

Our ref: PS212248-WSP-MEL-GEO-LTR-001 RevA SC

29 August 2025

Level 11, 567 Collins St
Melbourne VIC 3000

Tel: +61 3 9861 1111
Fax: +61 3 9861 1144
www.wsp.com

AE BESS 2 Pty Ltd ATF AE BESS 2 Unit Trust
c/o Jeremy Moore
Project Development Manager
Avenis Energy
Suite 2, Level 10/52 Alfred St S
Milsons Point NSW 2061

Dear Jeremy

**Moree BESS - Avenis Energy
Interim Geotechnical Design Advice Letter**

1. Introduction

WSP has been engaged by AE BESS 2 Pty Ltd as Trustee for AE BESS 2 Unit Trust (Avenis) to provide an Interim Geotechnical Design Advice (IGDA) letter to support the Development Works Application to Moree Shire Council for the construction of a Battery Energy Storage System (BESS) yard at Bulluss Drive, Moree, New South Wales as shown on Figure 1.

This IGDA, which is based on a desktop information review, has been prepared in general accordance with the scope presented in our Variation Request (request no. 004) which was approved by Avenis on 18 August 2025.

2. Background and proposed development

The proposed development (the Site) has a roughly rectangular footprint that measures about 300 m by 180 m, situated at Bulluss Drive in Moree as shown approximately in Figure 1. The site appears to be mainly grass-covered with no notable features aside from an existing dam in the northwest of the Site and a few small trees.

The Site is located within the Moree Special Activation Precinct (SAP), near Moree's Central Business District (CBD), and is bounded by Bulluss Drive to the west, farmland to the south and east, and the Moree 132kV Substation to the north.

WSP has undertaken a preliminary civil design of the BESS yard pad which we have reviewed to form our understanding of the project. The key components of the project include:

- Battery containers using lithium-ion technology with a capacity of 120 MW.
- Inverters and transformers.
- A switch room and maintenance building in the northeast part of the Site.
- A new access road that enters the Site from Bulluss Drive.
- A stormwater retention basin in the north east part of the Site and a water tank in the north west part of the Site.
- Lay down areas, internal access tracks and parking (the car park is in the west part of the Site).
- Security fencing.

WSP's preliminary civil drawings (ref. C000, C005, C006, C007, C010, C011, C030, C031, C032, C100, C101) dated 28 March 2024 show the following relevant information:

- The proposed hardstand for the BESS is to be built up above the current ground surface level by filling. Preliminary bulk earthworks plans indicate a total cut volume of about 405 m³ and a total fill volume of about 41,800 m³.
- The current ground surface level slopes down towards the north from about RL 212.4 m AHD to RL 212.0 m AHD within the footprint of the proposed earthworks. The proposed hardstand surface slopes down from about the southwest to the northeast, with finished surface levels ranging from about RL 214.4 m AHD in the southwest (about 2.0 m above the current ground surface level) to RL 212.6 m AHD in the northeast (about 0.6 m above the current ground surface level).
- Permanent hardstand fill batter slopes of 1V:3H are proposed.
- There is an existing dam in the northwest part of the Site that will be emptied of water and backfilled as part of the development. The survey drawings show the dam to be about 1 m deep from the existing ground surface level to the top of the water level at about RL 211.0 m AHD; the depth of water is unknown. The total depth of fill to be placed in the dam is expected to be more than 2 m (design final surface level of about RL 212.9 m AHD to RL 213.2 m AHD). No infrastructure is proposed to be constructed on the dam footprint.
- The base of the proposed stormwater detention pond/sediment basin in the northeast part of the site is at about RL 211.5 m AHD, about 1.0 m to 1.3 m below the surrounding finished hardstand surface level and about 0.5 m below the current surface level.
- Preliminary hardstand and pavement details for the BESS yard are shown on the preliminary civil drawings. The drawings indicate that fill materials required for the proposed bulk earthworks and hardstands/pavements will typically comprise imported select fill materials.



Figure 1: Aerial photo with the approximate Site boundary shown in red (nearmpas.com dated 19 July 2025)

3. Aims and method

The aims of the IGDA were as follows:

- Assess the likely subsurface conditions and groundwater level at the site based on available geotechnical information in the area.
- Provide preliminary comments and recommendations regarding the following:
 - Requirements for imported fill, including expected performance criteria for compaction and moisture control, and material description/characteristics to meet the civil design intent
 - Earthworks including excavatability, subgrade preparation, and fill placement.
 - Indicative bearing capacity for shallow foundations and comments and recommendations regarding potential footing types and settlement risk.
- Comment on data gaps in the information available.
- Comment on the key geotechnical risks associated with the proposed BESS development.
- A recommended scope for intrusive site investigation and development of the earthworks technical specification.

