Agricultural Land Utility Assessment

Yanco BESS

part 120 Houghton Road Yanco NSW (Lots 521 & 516/-/DP751745)

ACENERGY

Cadeema

DOCUMENT INFORMATION

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CONSULTANT INFORMATION

Cadeema - Soil, Water & Environmental Consulting

- A Shepparton based environmental consultancy servicing Victoria, NSW & South Australia
- An independent, science-driven company, Operating since 1996
- Ensuring Synergy between People, Productivity and Natural Resources
- Tertiary qualified staff with over 70 years of combined experience
- State-wide, big picture experience, but with a local community & site focus
- Specialising in:

Soil / Water Analysis	EMP	Renewable Energy	Agriculture
Contaminated Soil	LCA	Climate Challenges	Wastes
Wastewater	Groundwater	Water Modelling	Biosolids
Community Engagement	Soil Mapping	Soil Geotech	Horticultural
Environmental Monitoring (soil, surface water & groundwater, vegetation, air etc.)			EIS

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1 INTRODUCTION

ACEnergy propose to construct a 250 megawatt (MW) / 1100 MWh Battery Energy Storage System (BESS) and associated infrastructure including transmission and connection works on part of 120 Houghton Road Yanco (being 521/-/DP751745 and 516/-/DP751745 (‘*Lot 521*’ and ‘*Lot 516*’)). The total area of the property is approximately 357 ha and is located about 1.5 km southwest of the rural township of Yanco in New South Wales. Lot 521 and Lot 516 cover approximately 240 ha of the arable agricultural land on the property and the BESS would occupy approximately 8 ha across Lot 521 and Lot 516 (referred to herein as ‘*the site*’) with a total proposed development footprint of approximately 10.3 ha including, the access road and connection route outside of the subject land. Included in the appendices is the location of the property (*Appendix A - Locality Plan*) and a plan of the site (*Appendix B - Site Plan*) (*Image 1*). ACEnergy engaged Cadeema to undertake this Agricultural Land Utility Assessment to determine farm, district, and state impacts of the temporary reduction in useable arable agricultural land resulting from BESS development. In addition, the Assessment will also determine potential impacts to surrounding and district agricultural land use. The Assessment does not include consideration of land contamination, as that is covered in a separate Preliminary Site Investigation report. Details of the proposed BESS development have been compiled and provided by others.

Image 1: *The site in March 2024 consisted of open, irrigated, agricultural land containing canola stubble.*

2 METHODOLOGY

This Agricultural Land Utility Assessment involved the collection of relevant, publicly available environmental, land use and agricultural information such as site history and environmental features (vegetation, soil, surface water, groundwater etc) on and surrounding the site. Relevant environmental information was sourced from various NSW Government internet based databases including the central resource for sharing and enabling environmental data (Sharing & Enabling Environmental Data (SEED)) (SEED 2024). Information was gathered with the aim of assessing site agriculture viability and agricultural production potential to ascertain the agricultural resource and to determine, on a higher resolution scale than previously adopted, the Land and Soil Capability (LSC) (*Office of Environment and Heritage 2012*) status of the site. The site is zoned for primary production and is mapped as Draft State Significant Agricultural Land (SSAL) to promote agricultural production and environmental protection.

Cadeema conducted a series of interviews by phone in March 2024 with the current landowner, Pat Hulme. Two experienced soil, agricultural and environmental consultants undertook an investigation of the site on Wednesday 20th March 2024. The site inspection involved assessment of site biophysical characteristics including geology, landform, geomorphology, soils, vegetation (including remnant vegetation), hydrology (natural surface water occurrence and movement), drainage (soil profile and surface), topography, agricultural utility, irrigation utility, water supply, agricultural infrastructure, landscape context, climatic variables, hydrogeology and general pertinent features relating to agricultural use on and adjoining the site.

Soil physical characteristics across the site were documented and mapped by exposing the soil profile with a 100 mm diameter hand soil auger to depths of 40 to 80 cm below the surface. Numerous locations were assessed for soil physical characteristics and two representative locations were selected for soil sample collection for soil chemistry laboratory analysis. These two locations were identified as Sample 1 (S1) and as Sample 2 (S2). GPS coordinates for these soil sampling locations are provided in *Table 1* and the locations are demarcated in the appendices (*Appendix B - Site Plan*). Four soil samples (two surface soil and two subsoil samples) were analysed in a dedicated soil agronomic analysis laboratory (CSBP Laboratories in Perth (an ASPAC accredited laboratory)) for macronutrients (nitrogen, phosphorus, potassium and sulphur), micronutrients (copper, zinc, manganese, iron, boron and chloride), salinity (electrical conductivity ($EC_{1:5}$) and chloride), for pH ($pH(H_2O)_{1:5}$ and $pH(CaCl_2)$), organic carbon and for the exchangeable cations (calcium, magnesium, sodium, potassium and aluminium) facilitating determination of the cation exchange capacity (CEC), the calcium magnesium ratio (Ca:Mg) and soil sodicity with the exchangeable sodium percentage (ESP).

The collaboration and interpretation of this information was combined to determine and quantify the utility of the land for irrigated agricultural production. This information was correlated with existing LSC and SSAL mapping. This could then be compared with irrigated agricultural land utility and production in the Murrumbidgee Irrigation Area, the Murrumbidgee River catchment, in regional NSW and in the Murray Darling Basin. This facilitated quantification of potential agricultural production impacts to the farm, the irrigation district, and the State. In addition, an assessment has been made of the likely impacts and potential conflicts with surrounding land uses of the temporary removal of this land from irrigated agricultural production.

