APPENDIX Q –
LAND, SOIL AND EROSION ASSESSMENT

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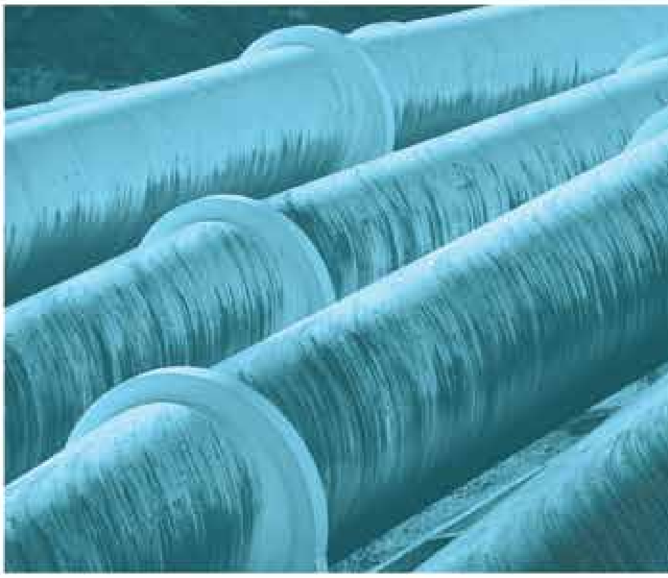
Prepared for Coombes Property Group & KLF Holdings Pty Ltd
June 2020

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Luddenham Advanced Resource Recovery Centre

Land, Soil and Erosion Assessment Report

Report Number

J190749 RP#9

Client

Coombes Property Group and KLF Holdings Pty Ltd

Date

17 June 2020

Version

v1 Final

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17 June 2020

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17 June 2020

Executive Summary

This land, soil and erosion assessment (LSEA) forms part of the environmental impact statement (EIS) for the Luddenham Advanced Resource Recovery Centre (ARRC) project. This LSEA identifies erosion and sediment control constraints at the ARRC site in relation to soil types and landscapes, rainfall, topography, hydrology and surface water quality.

The ARRC site has low to moderate land and soil capability limiting its use for agricultural production and is verified as non-BSAL land. Future agricultural land use will be sterilised by the proposed project.

An erosion risk and hazard analysis has been conducted to identify the impact of the project elements on soil loss in consideration of the above-mentioned factors.

As part of the erosion and hazard analysis, the physical erosion risk was calculated based on two methodologies. Firstly, physical erosion risk was calculated utilising texture derived K factors (soil erodibility factor). The erosion risk was high due to the electrochemical instability of the site soils. Secondly, the erosion hazard was calculated in relation to rainfall and slope in accordance with Landcom (2004), for which the rainfall erosivity for the ARRC site is 2,500 MJ.mm ha^{-1} h^{-1}. This means rainfall and slope in the ARRC site has a low hazard of causing erosion. Due to the low hazard determination further erosion hazard and the determination of soil loss classes was not required.

The objective of erosion and sediment control practices is to take all reasonable and practicable measures to minimise short and long-term soil erosion, whilst minimising sediment transport which can cause damage to assets and result in the need for re-work during and post construction.

The greatest erosion risk exists during the construction phase when potentially dispersive subsoils are exposed. A combination of amelioration of dispersive soils, source control of erosion and the use of Type D sediment basins will mitigate potential offsite impacts of this risk.

There is very low erosion risk during the operational phase of the project with the majority of the ARRC site covered by sealed hardstands, buildings or landscaped areas. The hardstands will be swept regularly to remove accumulated sediments. All potential turbid runoff from the hardstand areas will report to a water treatment plant.

Table of Contents

Tables

Figures

Photographs

1 Introduction

1.1 Overview

CFT No 13 Pty Ltd, a member of Coombes Property Group (CPG), has recently acquired the property at 275 Adams Road, Luddenham NSW (Lot 3 in DP 623799, 'the subject property') within the Liverpool City Council municipality. The site is host to an existing shale/clay quarry.

CPG owns, develops, and manages a national portfolio of office, retail, entertainment, land, and other assets. The company's business model is to retain long-term ownership and control of all its assets. CPG has the following staged vision to the long-term development of the site:

- Stage 1 Quarry Reactivation: **Solving a problem**. CPG intends to responsibly avoid the sterilisation of the remaining natural resource by completing the extraction of shale which is important to the local construction industry as raw material used by brick manufacturers in Western Sydney. Following the completion of approved extraction activities, the void will be prepared for rehabilitation.

- Stage 2 Advanced Resource Recovery Centre and Quarry Rehabilitation: **A smart way to fill the void**: CPG in partnership with KLF Holdings Pty Ltd (KLF) and in collaboration between the circular economy industry and the material science research sector, intends to establish a technology-led approach to resource recovery, management, and reuse of Western Sydney's construction waste, and repurposing those materials that cannot be recovered for use to rehabilitate the void. This will provide a sustainable and economically viable method of rehabilitating the void for development.

- Stage 3 High Value Employment Generating Development: **Transform the land to deliver high value agribusiness jobs**. CPG intends to develop the rehabilitated site into a sustainable and high-tech agribusiness hub supporting food production, processing, freight transport, warehousing, and distribution, whilst continuing to invest in the resource recovery R&D initiatives. This will deliver the vision of a technology-led agribusiness precinct as part of the Aerotropolis that balances its valuable assets including proximity to the future Western Sydney Airport (WSA) and Outer Sydney Orbital.

KLF is an Australian-owned and operated waste management company that operates two strategically located resource recovery and recycling facilities in Sydney; one at Camellia and another at Asquith. KLF has 20 years' experience in the waste recycling and resource recovery industry. KLF facilities are licensed by the NSW Environment Protection Authority (EPA) and have full International Organisation for Standardisation (ISO) accreditation.

This land, soil and erosion assessment (LSEA) report relates to a new development application relating to the Advanced Resource Recovery Centre as part of Stage 2 above. There is an existing clay and shale quarry on the subject property approved under Development Consent DA-315-7-2003, as modified. The quarry is currently inactive. CPG and KLF (the 'applicants') have commenced the application process to modify the quarry's consent to allow quarry operations to recommence, with the primary intention of changing the approved access to the subject property to allow quarry operations (Modification 5, also referred to as MOD 5).

It is proposed to develop an advanced resource recovery centre (ARRC) within the same lot to the north of the existing quarry void.

The project is integral in achieving the intended future commercial/industrial land use for the subject property as the project provides a commercially viable means to infill the quarry void (subject to separate development consent). This enables the site to be developed to meet the vision of the Western Sydney Aerotropolis.

A new State significant development (SSD) consent under Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) is required to establish the ARRC. On 24 April 2020, the Department of Planning, Industry and Environment (DPIE) issued Secretary's Environmental Assessment Requirements (SEARs) for the environmental impact statement (EIS) for the project. The SSD consent application number is SSD-10446.

This report has been prepared by EMM Consulting Pty Limited (EMM) on behalf of the applicants.

1.2 The site and surrounds

1.2.1 Regional context

The subject property is within the Liverpool LGA in the Greater Western Sydney region of NSW. The subject property is located at 275 Adams Road, Luddenham, approximately 19 kilometres (km) north-west of the city of Liverpool, 25 km south-west of the city of Parramatta and approximately 43 km south-west of the city of Sydney (Figure 1.1).

The subject property is approximately 19 hectares (ha) and is zoned RU1 Primary Production under the Liverpool Local Environmental Pan 2008 (Liverpool LEP). The Western Sydney Aerotropolis Planning Package shows the subject property also falls within the proposed Agribusiness zoning of the draft Western Sydney Aerotropolis State Environmental Planning Policy (Aerotropolis SEPP). Land along the eastern boundary of the site is shown as Environment and Recreation zoning in the Aerotropolis SEPP.

Luddenham and its surrounds are within the Hawkesbury-Nepean catchment. Oaky Creek forms the eastern boundary of the subject property. The Oaky Creek catchment has a total area of approximately 382 ha. Oaky Creek rises approximately 2 km south of the subject property and flows generally north until it reaches Cosgrove Creek about 900 metres (m) north of the subject property. Cosgrove Creek flows into South Creek, which ultimately contributes to the Hawkesbury River and Broken Bay. Oaky Creek is an ephemeral creek which only flows following significant rainfall events.

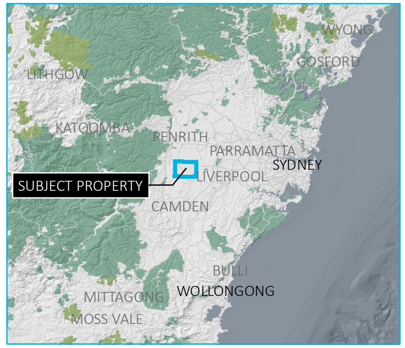
Under Division 1 of the Schedule 1 of Sydney Regional Environmental Plan (SREP) No 9 – Extractive Industries, the subject property is identified as being a clay/shale extraction area of regional significance.

1.2.2 Local context

The subject property is adjacent to Commonwealth-owned land to the east and south. Western Sydney Airport construction, including bulk earthworks and road infrastructure upgrades, are currently underway (Figure 1.2).

