APPENDIX H SOIL SURVEY REPORT

SOIL SURVEY REPORT

TARLEIGH PARK SOLAR FARM

July 2017

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SOIL SURVEY REPORT
TARLEIGH PARK SOLAR FARM

July 2017

Project brief

At the request of Raphael Morgan of NGH Environmental Pty Ltd, soil sampling, analysis and reporting was carried out to assess the site on 26 July 2017. The document provides information about the site and soil conditions from field observations and laboratory analysis.

Site identification

Address: Parfreys Road, Blighty NSW 2710
Real property description: Lot 88 DP756339
Centre co-ordinate: 338893 6058270 MGA GDA z55
Property size: approx. 250ha
Owner: c/o NGH Environmental Pty Ltd
Local Council Area: Edward River Council
Present use: Agriculture
Development Application Reference: not known
Report identification: 4592-Tarleigh Park

Certification

Name	Signed	Date	Revision Number
David McMahon BAppSc GradDip WRM ASSSI		31/08/17	1

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1.0 Introduction

The report presents the results of a soil survey carried out by DM McMahon Pty Ltd (McMahon) for the proposed Tarleigh Park Solar Farm near Blighty, NSW.

The soil and land survey work was commissioned by Raphael Morgan of NGH Environmental Pty Ltd and was undertaken in general accordance with an email dated 23 June 2017. The survey was carried out utilising an excavator to excavate soil pits for evaluation to a depth of approximately 1.5m. Alex Rudd of DM McMahon Pty Ltd conducted a free soil survey on 26th July 2017 using standard soil surveying techniques. Sampling and classification of in situ soils was carried out as per the Australian Soil and Land Survey Field Handbook (2009) and The Australian Soil Classification (Isbell, 1996). Density of investigation pits was determined via Guidelines for Surveying Soil and Land Resources (2008) where selection of a 'Moderately High (Detailed)' intensity level was deemed appropriate for satisfying the objectives for detailed project planning.

2.0 Site Characteristics

A brief desktop review and investigation of the topography, hydrology, soil, lithology, geology and hydrogeology of the site has been undertaken and are as follows:

2.1 Topography

The Blighty 1:50,000 Topographic map sheet (7926-N) indicates that the site is located at an elevation of approximately 98m AHD. The site slope is classed as level and the landform is a flat.

2.2 Vegetation

The site is used for agricultural production, predominantly irrigated cropping with improved pastures. Remnant vegetation consists of eucalypt communities of Grey Box. A more detailed assessment of vegetation present can be seen in NGH Environmental scoping report.

2.3 Weather

The mean rainfall for Deniliquin is approximately 375mm per annum, with the wettest months being September, October and November. Annual mean evapotranspiration range is 400-500mm. Annual pan evaporation range is 1600-1800mm. Deniliquin is characterised by cold wet winters and hot dry summers with mean maximum temperatures ranging from 14.2 ºC in July to 33.1 ºC in January and mean minimum temperatures ranging from 3.4 ºC in July to 16.6 ºC in January. Historical records obtained from years 1997 to current, Deniliquin Airport AWS 074258 (www.bom.gov.au).

2.4 Hydrology

The site is located on plains in the Murray River system catchment area. Natural watercourses have been extensively modified and altered with the introduction of irrigation and drainage channels. These channels include gravity-fed irrigation channels managed by

Murray Irrigation Limited and privately constructed irrigation and drainage channels. Run-off of surface waters from precipitation is unlikely, this can be attributed to the construction of flood irrigation banks on relatively impermeable vertosols.