3 SITE FEATURES

3.1 Locality & Context

As detailed earlier, the site forms part of an approximately 357 ha property, parts of which sustain dryland and irrigated cropping production and grazing. The property consists predominately of laser levelled irrigation land, but also includes areas of remnant trees, agricultural shedding, laneways, channels and drains. An area consisting of remnant trees, agricultural shedding and the homestead is located approximately 300 m south of the site, and an area of remnant trees and agricultural shedding is also located approximately 350 m southwest of the site. Whilst some limited areas of the property are cleared, arable, agricultural dryland, approximately 330 ha of the property is arable, irrigable agricultural land. The property is located in a district dominated by dryland and irrigated agricultural and horticultural production including fodder, winter and summer cropping, and grazing. As detailed in the appendices (*Appendix A - Locality Plan*), the site borders open, cleared, irrigated grazing/cropping land to the west and south, Hulme Road to the east (adjacent to the Yanco Substation) and a channel running parallel to Houghton Road along the northern boundary of the site (*Image 2*).

Image 2: *Facing east along the northern boundary of the site with the water authority irrigation water distribution channel to the left, the site to the right and the planted native vegetation parallel to the eastern boundary fence line adjacent to the Yanco Substation in the background.*

3.2 Vegetation

There are no trees and no native or remnant vegetation on the site. As mentioned above, planted native trees are located parallel to the eastern fenced boundary of the site (*Image 3 and Image 4*). There are some weeds concentrated along the flood irrigation channel along the eastern boundary of the site. In recent times, land on the site and on irrigation areas to the west and south of the site have been utilised for rotational winter cropping and grazing. The site currently contains canola stubble and the landowner indicated he will continue a winter cropping rotation, most likely barley in winter 2024. Over a 30 year period, the landowner indicated he grew lucerne for half of that time and other summer and winter crops for the other half. The landowner also advised that historically the site may have been used for rice production in a minor way.

Image 3: *Facing south from the northeast corner of the site; eastern boundary fence line and planted native trees adjacent to the Yanco Substation (left); irrigation channel with floodgates and minor weed and couch grass coverage (foreground); canola stubble (right).*

Image 4: *Facing south along Hulme Road parallel to the eastern boundary of the site and adjacent to the Yanco Substation.*

The landscape is Older Terrace Riverine Floodplain which would have originally supported Riverine Plains Grassy Woodland which would naturally have consisted of Riverine Grassy Forest and Riverine Grassy Chenopod Woodland ecosystems, which includes Grey Box, Yellow Box and River Red Gum Forests, Black Box Woodlands, White Cypress Woodlands and Native Grasslands.

3.3 Climate

The climate of the Yanco area (*Bureau of Meteorology 2024*) is generally characterised by warm to hot summer temperatures ranging from 18 to 32°C and cool to mild winter temperatures averaging 5 to 15°C. Moderate rainfall occurs, falling fairly evenly throughout the autumn to spring months at approximately 36 to 38 mm/month and 32 mm/month in the summer months. The long-term average annual rainfall approximates 428 mm and average annual evaporation approximates 1,600 mm. Plant evapotranspiration typically significantly exceeds rainfall providing opportunity for irrigation. Based on long-term average climatic data, annual plant irrigation water requirements range from 3.0 to 4.0 ML/ha for winter pastures and crops, to 5.0 to 7.0 ML/ha for summer crops, to 9.0 to 11.0 for perennials such as lucerne and up to 14 ML/ha for rice.

3.4 Irrigation

Irrigation water for the property is accessed from multiple 25 ML (Megalitre) per day capacity automated ‘modernised’ irrigation outlets located around the property periphery. This water is accessed from adjoining Murrumbidgee Irrigation surface water supply channels and the property has the right and capacity to access surface irrigation water from this system. Whilst several of these outlets are in the vicinity of the site, the proposed BESS will not impede the operation of these assets. In addition, the property is also serviced by a deep aquifer irrigation bore located on the property and has the right and capacity to access groundwater from this system.

The landowner undertook land forming and associated earthworks for row cropping (flood) irrigation on the site in approximately 1994; this land forming involved both ‘cut’ and ‘fill’ earthworks along with ‘topsoiling’ (topsoil removal, subsoil laser levelling, and subsequent re-application of topsoil); no soil was imported onto the site as part of this land forming. Irrigation water from the above-mentioned sources can be distributed across the property through an earthen farm irrigation channel network. The site is bordered to the north and east by some of these earthen farm irrigation water supply channels. Irrigation water is distributed to formed irrigation bays in the paddocks via bay outlets (*Image 5, Image 6 and*

Image 7). It is assumed the site has a fall approximating 0.2 % (1:500) as this is typically the design slope for laser graded irrigation land in this district. The site has a dedicated excess surface water run-off capture and reuse system.


Image 5: *Water authority irrigation supply channel parallel to the northern boundary of the site and alongside Houghton Road (left); automated 'modernised' slide gate irrigation outlet adjacent to water authority channel enabling water to be released into the farm irrigation water distribution channel along the northern boundary of the site (right).*


Image 6: *The farm irrigation water distribution channel along the eastern boundary of the site (left) from which water is released into the irrigation bays for crop irrigation via bay outlets (right); Yanco Substation (background).*


Image 7: *Water authority irrigation supply channel parallel to eastern boundary of the site and Hulme Road adjacent to the Yanco Substation pictured in the background (left); irrigation outlet and culvert allowing water to be released from the water authority supply channel into the farm irrigation water distribution channel along the eastern boundary of the site (right).*

3.5 Land Use

As detailed earlier, the site consists of open, irrigable, land formed, agricultural cropping and grazing land (*Image 8*). The landowner indicated he took ownership of the land in the mid-1970s and observed that the land was irrigated periodically for approximately 30 years prior to that time, as he owned land in proximity to the property. The landowner advised that the property was historically utilised for sheep grazing and may have been used for rice production in a minor way. The landowner indicated that he had utilised the site for irrigated summer crops and winter crops over a 30 year period from ownership – and that lucerne was grown for half of that time and other summer and winter crops for the other half. However, the landowner has since moved away from irrigated summer cropping on the site given difficulties with establishing summer crops due to the hard setting soil, which is more difficult to establish crops in and subsequently produces lower yields by comparison with other areas of the property. The landowner advised that he currently carries out rotational winter cropping and grazing on the site, growing predominately winter crops (wheat, barley, and canola) which are occasionally 'shoulder' irrigated in autumn and spring. The landowner indicated that he would continue rotational winter cropping on and in the vicinity of the site (most likely barley in winter 2024) and subsequently in the vicinity of the site during the proposed BESS construction and operation. He did not indicate any plans for other future uses of the site or land in the vicinity of the site.