The subject property is in a predominantly rural landscape. In addition, Western Sydney Airport, surrounding land uses include a mix of agricultural, rural industrial and commercial, and residential development.

The area surrounding the subject property is sparsely populated, with the closest densely populated area being the residential area of the Sydney suburb of Luddenham approximately 2.2 km to the south-west. The closest occupied residence is about 100 m west of the site. There are two unoccupied residences to the north of the site. Consultation with the property owner of these residences has confirmed one of these residences is condemned and uninhabitable. The closest agricultural property is a duck farm located to the north-west, about 300 m north-west of the intersection with Adams Road.



KEY

- Subject property
- ARRC site
- Western Sydney Airport
- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- NPWS reserve (see inset)
- State forest (see inset)

Source: EMM (2020); DFSI (2017); Nearmap (2020)

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Regional context

Luddenham Advanced Resource Recovery Centre
Aboriginal Heritage Due Dilligence
Figure 1.1

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KEY
Subject property
ARRC site
Western Sydney airport
Cadastral boundary
Watercourse

Source: EMM (2020); DFSI (2017); Nearmap (2020)

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Local context

Luddenham Advanced Resource Recovery Centre
Land, Soil and Erosion Assessment Report
Figure 1.2

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1.2.3 The subject property (Lot 3 DP 623799)

The topography of the site is largely flat other than the void. The site slopes gently from the south-west to the north-east, with elevation ranging between 60 m to 75 m AHD. The riparian corridor along the Oaky Creek is the lowest point on the site at 60 m AHD.

Much of the subject property is disturbed by the quarry (Photograph 1.1). The proposed ARRC site is within the northern portion of the subject property, immediately north of the quarry void. There is a residence and an agricultural shed on the subject property, approximately 110 m north-west of the northern edge of the quarry void.

Quarry operations were originally approved as SSD by Development Consent DA No. 315-7-2003. The consent was modified three times (MOD 1–3), with the fourth modification (MOD 4) withdrawn. The quarry has approval to produce and transport up to 300,000 tonnes per annum (tpa) of clay and shale product up to 31 December 2024. The quarry has been inactive for approximately two years. With the change of ownership of the subject property, the applicants are seeking to reactivate quarry operations including a revised access road route (MOD 5).

The subject property has an existing surface water management system. There are three sediment basins within the north-eastern part of the site. Two of the sedimentation basins were historically employed to collect runoff before discharge to Oaky Creek. Oaky Creek forms the boundary between the adjacent Commonwealth-owned land and the subject property.

Photograph 1.1 Existing quarry – view south towards Western Sydney Airport development site

1.2.4 The advanced resource recovery centre site

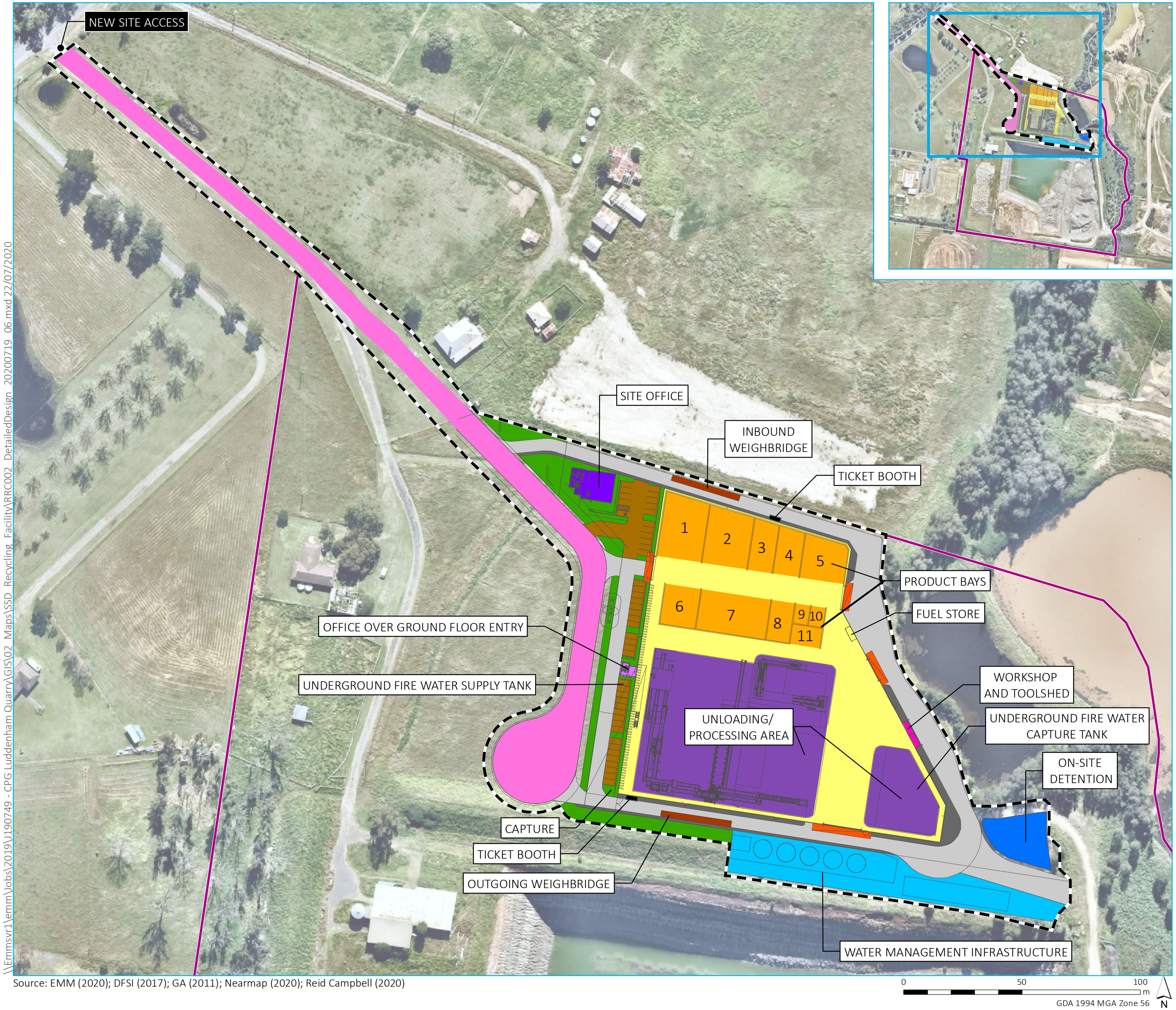
It is proposed to develop the ARRC on the northern portion of the subject property. The ARRC site is approximately 3 ha in area. This ARRC site is currently grassed, and there are small vegetation patches in the northern portion with more extensive vegetation along Oaky Creek on the eastern part of the subject property (Photograph 1.2).

Photograph 1.2 Undeveloped land within the northern part of the site (proposed AARC site)

The key components of the ARRC project are as follows:

- construction and operation of an advanced construction and demolition resource recovery centre;
- accepting and processing up to 600,000 tonnes per annum (tpa) of waste for recycling;
- despatch of approximately 540,000 tpa of recycled product;
- despatch of approximately 60,000–120,000 tpa of unrecyclable material either to an offsite licensed waste facility or to the adjacent quarry void (the later will be subject to separate approval);
- if required, upgrade the access road from the subject property to Adams Road;
- use of the access road from subject property to Adams Road; and
- the ARRC will operate up to 24 hours a day, 7 days per week.

The ARRC will accept general solid waste comprising building and demolition waste as well as selected commercial and industrial waste. No special, liquid, hazardous, restricted solid water, putrescible solid waste, or odorous waste will be accepted at the ARRC. The vast majority of materials accepted will be recovered, the remaining minor amount (10–20%) of unrecyclable materials will be disposed of at an offsite licensed landfill or to the quarry void on the site as part of rehabilitating the void. All waste acceptance, processing, storage and dispatch will occur within the enclosed ARRC warehouse. The ARRC site layout is shown in Figure 1.3.



Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020); Reid Campbell (2020)

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KEY

- Subject property
- ARRC site
- Indicative detailed layout

Proposed element

- Awning
- Carpark
- Hardstand
- ARRC access road
- Kerb/pedestrian area
- Landscaping
- Office over ground floor
- On-site detention
- ARRC warehouse
- Product bay
- Site office
- Ticketbooth
- Tool shed, workshop
- Unloading/processing
- Water management infrastructure, including treatment plant and storage
- Weighbridge

Product bays

1. Concrete/ rubble masonry
2. Clean timber
3. Rigid plastics
4. Paper/cardboard/film
5. Stumps/asphalt/metal
6. Heavy residual
7. Fines screened
8. Soil audit
9. Ferrous
10. Non-ferrous
11. Non-recyclables

Project overview

Luddenham Advanced Resource Recovery Centre
Land, Soil and Erosion Assessment Report
Figure 1.3

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The project will involve the development of a fully enclosed waste acceptance, processing and storage warehouse and supporting ancillary facilities consisting of the following:

- Construction of:
  - sealed site access via Adams Road;
  - internal sealed roads;
  - hard surfacing for the warehouse floor and external areas;
  - a 13,230 m^2 metal clad warehouse, with an elevation of 16m;
  - two site offices with the larger office (400 m^2) located in the outside parking area and the smaller office (140 m^2) located over the car parking area on the western side of the ARRC warehouse; and
  - surface water drainage system.
- Installing:
  - marked traffic and pedestrian areas;
  - approximately 47 parking spaces for staff and customers located to the west and north-west of the ARRC warehouse;
  - two weighbridges (inbound and outbound);
  - two ticket booths (inbound and outbound);
  - a wheel wash for outbound vehicles;
  - awnings attached to the warehouse at each warehouse entry/exit point to the east, west and south;
  - fire suppression system;
  - a stormwater management system including rainwater tanks and an onsite detention basin;
  - an on-site surface water management system consisting of a water treatment plant, onsite leachate and water detention areas;
  - an on-site wastewater management system comprising of a septic tank;
  - connection to services;
  - fencing at the front of the site; and
  - landscaping.