The IGDA is based on a desktop information review of publicly available geological maps and groundwater data near the site, in addition to relevant information available in our archives from nearby sites.

4. Review of information

4.1 Aerial imagery

We have reviewed available historical imagery¹ for the site from 1958 to present. Based on this review there appears to be no significant change in land use at the site during the period observed. However, there have been some development works near the site boundaries including the construction of Bulluss Drive to the west and the substation to the north since 1958. The substation appears to have been constructed between 1958 and 1977 based on a review of aerial imagery. Figure 2 shows an aerial image of the Site from 1958 with the approximate location of the site shown in red. The dam in the northwest part of the Site appears to have been constructed between 2002 and 2011 due to its absence in aerial imagery dated 11 July 2002.

¹ NSW Government, Historical Imagery,
<https://portal.spatial.nsw.gov.au/portal/apps/webappviewer/index.html?id=f7c215b873864d44bccddda8075238cb>



Figure 2: Historical aerial image of the Site (dated 22 June 1958) with the approximate location shown in red

4.2 Regional geology and previous investigations

According to published map data from the Geological Survey of New South Wales (GSNSW) 1:250,000 scale 'Moree' mapsheet, the regional surface geology at the site is Quaternary age Riverine Plain Deposits (Qrs) comprising black and red clayey silt, sand, and coarse gravel. An extract from this mapsheet is shown in Figure 3 with the approximate site location shown in red. According to the GSNSW 'Moree' mapsheet, the Riverine Plain Deposits are underlain by the Cretaceous age Rollings Downs Group which consists of claystone, siltstone and sandstone.

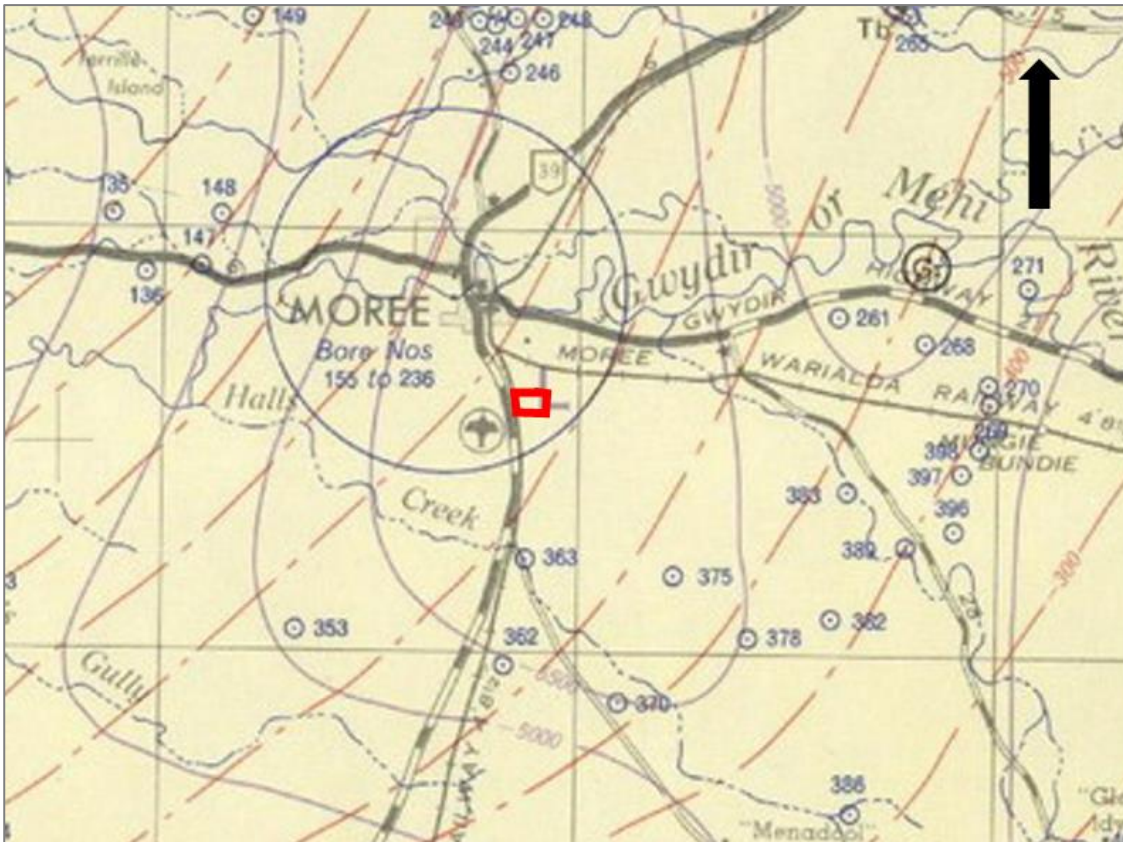


Figure 3: Regional Geology (extract of GSNSW "Moree" mapsheet) with the site location shown in red

