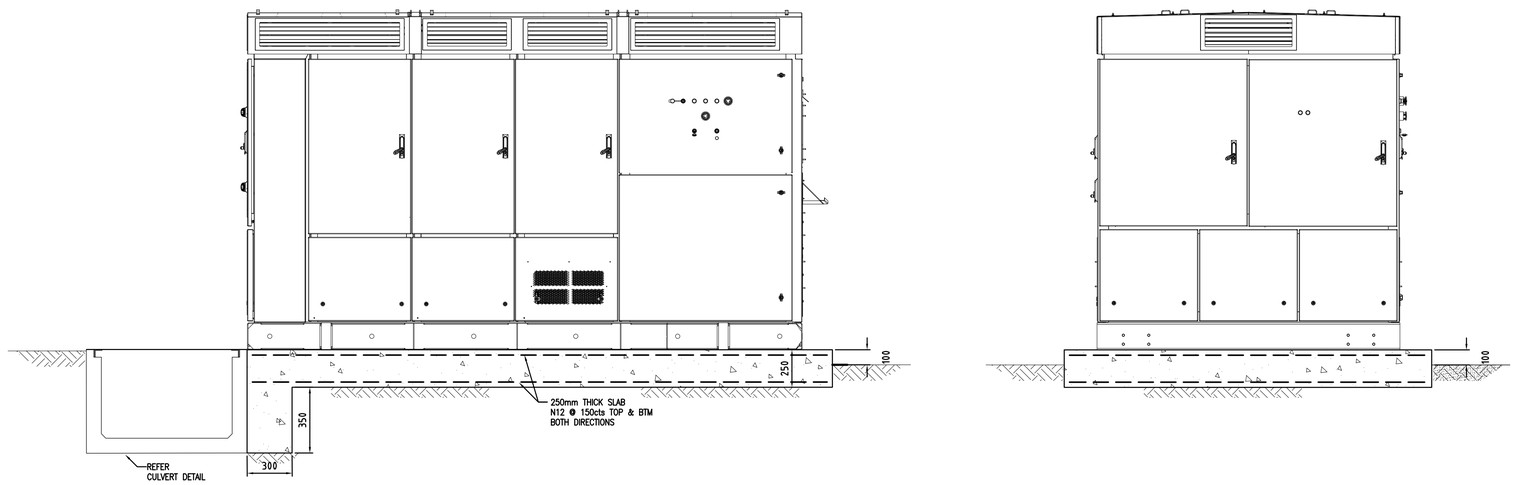
HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
RELAY ROOM DETAILS

FOLDER:	DISTRIBUTION:
DRAWING:	HUM\BAU0*842
COMPANY:	MERIDIAN ENERGY
NUMBER:	ISSUE: 03



INVERTER SLAB
SCALE. 1:20

FOUNDING NOTE:
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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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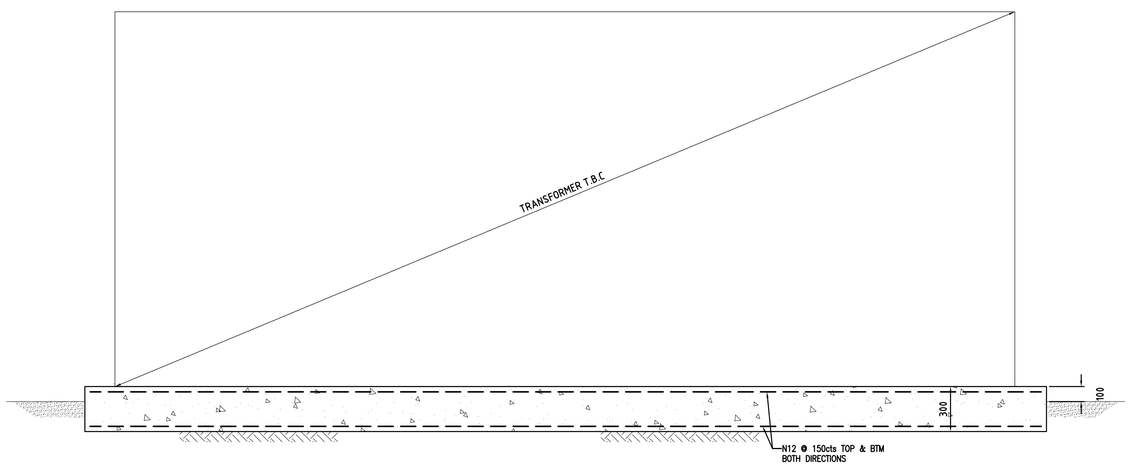
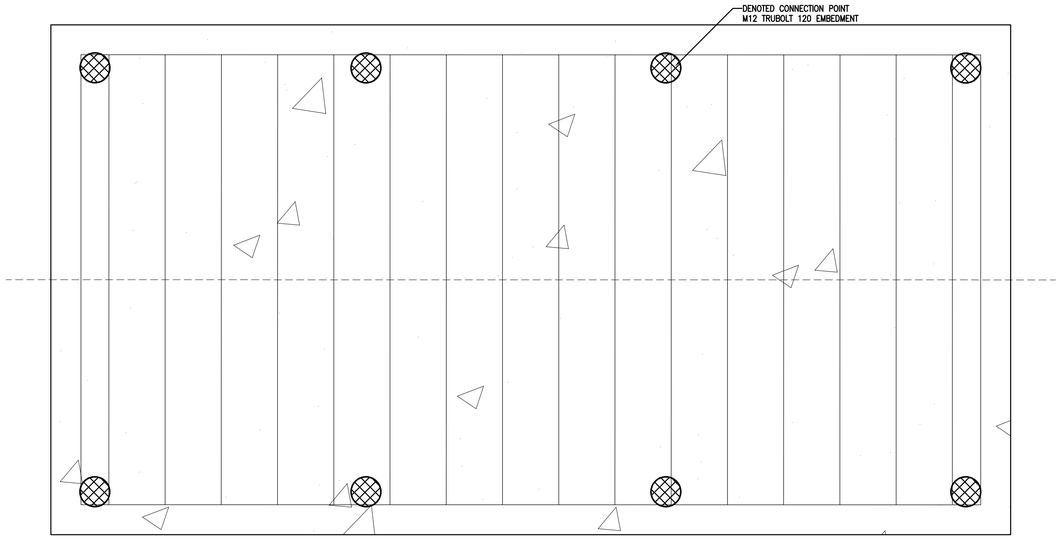
HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
INVERTER DETAILS

