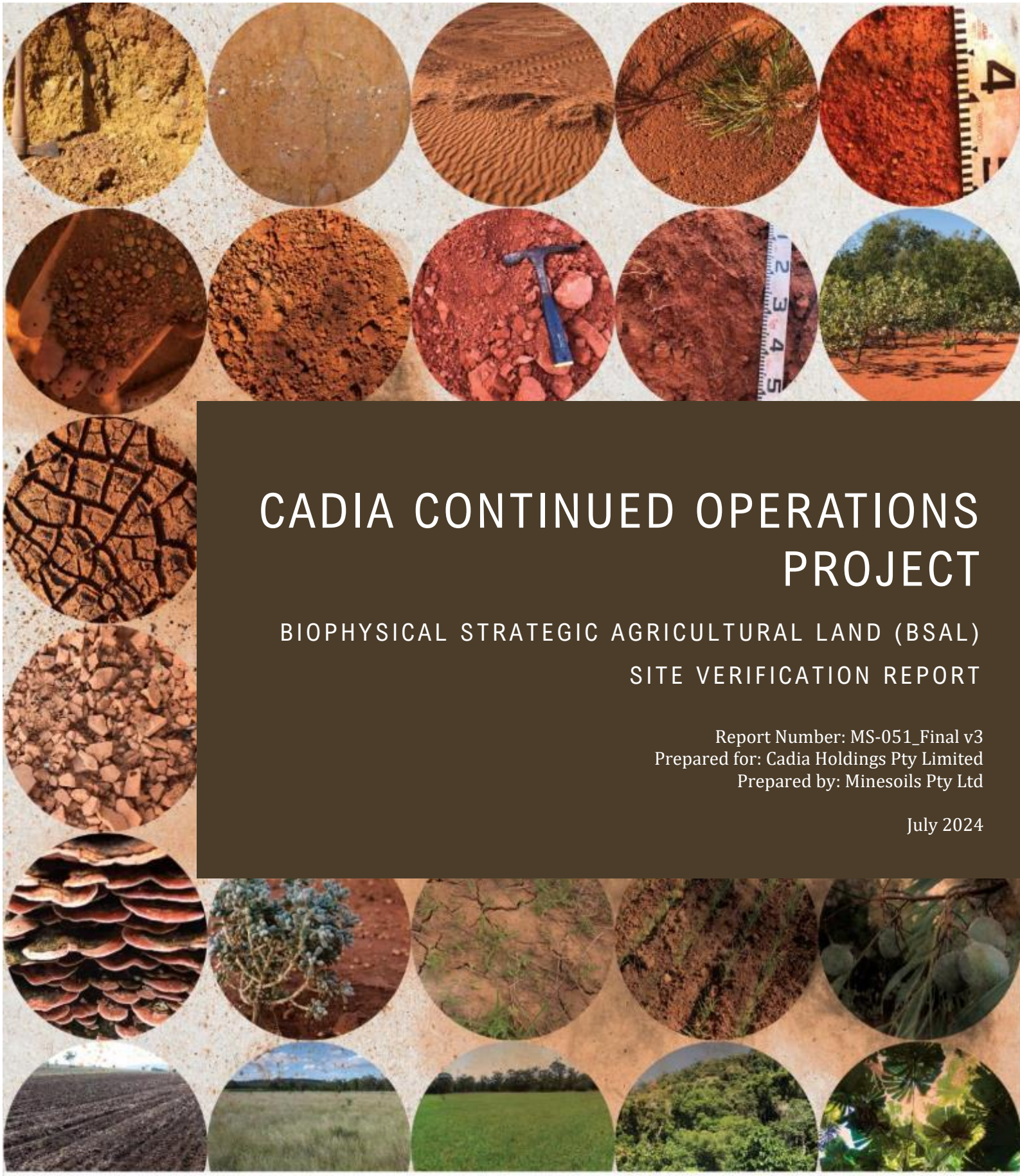
Appendix 1
BSAL Site Verification Assessment



CADIA CONTINUED OPERATIONS PROJECT

BIOPHYSICAL STRATEGIC AGRICULTURAL LAND (BSAL) SITE VERIFICATION REPORT

Report Number: MS-051_Final v3
Prepared for: Cadia Holdings Pty Limited
Prepared by: Minesoils Pty Ltd

July 2024

MINESOILS
LAND & REHABILITATION SPECIALISTS

PREPARED BY

Minesoils Pty Ltd
ABN 84 627 497 509

[redacted]
[redacted]
www.minesoils.com.au
[redacted]

DISCLAIMER

This report has been prepared by Minesoils Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with the Client. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Cadia Holdings Pty Limited. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from Minesoils. Minesoils disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared by	Approved
MS-051_Draft v1	11 October 2021	Matt Hemingway, Clayton Richards	Clayton Richards
MS-051_Draft v2	1 November 2021	Matt Hemingway, Clayton Richards	Clayton Richards
MS-051_Final	19 May 2022	Matt Hemingway	Clayton Richards
MS-051_Final v2	24 July 2024	Matt Hemingway	Clayton Richards
MS-051_Final v3	25 July 2024	Matt Hemingway	Clayton Richards

TABLE OF CONTENTS

List of Figures

1. INTRODUCTION

1.1 PROJECT BACKGROUND

Cadia Holdings Pty Limited (CHPL) owns and operates the Cadia mine, located approximately 20 kilometres (km) South-South-West of Orange in the Central Tablelands region of New South Wales (NSW) (refer **Figure 1**). The mining operation traverses two local government areas (LGAs), Blayney Shire Council and Cabonne Council.