A list of the reviewed relevant site investigations from within WSP archives and publicly available information is summarised below:

- WSP (2018) – Inland Rail Project: Site investigation along the rail corridor located about 300 m west of the Site. The investigation included test pits excavated to a depth of about 3 m.
- NSW Department of Commerce (2003) – Stanley Village: Investigation for a residential development located about 600 m northeast of the Site. The investigation consisted of 11 test pits up to 2 m deep and geotechnical laboratory testing.
- NSW Department of Commerce (2008) – Moree, ACDP Main Works Chester Street & Helensvale Avenue: Investigation for a residential development located about 800 m northwest of the Site. The investigation consisted of four test pits up to 3 m deep and geotechnical laboratory testing.
- Public Works Department of NSW (1992) – Moree Water Supply Augmentation: Investigation for a 3.5 ML steel water tank located about 1 km northwest of the site. The investigation consisted of four boreholes drilled to a maximum depth of 19.3 m.

In addition to the above, we have reviewed publicly available borehole data from monitoring wells installed in the area which offers some limited description of the ground conditions as described by the drillers. The monitoring wells reviewed were drilled up to a maximum depth of about 61.5 m and encountered a mixture of clay, sand and gravel over this depth. No material described as rock was encountered.

The general findings and potential risks that could broadly apply to the development Site based on the previous investigation information reviewed are outlined below:

- High plasticity clays: high plasticity clays, which range from firm to hard at various depths, were typically encountered in previous investigations nearby. The high plasticity (reactive) clays are susceptible to significant volume changes and fissuring due to moisture fluctuations.

- Alluvial soils: The presence of deep alluvial soils was a common feature of previous investigations. The alluvial soils are typically described as interbedded clay, sand and gravel. These layers may vary significantly in composition, consistency and density with depth.

Potential Risks:

- Shrink/swell movement: Due to the typical high plasticity of clay soils expected near the site, significant volume changes (shrink/swell movement) would be expected with moisture content fluctuations, leading to potential issues such as differential settlement or heave. The potential for shrink or swell movement of reactive clay soils is an important consideration for the proposed structures and infrastructure.
- Fissuring: Fissuring in clays (as encountered in one nearby investigation) could affect the stability of excavated batter slopes and retaining structures (noting only limited excavation is proposed as part of the development) and can lead to difficulties during construction of foundations and subgrade preparation for pavements.
- High swelling pressures: The clays may exert substantial swelling pressures, which could be exacerbated during wet conditions, potentially impacting the stability and performance of foundations and structures.
- Variable soil composition and consistency or density. There is the potential for variability in the engineering characteristics of the soils both laterally and with depth across the site, which may affect the development approach in different areas.
- Topsoil depth: There is limited information available about the topsoil thickness at the Site. The site investigation at Stanley Village encountered topsoil up to 0.3 m thick in some of the test pits. Topsoil would need to be removed as part of subgrade preparation for the proposed earthworks so the thickness of topsoil that is present will affect the depth of the topsoil strip and the volume of imported fill required (topsoil would not be suitable for reuse as engineered fill).

In summary, while the nearby investigations suggest a predominantly clayey profile (typically of at least stiff consistency) with potential for significant moisture-induced volume changes, it will be important to conduct a targeted geotechnical investigation at the Site to assess these conditions and respond to them in the design of the proposed development. Rock was not encountered in nearby investigations, which extended to depths of more than 60 m; therefore, it is unlikely that rock will be encountered during construction of the proposed development.

4.3 Groundwater

Groundwater levels in the vicinity of the site were reviewed using data obtained from the WaterNSW online database. The dataset included seven monitoring wells located within approximately 500 m of the site, with recorded groundwater depths ranging from 12.4 m to 15.7 m below ground level. On this basis it appears unlikely that development works would encounter groundwater. However, perched groundwater could potentially be encountered, for example near the dam in the northwest part of the site or following heavy rain or flood events.

4.4 Acid sulfate soils

Acid sulfate soils are natural sediments that contain metal sulfides (typically iron), commonly pyrite. They are common along the coast and when disturbed or exposed to air the sulfides oxidise and produce sulfuric acid, potentially damaging built structures and harming or killing animals and plants. Acid sulfate soils are found in parts of inland NSW under certain conditions but for the most part, are found in coastal areas that have an elevation lower than 5 m AHD (Australian Height Datum). Data from the NSW Government SEED online map shows that it is unlikely for acid sulfate soils to be present at the Site.