FOLDER:
DISTRIBUTION:
DRAWING: HUM\BAU00843
COMPANY: MERIDIAN ENERGY
NUMBER:
ISSUE: 03





TRANSFORMER SLAB
SCALE. 1:20

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
01	FIRST ISSUE	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	24/08/20
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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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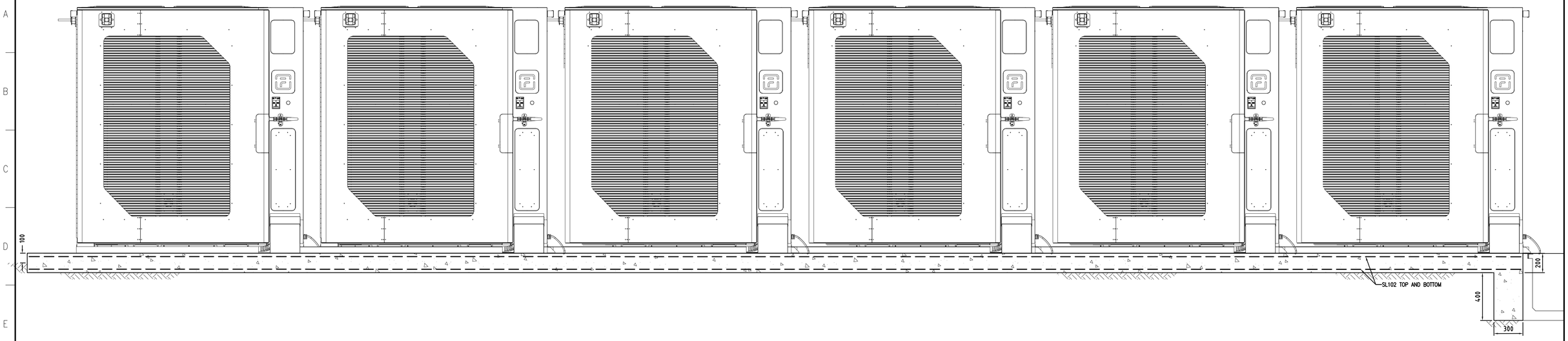
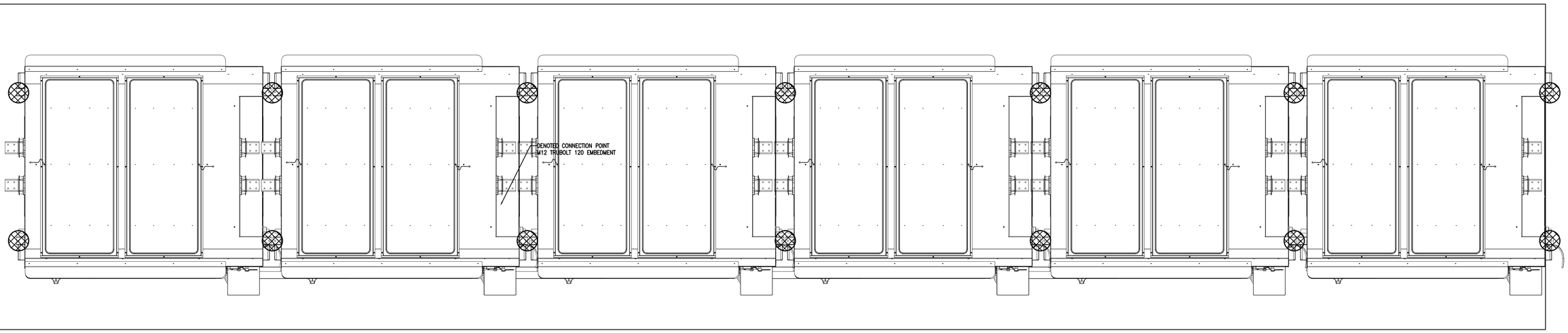
HUME POWER STATION

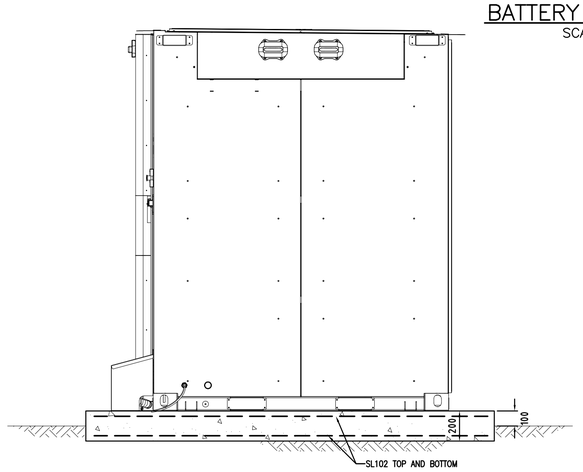
BATTERY ENERGY STORAGE SYSTEM
TRANSFORMER DETAILS

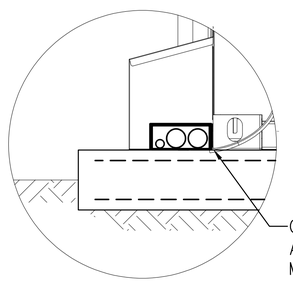
FOLDER:
DISTRIBUTION:
DRAWING: HUM\BAU00844
COMPANY: MERIDIAN ENERGY
NUMBER:
ISSUE: 03





BATTERY CUBE SLAB
SCALE. 1:20





BATTERY CUBE CABLE TRAY
SCALE. 1:20

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
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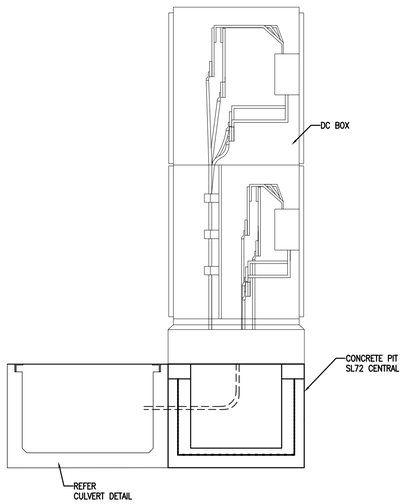
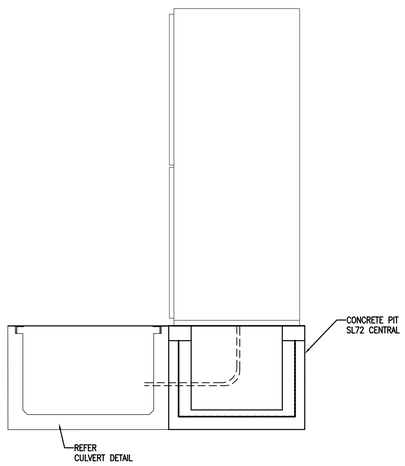
HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
BATTERY CUBE DETAILS