Cadia mine is one of Australia's largest polymetallic mining operations, producing gold, copper and molybdenum products. The mine has been operating continuously since it opened in 1998. Cadia provides an important economic contribution to the region and NSW and is a major regional employer providing direct employment of approximately 1,800 full time equivalent jobs. With confirmed mineable resources extending well beyond the life of the current Project Approval (PA 06_0295) which provides for mining until 30 June 2031, Cadia has commenced planning for the continuation of mining operations.

This project is known as the Cadia Continued Operations Project (CCOP/the Project). The CCOP Project Area, Gateway Application Area and Gateway Disturbance Area is shown on **Figure 2**, and further defined in Section 1.4. The Project involves:

- Continuation of operations beyond 2031 (for a period of 25 years from the date of approval, nominally 2050) using existing and approved but not constructed infrastructure and supporting site services.
- Continuation of and extension to underground mining within the Cadia East and Ridgeway mining areas, and associated changes in subsidence surface expression.
- The continued emplacement of tailings from ore processing over the life of the continued operations within existing approved storage facilities and an extension of the existing Southern Tailings Storage Facility (SSTSF)
- Development of an additional water storage on Cadiangullong Creek (known as the South Water Storage) to provide improved security of water supply.
- Realignment of portions of Panuara Road and Cadia Road to maintain public safety and account for the above project features.
- Changes to site infrastructure and facilities to enable ongoing mining operations.

A new development consent will be sought for CCOP, which will replace the existing Project Approval (PA 06_0295) and provide for a new and modern consent to govern future operations at Cadia.

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment 2013* (the 2013 Mining SEPP amendment) requires certain types of developments to verify whether the proposed site is on biophysical strategic agricultural land (BSAL).

CHPL is seeking a BSAL site assessment report that covers land associated with three proposed new project areas. As at the date of survey efforts these new project areas comprised the proposed additional south tailing storage facility (STSF) area at 1,443ha, the proposed south water storage dam area at 1,650ha, and the proposed extended subsidence/infrastructure area at 183ha (hereafter referred to as the proposed subsidence area). These components total an area of 3,276ha, herein referred to as the Project site (refer **Figure 2**).

1.2 PROJECT OBJECTIVES AND SCOPE

The objective of this report is to define and assess the Project site to verify BSAL or Non-BSAL. The assessment program was undertaken in accordance with the *Interim Protocol for Site Verification and Mapping of Biophysical*

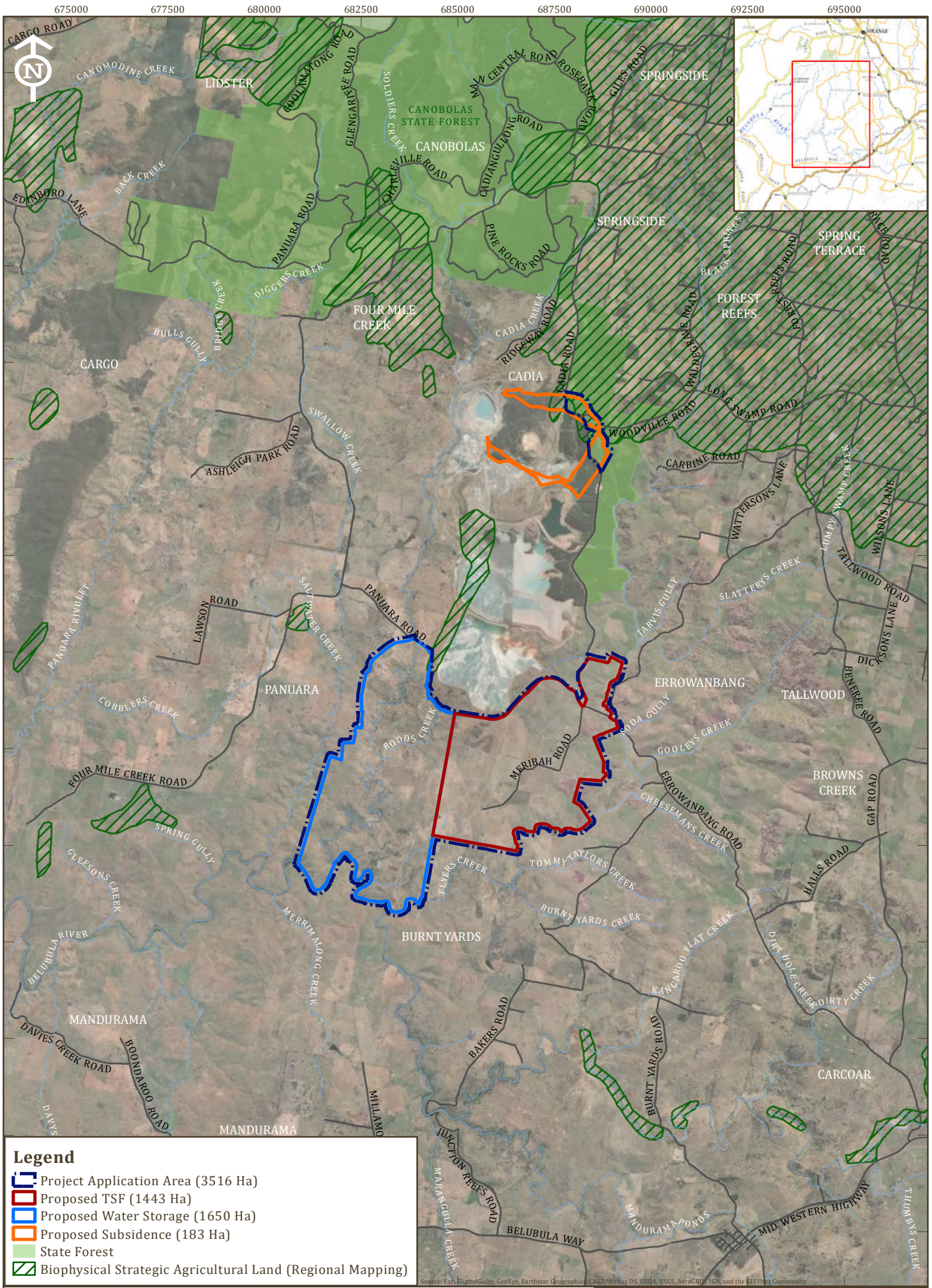
Strategic Agricultural Land (Office of Environment & Heritage (OEH) and Department of Primary Industries - Office of Agricultural Sustainability and Food Security (DPI-OAS&FS), 2013); hereafter referred to as the Interim Protocol.