Image 8: *The site consists of open, irrigable, land formed, agricultural irrigated cropping and grazing land; this view looking east from the southwest corner of the site.*

3.6 Landscape, Topography & Drainage

The site and property are located in a relatively flat landscape originally consisting of flat terrain with subtle undulations typical of a Prior Stream Landscape, consisting of prior streams, near, mid and far floodplains, and swamps. Significant anthropogenic intervention over the past 150 years has altered the original landscape surface to facilitate road construction, access, irrigation water supply and drainage. As detailed previously, the site is predominantly flat but has a slight surface slope created through land forming to facilitate excess surface water drainage for agricultural production. Slightly higher elevation land occurs to the northeast of the site whilst lower elevation land occurs to the south of the site. It is not likely that excess surface water run-on would impact the site due to its location in the landscape and the existing water authority and farm irrigation water supply channels, the latter which occur adjacent to the northern and eastern boundaries of the site. Accumulations of excess surface water on the site would drain to the western boundary of the site and enter the aforementioned farm drainage system. The soil profile on the site is moderately to poorly drained however, site drainage is generally adequate as the site has adequate surface slope to facilitate acceptable surface water drainage.

3.7 Groundwater

A search of publicly available groundwater information indicated a number of groundwater monitoring bores and an irrigation bore in the vicinity of the site however, these did not have any recorded information on groundwater depth or quality and the status of the bores was generally unknown. The district and the landscape are known for sporadic, shallow (in the upper 20 m) aquifers (typically in shoe-string sands in the Lower Murray Shallow Alluvium) which can yield low volumes of variable quality groundwater. Historically, the district has been susceptible to shallow groundwater (1 to 4 metres below the natural surface) and associated water table induced salinity however, this was exacerbated by wet climatic conditions, poor surface water management and inefficient irrigation practices. Over the past 20 years the depth to shallow groundwater has increased (5 to 10 metres below the natural surface) and now rarely causes adverse impacts. The site is not generally susceptible to shallow water table induced salinity due to its moderate elevation position in the landscape. No evidence of shallow groundwater or salinity were evident on or adjoining the site and the landholder reports no evidence of salinity on or adjoining the site over the longer term.

In deeper (40 to 300 metre) aquifers, groundwater yield and quality are generally good with low salinity levels however, some aquifers can contain elevated salinity groundwater. As detailed earlier, the site has access to deep aquifer groundwater through an irrigation bore and this is likely to be extracting groundwater from the Calivil Formation (depths up to 140 m) or the Renmark Group, the latter overlying basement rock at depths between 140 m to 350 m.

3.8 Soils

3.8.1 <u>Geology</u>

The site is located in the Murray Darling Basin of south-eastern Australia and is founded on Cenozoic alluvial floodplain deposits which typically consist of alluvial riverine and lacustrine deposits influenced by intervening aeolian activity and consisting of poorly consolidated clay, silt, sand and gravel. Land to the northeast of the site is documented as consisting of Quaternary mixed colluvial, alluvial and aeolian deposits consisting of poorly consolidated sands.

3.8.2 <u>Taxonomy</u>

The SEED facility (SEED 2024) documents the site as consisting of the Great Soil Group *Red-brown Earths* and the Australian Soil Classification (ASC) (*Isbell 2021*) *Chromosols*. The Great Soil Group *Grey, Brown and Red Clays* and the Australian Soil Classification (ASC) (*Isbell 2021*) *Vertosols* occur to the west of the site. A detailed assessment of soil physical characteristics across the site was undertaken (refer to earlier section on Methodology) and this confirmed that the soils across the site consist of Red-Brown Earths (Great Soil Group) and are Chromosols (ASC). Chromosols and Red-Brown Earths are duplex soils with dominant red, orange or yellow colouring, particularly in the subsoils. The soils across the site consist of approximately 20 cm of light brown loam surface soil overlying dull to bright red-brown clay, medium clay subsoils (*Image 9*).

Image 9: *The soils on the site are classified as Chromosols and Red-Brown Earths which are duplex soils with red subsoil colouring.*

3.8.3 Physical Characteristics

The soil profile, which is relatively uniform across the site, consists of 20 cm of a light brown loam surface soil which is poorly structured, massive, moderately friable and is susceptible to slaking and crusting. This topsoil relatively abruptly grades into the clay dominant initial subsoil layer which consists of dull to bright red-brown medium clay. This subsoil is slightly friable and is well structured typically consisting of moderate to strong subangular blocky structure. Deeper subsoil layers (> 40cm depth) grade into grey-brown, light to medium clays with fine, subangular blocky structure and traces of natural lime (calcium carbonate). Lime content gradually increases down the soil profile and cannot be discerned in the surface soil or upper subsoil, but increases to 1 to 2% in the deeper subsoil below depths of 40 cm and consists of fine powdery deposits and nodules, the latter < 5 mm in diameter. Clay content is likely to approximate 25% in the surface soils and 45% in the subsoils (*Image 10*).

Image 10: *The soils on the site are duplex and consist of approximately 20 cm of light brown loam with a relatively abrupt change to dull to bright red-brown, medium clay subsoil layers.*

Soil profile drainage is moderate to poor with slow profile permeability. Typical effective agricultural crop root depths are likely to approximate 40 cm. Apart from limited soil profile drainage and a relatively tough structure, the soil profiles have no significant physical or chemical barriers to plant root penetration or water infiltration in the upper 1.0 m of the soil profile.