2.5 Soil & Landform

The site encompasses two soil landscapes coded **wal** and **clo** from the Soil and Land Resources of Central and Eastern NSW (OEH, 2017). A brief description of the soil landscapes are as follows:

wal – Wait-A-While – Stagnant Alluvial	
Landscape	Broad level plain on alluvium, comprising the easternmost of the three extensive Riverine plains soil landscapes; to the west, with decreasing rainfall, grades into Jerilderie (jex) soil landscape. Slopes <1%, local relief <9m, elevation 90-180m. Includes sparse narrow linear drainage lines. Gilgais occur locally.
Soils:	Red and Brown Sub-plastic Chromosols and Sodosols (Red-brown Earths/transitional Red-brown Earths), with less common Reddish Brown Chromosol/Vertosols (transitional Red-brown Earths/Brown Podzolic soils) and Grey and Brown Self Mulching and Epipedal Vertosols (Cracking Grey and Brown Clays).
Geology and Regolith:	Cainozoic/Quaternary Alluvium of the Shepparton formation (Czsws) on the Riverine Plains. Parent materials include clays, silts and sands from various past flow regimes of the Murray and Murrumbidgee Rivers and their associated palaeochannels.
clo – Colleambally - Aeolian	
Landscape:	Undulating sandplain derived from reworked alluvium. Sand Ridges and swales. Prior stream aeolian infills. Slopes 1-5%, local relief <5m, elevation 70-140m. Extensively cleared box-cypress grassy woodland.
Soils:	Arenic Rudosols (Siliceous Sands) dominate this unit, occasionally grading to Red Kandosols (Red Earths). Adjacent levees/lower slopes commonly support scalded Red and Brown Sodosols (Solodic Soils/Re/Brown Earths). Occasionally confined within the unit are low lying channels containing Grey and Brown Vertosols (cracking clays).
Geology and Regolith:	Reworked materials from unnamed Cainozoic Alluvium (Cza). Thermoluminescence Dating (Page et al. 1996) estimated the ages of prior streams and these ridges – the streams were active during periods 30-100 thousand years ago; the ridges were therefore formed after.

The site lies within the mapping unit **Oc3** from the Digital Atlas of Australian Soils (CSIRO, 1991). The map unit **Oc3** is described as:

"Oc3"

"Plains with domes, lunettes, and swampy depressions, and divided by continuous or discontinuous low river ridges associated with prior stream systems--the whole traversed by present stream valleys; layered soil or sedimentary materials common at fairly shallow depths: chief soils are hard alkaline red soils (Dr2.33), grey and brown cracking clays, commonly (Ug5.24) and (Ug5.35), and other (D) soils in a complex soil pattern with the following general features: (i) well-drained to moderately drained plains of (Dr2.33) with (Db1.33 and Db1.43), often with thin A horizons (<4 in. thick); (ii) moderately to poorly drained gilgai plains subject to some seasonal flooding of (Ug5.3), (Dr2.33), (Db1.43), (Dy2.33 and Dy2.43), and (Ug5.2) soils; (iii) poorly drained gilgai plains subject to frequent seasonal flooding of (Ug5.2), (Ug5.3), (Db1.43), (Dy2.43), (Dd1.33 and Dd1.43), and (Ug5.4) soils; (iv) swampy depressions of (Dd1.33 and Dd1.43), (Db1.43), (Dy2.43), (Dy3.43), and (Ug5) soils; (v) domes and/or lu.

2.6 Lithology and Geology

The site geology is distributed over one unit: Unconsolidated Quaternary alluvium.

2.7 Hydrogeology

From the Geoscience Australia hydrogeology dataset, the groundwaters beneath the site are described as porous extensive aquifers of low to moderate productivity.

3.0 Geotechnical Investigation Scope of Works

The specifications for the geotechnical investigation and soil survey are as follows:

Table 1: Scope of Works

Item	Description	Description
1.	Where available, review plans and other general related documents provided to us to gain a comprehensive understanding of the proposed project.	-
2.	Undertake a desktop study of local landform, geological, lithological & hydrogeological conditions.	-
3.	Conduct Dial Before You Dig search	-
4.	Carry out field investigations by reference to Guidelines for Surveying Soil and Land Resources (2008) & AS1726:1993 Geotechnical Site Investigations.	9 pits in total. Samples of topsoils, B, B/C and C horizons taken where present in order to adequately classify soils as per ASC 1996.
5.	Analyse soils in situ and at our NATA accredited laboratory to AS/RMS methods.	3 x Representative samples for topsoil analysis – NPKS, CEC, pH, EC & OC 27 x Representative samples for subsoil analysis – pH, EC, dispersion
6.	Generate laboratory reports and review results.	-
7.	Compile results in report detailing methodology, desktop study, physical conditions, field work results, test locations, bore logs, in-situ test results, laboratory results and discussion.	-
8.	Recommendations for erosion control and prevention measures and management recommendations for earthworks.	-

As follows is a map of the investigated site and investigation pit locations.