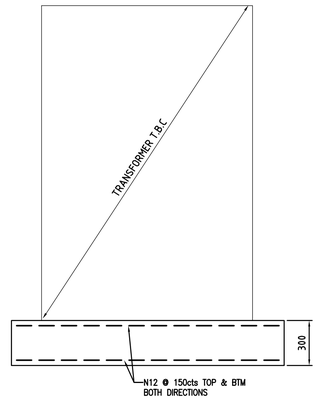
FOLDER:
DISTRIBUTION:
DRAWING: HUM\BAU00845
COMPANY: MERIDIAN ENERGY
NUMBER:
ISSUE: 03

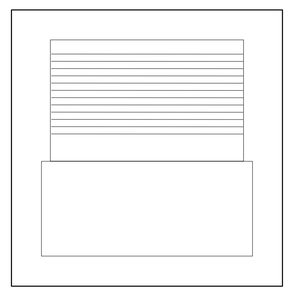


DC BOX PIT
SCALE. 1:20

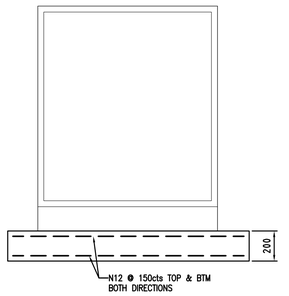


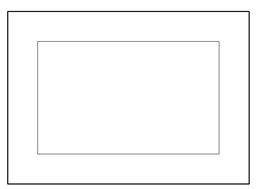
TELCO BOX PIT
SCALE. 1:20





AUX TRANSFORMER SLAB
SCALE. 1:20





FBG SLAB
SCALE. 1:20

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HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
AUX TRANS/DC/TELCO BOX DETAILS

FOLDER: | DISTRIBUTION:
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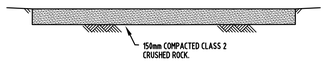
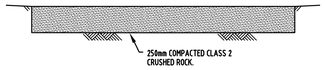
COMPANY: MERIDIAN ENERGY
NUMBER: | ISSUE: 03

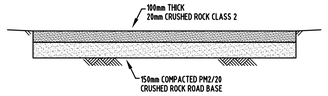
PIT SCHEDULE							
MARK	SIZE	TOP OF PIT	DEPTH OF PIT	IL INLET	IL OUTLET	PIT TYPE	PIT COVER
P1	600x600	-	-	-	-	JP	GRATED
P2	600x600	-	-	-	-	JP	GRATED
P3	600x600	-	-	-	-	JP	GRATED
P4	600x600	-	-	-	-	JP	GRATED



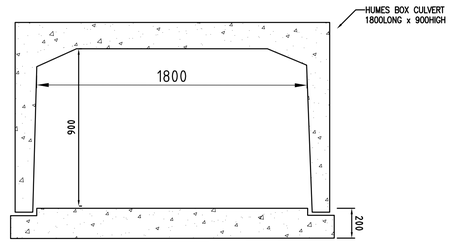
150THICK LIGHT TRAFFIC ROADWAY



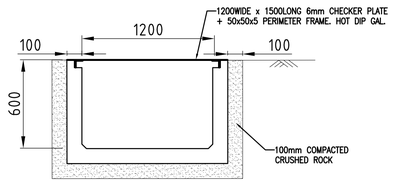
250THICK HEAVY VEHICLE ROADWAY



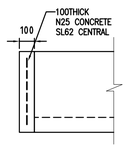
ACCESS ROADWAY DETAILS



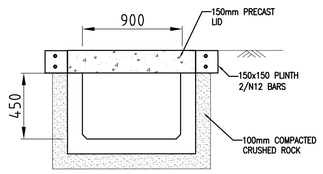
CULVERT 'B' DETAILS
SCALE 1:20



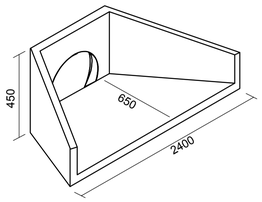
TYPICAL INVERTED CULVERT DETAILS
CABLE TRENCH
SCALE 1:20



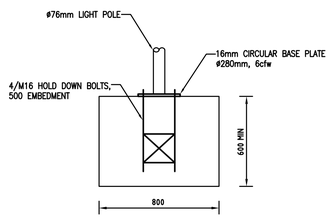
CULVERT END WALL DETAIL
SCALE 1:20



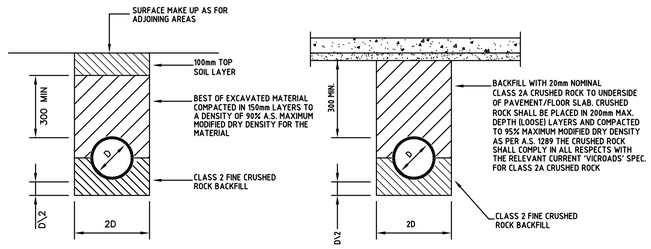
CULVERT 'A' DETAILS
SCALE 1:20



HEADWALL DETAIL

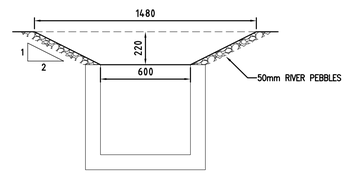


LIGHT POST FOOTING
SCALE 1:20



UNDER LANDSCAPED AREAS UNDER FLEXIBLE PAVEMENT

PIPE LAYING DETAILS



SWALE DRAIN DETAILS
SCALE 1:20

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
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03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

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HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
CIVIL DETAILS