The soil surface consists of soil clods, peds and partially slaked peds and when not influenced by agricultural machinery (ploughing), is relatively flat and uniform. No evidence of gilgais were noted. The soil profile does not contain any rock with the exception of traces of small (< 5mm in diameter) natural lime (calcium carbonate) nodules at depths greater than 40cm. Bedrock would be at depths of greater than 100 m. The soils are not susceptible to perched watertables and are not susceptible to erosion.

3.8.4 Chemical Characteristics

As detailed earlier, two surface soil samples and two subsoil samples were collected from representative locations on the site. These samples were analysed for agronomic soil parameters and the results are provided in *Table 1*.

Table 1: *Surface soil and subsoil agronomic soil chemistry laboratory analysis results.*

SOIL ANALYSIS RESULTS		Soil Sample ID				Statistics		
Sampling Location		Sample 1		Sample 2				
GPS Coordinates		34°36'2.04"S 146°23'25.40"E		34°36'4.32"S 146°23'37.40"E				
	Horizon	Topsoil	Subsoil	Topsoil	Subsoil			
	Sample I.D.	S1 A1	S1 B1	S2 A1	S2 B1			
Parameter	Units					Min	Max	Average
Nitrate Nitrogen	mg/kg	159	21	113	13	13	159	76.5
Ammonium Nitrogen	mg/kg	6	2	5	3	2	6	4
Total Nitrogen	%	0.29	0.14	0.24	0.10	0.10	0.29	0.19
Olsen Phosphorus	mg/kg	54	10	42	2	2	54	27
Colwell Phosphorus	mg/kg	132	29	104	6	6	132	68
Total Phosphorus	mg/kg	579	236	501	159	159	579	369
Colwell Potassium	mg/kg	479	141	328	182	141	479	282.5
Skene Potassium	mg/kg	475	119	305	185	119	475	271
Sulphur (KCl 40)	mg/kg	27.7	6.1	23.5	9.3	6.1	27.7	16.7
Organic Carbon	%	2.4	0.8	1.7	0.4	0.4	2.4	1.3
Organic Matter	%	4.2	1.3	2.9	0.7	0.7	4.2	2.3
Salinity (EC - H_2O1:5)	dS/m	0.447	0.076	0.292	0.130	0.076	0.447	0.236
Chloride	mg/kg	54	14	50	20	14	54	34
pH ($CaCl_2$)	pH	5.3	5.3	5.5	6.6	5.3	6.6	5.7
pH (H_2O)	pH	5.8	6.2	5.9	7.8	5.8	7.8	6.4
Copper (DTPA)	mg/kg	1.5	2.3	1.8	2.1	1.5	2.3	1.9
Zinc (DTPA)	mg/kg	2.7	0.6	2.4	0.3	0.3	2.7	1.5
Manganese (DTPA)	mg/kg	24	12	43	11	11	43	23
Iron (DTPA)	mg/kg	115	140	90	27	27	140	93
Boron	mg/kg	1.2	0.7	0.9	2.4	0.7	2.4	1.3
Exchangeable Ca	meq/100g	10.0	5.8	8.0	10.5	5.8	10.5	8.6
Exchangeable Mg	meq/100g	2.5	2.2	2.5	10.5	2.2	10.5	4.4
Exchangeable K	meq/100g	1.1	0.3	0.7	0.5	0.3	1.1	0.7
Aluminium (Exch.)	mg/kg	0.032	0.047	0.024	0.042	0.024	0.047	0.03625
CEC -Cation Ex. Cap.	meq/100g	14	9	12	23	9	23	14
Ca:Mg Ratio	ratio	4.0	2.7	3.2	1.0	1.0	4.0	2.7
ESP - Exchng. Na %	%	1.4	2.6	3.0	7.9	1.4	7.9	3.7

Soil pH – The surface soil pH (pH(H_2O)$_{1:5}$) levels ranged from 5.8 to 5.9 which are moderately acidic but typical. Subsoil pH levels ranged from 6.2 to 7.8 which are slightly acidic to slightly alkaline but are also typical. Soil layers in these soil profiles typically gradually become more alkaline with depth.

Salinity & Chloride – Soil salinity levels, measured as EC (Electrical Conductivity ($EC_{1:5}$) and chloride), were low in the surface soils (EC = 0.29 - 0.45 dS/m; Cl = 50 - 54 mg/kg). Levels were lower in the subsoils (EC = 0.08 - 0.13 dS/m; Cl = 14 - 20 mg/kg). These levels are low which indicates that salinity is not currently a problem on this site.

Phosphorus – Soil phosphorus levels, measured as Olsen Plant Available Phosphorus (Olsen P), ranged from 42 to 54 mg/kg in the surface soils and from 2 to 10 mg/kg in the subsoils. Colwell and Total Phosphorus levels corresponded with Olsen Phosphorous levels. These soil phosphorus levels are moderate to high for agricultural production indicating regular historical phosphorus fertiliser applications. Levels are slightly higher than desirable in the subsoils. However, these soil phosphorus levels are typical of these soil types under this land use in this district and are not of concern.

Nitrogen – Nitrogen is a transient element and typically varies over crop growing season is in agricultural soils. Surface soil nitrate nitrogen levels were high (nitrate N = 113 - 159 mg/kg) and subsoil levels were significantly lower but slightly higher than desirable (nitrate N = 13 - 21 mg/kg). Surface soil ammonium nitrogen levels were at typical adequate levels (ammonium N = 13 - 21 mg/kg) and subsoil levels were low (ammonium N = 2 - 3 mg/kg). Total Nitrogen levels corresponded with these top these soil nitrogen levels are typical of nitrogen in an agricultural system and the higher levels are likely to be a result of recent, past, agricultural fertiliser applications.