Figure 1: Soil survey investigation pit locations.

4.0 Results

4.1 Field Survey

A free soil survey was conducted using standard soil surveying techniques. Sampling and classification of in situ soils was carried out as per the Australian Soil and Land Survey Field Handbook (2009) and The Australian Soil Classification (Isbell, 1996). Density of investigation pits was determined via Guidelines for Surveying Soil and Land Resources (2008) where selection of a 'Moderately High (Detailed)' intensity level was deemed appropriate for satisfying the objectives for detailed project planning. Soils encountered were typical of the locale, generally falling into reconnaissance survey classes. Slight variations in profiles exist due to remnant channels and the complex soil sequences that are associated with such. Soil moisture contents varied considerably between soil types but were generally found to be moderately moist to wet at depth. Free groundwater was not encountered to the investigated depths.

4.2 Typical Soil Profiles

Soils can be classified into two typical soil profiles across the site as per the Australian Soil Classification system (Isbell, 1996). Representative photographs from profiles examined on site can be seen below with a brief description of the profile characteristics. All soil pits investigated were located on managed agricultural lands. Field soil log sheets can be seen attached.

4.2.3 Vertosols

Soils with shrink swell properties that exhibit strong cracking upon wetting and drying cycles, typically having a field texture containing 35% or more clay content throughout the solum. Strong cracking can occur at depth, extending to the surface or a confining pan, or from the surface to final depth of the self-mulching layer. Vertosols present on site were either **Brown or Black Epipedal or Self-Mulching Vertosols.** Slickensides and/or Gilgai micro-relief were not observed during the investigation. It should be noted that due to the moisture content of the profile at depth, smearing of the pit sidewalls can mask the presence of slickensides that would otherwise be evident. Also, any alteration of self-mulching clays to favour flood irrigation and rice production would temporarily mask evidence of micro-relief at the surface level. Figures 2 and 3.

Figure 2: *Brown Epipedal Vertosol*

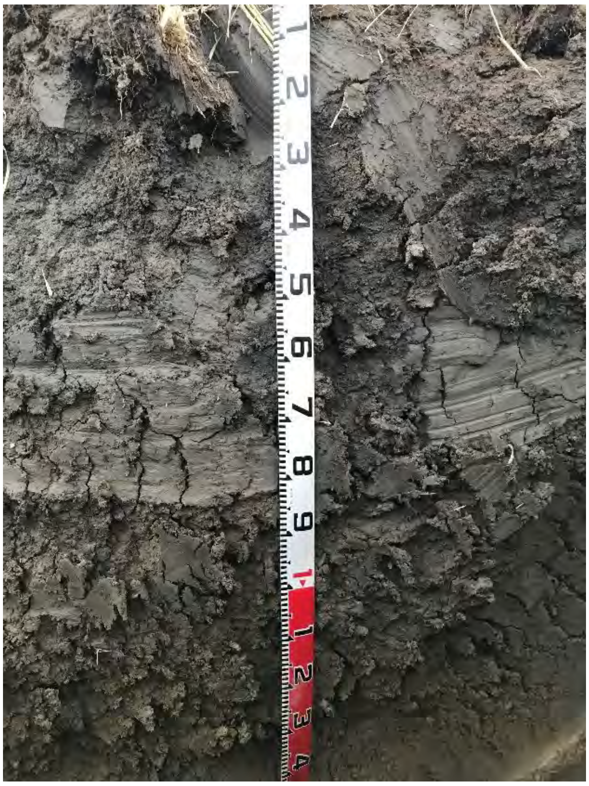

Figure 3: *Black Self-Mulching Vertosol*

4.4 Laboratory Analysis

Three representative topsoil samples were obtained and analysed at a NATA accredited laboratory for the establishment of baseline soil data that may be referred to and used in preparation of a site decommissioning plan. Laboratory COA's can be found in the attachments and soil parameters can be seen summarised in table 2. 8 subsoil samples were also analysed for pH, EC and 27 samples tested for dispersion (table 3).