FOLDER: | DISTRIBUTION:
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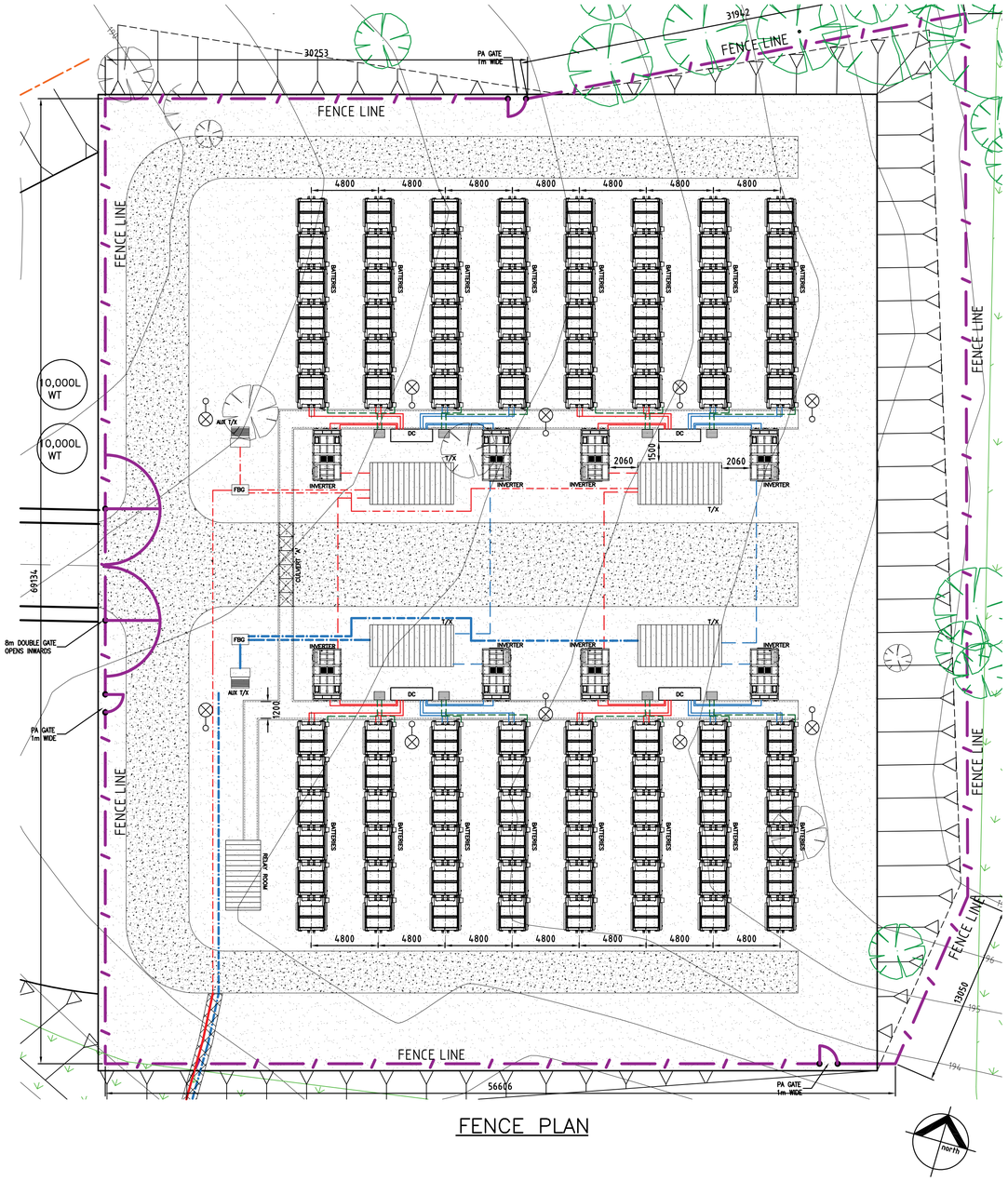
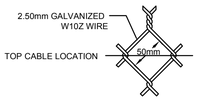
COMPANY: MERIDIAN ENERGY
NUMBER: | ISSUE: 03



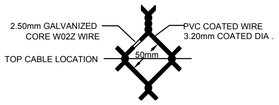
FENCE PLAN

Light Duty Fabric -50mm Pitch x 2.50mm Wire

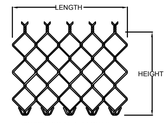
As defined in AS2423 is manufactured with 2.50mm wire which may be selected for light industrial /domestic applications where security and shorter service life are of a lower priority
(Note-2.50mm fabric has only 60% of impact strength compared to 3.15mm fabric)