The construction phase outlined above is expected to take around 18 months.

1.3 The purpose of this report

This LSEA report forms part of the SSD EIS for the project and is prepared in accordance with relevant SEARs, policies, standards and guidelines, as summarised in Chapter 2.

The specific objectives of this land, soil and erosion assessment report are to:

- describe and characterise the existing soil resources and topography;
- identify erosion and sediment control constraints for the project at the ARRC site in relation to soil types and landscapes, rainfall, topography and hydrology and surface water quality; and
- identify appropriate erosion and sediment control practises.

1.4 Secretary's Environmental Assessment Requirements

This report has been prepared in accordance with the SEARs for the project issued 24 April 2020. The specific requirements of the SEARs considered in this Report are listed in Table 1.1.

Table 1.1 Applicable requirements of the SEARs

SEARs requirements	Report section
The EIS must address the following specific matters:	
Soil and Water – including: • an assessment of potential impacts to soil resources, topography, hydrology, groundwater, drainage lines, watercourses and riparian lands on or nearby to the site, including mapping and description of existing background conditions and cumulative impacts and measures proposed to reduce and mitigate impacts.	Chapter 4 This report considers soil resources.
• description of the proposed erosion and sediment controls during construction.	Chapter 5
• consideration of salinity and acid sulphate soil impacts.	Section 3.7
Policies, Guidelines and Plans: • Acid Sulfate Soil Manual (Stone et al. 1998). • Managing Urban Stormwater Soils and Construction Volume 1 (Landcom 2004). • Managing Urban Stormwater: Treatment Techniques (DECC 1997). • Managing Urban Stormwater: Source Control (DECC 1998).	Chapter 5 (best-practice guidance applied in design of management and mitigation measures)

2 Regulatory framework

2.1 Standards and guidelines

2.1.1 Land and Soil Capability Assessment Scheme

The *Land and Soil Capability Assessment Scheme* (OEH 2012) assesses the capacity of subject land to support a range of land uses. It considers the inherent the biophysical features of the land and soil including landform position, slope gradient, drainage, climate, soil type and soil characteristics to derive detailed rating tables for a range of land and soil constraints. Potential constraints include erosion (water and wind), soil structure decline, soil acidification, salinity, waterlogging, and shallow soils and mass movement.

Each ranking is given a rating between 1 (best, highest capability land) and 8 (worst, lowest capability land). The final land and soil capability class (LSC) of the land is based on the most limiting constraints.

2.1.2 Erosion and sediment control guidelines

The following erosion and sediment control guideline is relevant to this assessment:

- *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom 2004).

2.1.3 Acid sulphate soil guidelines

The following acid sulphate soil guidelines are relevant to this assessment:

- *NSW Acid Sulphate Soil Manual* (Stone et al. 1998); and
- *National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Sampling and Identification Methods Manual* (Sullivan et al. 2018).

3 Biophysical environment

3.1 Land use

Land uses surrounding the ARRC site are a mix of modified rural use (eg rural dwellings and grazing), rural industrial (eg poultry farms and hot house crops) and rural residential. The proportion of rural residential and commercial/industrial land use is expected to increase in the wider Luddenham area consistent with the Western Sydney strategic infrastructure corridor and economic development priorities of the Greater Sydney Regional Plan and Western City District Plans leveraging off the Western Sydney Airport development.

Prior to initial quarrying the subject property was assessed as degraded agricultural land being predominantly grass covered and bare earth due to overgrazing and stock trampling, with small stands of remnant vegetation along Oaky Creek (Douglas Nicolaisen & Associates 2003).

3.2 Climate

The Luddenham climate is typical of that for south-east Australia being temperate with warm to hot summers and mild to cold winters. The long-term maximum average temperature is 23.2° and a long-term average annual rainfall of 756 millimetres (mm) based on data from Badgerys Creek McMasters F.Stn Bureau of Meteorology (BOM) station number 67068 (EMM 2020a).

The high rainfall erosion hazard (rainfall erosivity) occurs during the summer storm season from November through to March (Figure 3.1).

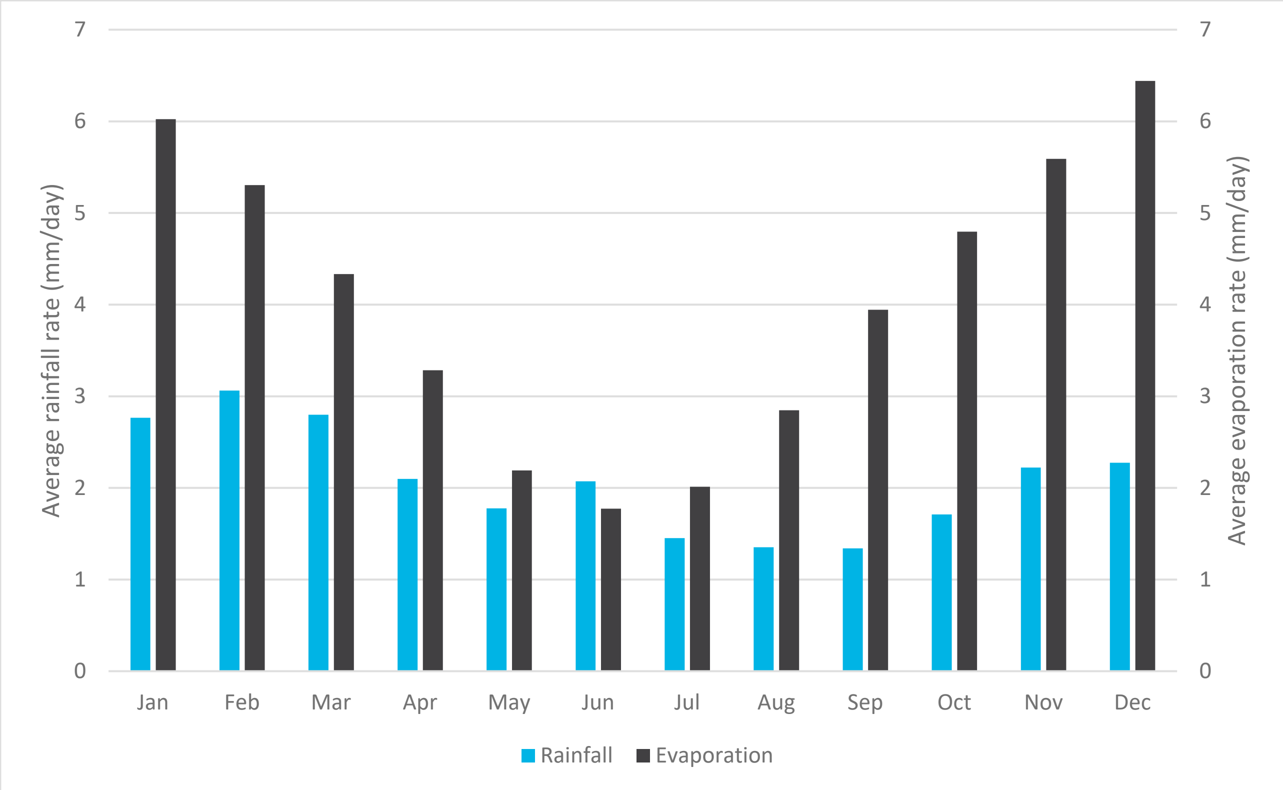


Figure 3.1 Average daily rainfall and evaporation rates (BOM station number 67068)

3.3 Topography

Local topography is characterised by gently undulating rises with local relief between 10–30 m, slopes generally between 5–10% gradient, and broad rounded crests and ridges with convex upper slopes grading into concave lower slopes.

The ARRC site elevation is approximately 62–68 meters Australian Height Datum mAHD) and, consistent with the regional topography, comprises predominantly flat but with gently sloping relief (0–10°) falling generally from the west to the east.

The topography of the ARRC site is shown in Figure 3.2.

3.4 Hydrology

3.4.1 Surface water

There are no distinct channels or drainage lines on the ARRC site with rainfall runoff occurring as sheet flow which runs to the north-east corner of the subject property into Oaky Creek following the natural slope. Oaky Creek at the site location is ephemeral and only flows because of prolonged rainfall in the upper catchment (EMM 2020a).

Further information on surface water in the surrounding area and at the subject property is provided in the *Luddenham Advanced Resource Recovery Centre, Surface Water Assessment* (EMM 2020a).

3.4.2 Groundwater

Groundwater at the ARRC site is typified by low hydraulic conductivity and moderate to high salinity (as represented by electrical conductivity) and is generally considered of poor quality (EMM 2020b) unsuitable for industrial or other beneficial uses.