5. Preliminary Geotechnical Recommendations

The recommendations in the follow sections are preliminary and need to be updated once a site specific geotechnical investigation has been completed.

5.1 Likely subsurface profile

Based on available information and experience in the Moree area the likely subsurface profile comprises the following units:

- Fill or topsoil; overlying
- Riverine Plain Deposits predominantly comprising clay (likely highly reactive and of high plasticity), possibly interbedded with sands, silts and gravels.

No shallow rock is expected at the development Site.

The thickness and composition of topsoil and fill materials may vary across the site, depending on the impact of historical land use or other development activities. If existing fill materials are present they are expected to be uncontrolled, as they are not expected to have been placed in accordance with an engineering specification and with engineering controls on the selection, placement, moisture conditioning and compaction of the fill. Based on the available information, for preliminary purposes and based on a review of aerial imagery we have assumed that the depth of fill is likely to be shallow and limited to local areas such as bunds or mounds of excavated materials near the dam in the northwest part of the Site. Topsoil thickness reported at the Stanley Village site investigation was up to 0.3 m thick.

Organic materials such as grass and tree roots may also be present in the upper soil layers.

The available information suggests that the depth to groundwater is likely to be greater than 10 m. However, there could be the potential to encounter perched water, for example near the existing dam.

5.2 Site classification to AS2870

For the purpose of a preliminary site classification in accordance with AS2870 (2011) “Residential slabs and footings”, it has been assumed that a fill platform comprising engineered select fill materials of low reactivity and low permeability, ranging from about 0.6 m to 2.0 m thick, will be constructed over the natural clay (i.e. no uncontrolled fill is present at the time of development). Note that the standard footing design systems in AS2870 (2011) may not be applicable to the proposed structures, but preliminary information about the likely site classification has been provided as a guide to likely reactive soil issues.

In accordance with AS2870 (2011) a site classification of Class P is applicable to sites with fill to depths of greater than 0.4 m for clay and 0.8 m for sand. However, assuming the fill will comprise engineered, select fill placed directly over suitable natural subgrade materials in accordance with the recommendations in Section 5.4.2 and 5.4.3, the site can be reclassified based on the combined reactive potential of the engineered fill and the underlying natural soil condition beneath the engineered fill.

As discussed in Section 4.2, the natural clay soils at the Site are likely to be highly reactive. The depth of clay soils on the Site is not known. However, we expect that it could be more than 4 m based on the results of the borehole and test pit investigations nearby. For preliminary purposes we recommend adopting a site classification of Class H2-D (highly reactive) in general accordance with the guidance in AS 2870 (2011).

There is the potential for deep moisture changes (i.e. the “-D” appended to the site classification) noting that published information suggests that the Moree area is semi-arid with a Thornthwaite Moisture Index (TMI) of about -22.9². This TMI corresponds to a Climatic Zone of 4 per Table 2.5 of AS2870 (2011), and hence has a design depth of soil suction change (H_s) of 3 m. In accordance with AS2870.2.1.2, since H_s is greater than 3 m there is the potential for deep moisture changes.

The characteristic ground surface movement (y_s) for a Class H2 site is up to about 75 mm. However, it is important to note the preliminary nature of this classification and estimated movement, which should be reviewed following a targeted geotechnical investigation during design development. More than 75 mm of movement could occur if the clay soils are more reactive than assumed. The total surface movement will also depend on the depth and the reactivity of the select engineered

² Chan & Mostyn (2009) *Climatic Factors For AS2870 For New South Wales*, Australian Geomechanics Vol 44 No 2 June 2009, Section 5 Appendix .

fill materials used to construction BESS yard pad. By using low reactive, low permeability select engineered fill material it may be possible to decrease the amount of ground surface movement expected.

5.3 Bearing capacity and footing type

Based on the limited information available about the proposed development we have assumed that the design loads and settlement tolerance of the proposed BESS structures means they can be supported on shallow spread footings. This assumption should be reviewed once more information about the development is available and a geotechnical investigation has been undertaken.

For preliminary purposes we suggest the following assumptions are adopted for the proposed BESS structures:

- Potential shallow footing options include pad, strip or stiffened raft footings, founding on natural clay soils that are of at least stiff consistency (given the likely subsurface profile) or suitable engineered select fill materials placed directly over natural subgrade materials of at least stiff consistency.
- The technical specification for the bulk earthworks will need to be developed considering that the engineered select fill is expected to be a founding stratum for lightly loaded footings. Subgrade preparation and the placement and compaction of engineered fill will take place with Level 1 inspection and testing provided by a geotechnical inspection and testing authority (GITA) in accordance with the guidance in AS3798 (2007) “Guidelines on earthworks for commercial and residential developments.”
- Topsoil or uncontrolled fill materials are not suitable founding materials for structural footings. We assume that these materials, if present, would be removed and replaced with suitable engineered select fill materials as part of the earthworks for the development.
- Pad or strip footings, and the load bearing edge or internal beams of stiffened raft slabs founding on natural clay of at least stiff consistency or suitable engineered fill are proportioned based on a maximum allowable bearing capacity of 100 kPa.