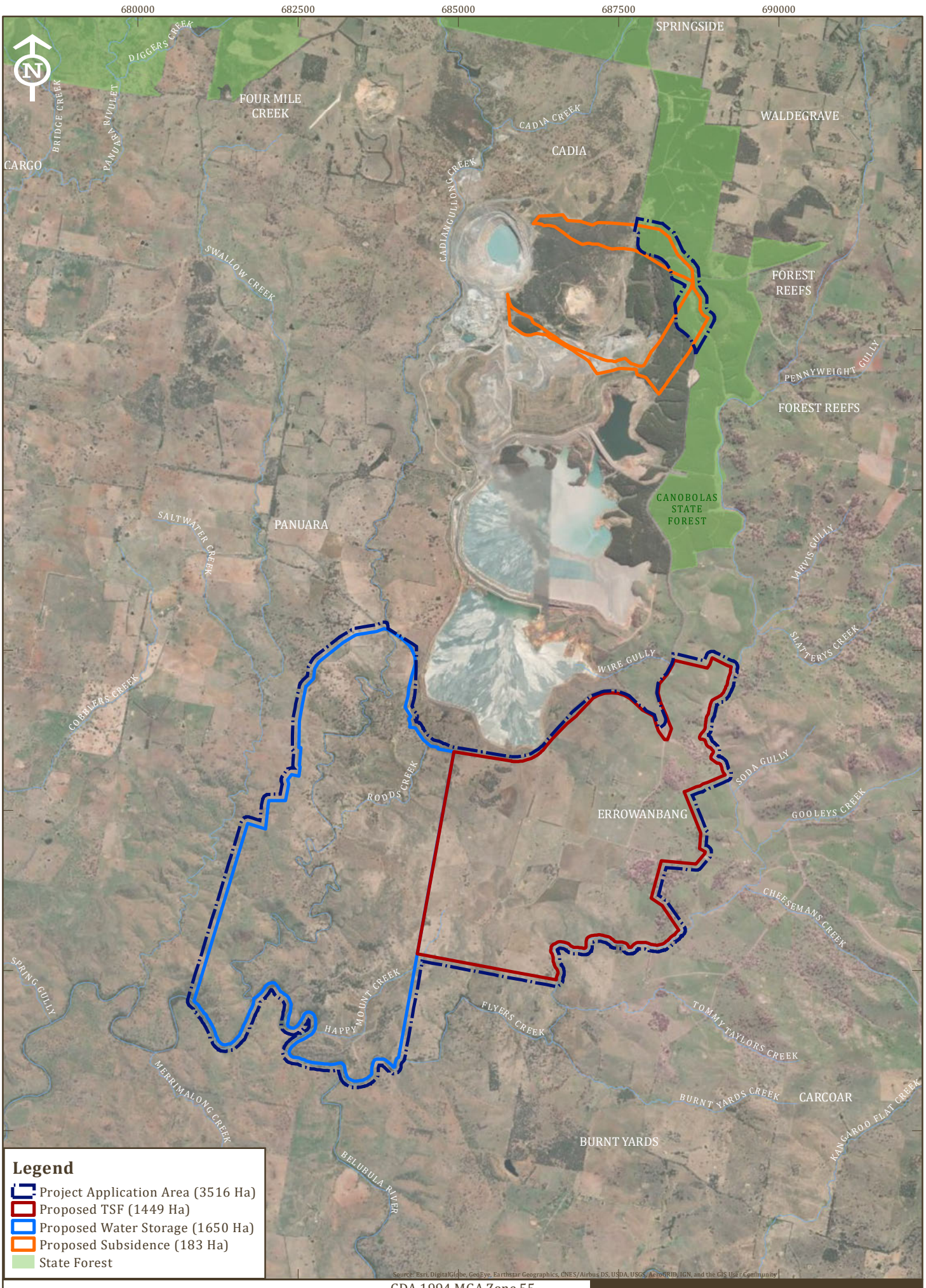
The purpose of this report is to provide the results of the BSAL verification program conducted in accordance with the Interim Protocol.