4.4.1 Topsoil Analysis

4.4.1.1 pH & Electrical Conductivity

Topsoil pH ranged from 4.2 to 6.2 and can be classed as 'Very Strongly Acid' to 'Slightly Acid' respectively (Bruce & Rayment, 1982). Electrical conductivity (EC) ranged from 700 – 1500µS/cm and are rated 'non-saline' to 'slightly saline' (Richards, 1954).

4.4.1.2 Cation Exchange Capacity & Exchangeable Sodium Percentage

Cation Exchange Capacity (CEC) ranges from 7.5 to 19.2cmol(+)/kg. CEC of the soils is rated by Metson, (1961) from low (6-12) to moderate (12-25). Exchangeable Sodium Percentage (ESP) ranges from 1.3 to 2.7% which is given a sodicity rating of 'non-sodic' (0-6) Hazelton & Murphy, 2007.

4.4.1.3 Colwell Phosphorus and Phosphorus Buffering Index

Colwell P is generally high (>35mg/kg). Phosphorus Buffering Index (PBI) ranged from 41 to 200 and is classed from 'very low' to 'moderate' (Burkitt *et al*., 2002).

4.4.1.4 Calcium:Magnesium Ratio

Ca:Mg ratio should be at least 2:1. Higher calcium contents are ok however higher magnesium content may result in soil dispersion. Ca:Mg determined for topsoils returned results ranging from 1.2 to 1.8, indicating that there is low potential for dispersion of topsoils upon wetting.

4.4.2 Subsoil Analysis

4.4.2.1 pH & Electrical Conductivity

Subsoil pH ranged from 7.6 to 8.8 and can be classed as 'Mildly Alkaline' to 'Strongly Alkaline' (Bruce & Rayment, 1982). EC ranged from 700 - 1500µS/cm and are rated as 'non-saline' (Richards, 1954).

4.4.2.2 Dispersion

Field determination of dispersion indicated that the majority of soils are unlikely to be sodic. (Hazelton & Murphy, 2007).

5.0 Summary of Test Results

Table 2: Topsoils - Results of laboratory testing.

Pit/Sample	Horizon	pH (1:5 Water)	pH (1:5 CaCl2)	Electrical Conductivity	Chloride	Organic Carbon	Organic Matter	Nitrate Nitrogen	Ammonium Nitrogen	Colwell P	PBI	Sulphur – KCl40	CEC	Calcium	Magnesium	Sodium	Potassium	Available Potassium	Aluminium	Aluminium % of Cations	Calcium % of Cations	Magnesium % of Cations	Sodium % of Cations	Potassium % of Cations	Ca/Mg Ratio
Units	-	-	-	**µS/cm**	**mg/kg**	**%**	**%**	**mg/kg**	**mg/kg**	**mg/kg**	-	**mg/kg**	**cmol(+)/kg**	**cmol(+)/kg**	**cmol(+)/kg**	**cmol(+)/kg**	**cmol(+)/kg**	**mg/kg**	**Cmol(+)/kg**	**%**	**%**	**%**	**%**	**%**	-
29/1	A	5.2	4.2	700	24	1.5	2.6	8	2	55	200	8	9.4	3.7	3.2	0.25	0.94	370	1.3	14.0	40.0	34.0	2.60	10	1.2
32/1	A	6.3	5.4	1000	25	1.0	1.7	16	21	73	41	11	7.5	4.2	2.3	0.18	0.77	300	<0.1	<1.0	56.0	31.0	2.40	10	1.8
33/1	A	6.8	6.2	1500	27	2.1	3.6	26	2	93	83	5	19.2	11.0	6.1	0.25	2.10	810	<0.1	<1.0	57.0	32.0	1.30	11	1.8

Table 3: Topsoil/Subsoils - Results of laboratory testing.

