

Gugaa BESS - 477 Gregadoo East Road

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Northrop Consulting Engineers Pty Ltd

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Preliminary Site Investigation

Northrop Consulting Engineers has been engaged to undertake a preliminary civil assessment for the proposed Gugaa Battery Energy Storage System (BESS) located at 477 Gregadoo East Road (Lot 114 DP 757261), Gregadoo NSW 2650. The purpose of this investigation is to identify key civil engineering considerations associated with the development, focusing on stormwater management, flooding, earthworks, and site access.

This report has been prepared as a desktop-level assessment to inform the early design and planning stages of the project. It draws upon available survey data, aerial imagery, local flood mapping, and relevant engineering standards including Australian Rainfall and Runoff (ARR 2019), Austroads Guidelines, AS2890.2, and Wagga Wagga City Council's Engineering Guidelines and Stormwater Policy.

The proposed BESS forms a critical component of regional renewable energy infrastructure, supporting network stability and energy storage for the broader Wagga Wagga area. The development will comprise multiple battery units, internal access roads, and associated drainage and earthworks infrastructure across an area of approximately 16 hectares.

This assessment provides a preliminary overview of the site's suitability, from a civil engineering perspective, for the proposed works and outlines key design considerations to be addressed in subsequent detailed design and approval stages.

Stormwater Management Strategy

OVERVIEW

The proposed development will incorporate a stormwater management system designed to manage both frequent and extreme rainfall events in accordance with relevant guidelines. The system incorporates a minor drainage network for frequent storm events and a major overland flow system for rare and extreme events. The objective is to ensure post-development runoff rates and volumes do not exceed pre-development conditions while achieving best-practice water quality outcomes.

The minor system will consist of a pit and pipe network designed to convey runoff from events with an Annual Exceedance Probability (AEP) of 5–10% (equivalent to a 10–20 year Average Recurrence Interval (ARI)). During major storm events (1% AEP / 100-year ARI), overland flow will be safely directed along the internal road network. This dual system approach provides reliable drainage performance under a range of design storm conditions.

The site naturally grades towards the south-eastern corner, where an existing dam (~1,400 m²) currently functions as the outlet for surface runoff. This dam is proposed to remain as the primary outlet for the post-development drainage network.

A review of aerial imagery, survey data and catchment topography indicates that the existing dam has limited storage capacity and will require enlargement by approximately 100% in both surface area and volume. This increase will provide the necessary capacity for detention and water quality treatment, ensuring compliance with Council's stormwater management objectives.

DRAINAGE NETWORK LAYOUT

The proposed stormwater system will integrate efficiently with the site layout and natural topography. The pit and pipe network will capture and convey runoff from the 5–10% AEP storm events and discharge flows to the enlarged dam located in the south-eastern corner.

During more extreme events (1% AEP), overland flow will be conveyed through the internal road network, which will be designed to safely direct runoff toward the same outlet point. The southern, eastern and central access roads will act as the main conveyance paths, providing a safe and efficient route for both pipe and surface flows. Flow depths and velocities will be verified to ensure compliance with Austroads and Council safety and serviceability limits.

POST-DEVELOPMENT HYDROLOGY

The proposed development will increase the proportion of impervious surfaces to approximately 70–90% of the total 16 ha site area. The final impervious fraction will be confirmed during the detailed design stage.

A hydrologic assessment has been undertaken using hand calculations in accordance with Australian Rainfall and Runoff (ARR 2019) and Bureau of Meteorology (BoM) rainfall data, using Wagga Wagga City Council's Stormwater Policy parameters. The site was assessed for both pre- and post-development conditions and demonstrated that with appropriate detention and treatment measures, post-development discharges can be maintained at or below pre-development levels.

DETENTION BASIN DESIGN AND PERFORMANCE

To manage increased runoff, an on-site bioretention basin will be constructed in the south-eastern corner of the site. The basin will provide both detention and water quality treatment functions.