The base of all footing excavations should be free of water and loose debris, water-softened or excessively dry materials at the time of footing construction. All footing excavations should be assessed by a suitably qualified geotechnical engineer to confirm that satisfactory founding materials are exposed and to assess construction practises such as base cleaning. Blinding of footing excavations once they are assessed can assist with limiting the potential for deterioration of the base due to wet or dry/hot conditions.

These preliminary assumptions must be reviewed once more information about the proposed development is available and a targeted geotechnical investigation has been undertaken. After this investigation, additional advice about other potential footing types such as piles or end-bearing bored piers can be provided, if required.

It will also be important to confirm that the strength and other geotechnical characteristics of the materials used as engineered fill are consistent with design assumptions regarding the fill. The GITA will need to prepare a completion report that confirms that the earthworks were carried out in accordance with the technical specification and there may also be a requirement for further investigation following the earthworks to confirm that the strength of the materials placed as engineered fill are consistent with the design assumptions. The potential impact of variable fill depth on differential settlement or footing movement should be reviewed as the design is developed and considering the as-constructed depth of fill as recorded by survey during the earthworks.

AS2870 (2011) should be referred to for guidance on footing construction and maintenance to reduce the potential for shrink-swell movement below shallow footings on reactive clay sites and for additional control measures that may be required to mitigate potential differential settlement issues across the interface between filled and natural ground areas.

5.4 Subgrade preparation and the selection and placement of engineered fill

5.4.1 General

Based on a review of the preliminary civil drawings we understand that between 0.6 m and 2.0 m of select engineered fill will be placed across the Site, following stripping of topsoil and subgrade preparation, to raise the BESS yard pad above flood levels and create a graded surface that will drain surface water. Based on the preliminary information available we have assumed that the fill materials for the earthworks will be imported to the Site, given there is limited cut proposed and the predominantly high plasticity natural clay soils at the Site are not expected to be suitable for use as engineered select fill. Topsoil and any existing uncontrolled fill materials at the Site are not suitable for use as engineered select fill.

Prior to the commencement of the earthworks, a technical specification should be prepared that considers the proposed future land use and the expected source(s) of imported fill. The preliminary comments in the following sections focus on the bulk earthworks and the typical requirements expected for the BESS earthworks, assuming the engineered fill materials are likely to support pavement/hardstand areas and lightly loaded footings. Further consideration should be given to requirements for specific areas such as the proposed stormwater retention basin as part of detailed design as there may be additional requirements relating to permeability and erosion protection in this area.

We recommend that subgrade preparation procedures, fill placement and compaction be continuously supervised by a GITA, and the compaction checked by field density testing. Tests should be performed in accordance with AS1289 'Methods of Testing Soils for Engineering Purposes'. AS3798 (2007) provides recommendations on the interpretation and application of relevant test methods specified in AS1289 and we recommend these be adopted. AS3798 (2007) should also be referred to for guidance on specifying, executing and controlling of the testing of the earthworks for this development.

Survey is as an integral part of earthworks and should be undertaken to record the extent and level of the prepared subgrade and the extent and thickness of the as-constructed engineered fill. Intermediate surveys may also be required to monitor compliance with the specified layer thickness requirements.

5.4.2 Subgrade preparation for earthworks

Subgrade conditions at the Site are expected to comprise highly reactive clay soils. We recommend that the procedure for preparing subgrade at the site as part of the bulk earthworks comprise the following:

- Strip to remove topsoil, soil containing organic matter (typically expected to be up to about 200 to 300 mm), tree roots, desiccated soils associated with the tree root zone, existing fill materials (if present) and sediment or other unsuitable materials that could be present at the base of the existing dam.
- Rip, moisture condition and recompact the stripped surface to a depth of at least 300 mm to achieve a dry density ratio (DDR) of not less than 98% of the maximum dry density for Standard compactive effort (SMDD), at a moisture content within 2% of the material's optimum moisture content for Standard compaction (SOMC).
- Any soft, weak or unstable areas exposed during this process which do not respond to further compaction or moisture conditioning should be excavated and replaced with select engineered fill which is placed in uniform layers not exceeding 200 mm loose thickness and compacted as described above.
- Following moisture conditioning and compaction of the exposed subgrade and the performance of a satisfactory proof roll assessment, place and compact select fill to form a protective capping layer over the prepared subgrade of a minimum thickness of 150 mm and then raise the surface to the design bulk earth works level in uniform layers. The select fill material should be of low permeability so as to restrict water ingress and softening of the subgrade materials and also to reduce the potential for them to dry out and crack.