Further information on groundwater in the surrounding area and at the subject property is provided in *Groundwater Assessment, Luddenham Quarry – Modification 5* (EMM 2020b).

3.5 Ecology

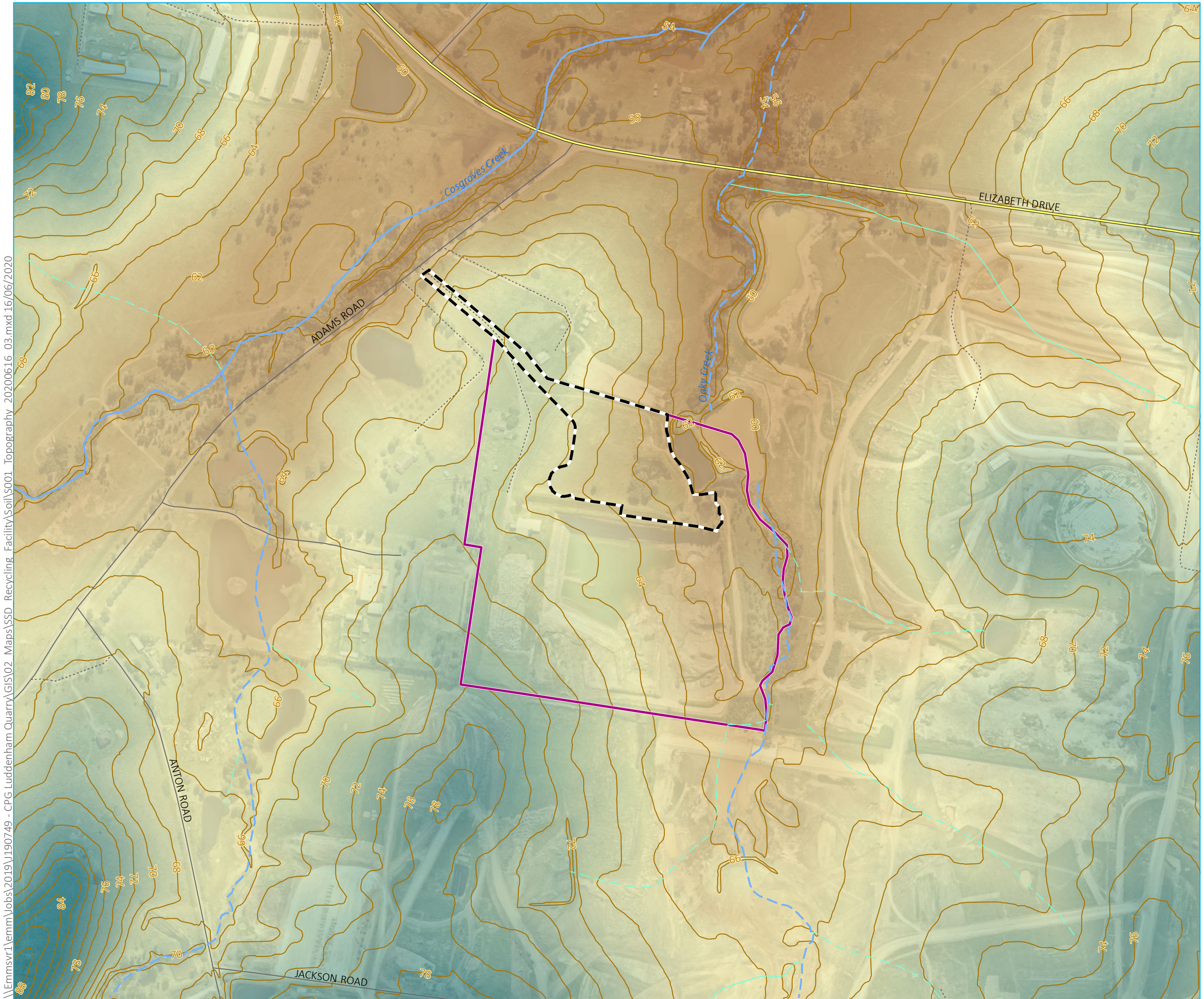
The ARRC site is within the Sydney Basin, Cumberland Interim Biogeographic Regionalisation of Australia region. The locality is considered highly fragmented with native vegetation often occurring in isolated patches surrounded by a matrix of agricultural land.

The subject property is dominated by open grasslands of varying condition and quality. Most of these areas have been heavily impacted by pastoral activities, particularly grazing, and are dominated by exotic plant species. The following native plant community types (PCTs) was recorded within the ARRC site:

- PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain; and
- PCT 1800 – Cumberland Swamp Oak riparian forest.

PCT 849 is located outside of the impact area for the ARRC. PCT1800 Cumberland Swamp Oak riparian forest was recorded in a poor and moderate condition and is associated with the *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community* listed under the BC Act.

Further information on biodiversity in the surrounding area and at the subject property is provided in the *Luddenham Advanced Resource Recovery Centre, Biodiversity Development Assessment Report* (EMM 2020c).



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Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020)

Site topography

Luddenham Advanced Resource Recovery Centre
Land, Soil and Erosion Assessment Report
Figure 3.2

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3.6 Geology

The Luddenham area lies within the central part of the Sydney Basin, which is comprised of several sedimentary strata including the thick coal seams in the greater region and extensive and continuous Hawkesbury Sandstone. These sandy sediments and the regional depression of the basin allowed the formation of shaly and silty strata (Wianamatta group) which includes the Ashfield and Bringelly Shales that are several hundred metres thick and form the bulk of the mineral resource at the quarry.

3.7 Soils

A desktop assessment was undertaken by EMM using existing information on soils and soil environments for the study area. The results of the desktop assessment are presented in the following sub-sections, together with the relevant sources which were reviewed.

Soils were tested and described in the *Biophysical Strategic Agricultural Land (BSAL) Site Verification Report* (Minesoils 2020).

The ARRC site soils are defined as dark topsoils (A horizon) characterised as silty clay loams to clay loams between 0.2 to 0.4m thick which are non-saline and occasionally sodic. Subsoils (B horizon) are medium to heavy clays that are non-saline to slightly saline, moderately to strongly acidic and are predominantly strongly sodic (Minesoils 2020). The underlying clays have negligible to no agricultural value and provide the saleable clay resource for the quarry, used as plastic bonding clays in brick manufacture (Cole Town Planning 1992).

3.7.1 Soil landscape mapping

Soil landscape in the Western Sydney area was mapped by Bannerman and Hazelton (1990), as presented as the *Soil Landscapes of the Penrith 1:100,000 sheet*. With reference to the NSW Soil and Land Information (SALIS) System (DPIE 2020) through the 'eSPADE' Soil Profile Database, Version 2.0 (OEH 2016) the mapped soil landscape is the Blacktown (bt) soil landscape and the soil and land resource units mapped for the site and modification area are the Second Ponds Creek (spz) soil landscape and the Blacktown (bty) soil landscape (OEH 2019) as described in Table 3.1.

The soil landscape units are presented in Figure 3.3.

Table 3.1 Soil and Land Resource landscape units applicable to ARRC site

Soil landscape unit	Description
Second Ponds Creek (spz)	• Landscape – Foot slopes and plains on Colluvium/Alluvium and Wianamatta Group Shale (shale and colluvium) in the Cumberland Plain. Local relief 5–30 m; altitude 10–112 m; slopes 0-3%; rock outcrop nil. Extensively cleared woodland. • Soils – Brown and Yellow Sodosols (Soloths), Brown and Yellow Chromosols and Kurosols (Yellow Podzolic Soils). Widespread low soil fertility. • Limitation – Widespread sheet and gully erosion with localised gully erosion along drainage depressions; localised permanent waterlogging. • Development – moderate to very high limitations to urban development with widespread foundation and salinity hazard, and localised flood hazard.

Table 3.1 Soil and Land Resource landscape units applicable to ARRC site

Soil landscape unit	Description
Blacktown (bt)	• Landscape – gently undulating rises on Wianamatta Group shales. Local relief to 30 m, slopes usually >5%. Broad rounded crests and ridges with gently inclined slopes. Cleared Eucalypt woodland and tall open forest (dry schlerophyll). • Soils – typically shallow to moderately deep (>100 cm) hard setting mottled texture contrast soils, red and brown podzolic soils (Dr3.21, Dr3.31, Db2.11, Db2.21) on crests grading to yellow podzolic soils (Dy2.11, Dy3.11) on lower slopes and in drainage lines. • Limitations – localised seasonal waterlogging, localised water erosion hazard, moderately reactive highly plastic subsoil, localised surface movement potential. • Development – high capability for urban development with appropriate foundation design. Small portions of this landscape not yet urbanised are capable of sustaining cultivation and grazing.