In accordance with the Interim protocol, a 100m buffer zone was added to the Project site. Additionally, areas within existing mining leases were discounted from assessment. This results in an area of 3,516 ha and is referred to as the Project Application Area (PAA) (refer **Figure 2**).

This report provides the results of the soil survey and BSAL assessment undertaken in 2021, for the PAA as defined at the time of survey works.

This report does not include the results of subsequent soil assessment efforts as referenced in the Gateway Report, which were undertaken at a later date and targeted areas associated with the Cadia Modification 15 development application, and areas of >10% slope within the PAA.


675000
677500
680000
682500
685000
687500
690000
692500
695000
6305000
6302500
6300000
6297500
6295000
6292500
6290000
6287500
6285000
6282500
6280000
6277500
6275000
CARGO ROAD
CANOMODINE CREEK
LIDSTER
COOLAMATONG ROAD
GLENGARRIE ROAD
SOLDIERS CREEK
CANOBOLAS STATE FOREST
CANOBOLAS
W CENTRAL ROAD
ROSEBANK ROAD
GILES ROAD
SPRINGSIDE
CADIANGULLONG ROAD
CHARLEVILLE ROAD
EDNBORO LANE
BACK CREEK
PANUARA ROAD
DIGGERS CREEK
BRIDGE CREEK
PINE ROCKS ROAD
SPRINGSIDE
BLACK SPRINGS
REEFS ROAD
SPRING TERRACE
RACE ROAD
FOREST REEFS
FOUR MILE CREEK
CADIA CREEK
RIDGEWAY ROAD
CADIA ROAD
WALDEGRAVE ROAD
BULLS GULLY
CARGO
CADIA
WOODVILLE ROAD
LONG SWAMP ROAD
SWALLOW CREEK
ASHLEIGH PARK ROAD
CARBINE ROAD
WATTERSONS LANE
LUMPY SWAMP CREEK
WILSONS LANE
TALLWOOD ROAD
SLATTERYS CREEK
JARVIS GULLY
DICKSONS LANE
BENEREE ROAD
PANUARA RIVULET
LAWSON ROAD
SALTWATER CREEK
PANUARA ROAD
PANUARA
ERROWANBANG
TALLWOOD
COBBLERS CREEK
RODDS CREEK
SODA GULLY
GOOLEYS CREEK
MERIBAH ROAD
FOUR MILE CREEK ROAD
BROWNS CREEK
GAP ROAD
ERROWANBANG ROAD
CHEESEMANS CREEK
SPRING GULLY
GLEESONS CREEK
TOMMY TAYLORS CREEK
FLYERS CREEK
HALLS ROAD
BURNT YARDS CREEK
BELUBULA RIVER
MERRIMALONG CREEK
BURNT YARDS
KANGAROO FLAT CREEK
DIRT HOLE CREEK
DIRTY CREEK
MANDURAMA
DAVIES CREEK ROAD
BOONDAROO ROAD
BAKERS ROAD
BURNT YARDS ROAD
CARCOAR
DAVYS
MILLAMO
MANDURAMA
JUNCTION REEFS ROAD
MARANGULLA CREEK
BELUBULA WAY
MANDURAMA PONDS
MID WESTERN HIGHWAY
THUMBYS CREEK
Legend
Project Application Area (3516 Ha)
Proposed TSF (1443 Ha)
Proposed Water Storage (1650 Ha)
Proposed Subsidence (183 Ha)
State Forest
Biophysical Strategic Agricultural Land (Regional Mapping)
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
GDA 1994 MGA Zone 55
MINESOILS
LAND & REHABILITATION SPECIALISTS
0 0.5 1 2
Kilometers
Scale 1:125000 at A4
Regional Context
FIGURE 1
E:\RST002_MineSoils\MS051_Cadia\MS051_009_RegionalContext.mxd 3/11/2021 9:05:07 AM



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

0 0.5 1 2 Kilometers

Scale 1:75000 at A4

Project Site

FIGURE 2

E:\RST002_MineSoils\MS051_Cadia\MS051_010_Site.mxd 2/11/2021 10:23:02 PM

2 EXISTING ENVIRONMENT

2.1 GEOLOGY, HYDROLOGY AND TOPOGRAPHY

The PAA is located within the eastern Lachlan Fold Belt of NSW. The surficial geology of the region consists of andesite, tuff, limestone, siltstone, shale, feldspathic greywacke, chert and diorite, with coarse-grained intermediate rocks including syenite and monzonite, and in-situ and alluvial/colluvial materials derived from above parent rock (Source: DMR (2002) in Murphy & Lawrie (1989) (refer **Figure 3**).

The PAA is located in the Lachlan River Catchment. Rodds Creek and Cadiangullong Creek is located within the PAA and Flyers Creek is located immediately to the east of the PAA. These flow in a generally southerly direction into the Belubula River, which eventually flows into the Lachlan River to the west. Several un-named first and second order ephemeral streams occur within the PAA.