Potassium - These soil types in this district typically inherently contain adequate levels of potassium. Soil potassium levels, measured as Skene Potassium (Skene K), were at good adequate levels in both the surface soils (305 to 475 mg/kg Skene K) and the subsoils (119 - 185 mg/kg Skene K). These levels are typical of these soil types in this district and provide sufficient potassium for agriculture.

Sulphur – The surface soils contain typical levels of sulphur (measured as Sulphur KCl 40) with higher levels recorded in the surface soils (24 - 28 mg/kg) and lower levels recorded in the subsoils (6 - 9 mg/kg. These levels are typical of these soil types under this land use and surface soil levels are likely to have been enhanced by past agricultural fertiliser and/or gypsum applications.

Cation Exchange Capacity - The cation exchange capacity (CEC) of these soils was adequate to good, reflects soil clay content and indicates a good capacity to retain nutrients. Levels in both the surface soils and the subsoils ranged from 9 to 23 meq/100g. These levels are typical and are not of concern.

Ca:Mg Ratio - The surface soil calcium/magnesium ratio (Ca:Mg) was adequate to good ranging from 3.2 to 4.0 which indicates sufficient soil calcium levels to help enhance and maintain soil structure. The subsoil Ca:Mg levels were low ranging from 1.0 to 2.7 which indicates low subsoil calcium levels which are typical of these soil types and which increases the susceptibility of the subsoils to poor structure.

Sodicity (ESP) - Soil sodium (sodicity) levels, measured as the exchangeable sodium percentage (ESP), were low in the surface soils with ESP levels ranging from 1 to 4. Subsoil sodicity ranged from low to slightly elevated with subsoil ESP levels ranging from 3 to 8. These levels are typical of these soil types under this land-use in this district and are far from excessive. Subsoil sodicity in these soil types can be elevated which can adversely impact soil structure. These levels are not of concern.

Organic Carbon - Soil organic carbon is an indicator of soil organic matter content and these results indicate typical, marginal to good soil organic matter levels. As is typical of surface soil organic carbon levels in agricultural soils, levels were higher in the surface soils (organic carbon = 1.7 to 2.4 %) and, as would be expected, levels were low in the subsoils (organic carbon = 0.4 to 0.8 %). These levels are typical and are not of concern.

Trace Elements - Based on the soil samples analysed, the results indicate that these soils have adequate to good copper and zinc levels), good and adequate manganese and iron levels, and adequate boron levels. Soil aluminium levels were low which is good. These results are typical of these soil types under this land-use in this district and are not of concern.

Summary - The soil chemistry analysis results indicate soils with chemical characteristics typical of these soil types under this land-use in this district. The surface soils were acidic which can adversely impact agricultural production. Soil salinity levels were low which is good. The soils had good and adequate macronutrient levels (nitrogen, phosphorus, potassium, and sulphur), adequate organic matter levels and typical and adequate micronutrient levels (copper, zinc, iron, manganese, and boron). The soils had low sodicity and adequate calcium in the surface soils however, calcium levels were low and sodicity slightly elevated in the subsoils. There is no record of acid sulphate soils on or in the vicinity of the site and the soils on the site are not susceptible to the development of acid sulphate conditions. These soil chemical characteristics a indicate good fertility for agricultural production however, the low soil organic matter levels, combined with slightly elevated sodicity and low soil calcium levels, make the soils are set will to soil structural decline and particularly slaking, hard setting and dispersion.

4 AGRICULTURAL UTILITY

4.1 Land & Soil Capability Classification

The NSW Government Office of Environment and Heritage utilises a land and soil capability (LSC) rating scheme for NSW (*Office of Environment and Heritage 2012*). This scheme considers the inherent land physical capacity to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources. The LSC assessment scheme uses land biophysical features such as landform position, slope gradient, drainage, and climate, along with soil characteristics which determine land and soil hazards such as erosion, soil structure decline, soil acidification, salinity, and waterlogging. Through assessment of each of these land features or hazards, the scheme assigns a rating between 1 (best, highest capability land) and 8 (worst, lowest capability land) with the final LSC class of the land based on the most limiting hazard. The LSC class provides an indication of land management practices that can be applied to the land without causing degradation to the land and environment on and adjoining the site. The aim of the scheme is to provide an indication of land use capability which can then tailor management aimed at the long-term sustainable use and management of land and soil resources (*Office of Environment and Heritage 2012*).

4.2 LSC Rating

Whilst predominantly undertaken on a broad scale, LSC assessment and mapping has been undertaken across the majority of NSW and is regularly updated and amended as higher resolution data becomes available and is incorporated (*Office of Environment and Heritage 2012*). The SEED facility (*SEED 2024*) documents the site as having a Land and Soil Capability of 6 which is described as having very severe limitations capable of sustaining low impact land uses such as grazing, forestry and nature conservation requiring careful management to prevent land and environmental degradation. It is likely that this area of land was mapped as LSC Class 6 based on the soil type (Red-Brown Earth / Chromosol - see earlier). An independent assessment of LSC undertaken by the authors as part of this assessment indicates that the site is LSC Class 6 with the main limitations being risks of soil structural decline (from dispersion, salinity, or slaking), limited soil surface and soil profile drainage, and waterlogging. The Office of Environment and Heritage (*2012*) specify that LSC Class 6 land has very severe limitations for a wide range of land uses and few management practices are available to overcome these limitations. They indicate that the land is generally only suitable for grazing and is not suitable for cultivation. Observations and discussions with the landholder indicate that whilst regular cultivation has historically occurred on the site, specialised practices are required to overcome soil structural decline and the associated hard setting of the surface soils. In addition, the soils are not well drained and this limits the effectiveness of irrigation. As a result, the landholder rarely irrigates the site, limits production to no-till, dryland, winter crops, and strives to minimise soil disturbance, retain perennial ground cover, and increase the low soil organic matter levels.