5.4.3 Select fill requirements

For preliminary purposes we recommend that all select engineered fill materials used for the development are of relatively low permeability (due to their fine fraction) to reduce the potential for surface water infiltration that could affect the reactive clay subgrade materials, and of a predominantly granular nature to help improve bearing capacity and subgrade strength for footing and pavement or construction plant loads. Any select fill used should also be relatively stable to volume change with changes in moisture content. Suitable imported material types are expected to include predominantly granular materials such as non-descript crushed rock (NDCR), weathered siltstone or sandstone or clayey sand. The select fill should be well graded with a maximum particle size after compaction of 50 mm.

As a preliminary guide to the selection of select fill, we recommend the following requirements be adopted:

- Soaked California bearing ratio (CBR): $\geq 6\%$ (on samples remoulded to a target DDR of 98% the SMDD at the SOMC, soaked for 4 days with a 4.5 kg surcharge)
- CBR Swell: $\leq 1.5\%$
- Permeability: $\leq 5 \times 10^{-9}$ m/s
- Grading
 - % passing 75 mm: 100%
 - % passing 4.75 mm: 40-80%
 - % passing 0.075 mm: 10-40%
- Plasticity Index x % Passing 0.425 mm sieve (post construction): ≤ 1000
- Plasticity Index (post construction): 6 – 25%

There is the potential to review these requirements during detailed design considering the availability of potential sources of imported fill materials. The type of materials that are used will need to be considered in the eventual development on the fill materials.

All select fill used to raise the level of the site to the design level (fill placement) should be placed in uniform horizontal layers not exceeding 200 mm loose thickness and each layer compacted to achieve a minimum DDR of 98% of the SMDD. The moisture content of the minus 19 mm fraction should be within 2% of the SOMC.

The select fill materials used should also satisfy any assumptions made as part of the civil design with respect to surface runoff characteristics. Consideration should also be given to erosion protection for the finished fill surface.

5.4.4 Pavement design considerations

Based on the preliminary civil drawings it is expected that pavements and hardstands at the Site would be constructed over subgrade materials that comprise select engineered fill placed directly over suitable natural subgrade materials as part of earthworks in accordance with the above preliminary recommendations.

Assuming the select engineered fill materials have been placed in accordance with the above preliminary recommendations the requirement for further subgrade preparation at the time of pavement construction may be limited to assessment of a proof roll of the engineered fill materials at the design subgrade level, after excavation to this level. However, depending on the time between fill placement and pavement subgrade preparation there could also be a requirement to recompact and/or moisture condition the subgrade materials prior to pavement construction.

Based on the expected ground conditions we recommend adopting a preliminary design CBR value of 2% for design of pavements. It may be possible to increase the design CBR once a site investigation and laboratory testing has been undertaken and considering the thickness and geotechnical characteristics of the select engineered fill used to raise the ground surface level prior to pavement construction.

Given the natural subgrade materials are expected to comprise high plasticity clay there would usually be a requirement to place a capping layer of low permeability and low reactivity at least 150 mm thick above the reactive clay subgrade materials at the base of the pavement profile. However, assuming the select fill materials satisfy the preliminary requirements outlined in Section 5.4.3 above, given the thickness of select fill proposed to be placed as part of the bulk earthworks there would not typically be a need to place additional capping materials once the bulk earthworks are completed.

5.4.5 Other considerations for reactive clay subgrade

Trafficability on and workability of reactive clay is difficult when the clay is wet. It is preferable that earthworks be performed during drier periods at this site. The issues generally encountered during construction include:

- Poor workability.
- Difficult for construction equipment to traffic.
- Unable to meet stringent proof rolling criteria.
- Lack of the support required to achieve compaction in the lower pavement or engineered fill layers.

We recommend the following procedures are adopted to reduce potential deterioration of exposed subgrade surfaces:

- Limit the extent of subgrade areas opened prior to placement of additional fill or pavement construction.
- Avoid trafficking the exposed subgrade, particularly where the subgrade is wet.
- Consider the weather conditions and reduce the potential for exposed subgrade materials to be subject to heavy rainfall or surface water runoff.

Consideration could also potentially be given to lime and/or cement stabilisation of reactive clay subgrade materials if they are wet or to improve their geotechnical strength and reactivity characteristics. Field and laboratory trials would be required to assess stabilisation requirements.