The typical soil profile and dominant soil materials are summarised in Table 3.2. From this information the soils across both soil landscape units can be generally characterised as:

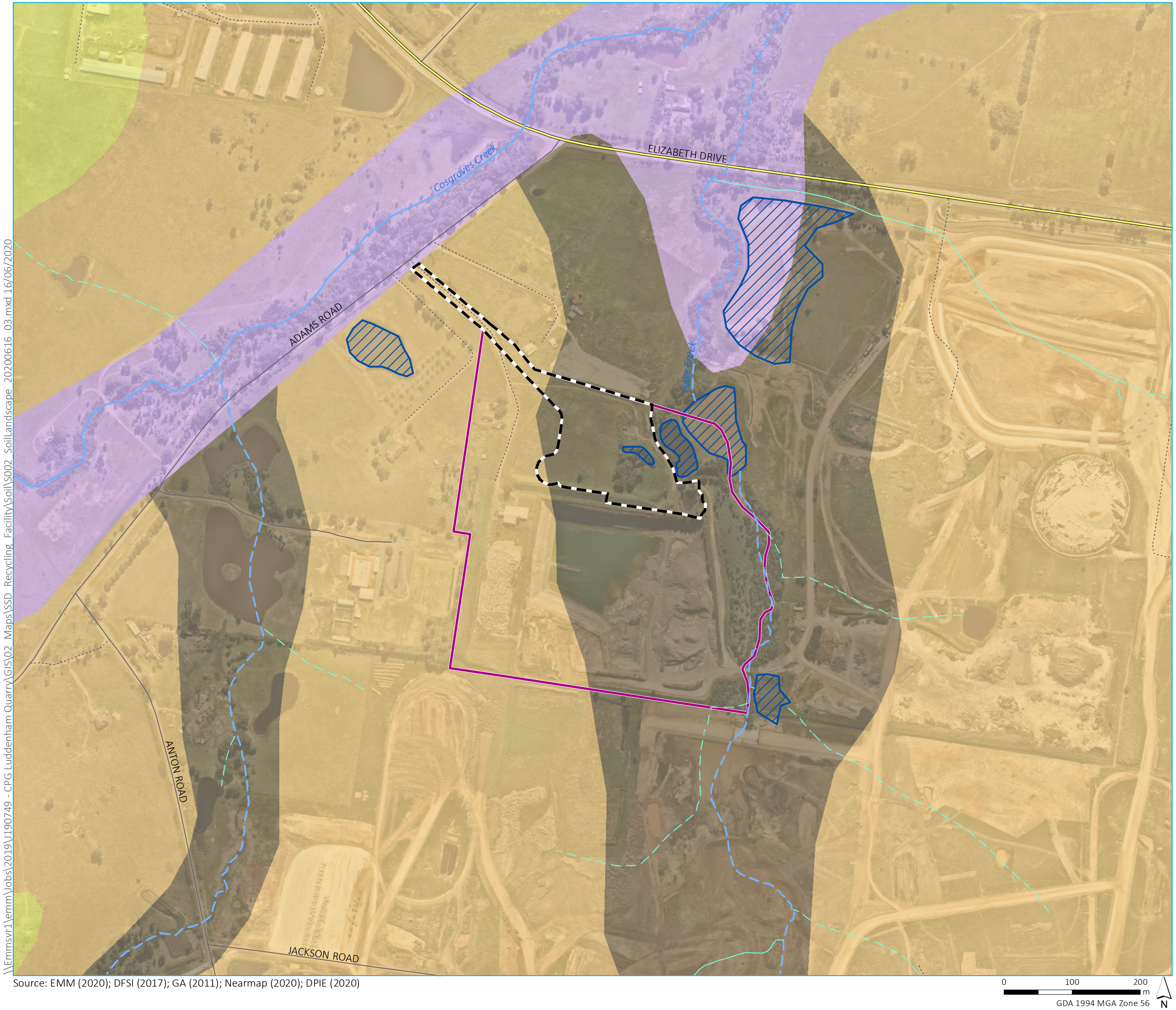
- slightly to strongly acid;
- often hard setting with low permeability and water holding capacity;
- localised saline, sodic subsoils prone to tunnel erosion and with low chemical fertility and elevated aluminium; and
- generally low fertility.

Table 3.2 Soil landscape units – dominant soil materials

Soil Landscape	Dominant Soil Materials	Description
Blacktown (bty)	bt1 – friable brownish black loam	• Occurs as topsoil (A horizon). • Friable brownish black loam to clay loam with moderately pedal subangular blocky structure and rough-faced porous ped fabric. • pH varies from moderately acid (pH 5.5) to neutral (pH 7.0). • **Limitations to development: strongly acid**
	bt2 – hard-setting brown clay loam	• Occurs as topsoil (A2 horizon). • Brown clay loam to silty clay loam which is hard setting on exposure or when completely dried out. • Apedal massive to weakly pedal structure and slowly porous earthy fabric. Peds when present are weakly developed, subangular blocky and are rough faced and porous. They range in size between 20–50 mm. This material is water repellent when extremely dry. • pH varies from moderately acid (pH 5.0) to slightly acid (pH 6.5). • **Limitations to development: hard-setting, low fertility, strongly acid, high aluminium toxicity**

Table 3.2 Soil landscape units – dominant soil materials

Soil Landscape	Dominant Soil Materials	Description
	bt3 – strongly pedal, mottled brown light clay.	• Usually occurs as subsoil (B horizon) • Brown light to medium clay with strongly pedal polyhedral or sub-angular to blocky structure and smooth-faced dense ped fabric. • pH varies from strongly acid (pH 4.5) to slightly acid (pH 6.5). • **Limitations to development: high shrink-swell (localised), low wet strength, low permeability, low available water capacity, salinity (localised), sodicity (localised), very low fertility, very strongly acid**
	bt4 – light grey plastic mottled clay.	• Usually occurs as deep subsoil above shale bedrock (B3 or C horizon). • Plastic light grey silty clay to heavy clay with moderately pedal polyhedral to subangular blocky structure and smooth-faced dense ped fabric. • **Limitations to development: high shrink-swell (localised), low wet strength, stoniness, low available water capacity, salinity (localised), sodicity (localised), low fertility, strongly acid, very high aluminium toxicity, high erodibility.**



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Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020); DPIE (2020)

Soil landscape units

Luddenham Advanced Resource Recovery Centre
Land, Soil and Erosion Assessment Report
Figure 3.3

EMM creating opportunities

3.7.2 Australian Soil Classification

The Australian soil classification (ASC) scheme (Isbell 2016) is a multi-category scheme with soil classes defined based on diagnostic horizons and their arrangement in vertical sequence as seen in an exposed soil profile.

The Australian soil resource information system (ASRIS) and eSPADE mapping (OEH 2016) indicates that site soils are Kurosols and Sodosols (Table 3.3), with field-survey and ASC classification (Minesoils 2020) indicating the soils to be acidic/sodic, eutrophic, red/brown Dermosols. The Minesoils (2020) assessment notes that the classification of the soils as Dermosols was based only on a lack of definitive texture contrast between the A and B2 horizons, and that soils may be classed as Sodosols or Kurosols per the ASRIS mapping given the variability in soil horizon clay content across the site, high Exchangeable Sodium Percentages (ESP) and increased acidity in the B2 horizons. Given the low intensity of the ASRIS/eSPADE ASC mapping, derived from 1:100 000 soil landscape mapping, the soil classification is within reasonably expected variability of soil classification, especially considering the Minesoils (2020) assessment findings noted above.

Kurosols and Sodosols are considered to have very low agricultural potential due to low chemical fertility and poor soil structure whereas Dermosols are considered to have high inherent agricultural productivity with few chemical and physical constraints (Gray and Murphy 2002). However, due the nature of the historical land disturbance and degraded state, the soils on the ARRC site offer low capability.

The ASC soil map for the ARRC site from eSPADE (OEH 2017a) is presented in Figure 3.4.