The landscape within the PAA ranges from gullies and creeks into low hills and smooth, undulating slopes to steep, rocky hillslopes and high plateaus, ranging from 450m AHD in the south west areas of the proposes water storage domain, up to 950m AHD in the northern areas of the proposed subsidence area domain (refer **Figure 4**). Slopes within the PAA range from 0 - 1% along the open drainage lines and flats up to steep, rocky upper slopes and crest rises. A significant portion (1,891 ha or 54%) of the PAA has a slope >10%. Increased slopes are primarily concentrated in the proposed water storage domain and proposed subsidence domain (refer **Figure 5**).

2.2 SOIL LANDSCAPES

Soil Landscape units for the PAA are mapped by the DPIE (2020) which compiled all 40 published soil landscape maps that cover central and eastern NSW, based on standard 1:100,000 and 1:250,000 topographic sheets. The mapping provides an inventory of soil and landscape properties of the area and identifies major soil and landscape qualities and constraints. It integrates soil and topographic features into single units with relatively uniform land management requirements. In the associated reports, soils are described in terms of soil materials in addition to the Australian Soil Classification, the Great Soil Groups, and the Northcote systems.

The PAA consists of the Panuara, Quarry, Razorback, Stoke-Burnt Yards Vittoria Blayney and Spring Hills Soil Landscapes (refer **Figure 6**), which are described below.

Panuara Soil Landscape

Undulating low hills to rolling hills, 500 –965 m above sea level. Local relief is usually between 100–120 m, although it can be as low as 60 m for undulating slopes around Panuara. Slopes vary from 5–8% but are up to 15% in the steeper terrain. Slope lengths vary from 500–800 m. Drainage lines run west and are spaced from 500–800 m apart.

Vegetation has been extensively cleared; however, remnant native vegetation consists of dry sclerophyll forest dominated by mountain gum and manna gum.

Soil distribution consists of Red Podzolic Soils on mid to upper slopes, Yellow Solodic Soils occur in drainage lines. Yellow Podzolic Soils occur on lower slopes with Red Earths or Brown/Red Earths. Chocolate Soils or Euchrozems occur on remnants of basaltic mesas.

Quarry Soil Landscape

Rolling low hills, 860–980 m in elevation with slope lengths ranging from 500–7 900 m, and slopes in the 12–15% range. Local relief is between 60–100 m.

Remnant native vegetation consists of Savannah woodland of yellow box with Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint on slopes.

Soil distribution consists of pale Siliceous Sands on midslopes with Yellow Earths and Yellow Podzolic Soils on lower slopes. Shallow Sands and Red Podzolic Soils occur on upper slopes.

Razorback Soil Landscape

Rolling to steep hills, from 660–1 000 m elevation with average slopes from 20–25%, with some ranging between 30–50%. Slope lengths vary from 400–700 m, with some up to 1 000 m. Local relief varies from 140–220m.

A white box-red stringybark community is found extensively on this landscape, mainly on the slopes and ridges, with yellow box and apple box in valleys and on midslopes. Tumbledown red gum grows on some stony ridges, in place of red stringybark.

Shallow Red Podzolic Soil/Krasnozem intergrades are common, with Red Earths also on slopes. Large outcrops of rocks are present. Shallow skeletal soils are dominant and are formed on most upper slopes.

Stoke-Burnt Yards Soil Landscape

Rolling low hills with elevations ranging from 640–840 m. Slopes vary from 8–15%, but near Carcoar they are up to 20%. Slope lengths range from 400–900 m, with most local relief from 40–80 m, but up to 100 m. Drainage lines are from 300–900 m apart, converging into the Belubula River.

Vegetation has been extensively cleared, however remnant native vegetation consists of yellow box occurring in valleys, while brittle gum and white box grow on midslopes in association with red box and broad-leaved peppermint. Red stringybark occurs on higher slopes.

Soil distribution consists of Krasnozems, Euchrozems and Red Clays. Yellow Soloths occur in drainage lines on lower slopes.

Vittoria Blayney Soil Landscape

Undulating to rolling hills with 800–1050 m elevation, and local relief from 30–80 m but most to 50–60 m. Slopes are from 6–10%, with lengths averaging 600 m but ranging from 200–1500 m. Fixed drainage channels are spaced from 800–1000 m apart. The catchment boundary between the Macquarie and Lachlan River systems bisects this landscape. Upland drainage depressions have slopes from 4–5%, but in lower areas slopes are less than 2%. Broad drainage depressions (500 m wide) have plains with 1–2% slopes.

Remnant native vegetation consists of savannah woodlands with yellow box communities. Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint on lower slopes.

Soil distribution consists of Red Earths on well-drained crests and sideslopes, with Yellow Earths on moderately to imperfectly drained footslopes. Yellow Soloths/Yellow Podzolic Soil intergrades are found in imperfectly to poorly drained drainage depressions. Other soils include red and yellow structured earths midslope, with shallow sands and loams on crests and upper slopes.

Spring Hills

Gently undulating to undulating rises with broad flats. Elevation is between 900–980 m. Slopes are from 2–5% and slope lengths from 500–700 m, with local relief normally to 10 m, but up to 30 m. Drainage depressions form broad flats to 1 000 m wide, with slopes <1% and often <0.5%. Drainage channels are fixed and spaced 600–800 m apart.

Remnant native vegetation includes savannah woodlands with yellow box communities. Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint are on lower areas.

Krasnozems are the dominant soils. Yellow Podzolic Soils occur on the lower slopes with Yellow Solodic Soils in drainage lines.