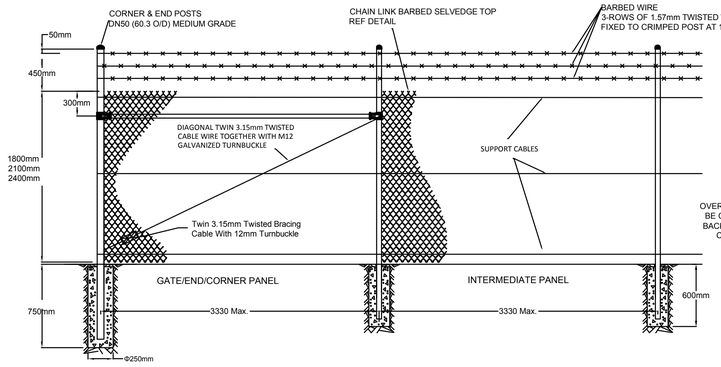
BARBED SELVEDGE - TOP

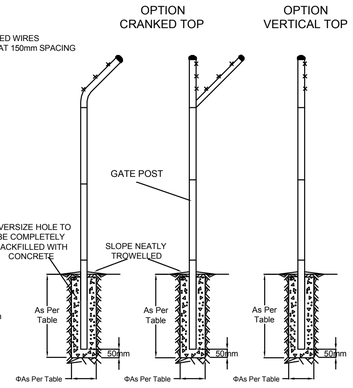


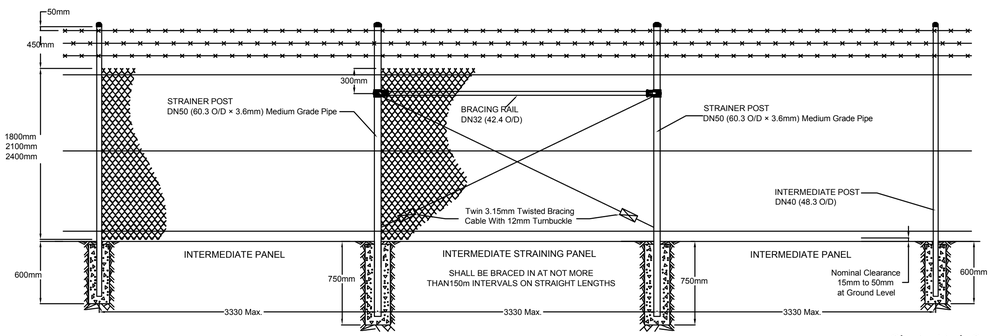
BARBED SELVEDGE - TOP

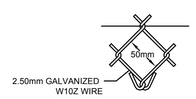


NOTE:
ALL GATES TO OPEN INWARDS TO B.E.S.S SITE



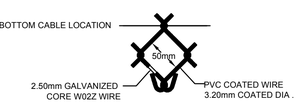






BOTTOM CABLE LOCATION

KNUCKLED SELVEDGE - BOTTOM



KNUCKLED SELVEDGE - BOTTOM

FENCE DETAILS

Chain Link Security Fencing

Light Duty Fabric - 50mm Pitch × 2.50mm Wire Heavy Galvanized Quality (W10Z)
Light Duty Fabric - 50mm Pitch × 2.50mm Wire Zinc/Aluminium Coated Quality (W05Z5A)
Light Duty Fabric - 50mm Pitch × 2.50mm Wire Galvanized Core Wire (W02Z) With PVC Coating

STAKEHOLDERS TO SPECIFY PIPE TABLE REQUIRED CLASS 2 - 3

Gate Posts & Terminal Posts applicable for all Classes of Fencing Refer AS1725-2010
*Class 1 - Medium Grade (MG) Pipe is a requirement for all Gate posts & Terminal Posts

Gate Post Type & Terminal Post Type	Nominal Pipe Size DN	Outside Diam O/D	Pipe Grade	Minimum Wall Thickness	Concrete Diameter	Footings Depth
Gate Posts 3.70m to 4.80m Leaf Size	DN100	114.3mm	Medium	4.5mm	400mm	1100mm
Gate Posts 2.50m to 3.60m Leaf Size	DN80	88.9mm	Medium	4.00mm	300mm	1000mm
Gate Posts 1.30m to 2.40m Leaf Size	DN80	88.9mm	Medium	4.00mm	300mm	900mm
Gate Posts 900mm to 1200mm Leaf Size	DN50	60.3mm	Medium	3.60mm	250mm	750mm
End, Corner & Strainer Terminal Posts	DN50	60.3mm	Medium	3.60mm	250mm	750mm
Class 2 LIGHT Grade Pipe (L/G) Refer AS1725-2010 *Class 2 - Light Grade (L/G) Pipe for Intermediate posts and or rails is the more commonly used pipe for medium service life for fencing purposes						
Intermediate Posts	DN40	48.3mm	Light	2.9mm	250mm	600mm
Optional Back Stays	DN32	42.4mm	Light	2.6mm	250mm	600mm
Bracing (Diagonal Stay)	DN32	42.4mm	Light	2.6mm	250mm	600mm
Pipe Bracing Rail	DN32	42.4mm	Light	2.6mm	-	-
Pipe Top & or Bottom Rail	DN32	42.4mm	Light	2.6mm	-	-
Class 3 EXTRA LIGHT Grade Pipe (XL/G) Refer AS1725-2010 *Class 3 - Extra Light Grade (XLG) Pipe for intermediate posts and or rails are used for Domestic or light duty commercial applications mainly for short term security purpose						
Intermediate Posts	DN40	48.3mm	Extra Light	2.3mm	250mm	600mm
Optional Back Stays	DN32	42.4mm	Extra Light	2.0mm	250mm	600mm
Bracing (Diagonal Stay)	DN32	42.4mm	Extra Light	2.0mm	250mm	600mm
Pipe Bracing Rail	DN32	42.4mm	Extra Light	2.0mm	-	-
Pipe Top & or Bottom Rail	DN32	42.4mm	Extra Light	2.0mm	-	-

LEGEND

- FENCE LINE
- BAU1 SYSTEM
- BAU2 SYSTEM
- DATA CABLES
- BATTER
- SEDIMENT FENCE
- ACCESS ROAD
- DRAINAGE CHANNEL
- DRAINAGE PIPES
- NATURAL WATER COURSE
- EASEMENT
- UNDISTURBED NATURAL GROUND
- EXISTING WETLANDS
- TREES TO REMAIN
- TREES TO BE REMOVED