Hydraulic analysis indicates that the basin must limit post-development outflows to 0.53 m³/s, consistent with the existing pre-development peak discharge. Stage-storage-discharge routing shows that approximately 2,700 m³ of active detention storage will be required to achieve this target.

The outlet structure will consist of an orifice (Ø525–Ø600 mm) for flow control and an emergency overflow weir to manage extreme rainfall events, safely discharging to Livingstone Gully Road. Erosion protection will be incorporated downstream of the outlet to prevent scour and maintain stability.

Stage-storage-discharge relationships were established for the detention basin and applied within a routing model to assess system performance under multiple storm durations. Sensitivity testing considered imperviousness levels (70%, 80%, and 90%), inlet blockage scenarios, and tailwater conditions at the outlet. Results confirm that the proposed system effectively mitigates increases in peak flow and maintains acceptable flow conditions within the road network.

WATER QUALITY TREATMENT SYSTEM

The detention basin will include an integrated water quality treatment system comprising a forebay and biofiltration zone. The forebay will be located upstream to capture coarse sediments and gross pollutants, facilitating maintenance and improving the lifespan of the treatment system.

Downstream of the forebay, a biofiltration area of approximately 2,880 m² will be constructed to provide fine sediment and nutrient removal prior to discharge. The biofiltration system is expected to achieve pollutant reduction targets consistent with Wagga Wagga City Council's best practice objectives, particularly for Total Suspended Solids (TSS), Total Phosphorus (TP), and Total Nitrogen (TN).

OPERATIONS, MAINTENANCE, AND ACCESS

The stormwater management system will be designed to enable straightforward access for maintenance and inspection. The forebay will include an accessible sediment cleanout area, and the biofiltration zone will incorporate appropriate vegetation and filtration media. Maintenance activities will include regular inspections following rainfall events exceeding 20 mm, quarterly inspections, and annual reviews of basin performance.

A detailed Operation and Maintenance Plan shall be prepared at the detailed design stage to guide inspection schedules, maintenance triggers, and rehabilitation requirements.

DESIGN INPUTS AND PARAMETERS

Parameter	Value / Description	Source / Standard
Site Area	16 ha	Survey Data
Existing Dam Area	1,400 m ²	Aerial Imagery
Post-Development Imperviousness	70–90%	Preliminary DA Design
Minor System Design	5–10% AEP (10–20 yr ARI)	WWCC Guidelines
Major System Design	1% AEP (100 yr ARI)	ARR 2019
Peak Discharge (Target)	0.53 m ³ /s	General Analysis. Sizing TBC using DRAINS modelling
Required Detention Storage	2,700 m ³	General Analysis. Sizing TBC using DRAINS modelling
Biofiltration Area	2,880 m ²	General Analysis. Sizing TBC using MUSIC modelling
Dam Enlargement	~100% (area and volume)	Concept Design
Standards Applied	ARR 2019, WWCC Stormwater Policy	

COMPLIANCE

Stormwater infrastructure is to be designed in accordance with Wagga Wagga City Council's Engineering Guidelines and Stormwater Policy, Australian Rainfall and Runoff (ARR 2019), and relevant Australian Standards. The proposed strategy ensures that post-development discharges are consistent with pre-development conditions, downstream impacts are minimised, and water quality objectives are met.

Flooding

A desktop flood assessment has been undertaken and initial advice obtained from Wagga Wagga City Council. Flood imagery provided by Council indicates that the site is not directly flood-affected (Figure 1).



Figure 1

Two mapped watercourses traverse the land, namely Big Spring Creek and an unnamed second-order channel, both of which drain to Gregadoo Creek before flowing into Obriens Creek, Kyemba Creek and ultimately the Murrumbidgee River. The site lies within the Wagga Wagga Revised Murrumbidgee River Flood Study area, although the mapping does not identify the site as being impacted by flooding from the Murrumbidgee itself.