Where highly reactive soils are present careful consideration needs to be given to issues such as drainage and landscaping near pavement, hardstand and shallow footing areas to reduce the potential for shrink/swell movement associated with changes in the soil moisture content. The service life of pavements on reactive clay subgrades may be increased if the following recommendations are implemented:

- Roads are designed with generous crossfalls or grades so that they are freely draining even after undergoing some permanent deformation.
- Subsurface drains for new pavements should be located within low permeability capping layer materials and should not extend into the expansive reactive clays.
- Drains are checked and cleared regularly.
- Cracks in pavements are quickly repaired.
- Trees are located at a clear distance of at least 1.5 times their mature height from roads.

Careful consideration should also be given to the approach for backfilling service trenches, as service trench backfill materials could provide a conduit for water infiltration into the reactive clay subgrade materials. We recommend that low permeability, low reactivity select fill materials are used as service trench backfill if they are located in areas where water infiltration and shrink/swell movement is a potential concern (including near structural footings).

5.5 Excavation conditions

For excavations to be undertaken as part of the proposed development, we expect the following:

- Excavations to typical depths for underground services, building footings and similar purposes are anticipated to reach a maximum depth of about 2 m.

- These excavations are expected to predominantly be in natural clay soils or engineered fill placed as part of the proposed bulk earthworks. We expect that standard mechanical earthworks machinery could be used for excavation to this depth in the expected subsurface materials.

Preliminary groundwater considerations for excavations are as follows:

- Based on the available information we would not typically expect groundwater to be encountered in excavations to a depth of about 2 m. However, there may be perched groundwater present at the site, for example near the existing dam.

5.6 Earthquake classification

According to the AS1170.4 (2024) hazard class maps, a site hazard factor (Z) of 0.08 should be adopted for the Moree area. Given the likely sub-surface profile (depth to rock greater than 60 m), the site sub-soil class for the Site assessed in accordance with AS1170.4 (2024) is likely to be either Class C_e – Shallow Soil or Class D_e – Deep or soft soil depending on the soil strength. For preliminary purposes we suggest adopting Class D_e. Targeted geotechnical investigation is required to assess the site sub-soil class for detailed design.

6. Geotechnical considerations and data gaps

Based on our desktop assessment, a key geotechnical data gap is the absence of a targeted intrusive investigation at the Site, to provide information about the subsurface conditions including the presence, depth and extent of fill, the engineering characteristics of the subsurface materials, and further information about the depth to groundwater. Refer to Section 7 for further comments on likely requirements for geotechnical investigation.

From a geotechnical perspective, the other main data gap relates to details about the proposed development such as the likely source(s) of engineered select fill materials to be used in bulk earthworks, and design loads and settlement/ground movement tolerance associated with proposed structures.

Key geotechnical considerations that may present risk to the proposed development include the following:

- Uncertainty about the thickness and extent of existing fill or topsoil at the Site.
- The approach to subgrade preparation and the selection and placement of engineered select fill. The availability of suitable engineered select fill materials for earthworks will also be an important geotechnical consideration.
- The potential for high plasticity (reactive) clay soils to be present.
- The suitability of natural soils and engineered fill (where relevant) as a founding stratum for proposed structures.
- Subgrade preparation requirements for access roads and hardstands on natural and engineered fill materials.
- Excavation conditions for underground service trenches and other excavations, and the thermal conductivity/resistivity of trench backfill and surrounding materials for transmission cables.

7. Indicative scope for geotechnical investigation

WSP has assumed that a targeted geotechnical investigation will be undertaken to support any future BESS development and to assess the subsurface conditions. The scope of future investigation is expected to include the following items:

- Assessment of the subsurface profile relevant to the proposed development, for example via the drilling of geotechnical boreholes (with in situ testing such as standard penetration tests in the boreholes), the performance of cone penetrometer tests, and/or the excavation of test pits.
- Assessment of the topsoil thickness as well as the presence, depth and nature of uncontrolled fill.

- A site walkover to assess the surface conditions including evidence for existing fill, or visible cracking at the surface that could indicate the presence of reactive clay soils. Assessment of the condition of the existing Moree substation and roads near the site could also provide an indication of the performance of similar structures and infrastructure in the subsurface conditions at the site.
- Assessment of the groundwater depth, based on measurements in monitoring standpipes to be installed as part of the geotechnical investigation.
- Field and laboratory electrical and thermal resistivity tests.
- Geotechnical laboratory testing, including particle size distribution, Atterberg limit and shrink-swell index tests to assess the engineering characteristics of the natural subsurface materials at the site. Laboratory CBR and associated compaction tests should also be undertaken for pavement design purposes.

It will also be important to develop a technical specification for bulk earthworks at the site, assuming that some structures or infrastructure may be supported on the fill. As noted earlier in this letter, the earthworks should take place with Level 1 inspection and testing by a GITA, as well as survey control, with completion reporting to provide confirmation that the earthworks were performed in accordance with the specified requirements.