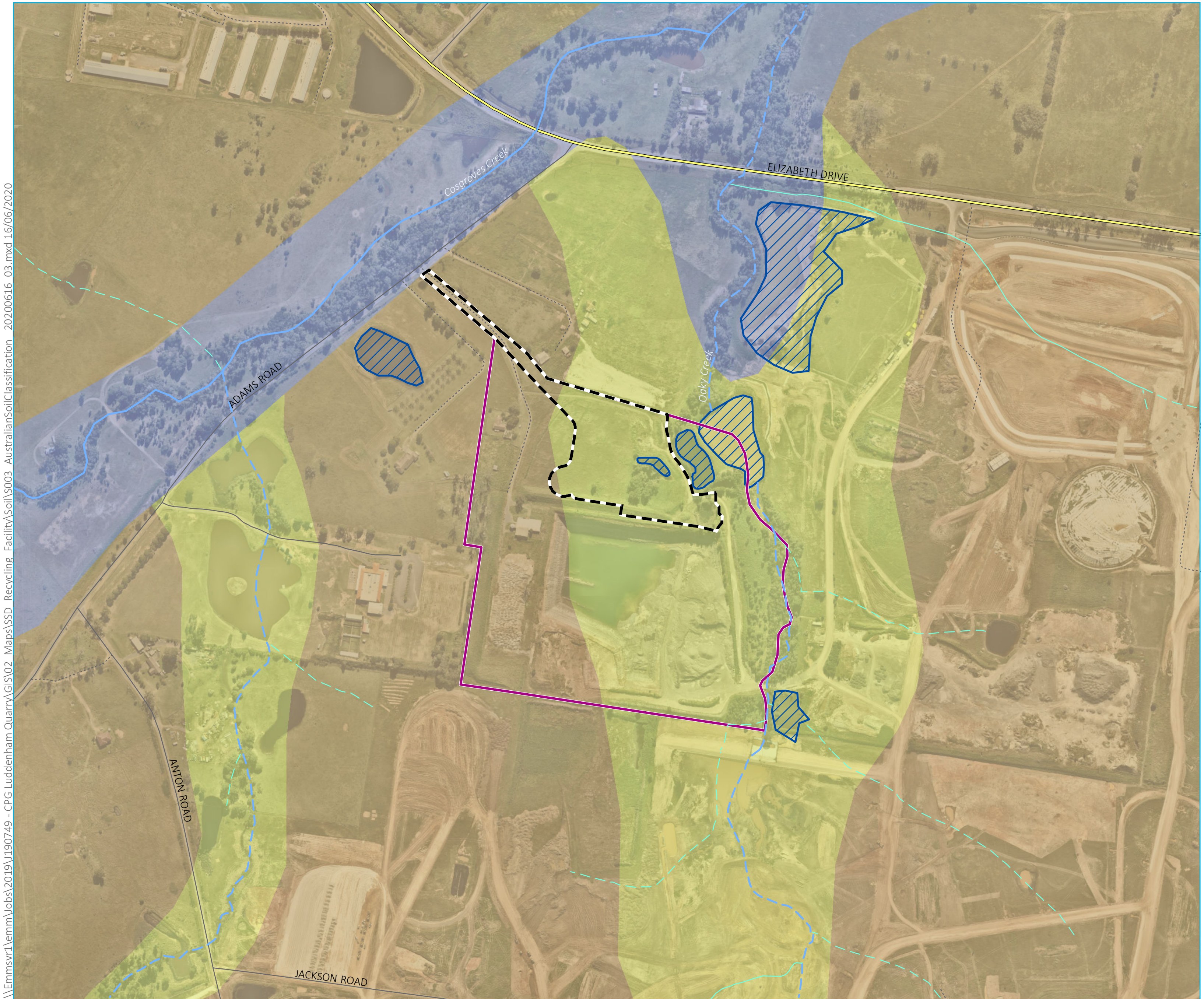
Table 3.3 Summary of regional ASC soil mapping: Greater Luddenham area

Soil Type	ASC description	Agricultural potential[1]
Kurosols (KU) (possibly present on site)	• Soils with strong texture contrast between A horizons and strongly acid B horizons. • Many of these soils have some unusual subsoil chemical features (high magnesium, sodium and aluminium). • Upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is strongly acid.	• Typically, very low agricultural potential with high acidity (pH <5.5) and low chemical fertility. • Commonly have low water-holding capacity, often sodic.
Sodosols (SO) (possibly present on site)	• Soils with strong texture contrast between A horizons and sodic B horizons which are not strongly acid. • Upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is sodic and not strongly acid.	• Only found in poorly drained sites with rainfall between 50 mm and 1,100 mm. • Typically have very low agricultural potential with high sodicity leading to high erodibility, poor structure and low permeability. • Subsoils are dispersive and prone to gully and tunnel erosion. • Often hard setting when dry and prone to crust formation. • Low to moderate chemical fertility and can be associated with soil salinity. • High capability.

Table 3.3 Summary of regional ASC soil mapping: Greater Luddenham area

Soil Type	ASC description	Agricultural potential[1]
Dermosols (DE) (mapped on site)	• Soils with structured B2 horizons and lacking strong texture contrast between A and B horizons. • Well-structured B2 horizon containing low levels of free iron. The parent materials of dermosols range from siliceous, intermediate to mafic in composition.	• Red/brown Dermosols typically found in well-drained sites with rainfall between 450–1200mm. • Usually have high organic matter levels in the surface horizons and have strongly acid subsoils (B horizons). • Usually friable when moist. • Dermosols generally have high agricultural potential with good structure and moderate to high chemical fertility and water-holding capacity with few problems

[1] As per Gray and Murphy (2002).



Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020); OEH (2017)

KEY
- Subject property
- ARRC site
- Waterbody
- Major road
- Minor road
- Vehicular track

Strahler stream order
- 1st order
- 2nd order
- 3rd order
- 4th order

Australian soil classification (order level)
- Hydrosols
- Kurosols
- Kurosols, Natric

Regional soils mapping – Australian Soils Classification

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Figure 3.4

creating opportunities

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3.7.3 Hydrologic soil group

The hydrologic soil groups (OEH 2017b) present in the vicinity of the ARRC site are Groups C and D, defined as:

- **Group C**: soils having slow infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.

- **Group D**: soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

3.7.4 Inherent soil fertility

Indicative mapping of inherent soil fertility is also provided via the eSPADE database (OEH 2016), with the soils of the ARRC site mapped as 'moderately low' fertility soils.

As per OEH (2017c), these are soils are described as soils with low fertilities that, generally, will only support vegetation suited to grazing with large inputs of fertiliser required to improve the soils and make them suitable for arable purposes.

3.7.5 Land and soil capability classes (agricultural value)

The NSW Office of Environment and Heritage (OEH) has undertaken Land and Soil Capability assessment and mapping for most of NSW at a very broad scale. The LSC classes distinguish between the inherent physical capacity of the land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources.

With reference to the eSPADE database (OEH 2016) and OEH (2017d) the ARRC site is mapped as Classes 4–6, which represents land with 'moderate to severe limitations' to cropping (moderate to low capability land, as per the OEH (2012) classifications) with agricultural land uses restricted to grazing, forestry, and nature conservation (Table 3.4). Limited options exist to improve the agricultural viability of the land without causing degradation.

The LSC class map for the ARRC site is presented in Figure 3.5.

Table 3.4 Land and soil classifications mapped for the ARRC site

LSC Class[1]	Description
Class 4 – Moderate Capability Land	• Land has moderate to high limitations for high-impact land uses. • Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. • These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
Class 5 – Moderate-low capability land	• Land has high limitations for high-impact land uses. • Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. • The limitations need to be carefully managed to prevent long-term degradation.

Table 3.4 Land and soil classifications mapped for the ARRC site

LSC Class[1]	Description
Class 6 – Low capability land	• Land has very high limitations for high-impact land uses. • Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. • Careful management of limitations is required to prevent severe land and environmental degradation

1. As per OEH (2012).

3.7.6 Modelled soil erosion

Modelled sheet and rill soil erosion potential for the ARRC site based on bare soil and natural topography, expressed in tonnes per hectare per year of soil loss (t/ha/year), is indicated within the eSPADE database (OEH 2016). This modelling was undertaken using the revised universal soil loss equation (RUSLE) and rainfall-runoff erosivity (R) and soil erodibility (K) factors per Yang and Yu (2015) and Yang et al (2017).

This modelled data indicates that erosion potential is variable across the ARRC site ranging from <20 t/ha/year to <200 t/ha/year based on bare soil (Figure 3.6). These represent lower range rates of erosion based on the scale applied to this data.

The modelling is based on topsoil exposure. Subsoil erosion is likely to be higher given that sodic and/or magnesic properties of subsoils are likely to increase at depth.

Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020); OEH (2017)

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Land and soil capability class

Luddenham Advanced Resource Recovery Centre
Land, Soil and Erosion Assessment Report
Figure 3.5

EMM creating opportunities

KEY

Subject property
ARRC site
Major road
Minor road
Vehicular track
Strahler stream order
1st order
2nd order
3rd order
4th order
Modelling soil erosion (t/ha/yr)
< 20
20 - 50
50 - 200

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Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020); DPIE (2020)

0 100 200 m
GDA 1994 MGA Zone 56
N

Modelled soil erosion

Luddenham Advanced Resource
Recovery Centre
Land, Soil and Erosion Assessment
Figure 3.6

EMM
creating opportunities

3.7.7 Salinity

Soil salinity mapping for the ARRC site in the eSPADE system (OEH 2016), as measured by electrical conductivity (EC), ranges from >0.05–0.3 dS/m in both the upper (0–30 cm) and lower (30–100 cm) of the soil profile which is considered non-saline. This modelled data was confirmed by soil salinity results measured and presented in the *Luddenham Quarry MOD5 Biophysical Strategic Agricultural Land (BSAL) Site Verification Report* (Minesoils 2020) with EC ranges from 0.5–3.7 dS/m across the sites surveyed.

Based on this modelled and surveyed data the ARRC site soils are not considered a salinity hazard.

3.7.8 Acid sulphate soils

There are no acid sulphate soils (ASS) in the ARRC site, as per the Guidelines for the *Use of Acid Sulfate Soil Risk Maps* (DLWC 1998) and based on ASS mapping in the eSPADE system (OEH 2016). Acid sulphate soils are typically found in coastal areas which does not apply to the ARRC site.

This is consistent with the geotechnical assessment findings of the EIS for the nearby Western Sydney Airport which indicated that isolated ASS might be found across the proposed airport site but was not sufficient in extent to require management (Commonwealth of Australia 2016, Western Sydney Airport 2019).

3.8 BSAL

The ARRC site has not been formally recognised or mapped as biophysical strategic agricultural land (BSAL).

The desktop review of the project soil capability (Section 3.7.5) also identifies that site soils are within capability Classes 4-6, whereas BSAL only applies to soils in Classes 1-3 (OEH 2012).