4.3 Estimated Inherent Soil Fertility

The NSW Government Office of Environment and Heritage also utilises a scheme to classify estimated inherent soil fertility across NSW. Estimated inherent soil fertility is described according to a five class system ranging through 1 (Low), 3 (Moderate) to 4 (High). SEED (*2024*) maps the site as having an Estimated Inherent Soil Fertility described as moderate (3); this is likely to be based on soil type. This confers with the limited agricultural suitability and productivity potential detailed above.

4.4 Agricultural Utility

Based on the information detailed in Sections 3 and 4 above, it can be concluded that the site has low to moderate agricultural suitability for grazing and limited (predominantly dryland) winter cropping. The site has low to moderate agricultural productivity potential. The site is suitable for dryland and opportunistically irrigated annual pastures, grain crops, fodder crops and field/row crops. The site is not suitable for high productivity agricultural uses and is generally not suitable for most horticultural fruit or vegetable crops. Irrigation of the site is limited by the availability and cost of irrigation water which mandates high yielding, high-quality agricultural production to be viable. Cultivation of the surface soils depletes soil organic matter and adversely impacts soil structure resulting in hard setting (*Image 11*). As a result, the landholder limits agricultural production to predominantly dryland winter cropping combined with practices aiming to increase soil organic matter and limit soil structural decline. The consultant's observations on-site, combined with the landholder's insights, indicate that the site has limited utility for high production, high-value, irrigated cropping.

Image 11: *The surface soils on the site are susceptible to hard setting which is exacerbated by cultivation which depletes soil organic matter adversely impacting soil structure.*

5 BESS AGRICULTURAL IMPACTS

5.1 Planning & SSAL

The land is currently zoned RU1 Primary Production, which is a rural zone primarily intended to promote agricultural production and environmental protection. Because the land is serviced by irrigation as part of the Murrumbidgee Irrigation Area, the site is designated as Draft State Significant Agricultural Land (SSAL). The NSW Department of Primary Industry (NSW DPI) is currently undertaking a project to identify, determine and map State Significant Agricultural Land (SSAL) (*NSW DPI 2021*) and SSAL is currently part of a draft land use planning policy proposed to identify higher quality agricultural land to inform appropriate land use, appropriate use of natural resources and regulatory authority strategic planning decision-making processes to improve planning outcomes for agriculture and bring clarity for producers, investors, developers and land regulators. This process is currently in draft stage, is subject to ongoing review and is currently in a high-level form unsuited to single or site-specific development assessment.

5.2 Impacts on Property Agriculture

The proposed BESS will encompass approximately 8 ha or 2.2% of the 357 ha property. According to the site owner and manager, agricultural production on the property is limited by the availability and cost of irrigation water and irrigated crop production is only undertaken when sufficient water is available and, based on the cost of sourcing and applying irrigation water, it is economically viable to do so. According to the landholder, the site constitutes some of the lower productive land on the property and land not particularly suited to high yielding, high value, irrigated crops. The landholder indicated that the 2.2% reduction in the area of land available for irrigated agricultural production will allow the irrigation water which could have been applied to this area to be applied to other more productive areas on the property. Rarely, if ever, is sufficient and cost-effective irrigation water available to effectively and viably crop, in both summer and winter, all land developed for irrigation on the property. As a result, the removal of the 8 ha of land from property agricultural production will not adversely impact property production, income or viability.

The proposed BESS is located in the northeastern extremity of the property and will not therefore adversely impact agricultural utilisation of the remaining areas of the property. BESS development will not segregate surrounding land in relation to access, irrigation viability, stock management or drainage.

According to the landholder, the reduction in the area available on the property for agricultural production through installation of the proposed BESS will not significantly decrease property income or agricultural enterprise viability. It is the landholder’s opinion that the regular, ongoing, long-term income provided through BESS installation will increase security of income as it is seen as an advantage to realise this type of income without increased costs (outgoings). In addition, the proposed BESS installation provides the opportunity to diversify revenue streams without investing more money into the property which assists long-term financial stability of the property.

5.3 Impacts on Adjoining Land

It is not likely that the change in land use from agriculture to the proposed BESS will have adverse impacts on land adjoining the site (*Image 12*). Land to the south and west of the site is part of the same property, is managed by the property owner, and is utilised for agricultural production. As detailed above, the proposed BESS would not adversely impact agricultural land use on these areas. Land to the north and east is utilised for access, traffic and for service easements including power supply, irrigation water supply and drainage infrastructure. The construction and ongoing operation of the proposed BESS is not anticipated to adversely impact options for land use on adjoining land. Adjoining land can continue to be utilised for existing land uses and/or could be utilised for a range of other land uses independent of the presence of the proposed BESS.

Image 12: *Land to the south of the site is more productive, irrigated agricultural land which will not be adversely impacted or segregated by the proposed BESS development.*

As part of the proposed BESS, we understand alternate options for connection routes to the power substation located approximately 125 m east of the site (and east of Hulme Road) are proposed including an underground or overhead option immediately east of the site and an underground or overhead option to the southeast of the site. The installation and operation of this infrastructure is not likely to adversely impact land use on or adjoining these two routes. However, care will be required, particularly during installation, to minimise disturbance to Hulme Road, existing irrigation water supply infrastructure, surface water drainage infrastructure and the aforementioned planted, native trees which adjoin Hulme Road. Where the underground option is adopted, the directional boring entry and exit points should be located outside tree protection zones and structural root zones to minimise adverse impacts on this existing vegetation.

5.4 Impacts on District Agriculture

The site is located in the Murrumbidgee Irrigation Area which provides irrigation and drainage services to the major townships of Griffith and Leeton, as well as over 3,000 agricultural landholdings comprising approximately 190,000 ha of irrigated farms. Irrigation water supply comes from the regulated Murrumbidgee River with two river offtakes – Berembed Weir and Gogeldrie Weir.