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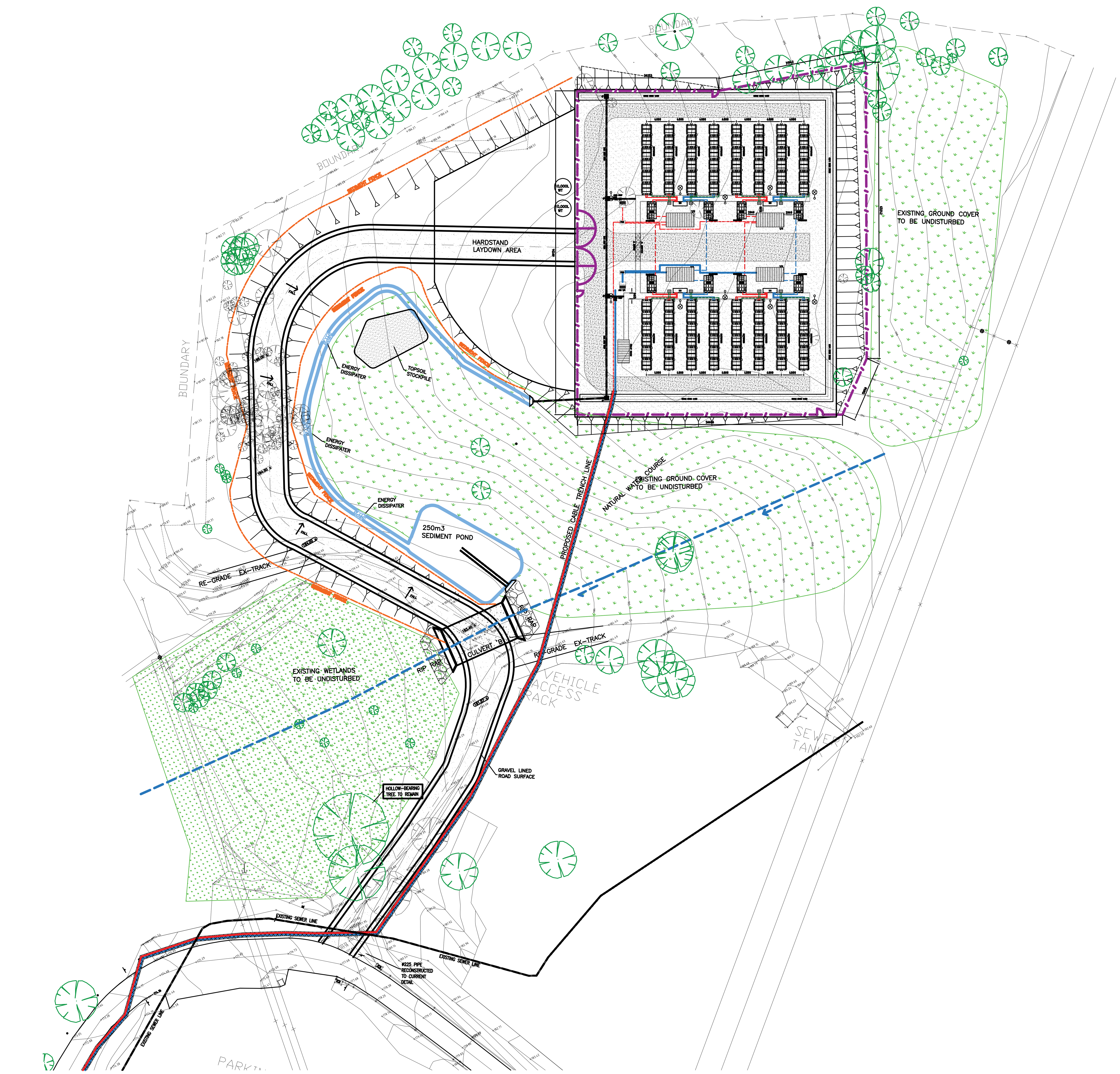
HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM
FENCE DETAILS

FOLDER:
DISTRIBUTION:
DRAWING: HUM\BAU00861
COMPANY: MERIDIAN ENERGY
NUMBER:
ISSUE: 03

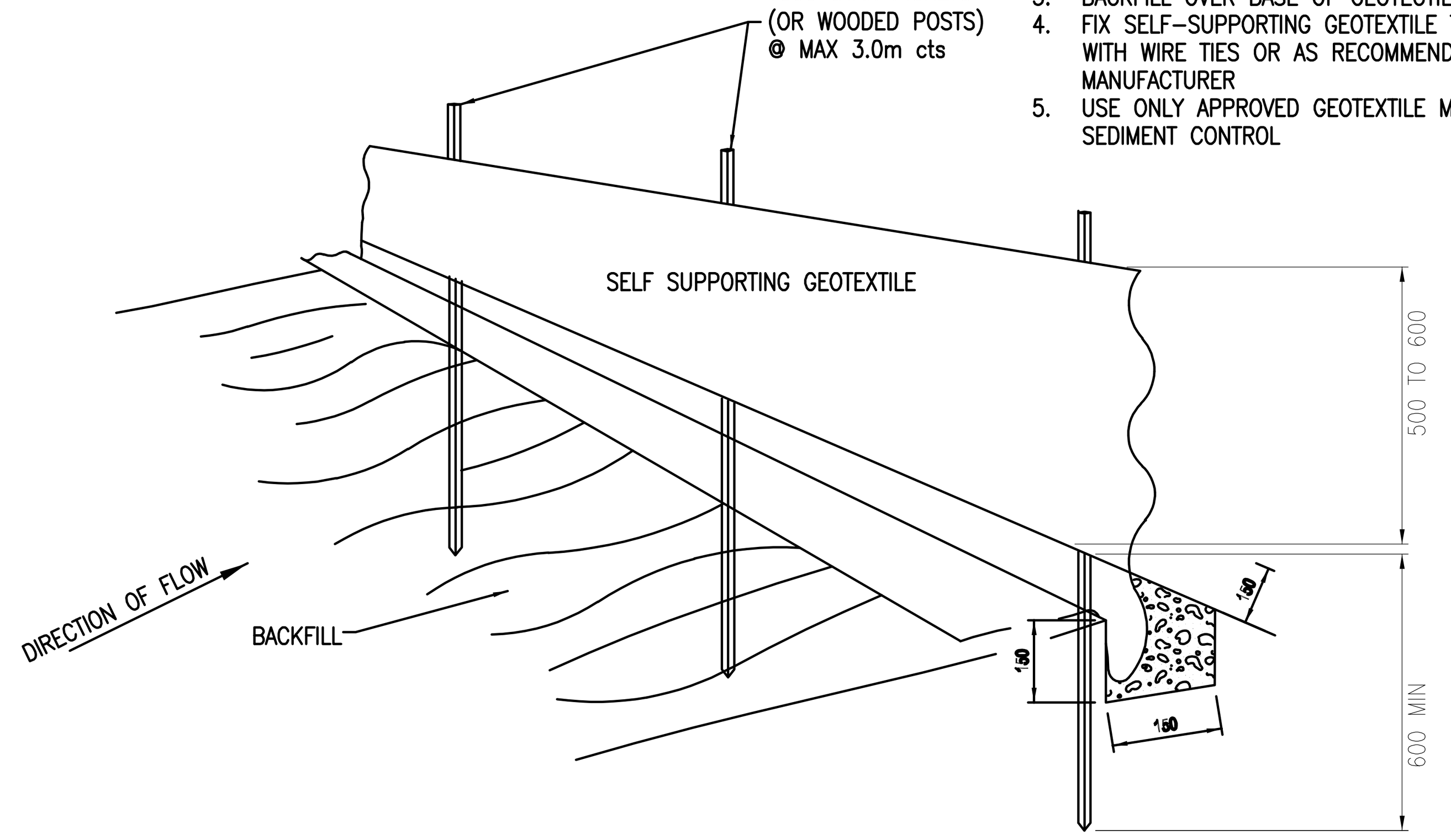
LEGEND

FENCE LINE	EASEMENT
BAU1 SYSTEM	UNDISTURBED NATURAL GROUND
BAU2 SYSTEM	EXISTING WETLANDS
DATA CABLES	TREES TO REMAIN
BATTER	TREES TO BE REMOVED
SEDIMENT FENCE	
ACCESS ROAD	
DRAINAGE CHANNEL	
DRAINAGE PIPES	
NATURAL WATER COURSE	