Figure 2

No published mapping is available for flooding associated with the two watercourses on the site, and Council has yet to confirm if any detailed studies currently exist. While it is not expected that the site is flood affected, it is recommended that an assessment of the flood extents across the site be undertaken to confirm. Council's Major Overland Flow Floodplain Risk Management Study and Plan (2021) provides catchment-scale information for the Gregadoo sector, but numeric Flood Planning Levels are not available for the subject site. Property-specific flood data will therefore need to be obtained through a formal Flood Information request or a Section 10.7 Planning Certificate.

Site Grading and Earthworks

The site generally falls towards the west, with average slopes ranging from 1% to 6%. Given the scale of the proposed development and the limited opportunity to regrade the battery storage pads, earthworks and access will need to be carefully planned. We have assumed a level difference of 1,500mm between each adjoining battery is acceptable (tbc). Northrop has undertaken a preliminary site grading and earthworks assessment to determine anticipated pad levels, cut and fill volumes, and access constraints. To achieve a cut/fill balance across the site, the western pads are proposed to be cut into the natural ground (orange to red), while the eastern pads will be constructed on fill (green to purple).

Additionally, an earth mound is to be provided along the northern edge of the site, approx. 418m in length and 2m high. The mound is to be incorporated with the required fencing/barriers for the site and assist in balancing earthwork volumes. The mound is to have 1V:3H batters and a 2m wide plateau for maintenance and stability. The current estimated cut and fill volumes are as follows:

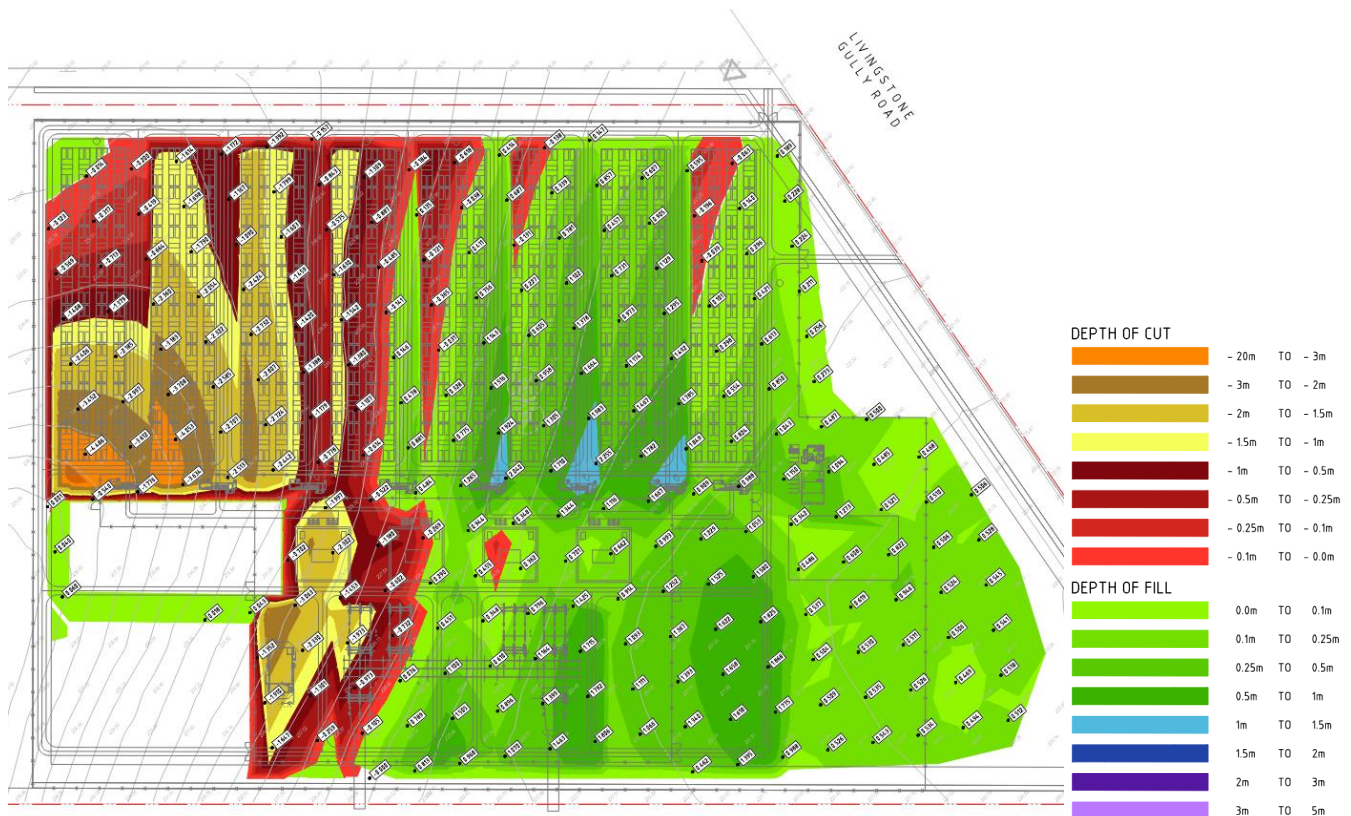


Figure 3 – Cut/Fill Plan

Estimated Cut/Fill Volumes

Cut = 85,760m³

Fill = 79,640m³

Balance = 6,120m³ (excess fill)

As noted above, the site may be capable of achieving an earthworks balance; however, further consideration is required with respect to battery pad tolerances (including allowable stepping or grading), interface treatments to the existing surface (such as battering or retaining walls), and subsurface ground conditions (e.g., rock), all of which may affect the overall feasibility of excavation.

Site Access

Access to the site must be capable of accommodating the designated design vehicles associated with both construction and ongoing operation of the Battery Energy Storage System (BESS). Based on the findings of the *Preliminary Traffic Assessment* (Amber Organisation, 2025), it is anticipated that the primary delivery vehicles during construction will include 25 m B-doubles transporting battery units and other prefabricated components, in addition to rigid trucks, truck-and-dog combinations, and occasional over-dimensional (OSOM) vehicles for transformer and inverter deliveries.

A preliminary swept path analysis has been undertaken for a 25 m B-double, indicating that both entry to and exit from the proposed access point on Livingstone Gully Road should be achieved at low speeds without significant encroachment beyond the formed road shoulders. The proposed internal access road, approximately 65 m in length, will require a longitudinal grade of around 5% to connect from the existing road level to the raised development pad levels. This gradient is within the acceptable limits for heavy vehicles as outlined in AS2890.2:2023 – Off-Street Commercial Vehicle Facilities and Austroads Guide to Road Design (AGRD). The road width, pavement structure, and turning geometry will be refined during detailed design to ensure compliance with these standards.