Given the geotechnical investigation is expected to take place before the bulk earthworks, the specification should include requirements for laboratory classification and CBR testing so that information about the geotechnical characteristics of the select fill materials used that is relevant to future development activities is recorded during the earthworks. There is likely to be a requirement for supplementary investigation or construction phase assessments after the earthworks to provide confirmation that design assumptions relating to the strength of the as-constructed engineered fill materials have been met.

If requested, WSP could provide a proposal for geotechnical investigation to help develop the design for the proposed development.

8. Limitations

Your attention is drawn to the WSP Limitations Statement which is attached to this letter. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations WSP has under the contract between it and its client.

Please do not hesitate to contact the undersigned if you have any questions about the information presented in this letter.

Yours sincerely

WSP Australia Pty Ltd



Tom Dorrington
Associate Geotechnical Engineer



Stuart Colls
Technical Director

Encl: Limitation Statement



Limitation Statement: Geotechnical Site Investigation

SCOPE OF SERVICES

This geotechnical site assessment report (the report) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and WSP (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

RELIANCE ON DATA

In preparing the report, WSP has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, WSP has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. WSP will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

GEOTECHNICAL INVESTIGATION

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared to meet the specific needs of individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor or even some other consulting civil engineer. This report was prepared expressly for the client and expressly for purposes indicated by the client or his representative. Use by any other persons for any purpose, or by the client for a different purpose, might result in problems. The client should not use this report for other than its intended purpose without seeking additional geotechnical advice.

THIS GEOTECHNICAL REPORT IS BASED ON PROJECT-SPECIFIC FACTORS

This geotechnical engineering report is based on a subsurface investigation which was designed for project-specification factors, including the nature of any development, its size and configuration, the location of any development on the site and its orientation, and the location of access roads and parking areas. Unless further geotechnical advice is obtained this geotechnical engineering report cannot be used:

- when the nature of any proposed development is changed
- when the size, configuration location or orientation of any proposed development is modified.

This geotechnical engineering report cannot be applied to an adjacent site.

THE LIMITATIONS OF SITE INVESTIGATION

In making an assessment of a site from a limited number of boreholes or test pits there is the possibility that variations may occur between test locations. Site exploration identifies specific subsurface conditions only at those points from which samples have been taken. The risk that variations will not be detected can be reduced by increasing the frequency of test locations; however this often does not result in any overall cost savings for the project. The investigation program undertaken is a professional estimate of the scope of investigation required to provide a general profile of the subsurface conditions. The data derived from the site investigation program and subsequent laboratory testing are extrapolated across the site to form an inferred geological model and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite investigation the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

The borehole logs are the subjective interpretation of subsurface conditions at a particular location, made by trained personnel. The interpretation may be limited by the method of investigation, and can not always be definitive. For example, inspection of an excavation or test pit allows a greater area of the subsurface profile to be inspected than borehole investigation, however, such methods are limited by depth and site disturbance restrictions. In borehole investigation, the actual interface between materials may be more gradual or abrupt than a report indicates.



Limitation Statement: Geotechnical Site Investigation

SUBSURFACE CONDITIONS ARE TIME DEPENDENT

Subsurface conditions may be modified by changing natural forces or man-made influences. A geotechnical engineering report is based on conditions which existed at the time of subsurface exploration.

Construction operations at or adjacent to the site, and natural events such as floods, or groundwater fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

AVOID MISINTERPRETATION

A geotechnical engineer should be retained to work with other appropriate design professionals explaining relevant geotechnical findings and in reviewing the adequacy of their plans and specifications relative to geotechnical issues.

BORE/PROFILE LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final bore/profile logs are developed by geotechnical engineers based upon their interpretation of field logs and laboratory evaluation of field samples. Customarily, only the final bore/profile logs are included in geotechnical engineering reports. These logs should not under any circumstances be redrawn for inclusion in architectural or other design drawings. To minimise the likelihood of bore/profile log misinterpretation, contractors should be given access to the complete geotechnical engineering report prepared or authorised for their use. Providing the best available information to contractors helps prevent costly construction problems. For further information on this matter reference should be made to 'Guidelines for the Provision of Geotechnical Information in Construction Contracts' published by the Institution of Engineers Australia, National Headquarters, Canberra 1987.

GEOTECHNICAL INVOLVEMENT DURING CONSTRUCTION

During construction, excavation is frequently undertaken which exposes the actual subsurface conditions. For this reason geotechnical consultants should be retained through the construction stage, to identify variations if they are exposed and to conduct additional tests which may be required and to deal quickly with geotechnical problems if they arise.

REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the client and no other party. WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

OTHER LIMITATIONS

WSP will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.