This is supported by a similar determination in the EIS for the nearby Western Sydney Airport (Commonwealth of Australia 2016), the original EIS assessment and classification of the Adams Road site (denuded agricultural land impacted by overgrazing), the findings of the regional soil mapping (Section 3.7.1) which indicate that the site is unsuitable for high-value agricultural land use and the *Luddenham Quarry MOD5 Biophysical Strategic Agricultural Land (BSAL) Site Verification Report* (Minesoils 2020).

3.9 SAL

The ARRC site is not explicitly identified as strategic agricultural land (SAL) or high-value agricultural land in either the Greater Sydney Regional Plan or Western City District Plans (Greater Sydney Commission 2018a; 2018b) and is unlikely to be considered SAL in the future given that:

- the site is considered degraded agricultural land;
- the LSC classes for the site are mapped as having 'moderate to very severe limitations' to cropping (ie they cannot support high-value agricultural land uses);
- the site has been surveyed and verified as non-BSAL land (Minesoils 2020); and
- current and future quarry operations are complimentary to the strategic economic and industrial planning objectives for region.

4 Erosion hazard analysis

The erosion potential of a soil is determined by its physical and chemical properties.

The clay soils of the ARRC site have low surface infiltration rates and potentially sodic and magnesic chemical properties and have low inherent water erosion risk provided they have good vegetation cover and are not disturbed. During construction, surface soils will be stripped, compacted with vegetative cover removed, thereby increasing erosion risk. Sodic and/or magnesic soils have a higher risk of soil dispersion and increased runoff due to compaction, particularly at depth. Exposed subsoils have high potential to generate highly turbid runoff during rainfall.

Site specific soil erodibility factors (K-factors) have not been determined, however Loch (1998) recommends a minimum K-factor of 0.06 for dispersive soils which aligns with the modelled K-factors for the site (OEH 2016). An assessment of project K-factors against the Rosewell (1993) soil erosion ranking (Table 4.1) demonstrates a 'high' soil erosion potential.

Table 4.1 Rosewell (1993) Soil Erosion Ranking

K factor (t ha h $ha^{-1}MJ^{-1}mm^{-1}$)	Erosion potential
<0.02	Low
>0.02 to <0.04	Moderate
>0.04	High

The erosion hazard for the ARRC site has been determined using the procedure described in Section 4.4.1 of Landcom (2004). The first step in the hazard assessment uses a nomograph from Figure 4.6 of Landcom (2004) (reproduced as Figure 4.1) that considers slope of the land and the Rainfall Erosivity (R factor) to provide a low to high erosion hazard.

For the ARRC site, the slope gradient of planned disturbed areas range from <2%–10% (Figure 4.1) and has an R factor of 2,500 MJ.mm ha^{-1} h^{-1} (Map 10, Appendix B in Landcom (2004)). Applying these parameters to the erosion hazard nomograph results in a low erosion due to slope and rainfall.

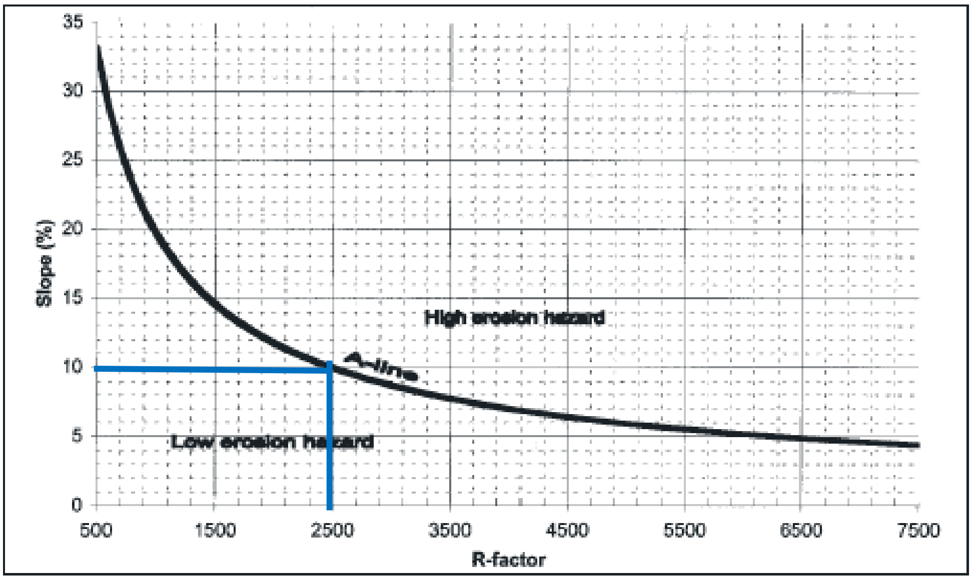


Figure 4.1 Assessment of potential erosion hazard (Landcom 2004)

The soils on site that have the greatest erosion potential are dispersive soils with an exchangeable sodium percentage of >4%. These are likely to be found in the subsoils.

The presence of dispersive soils and a disturbed area footprint greater than 2,500 m^3 triggers the need for sediment basins during the construction phase of the project. The turbidity generated by the erosion of dispersive soils cannot be treated by temporary sediment control measures such as silt fences and check dams. Type D sediment basins treated with appropriate coagulants and/or flocculants will be required during the construction phase.

To summarise, the overall erosion hazard for the project has been assessed as low using the Landcom (2004) method that considers the rainfall erosivity and the slope of the land. An assessment of site soils in accordance with Rosewell (1993) has demonstrated that the soils have a high erosion potential due to their electrochemical instability.

Further detail on proposed management and mitigation measures to address the identified erosion and sedimentation risk are provided in Section 5.

5 Management and mitigation measures

5.1 Land and soil capability

The ARRC site has low to moderate land capability for agricultural purposes (Section 3.7.5). The existing agricultural capability will be sterilised by the proposed project as topsoil will be stripped to allow for construction and the bulk of the ARRC site will be sealed hardstand.

5.2 Erosion and sediment control

The ARRC will implement reasonable and practicable measures to minimise short and long-term soil erosion and the adverse effects of sediment transport to minimise the potential of environmental harm and to minimise damage to assets and the need for re-work during and post construction.

This will be achieved by applying the key fundamental principles of erosion and sediment control detailed in Landcom (2004) to the identified site constraints and erosion hazards. This is addressed in the following sections.

5.3 Appropriately integrate the development into the site

The ARRC design generally utilises the existing topography and minimises the need for extensive land reshaping other than a disused sedimentation pond associated with the quarry. The project will require minor reshaping and sealing of the existing land surface.

5.4 Construction planning – erosion and sediment control

Best practice construction planning involves the early recognition and management of those components of the project and construction process that can significantly influence the impacts that construction may have on the surrounding environment.

A soil and water management plan (SWMP) will be prepared for the project. The SWMP will be underpinned by primary erosion and sediment control plans (PESCPs) that will need to be prepared for all discrete disturbance areas. The PESCPs will be living documents to be updated as site conditions change or current PESCPs fail to meet necessary performance objectives. The content requirements of the SWMP and PESCPs are prescribed in Landcom (2004).

5.5 Minimise the extent and duration of soil disturbance

The highest erosion risk for the project is during the stripping and land shaping phase when subsoil is exposed. If these works are carried out during periods of higher rainfall (eg April to October), soil and erosion control measures will be adjusted to ensure appropriate management of erosion and sediment.

The highly erodible subsoils will be permanently covered with sealed hardstands which means subsoils should only be exposed for a short period of time.

Land disturbances will be restricted to those areas required for the current stage of works.

The use of flagging tape or bunting will be implemented to minimise the potential for any disturbance outside the designated work areas.

5.6 Control water movement through the site

The PESCPs prepared for each of the surface construction areas will address the temporary and permanent requirements of each area. Due to the low slope gradients, sheet flow velocities are unlikely to exceed the maximum permissible velocity of the site soils, as per IECA (2018a) (Table 5.1). Where necessary, soil stabilising polymers will be applied to exposed soils to protect them from rain drop splash erosion and sheet flows.

In concentrated flow situations, the drains will either have flow velocities less than the maximum permissible velocity of the soils or will be lined to protect the soil from erosion. Drain linings will be specified in the PESCPs.

Table 5.1 Maximum permissible velocities for different soil types (adapted from Table A23, IECA 2008a)

Soil description	Allowable velocity	Impacted by the project
Extremely erodible soils	0.3 m/s	Yes
Sandy soils	0.45 m/s	-
Highly erodible soils	0.4 to 0.5 m/s	Yes
Sandy loam soils	0.5 m/s	-
Moderately erodible soils	0.6 m/s	-
Silty loam soils	0.6 m/s	-
Low erodible soils	0.7 m/s	-
Firm loam soils	0.7 m/s	-
Stiff clay very colloidal soils	1.1 m/s	-

Where feasible, up-slope clean run-on water will be diverted around soil disturbances and unstable slopes in a manner that minimises soil erosion and the saturation of soils within active work areas.

Clean water will be diverted around the catchments to sediment traps and basins to minimise the volume of clean water that encounters exposed soils and requires treatment.

The sequencing of construction and drainage, erosion and sediment control works will allow for the installation of the temporary drainage system, and preferably the permanent stormwater drainage system as soon as practicable.

Clean, sealed surfaces such as roofs and paved areas will be connected to the permanent drainage system as soon as possible.