CONSTRUCTION SEDIMENT CONTROL PLAN

NOTES:
1. DRIVE 1.5m LONG STAR PICKETS INTO GROUND 3.0m APART
2. DIG A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCEFOR THE BOTTOM OF THE GEOTEXTILE TO BE ENTRENCHED AND SUTITABLY COMPACTED TO PREVENT SCOURING
3. BACKFILL OVER BASE OF GEOTECTILE
4. FIX SELF–SUPPORTING GEOTEXTILE TO UPSLOPE SIDE OF POSTS WITH WIRE TIES OR AS RECOMMENDED BY GEOTEXTILE MANUFACTURER
5. USE ONLY APPROVED GEOTEXTILE MATERIALS SUITABLE FOR SEDIMENT CONTROL



SEDIMENT FENCE DETAIL

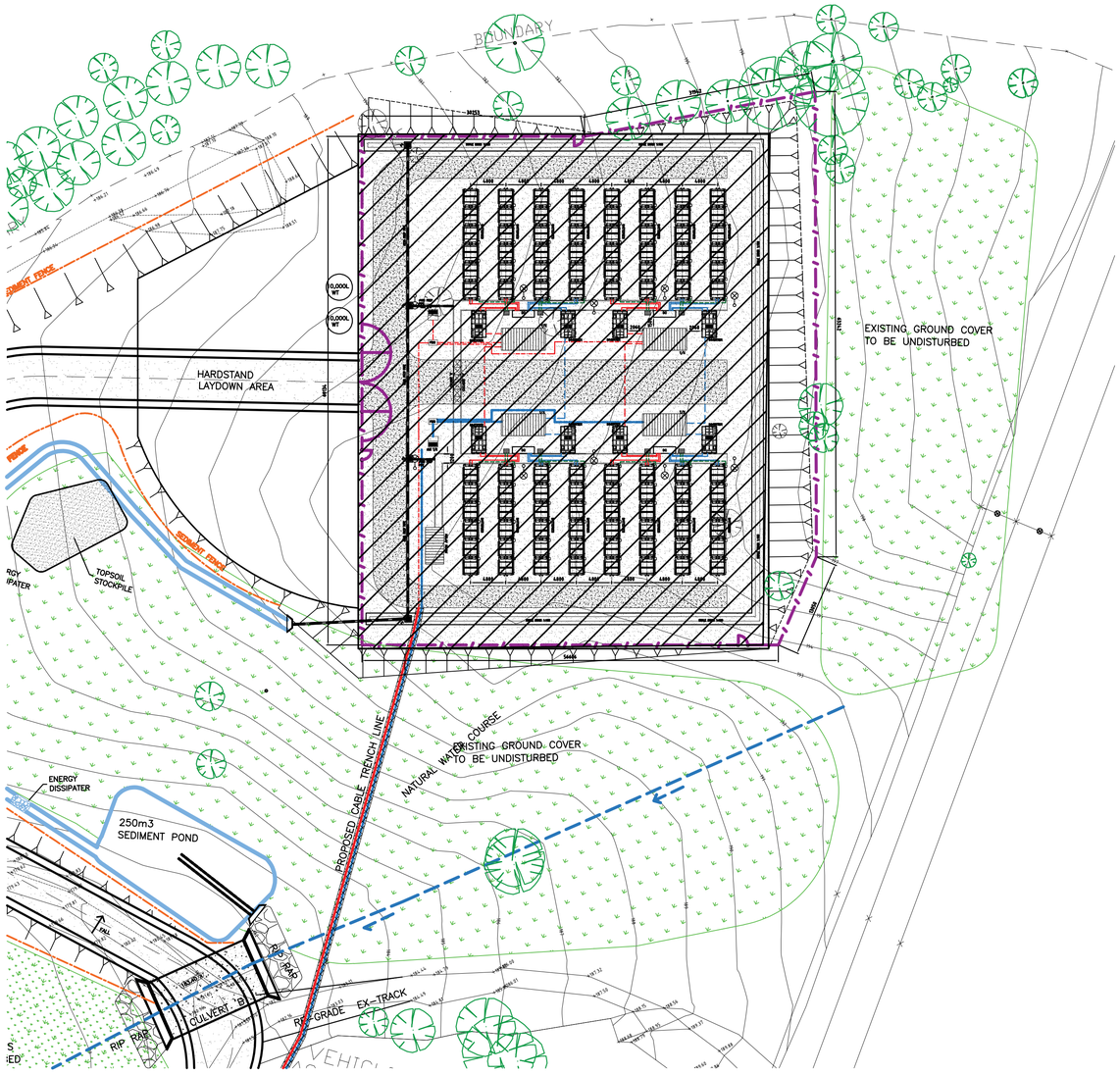
ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
01	FIRST ISSUE	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	24/08/20
02	FBG BOX ADDITION	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	28/08/20
03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

Meridian.