Pit/Sample	Horizon	pH (CaCl2)	Electrical Conductivity	Dispersion	Pit/Sample	Horizon	pH (CaCl2)	Electrical Conductivity	Dispersion	Pit/Sample	Horizon	pH (CaCl2)	Electrical Conductivity	Dispersion
Units	-	-	**µS/cm**	-	**Units**	-	-	**µS/cm**	-	**Units**	-	-	**µS/cm**	-
27/1	A	-	-	N	30/1	A	-	-	N	33/1	A	6.2	1500	N
27/2	B	8.8	360	N	30/2	B	-	-	N	33/2	B	-	-	N
27/3	C	8.5	551	N	30/3	B	-	-	P	33/3	B	-	-	N
28/1	A	-	-	N	31/1	A	-	-	N	34/1	A	-	-	N
28/2	B	-	-	N	31/2	B	-	-	N	34/2	B	-	-	N
28/3	B	-	-	N	31/3	C	-	-	N	34/3	B/C	-	-	N
29/1	A	4.2	700	N	32/1	A	5.4	1000	N	35/1	A	-	-	N
29/2	B	7.6	142	N	32/2	B	7.8	138	N	35/2	B	8.4	501	N
29/3	B	8.8	363	N	32/3	B	8.5	240	N	35/3	B/C	8.5	726	N

- *Dispersion testing results were rated N, P or C being Nil, Partial or Complete dispersion.*

6.0 Comments and Recommendations

The discussion and recommendations provided below are based on field observations and testing at discrete locations.

6.1 Potential Limitations

Potential landscape limitations have been summarised in table 4 below.

Table 4: Potential landscape limitation assessment

Soil Type	Erosion Hazard	Salinity Risk	Acid Soil	Waterlogging Risk	Acid Sulfate Soils	Infrastructure
Vertosol	LOW	LOW	NO	HIGH	NO	MODERATE

As follows (figures 6 & 7) is the soil landscape map (OEH, 2017) that has been generally validated by the soil survey through laboratory and field techniques. As such, management practices can be grouped into management classes of either soil landscape units or Australian Soil Classification units. This report identifies management practices for ASC units in section 6.5 below.

Figure 4: Colleambally and Wait-A-While Soil Landscape Map with site overlay.

6.2 Erosion Control

In order to mitigate the occurrence of erosion the following primary principles should be adhered to, particularly throughout the construction period of the project. Best Management Practices (BMP's) should be employed where applicable to further reduce the risk of potential erosion and sediment control.

- Integrate project design with any site constraints.
- Preserve and stabilise drainageways.
- Minimise the extent and duration of disturbance.
- Control stormwater flows onto, through and from the site in stable drainage structures.
- Install perimeter controls.
- Stabilise disturbed areas promptly.
- Protect steep slopes.
- Employ the use of sediment control measures to prevent off and on-site damage.
- Protect inlets, storm drain outlets and culverts.
- Provide access and general construction controls.
- Inspect and maintain sediment and erosion control measures regularly.

The risk of erosion on site due to construction activities is considered low due to the very low relief and generally low salinity and sodicity of topsoils and subsoils. Excavation of subsoils should be limited where possible, and excavated subsoils should be stockpiled and contained to avoid potential dispersion and sediment transfer. Ground cover around the structures should be maintained where possible. Maintenance of ground cover will also aid in the prevention of topsoil losses from wind erosion.

Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Volume 2A & 2C (DECC, 2008) should be consulted further in the development an Erosion and Sediment Control Plan (ESCP).

6.3 Acid Sulfate Soils

Acid sulphate soils is the common name given to naturally occurring soils containing iron sulphides. Exposure of the sulphides present in these soils to oxygen from drainage or excavation will lead to the generation of sulfuric acid. Field pH of these soils in their undisturbed state is generally pH4 or less.