While the annual volumes of irrigation water utilised across the irrigation districts supplied from the Murrumbidgee River are significant, there is significantly more irrigation land available by comparison with the volume of irrigation water available to irrigate this land. This results in significant areas of irrigable, but un-irrigated ‘dryland’, which has access to irrigation water but does not utilise this water or practice irrigation. In years of limited water supply and increased water costs, this area of irrigable, but unirrigated dryland, increases. A significant proportion of this irrigable dryland with access to irrigation water consists of soils suitable for high productivity potential, high-value agriculture. It is water and not land that is currently limiting production in the region and this is likely to continue to be the case into the future in this region and in irrigation districts across the southern Murray Darling Basin. There is a significant area of available land with access to irrigation water which could be utilised for irrigated agricultural production but is not currently utilised due to a lack of irrigation water.

Where the land on the proposed BESS site is removed from irrigated agriculture production, irrigation water previously used on this land could readily be utilised on other land on the property, or elsewhere in the Murrumbidgee Irrigation Area. Agricultural production from the site could readily be achieved on other areas of available ‘dryland’ in the district which has access to irrigation water and which is not currently irrigated. Therefore, the actual loss to the district of agricultural production from BESS installation on the site is not a loss of current production levels or the potential irrigated agricultural production levels, rather, it is a loss of the equivalent value of dryland production.

The loss of agricultural production should therefore be considered to be equivalent to 8 ha of dryland agricultural cropping production. Because the agricultural crop suitability and productivity potential of the site is moderate to poor, the existing or potential agricultural production from this land is limited. Whether considered on an area (yield/ha) or a financial ($/ha) basis, this loss in agricultural production is small when considered across the Murrumbidgee Irrigation Area and is even smaller when considered across the wider southern Murray Darling Basin. It is therefore concluded that the loss in agricultural production is not significant and is not likely to impact the economy of the district.

6 SOIL IMPACTS & MITIGATION

6.1 Potential Impacts

Traffic and soil disturbance always has the potential to adversely impact soils in an agricultural setting such as this. Soil physical properties are most likely to be adversely impacted whilst soil chemical characteristics are only likely to be adversely impacted from mixing of soil layers which has the potential to relocate elevated salinity, pH and sodicity soils from lower to upper layers. It will therefore be important to minimise the mixing of soil layers and to target topsoil reinstatement where possible where excavation occurs. Adverse soil physical impacts may include traffic and infrastructure induced compaction, soil organic matter reduction and associated soil structural deterioration and/or erosion causing sediment mobilisation. It will be important to maintain and maximise vegetative cover where possible to help protect surface soil structure. It will also be important to minimise soil disturbance and excavation where practical. If topsoil excavation, stockpiling and re-use is proposed, minimising the disturbance of this topsoil material will help preserve soil structure. If topsoil is to be removed, topsoil should be reinstated if and when the land is to be converted back to agricultural production.

As detailed earlier, the soils on this site are susceptible to soil structural decline and it will be important to implement measures to minimise adverse impacts. General strategies should include maximising vegetative cover to protect the soil surface, employing practices which maintain/increase soil organic matter levels, minimising soil disturbance (working/ploughing surface soils, excavating and/or exposing subsoil layers), minimising traffic and infrastructure induced compaction where practical, and the implementation of surface water management measures to minimise the risk of the collection and concentration of mobile surface water which has the potential to mobilise sediment and cause erosion.

6.2 Mitigation Plans

It is recommended that a Construction Erosion and Sediment Control Plan (ESCP), in accordance with Landcom (2004), is compiled as part of the detailed design stage. In addition to the ESCP which covers construction, it is recommended that a Soil and Water Management Plan (SWMP) is also compiled in accordance with Landcom (2004) to cover site development, operation, and decommissioning. In addition to including all necessary measures from Landcom (2004), the ESCP and the SWMP should include and expand further upon the strategies and concepts detailed herein.

6.3 Mitigation Measures

As detailed above, a range of soil protection measures should be implemented in the planning, construction, operation and decommissioning of the site. Reference should be made to, and strategies should be included from, Landcom (*2004*). Soil protection measures can be expanded on and include more detail once detailed design is undertaken and as part of compilation of the ESCP and the SWMP. General soil management measures to minimise the risks of adverse impacts to soils on the site include:

- Minimise soil disturbance and excavation where possible
- Minimise mixing of soil layers where practical
- Retain and stockpile all disturbed or excavated soil
- Ameliorate any excavated and/or stockpiled soils in accordance with advice obtained from the NSW Soil Conservation Service
- Consider soil amelioration with gypsum prior to reinstatement and/or as part of decommissioning
- Return stockpiled soil to its original location (where possible) as soon as reasonably practicable
- Ensure topsoil and subsoils are stockpiled separately and returned in order
- Minimise overworking of the surface soils (*in-situ*, in excavation, stockpiling and reinstatement)
- Reinstate topsoil where possible where excavation occurs
- Minimise vehicular traffic induced compaction where practical
- Minimise stock compaction by excluding livestock during construction, minimising stocking rates and/or minimising the risk of stock coinciding with wet topsoil conditions
- Minimise infrastructure induced compaction where possible (spread loads etc)
- Maintain and maximise vegetative cover where possible to help protect surface soils
- Employ practices which maintain/increase soil organic matter levels such as maintaining grass cover where practical, minimising soil disturbance and the retention/incorporation of any cleared vegetation or organic matter as soon as reasonably practicable
- Avoid bare (fallow) soil surface where practical
- Whilst good weed control should be implemented, retention of less detrimental weeds may help maintain vegetal of cover and/or increase soil organic matter levels
- Minimise the exposure of subsoil layers particularly to rainfall/surface water run-off impacts
- Implement excess surface water controls to minimise collection/concentration of mobile surface water
- Implement practices to minimise sediment mobilisation and/or sediment capture
- Minimise site activities and soil disturbance during wet weather conditions where possible

- Regularly monitor soils for potential adverse impacts and if and when identified, implement appropriate mitigation or remediation actions
- Implement construction and/or site rehabilitation and revegetation in accordance with an appropriate landscape, revegetation or rehabilitation plan prepared by a suitably qualified professional
- Ensure rehabilitation is undertaken progressively to minimise the total disturbance area at any one time
- Prepare an appropriate decommissioning management plan which aims to minimise adverse soil impacts and aims to return the site to preconstruction land and soil capability (or better)
- The decommissioning management plan should determine soil conditions prior to decommissioning to ensure any existing soil conditions and/or adverse impacts, which may have changed/developed throughout the life of the development, are catered for.