Towac Soil Landscape

Undulating hills to rolling low hills, from 980–1,080 m in elevation. Local relief varies from 40–60 m, with some to 100 m. Slopes are between 6–10% but can be up to 20%. Slopes in drainage depressions range from 8% on higher areas to 1–2% in the lower lands. Drainage lines are fixed and moderately spaced, flowing north to Molong and Heifer Station Creeks.

Remnant native vegetation consists of savannah woodlands with yellow box communities. Blakely's red gum, grey box, apple box, bastard box and broad-leaved peppermint on lower areas.

Krasnozems occur on the upper to midslopes and are dominant. Red Podzolic/Krasnozem intergrades are found on upper slopes, with Yellow Podzolic/Solodic Soils in drainage depressions.

2.3 SOIL TYPES

Australian Soil Classification (ASC) mapping indicates the PAA is primarily dominated by Kurosols, with a sporadic occurrence of Ferrosols throughout, an area of Dermosols in the water storage domain, and an extensive Kandosol unit in the proposed SSTSF domain. A limited occurrence of Tenosols are also found within the proposed SSTSF domain (Refer to **Figure 7**).

2.4 INHERENT FERTILITY

Inherent fertility is based on the physical and chemical features of soils in their natural, undegraded condition and correlates to ASC mapping. Regional soil inherent fertility has been mapped for the area and indicates the Study Area contains soils with 'Low', 'Moderately Low', 'Moderate' and 'Moderately High' inherent fertility (Refer to **Figure 8**).

Soils with 'Low' fertility, due to their poor physical and/or chemical status, only support limited plant growth. Soils with 'Moderately Low' fertility can generally only support plants suited to grazing; large inputs of fertiliser are required to make the soil suitable for arable purposes. Soils with 'Moderate' fertility usually require fertilisers and/or have some physical restrictions for arable use. Soils with 'Moderately High' fertility have a high level of fertility in their virgin state which is significantly reduced after a few years of cultivation (Murphy et al 2007).

2.5 LAND AND SOIL CAPABILITY

Land and Soil Capability (LSC) Mapping uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes, which classify the land based on the severity of long-term limitations. Regional Land and Soil Capability (LSC) Mapping indicates the PAA contains Class 3, Class 4 and Class 7 land (refer to **Figure 9**).

Class 3

This classification indicates land that has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.

Class 3 lands have been mapped in a very small area in the water storage domain and more extensively in the proposed subsidence domain, comprising 51 ha or 1% of the PAA.

Class 4

This classification indicates moderate capability land that 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 4 lands are the most spatially extensive of the land classes and have been mapped on 3,200 ha or 91% of the PAA.

Class 7

This classification indicates very low capability land that has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.

Class 7 land occurs within the proposed water storage domain and comprise 265 ha or 8% of the PAA.

2.6 MAPPED BSAL

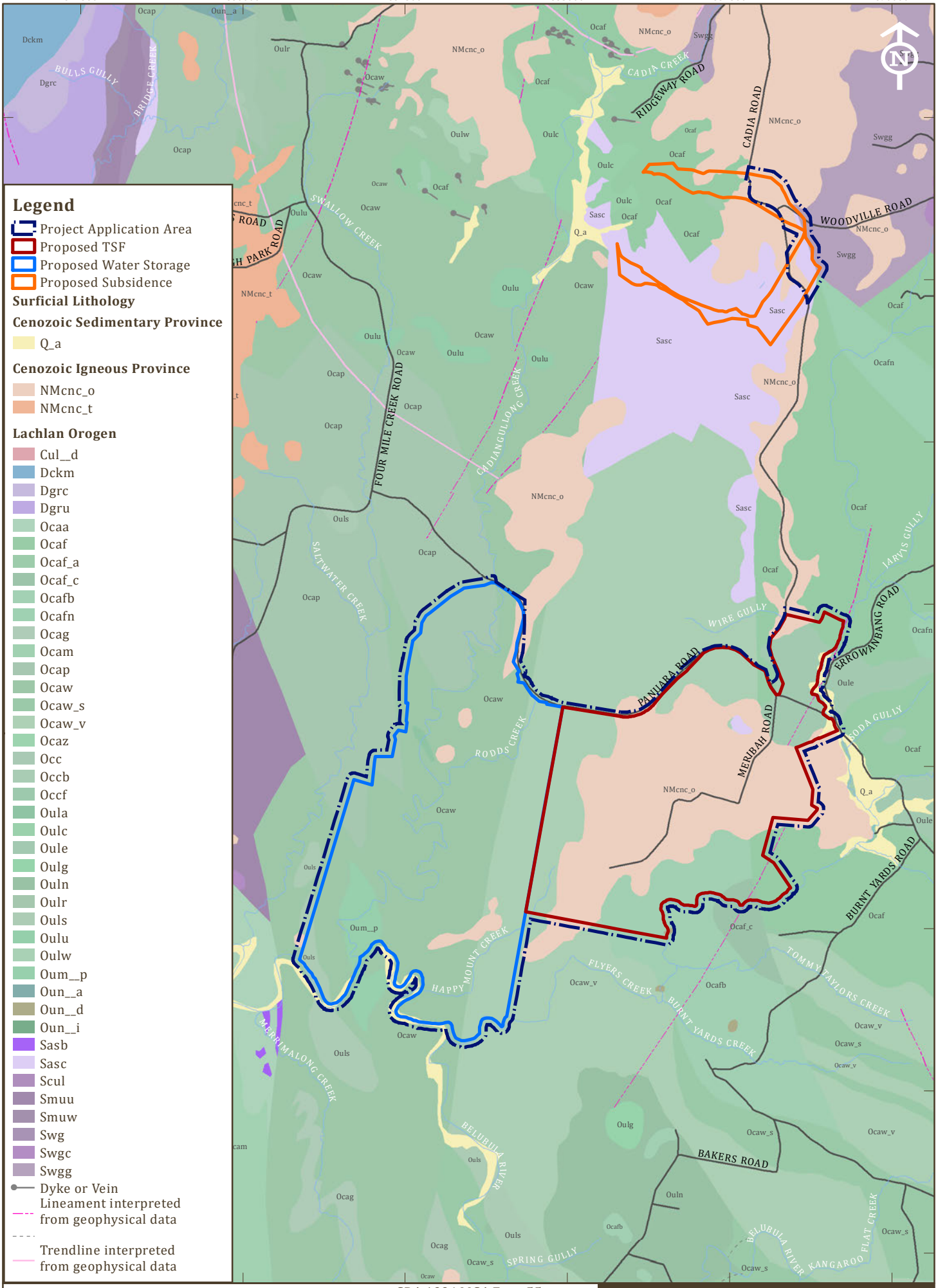
There are two separate areas of regionally mapped BSAL within the PAA (refer to **Figure 1**). Approximately 6 ha occurs in the northern most section of the proposed water storage domain, and approximately 25 ha occurs in the north east portion of the proposed subsidence area. Additionally, regionally mapped BSAL occurs sporadically throughout the Project locality, with significant extents of mapping located to the north and north east of the PAA between Orange and the PAA.