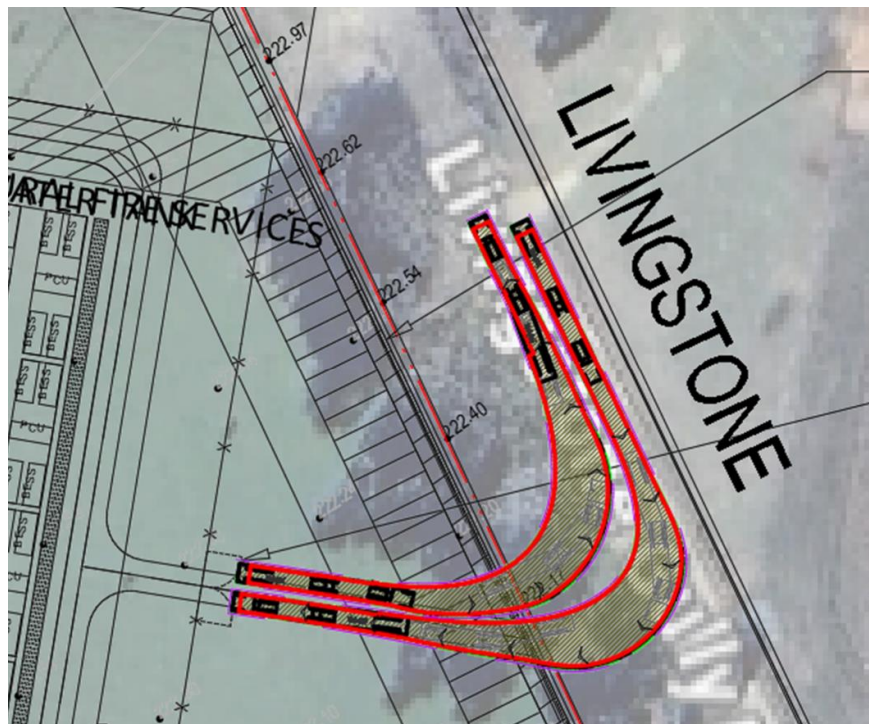


Figure 4 – B-Double (25m) swept path

The Preliminary Traffic Assessment confirms that Livingstone Gully Road is currently rated to accommodate B-double vehicles under the National Heavy Vehicle Regulator (NHVR) network and that the adjoining regional road network, including Gregadoo East Road and Tumberumba Road, is similarly approved for 25/26 m B-double movements.

Additional analysis will be required to confirm that Safe Intersection Sight Distance (SISD) and Approach Sight Distance (ASD) are achieved at the proposed site access, in accordance with Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections. Given the undulating nature of Livingstone Gully Road, the proposed access location has been selected to maximise visibility and provide adequate forward sight for both northbound and southbound approaches.

Construction-phase traffic management will require particular attention. Heavy vehicle deliveries, particularly those involving OSOM components such as transformers, will be accompanied by traffic control measures including pilot vehicles, police escorts where necessary, and advance public notifications to local residents. Construction traffic impacts will be managed through a Construction Traffic Management Plan (CTMP) prepared in consultation with Council and relevant road authorities.

This plan will detail haul routes, delivery timing restrictions, driver protocols, and safety measures for interactions with local road users, including school bus services operating along Livingstone Gully Road and Gregadoo East Road.

Where any works are proposed within the road reserve, such as pavement widening, shoulder sealing, or culvert reconstruction, a Section 138 approval under the Roads Act 1993 will be required from Wagga Wagga City Council in addition to development consent. Should existing road widths, sight lines, or pavement conditions be found inadequate during detailed design, targeted upgrades may be conditioned as part of the development approval process.

Conclusion

Northrop has undertaken a preliminary desktop assessment for the proposed Battery Energy Storage System (BESS) at 477 Gregadoo East Road, Gregadoo NSW, reviewing stormwater, flooding, earthworks, and access considerations. The study confirms that the site is suitable for development from a civil perspective, subject to detailed design and further geotechnical and hydrologic verification.

The stormwater management strategy demonstrates that post-development runoff can be maintained at or below existing conditions using an integrated pit and pipe network, overland flow routing, and a detention basin (~2,700 m³) incorporating a 2,880 m² biofiltration zone for water quality treatment. This approach satisfies the requirements of ARR 2019 and Wagga Wagga City Council's Stormwater Policy.

The site is not flood-affected by the Murrumbidgee River, although localised overland flow from two watercourses should be confirmed through detailed flood modelling. Preliminary earthworks analysis indicates a near-balanced outcome with 85,760 m³ of cut and 79,640 m³ of fill, managed by cutting western pads and filling to the east, supported by a 2 m high, 418 m long northern mound.

The traffic assessment confirms that Livingstone Gully Road can accommodate 25 m B-double access under the NHVR network, with a compliant 5% internal access grade. Detailed sight distance checks and a Construction Traffic Management Plan (CTMP) will be required at the next design phase.

Overall, no prohibitive constraints have been identified. With further detailed design, survey, and consultation with Wagga Wagga City Council and TfNSW, the Gugaa BESS project can proceed in accordance with relevant civil, stormwater, and access standards.

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