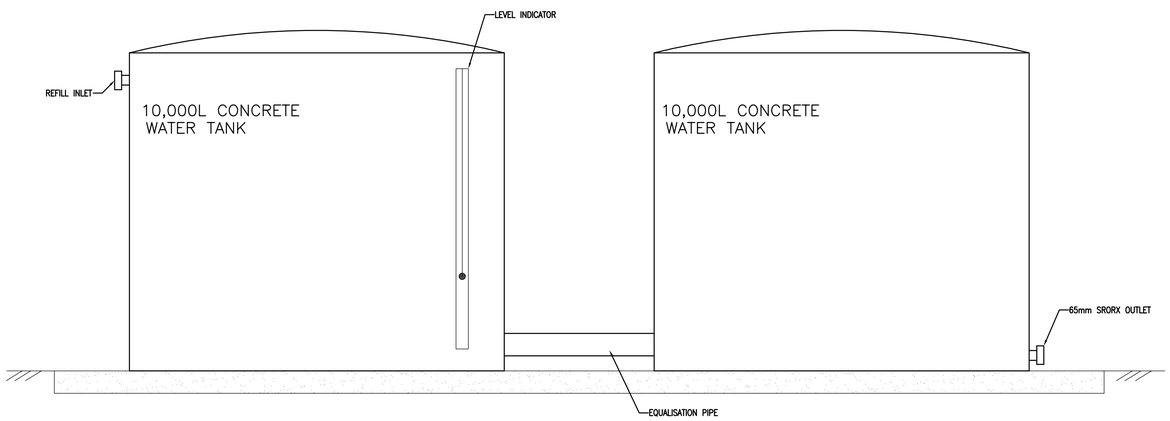
HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM EROSION AND SEDIMENT CONTROL PLAN

FOLDER:
DISTRIBUTION:
DRAWING: HUM\BAU00871
COMPANY: MERIDIAN ENERGY
NUMBER:
ISSUE: 03



ASSET PROTECTION ZONE



STATIC CONCRETE WATER TANK DETAIL

ISSUE	AMENDMENT	BY	CH'D	COMPANY	PROJECT	APP'D	DATE
01	FIRST ISSUE	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	24/08/20
02	FBG BOX ADDITION	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	28/08/20
03	REVISIONS	JT	RN	TGA / FLUENCE ENERGY	MERIDIAN HUME B.E.S.S	RN	30/09/20

Meridian.

HUME POWER STATION

BATTERY ENERGY STORAGE SYSTEM WATER TANK DETAILS

FOLDER: | DISTRIBUTION:

DRAWING: HUM\BAU00881

COMPANY: MERIDIAN ENERGY

NUMBER: | ISSUE: 03

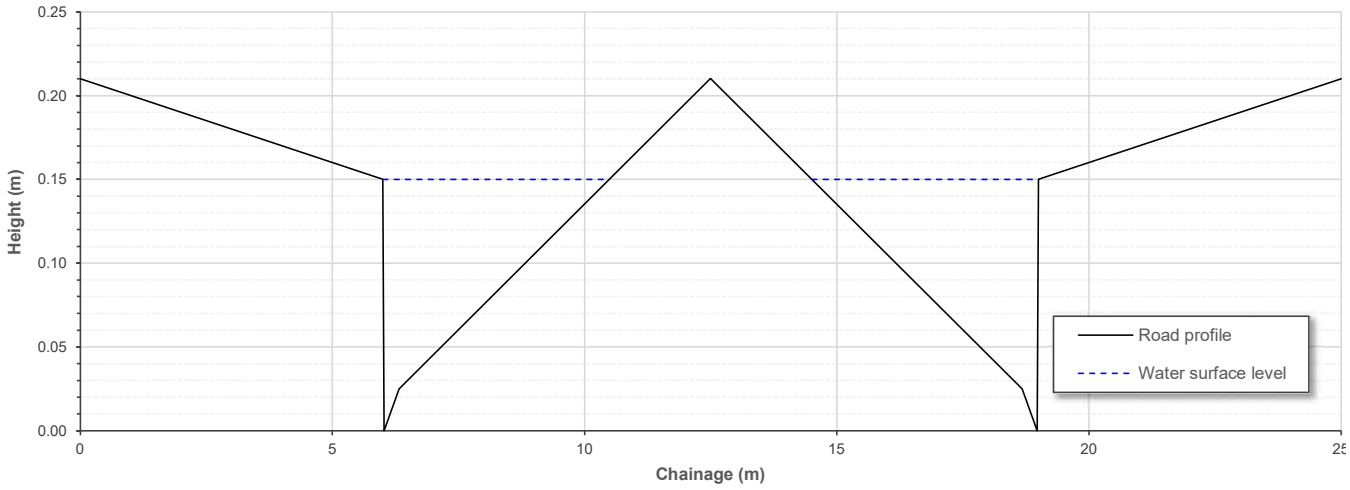
Appendix B

Road capacity calculations

Flow capacity contained by the kerbs

Road Profile		
Verge:		
Width	6.0	m
Crossfall	1.0	%
Manning's roughness (n)	0.020	
Kerbface:		
Width	0.025	m
Height	0.150	m
Manning's roughness (n)	0.013	
Watertable:		
Width	0.300	m
Depth	0.025	m
Manning's roughness (n)	0.013	
Pavement:		
Width	6.2	m
Crossfall	3.0	%
Manning's roughness (n)	0.016	
Summary:		
Road reserve width	25.00	m
Road width (kerb to kerb)	13	m
Fall across road	0.185	m
Fall across verge	0.06	m
Maximum pond depth	0.210	m

Hydraulic properties		
Longitudinal grade	1	%
Flow characteristics:		
Flow depth	0.15	m
Crown of road	Below	
Kerb level	Equal to	
Boundary level	Below	
Hydraulic calculations:		
Form correction factor	0.9	
Flow within verge	0.000	m^3/s
Flow within watertable	0.082	m^3/s
Flow within road	0.549	m^3/s
Total flow	0.631	m^3/s



Flow capacity contained by the road reserve

Road Profile		
Verge:		
Width	6.0	m
Crossfall	1.0	%
Manning's roughness (n)	0.020	
Kerbface:		
Width	0.025	m
Height	0.150	m
Manning's roughness (n)	0.013	
Watertable:		
Width	0.300	m
Depth	0.025	m
Manning's roughness (n)	0.013	
Pavement:		
Width	6.2	m
Crossfall	3.0	%
Manning's roughness (n)	0.016	
Summary:		
Road reserve width	25.00	m
Road width (kerb to kerb)	13	m
Fall across road	0.185	m
Fall across verge	0.06	m
Maximum pond depth	0.210	m

Hydraulic properties		
Longitudinal grade	1	%
Flow characteristics:		
Flow depth	0.21	m
Crown of road	Above	
Kerb level	Above	
Boundary level	Above	
Hydraulic calculations:		
Form correction factor	0.9	
Flow within verge	0.195	m^3/s
Flow within watertable	0.154	m^3/s
Flow within road	1.585	m^3/s
Total flow	1.933	m^3/s