7 CONCLUSIONS

This Agricultural Land Utility Assessment of the 8 ha site indicates that conversion of the site from the existing winter cropping production to a BESS will not result in a significant loss in agricultural production when considered across the 357 ha property, the Murrumbidgee Irrigation Area, the local region, or across the southern Murray Darling Basin (*Image 13*). This conclusion is based on the limited agricultural suitability and productivity potential of the site, and on the fact that irrigation water potentially used on the site can readily be utilised on other areas of the property or other irrigation land in the region. Because there is significantly more irrigation land available for irrigation in the Murrumbidgee Irrigation Area by comparison with the volume of irrigation water available to sustain economic irrigated agricultural enterprises across this land, the loss in agricultural production is equivalent to the loss of 8 ha of low productivity dryland agricultural production. It is therefore concluded that the temporary removal of agricultural production from the site will not have significant adverse impacts on agricultural production or land use on the property, in the district, or in the wider region.

Image 13: *Conversion of the site from irrigated agricultural production to the proposed BESS is not likely to significantly reduce agricultural production by comparison with that from the property and from the district.*

8 REFERENCES

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9 APPENDICES

9.1 Appendix A - Locality Plan

Image sourced from Google Earth 2024.

9.2 Appendix B - Site Plan

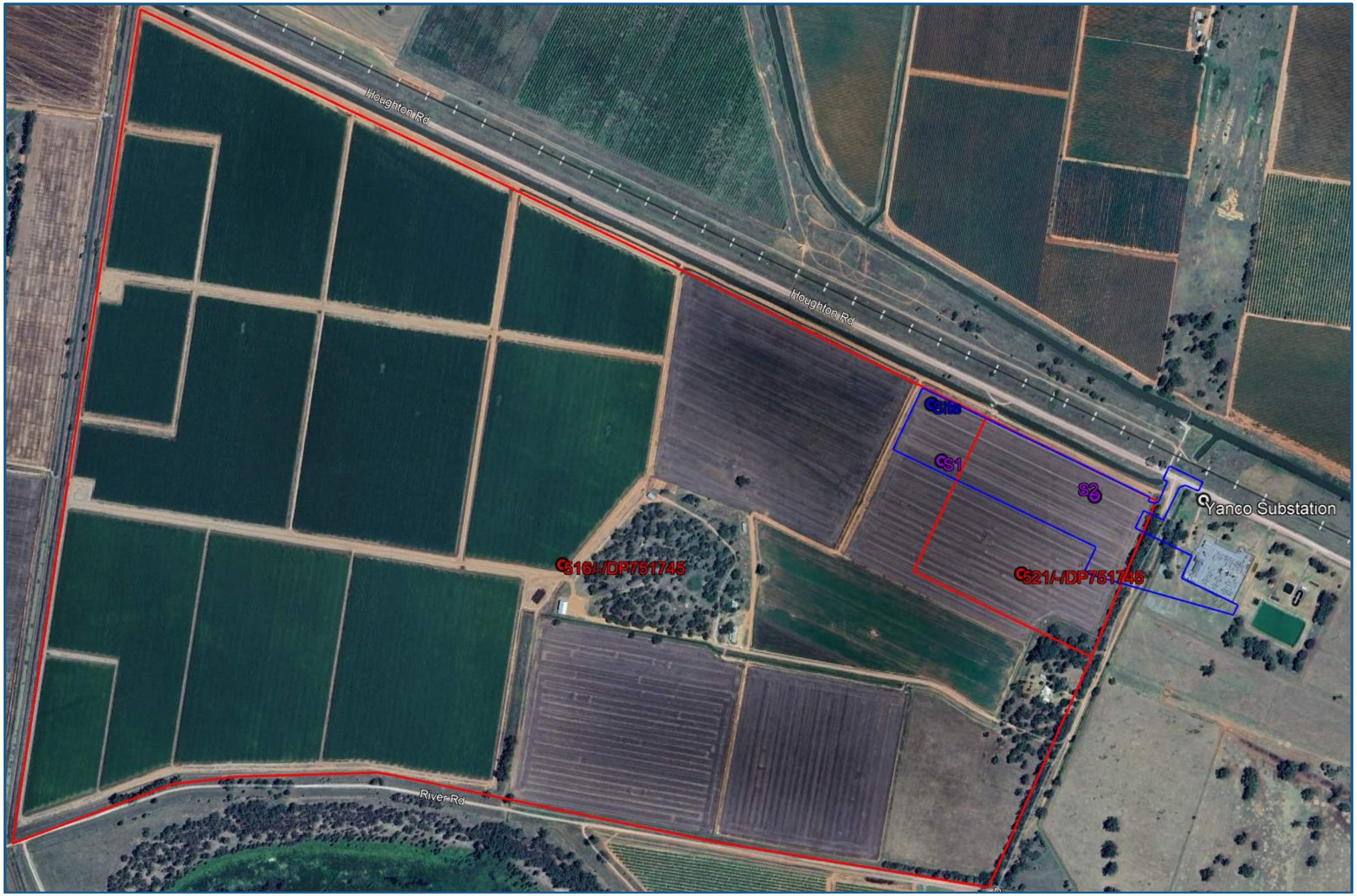

Image sourced from Google Earth 2024.