Landscape characteristics such as; the dominance of mangroves, reeds, rushes and other marine/estuarine or swamp-tolerant vegetation, low lying areas, back swamps or scalded areas of coastal estuaries and floodplains and sulphurous smell following rain after prolonged dry periods (Stone *et al*, 1998) after soil disturbance were not observed. There was no evidence of a jarositic horizon or jarosite precipitates or coatings on any root channels or cracks in the soil.

From the soil survey conducted, it has been deduced that acid sulfate soils are not present on site.

6.4 Potential Impacts on Salinity, Groundwater Resources and Hydrology

Current operational procedures include irrigation via lateral movement irrigator and flood irrigation for the production of rice. Associated water features include supply and drainage channels, along with a large water storage dam. The proposed development is likely to have a positive effect on the local groundwater table by reducing the amount of irrigation and water influx from sources other than precipitation.

Soils on site have a low ESP <6; these topsoils are classified as 'non-sodic'. Disturbance of these sites and associated areas should be kept to a minimum as a precaution due to the potential risk of soil degradation where higher localised salinity or sodicity may be present. Direction of surface waters and any run-on should be avoided as local changes in the water regime are likely to mobilise salts stored in the soil, causing potential localised surface scalding and salinity related issues. Deep rooted vegetation should be maintained where present and ground clearing should be minimised.

6.5 Soil Characteristics and Management Responses

6.5.1 Vertosols

Soil Pits: 27, 28, 29, 30, 31, 32, 33, 34 and 35.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Soil Surface		
These soils generally have a well-structured surface with a surface condition which is self-mulching, cracking, firm and sometimes crusting.	A fine well-structured clay surface generally provides good soil-seed contact, but soil-seed contact may be poor in coarse structured soils (more likely to occur on black or grey clays).	For coarse structured soils, adequate seed bed preparation and rolling (i.e. press wheels or light rollers on seeding equipment) will improve germination. The addition of gypsum and/or composted organic matter is likely to assist with improving surface structure in coarse structured soils.
	Infiltration in these soils may initially be rapid particularly if large cracks exist, but once wet infiltration will be slow and surface sealing will result in almost all water running off.	Surface infiltration rate can be increased through the incorporation of organic matter and by maintaining vegetative cover. Be mindful about irrigation rate. Low intensity irrigation will assist deep water penetration and limit surface sealing.
Expansive Clays		
These soils contain expansive clays and some soils will have very high shrink swell properties.	All these soils contain shrink-swell clays.	Appropriate design is required to avoid damage to infrastructure. Maintaining constant moisture content will limit shrink swell damage. Compaction relief for revegetation may be required when near surface and required for initial establishment. Soil will naturally crack compacted layers on successive drying and wetting cycles.
Clay subsoils		
These soils may be grouped into, red, brown, grey or black sub groups.	Soils with grey colours generally have imperfect to poor drainage, black colours are slightly better drained while brown and red colours indicate moderate to well drained conditions.	Subsoil drainage will be slow and these soils are generally unsuitable for septic systems, however home sewage treatment systems with adequate area for surface irrigation are suitable.
	Depending on landscape position these soils can stay wet for long periods of time.	Appropriate drainage design and materials (i.e. sand and gravel) can improve site access for construction. Water diversion or vegetation may limit waterlogging at some locations.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Dispersion		
These soils often have dispersive subsoils. Soils formed on dolomite or limestone are usually nondispersive.	Dispersive soils have a high erosion risk.	Do not expose dispersive subsoil or at least minimise exposure e.g. Staging construction disturbance, topsoil replacement and rehabilitation immediately following construction, installation of pipes and culverts for drains and other general earthworks. Gypsum can be used to ameliorate dispersive soils and assist drainage and improve soil structure. Avoid ponding of water. Do not concentrate water flow unless using appropriate treatment measures. Erosion and sediment controls may need to be installed to manage drainage, erosion and prevent movement of sediment off-site.
Salinity		
These soils can have high salt levels (depending on parent material and landscape practices) particularly on lower slopes.	High salt levels will affect plant growth and will also impact water quality if leached or washed off.	If irrigating salty soils, maintain a leaching profile (i.e. increased irrigation) to reduce salt levels (the salinity management handbook (DERM 2011) contains thresholds for different plants). Treat salty soils as dispersive soils, even if field testing results are negative because salt can mask dispersion
	Salt can cause scalding and erosion and damage infrastructure.	Salinity expressions can be managed by reducing water inputs and by increasing soil water usage at the site or upslope if possible. Soil amelioration with gypsum and planting salt tolerant species may assist scald areas.
Fertility		
These soils are often very fertile.	High clay content and generally high fertility.	Fertiliser additions will generally improve plant growth, particularly nitrogen and phosphorus. Fertiliser selection will depend on plant species. Topsoil retention should be maximised through appropriate soil handling practices.