Although adjacent to Oaky Creek (Figure 1.2), the development will not result in disturbance to any riparian areas.

5.7 Minimise soil erosion

Due to the erosion risk associated with the presence of dispersive soils, priority will be given to the prevention, or at least minimisation, of soil erosion rather than allowing erosion to occur and relying on sediment control measures to trap and contain sediment and turbid runoff. This is particularly important where it is not possible or is impractical to divert turbid runoff to a sediment basin.

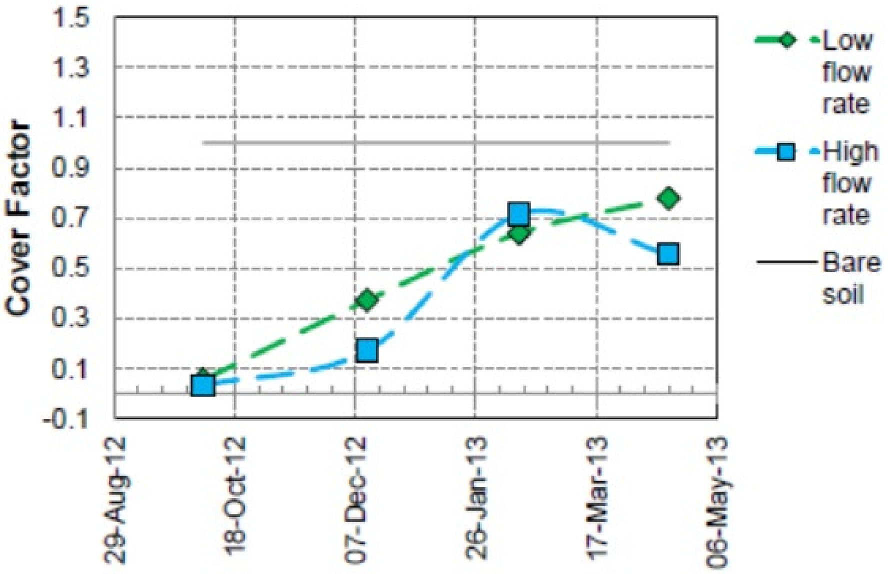
Sediment basins are required where soil loss calculations exceed 150 t/ha and/or land disturbance exceeds 2,500 m^2. In areas where it is not possible to divert all turbid water to site sediment basins (referred to in Landcom (2004) as 'local management areas'), the project will provide the necessary level of erosion and temporary sediment control protection to achieve an equivalent level of environmental protection were sediment basins able to be constructed.

Appropriate erosion protection will be incorporated into all stages of soil disturbance and will be appropriate for the erosion risk posed by the potentially dispersive site soils. The electrochemical instability of the site soils will be ameliorated by the incorporation of gypsum into the soil at rates determined by site-specific soil testing.

Land disturbed by the project following construction will either be hardstand or landscaped areas post construction and will have a very low erosion risk.

5.8 Promptly stabilise disturbed areas

Hydraulically applied soil stabilising polymers can provide erosion protection equivalent to 60% grass cover for up to three months using a 10% solution applied at 1 L/m^2 (Figure 5.1; from Landloch (2013)) and are therefore recommended as an important temporary erosion control in sheet flow environments within the site, particularly in preparation for periods of predicted rainfall or during shut down periods.



Source: Landloch (2013).

Figure 5.1 C-Factor assessment of soil stabilising polymers

Landcom (2004) nominates target stabilisation timing and standards for disturbed areas during construction and post-construction (Table 5.2). The project will comply with these requirements.

5.9 Maximise sediment retention on site

Oaky Creek is sensitive to the discharge of sediment and turbid run-off from project construction. All reasonable and practicable measures need to be taken to protect downstream waters and adjacent properties from the adverse effects of sediment and turbid water discharge.

Table 5.2 Target C factors and timing

Lands	Target C-factor	Description
Waterways and other areas subjected to concentrated flows, post construction	0.05	A target C factor of 0.05 (approx. 70% soil surface cover) will aim to be achieved ten (10) days from completion of construction and prior to exposure to concentrated flows.
All lands, including waterways and stockpiles during construction	0.15	A target C factor of 0.15 (approx. 50% soil surface cover) will aim to be achieved twenty (20) working days of inactivity or from completion of construction.
Stockpiles, post construction	0.10	A target C factor of 0.10 (approximately 60% soil surface cover) will aim to be achieved ten (10) working days from completion of construction.

As detailed in Chapter 4, Type D sediment basins are required. Given the proximity of Oaky Creek to the ARRC site, Landcom (2004) considers this to be a sensitive environment, and as the construction phase will be greater than 6 months, any sediment basins will be designed to contain an 85^{th} percentile, 5 day rainfall depth and will have a sediment storage zone that will contain the 3-month soil loss as determined by the Revised Universal Soil Loss equation (RUSLE).

The selection of appropriate coagulants and/or flocculants for use in the sediment basins and the determination of dosing rates will be undertaken using the bench testing procedure described in the *Chemical Coagulants and Flocculants Fact Sheet* (IECA 2018b).

During the operational phase of the project, the only turbid water expected to be generated on site will be from imported waste and all run-off from these areas will report to a water treatment plant as described in the *Surface Water Assessment* (EMM 2020a). The site hardstand will be swept on a regular basis to minimise sediment tracking to public roads.

5.10 Drainage, erosion and sediment control maintenance

All drainage, erosion and sediment control measures will be maintained in proper working order until their function is no longer required. To assist in achieving these requirements, PESCPs will include construction, inspection and maintenance requirements for all drainage, erosion, and sediment control measures.

Inspections will be undertaken 24 hours prior to predicted rainfall events and immediately following rainfall events that cause run-off, and weekly during periods of no rain.

All clean and dirty water, debris and sediment removed from drainage, erosion and sediment control measures must be disposed of in a manner that will not create erosion, sedimentation, or a pollution hazard.

Upon decommissioning any drainage, erosion and sediment control measures, all materials used to form the control measures will be disposed of appropriately.

5.11 Drainage, erosion and sediment control monitoring

PESCPs are living documents that can and should be modified as site conditions change, or if the adopted control measures fail to achieve the required treatment standard. When site personnel detect a notable failure in the adopted control measures, the source of the failure will be investigated, and appropriate amendments made to the controls and PESCPs.

6 Conclusion

This land, soil and erosion assessment identifies erosion and sediment control constraints for the project at the ARRC site in relation to soil types and landscapes, rainfall, topography and hydrology and surface water quality.

The ARRC site has low to moderate land and soil capability limiting its use for agricultural production and is verified as non-BSAL land. Future agricultural land use will be sterilised by the proposed project.

An erosion risk and hazard analysis has been conducted to identify the impact of the project elements on soil loss in consideration of the above-mentioned factors.

As part of the erosion and hazard analysis, the physical erosion risk was calculated based on two methodologies. Firstly, physical erosion risk was calculated utilising texture derived K factors (soil erodibility factor). The erosion risk was high due to the electrochemical instability of the site soils. Secondly, the erosion risk was calculated in relation to rainfall and slope, for which the rainfall erosivity for the ARRC site is 2,500 MJ.mm ha^{-1} h^{-1}. This means rainfall and slope in the ARRC site has a low hazard of causing erosion. Due to this low hazard determination, further erosion hazard assessment and determination of soil loss classes was not required.

The objective of erosion and sediment control practices is to take all reasonable and practicable measures to minimise short and long-term soil erosion, whilst minimising sediment transport which can cause damage to assets and result in the need for re-work during and post construction.

The greatest erosion risk exists during the construction phase when potentially dispersive subsoils are exposed. A combination of amelioration of dispersive soils, source control of erosion and the use of Type D sediment basins (see Robson, 2015) will mitigate potential off-site impacts.

There is very low erosion risk during the operational phase of the project with most of the site to be covered by sealed hardstands, buildings, or landscaped areas. The hardstands will be swept regularly to remove accumulated sediments. All potential turbid runoff from the hardstand areas will report to a water treatment plant.

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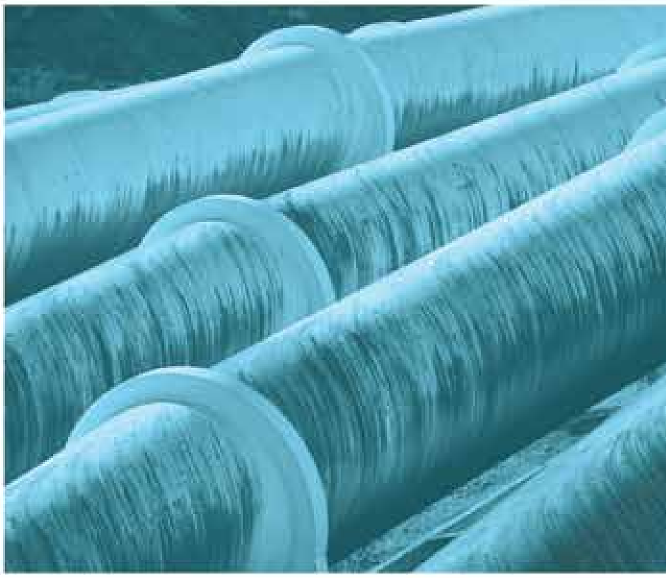

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