Soil Property	Behaviour of soil to activity or environment	Management responses/measures
Revegetation		
These soils crack, are alkaline, moderately to poorly drained with good fertility and high plant available water holding capacity.	Plant species need be selected that are adapted to these unique soil conditions.	Plant selection targeted specifically to shrink-swell soils. Depending on landscape position these soils can stay wet for long periods of time, therefore plants need to be tolerant of these conditions. Low intensity, deep watering will assist full profile wetting and longer interval between irrigations. Fertiliser additions should be applied before and during plant growing periods. Stabilisation and revegetation targets and timeframes should be in accordance with IECA (2008) guidelines.
Soil Handling		
Some of these soils may have very salty and/or dispersive subsoils.	The objective of soil handling is to minimise off site impacts and maximise the productive capacity of the soil on site consistent with the intended use.	Topsoil stripping should maximise available reserves and should avoid mixing salty and/or sodic subsoils with the topsoil – testing is recommended. Topsoil or subsoil stockpiles should be kept separate. Ensure subsoil is adequately covered with topsoil material. Plant establishment may not be possible in subsoil material alone. Reinstate soil in the order they were removed (ie. deeper subsoil reinstated below upper subsoil) Dispersive materials should be covered with adequate topsoil material to protect from erosion (amelioration with gypsum and/or soil stabilisers may be needed). Install erosion and sediment control structures where soil is exposed. Wet clay soil material is difficult to handle. Traffic movement not recommended when wet.

7.0 Notes relating to results

Groundwater

No Free groundwater was encountered during the investigation. A groundwater table or seepage may be present at other times and fluctuations in groundwater levels and seepage could occur due to rainfall, changes in temperature and other factors.

Bore hole / test pit logging

The information supplied in the log sheets is based on visual and tactile assessment based on field conditions at the time of testing. The log sheets can include inferred data based on the experience of the geotechnician as well as factual data from in situ testing.

Samples

D	Disturbed sample
B	Bulk or composite sample
U	Undisturbed sample

Moisture Condition

D	Dry – runs freely through the fingers
M	Moist – does not run freely but is able to be formed
W	Wet – free water visible on the soil surface

Consistency (Cohesive Soils)

Description	Unconfined Compressive Strength (UCS)
Very soft	<25kPa
Soft	25-50kPa
Firm	50-100kPa
Stiff	100-200kPa
Very Stiff	200-400kPa
Hard	>400kPa

Relative Density (Cohesionless Soils)

Description	N Value blows per 300mm	Density Index Range%	Soil Friction Angle (degrees)
Very Loose	0-4	<15	<30
Loose	4-10	15-35	30-35
Medium	10-30	35-65	35-40
Dense	30-50	65-85	40-45
Very Dense	>50	>85	<45

8.0 Disclaimer

The information contained in this report has been extracted from field and laboratory sources believed to be reliable and accurate. DM McMahon Pty Ltd will not assume any responsibility for the misinterpretation of information supplied in this report. The accuracy and reliability of recommendations identified in this report need to be evaluated with due care according to individual circumstances. It should be noted that the recommendations and findings in this report are based solely upon the said site location and the ground level conditions at the time of testing. The results of the said investigations undertaken are an overall representation of the conditions encountered. The properties of the soil within the location may change due to variations in ground conditions outside of the tested area. The author has no control or liability over site variability that may warrant further investigation that may lead to significant design changes.

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10.0 Attachments

Field Soil logs

Laboratory results