2.7 LAND USE

The dominant land uses in the area include mining and agricultural activities in the form of cultivation and grazing on improved/native pastures. An extensive portion of the region to the east and north of the PAA has designation as State Forest.

The PAA that comprises the proposed SSTSF and the proposed water storage areas is used for agricultural production purposes, primarily grazing and occasional cropping. As a result, the majority of the PAA is characterised by previously disturbed and largely cleared agricultural land. Some sparse patches of remnant woodland vegetation are located on low hills, with scattered paddock trees occurring across the land.

A section of the proposed subsidence domain of the PAA lies within the Canobolas State Forest which is dominated by pine plantation, with the remaining area comprising remnant native bushland or land previously disturbed by mining activity.



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

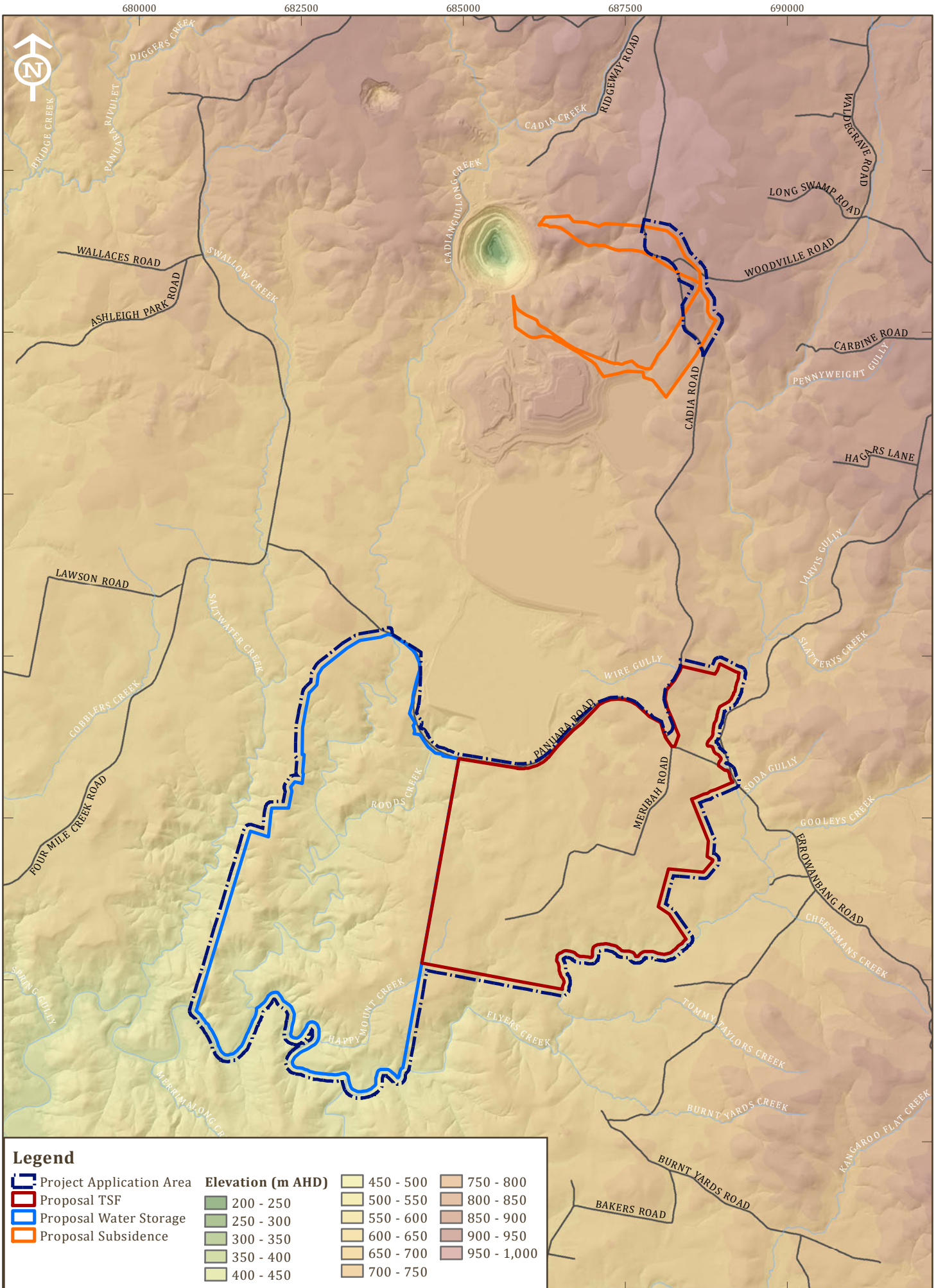
0 0.5 1 2 Kilometers

Scale 1:75000 at A4

Surficial Geology

FIGURE 3

E:\RST002_MineSoils\MS051_Cadia\MS051_011_Geology.mxd 2/11/2021 10:27:56 PM

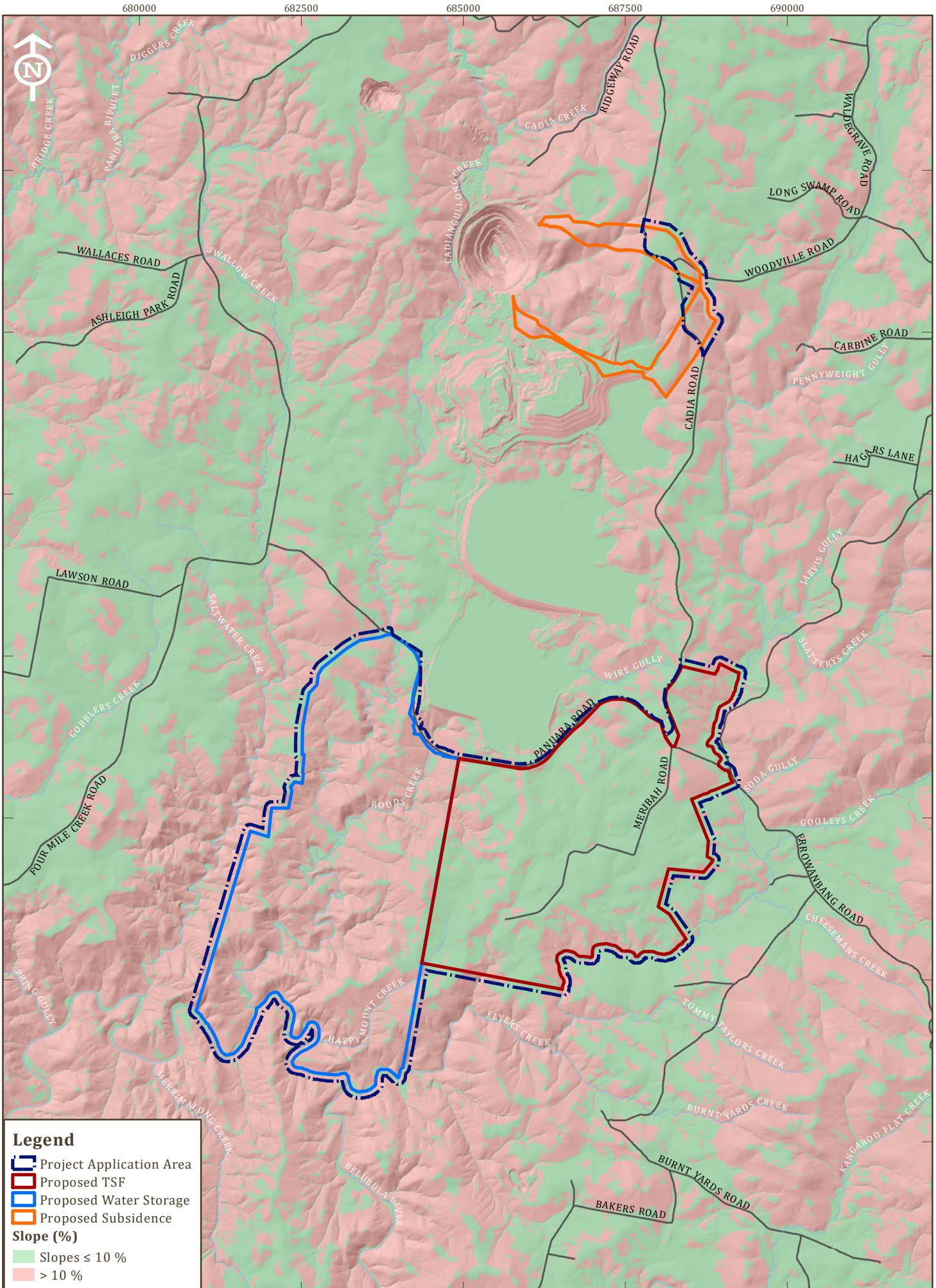


MINESOILS
LAND & REHABILITATION SPECIALISTS

Topography

FIGURE 4

E:\RST002_MineSoils\MS051_Cadia\MS051_012_Topography.mxd 2/11/2021 10:27:13 PM



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

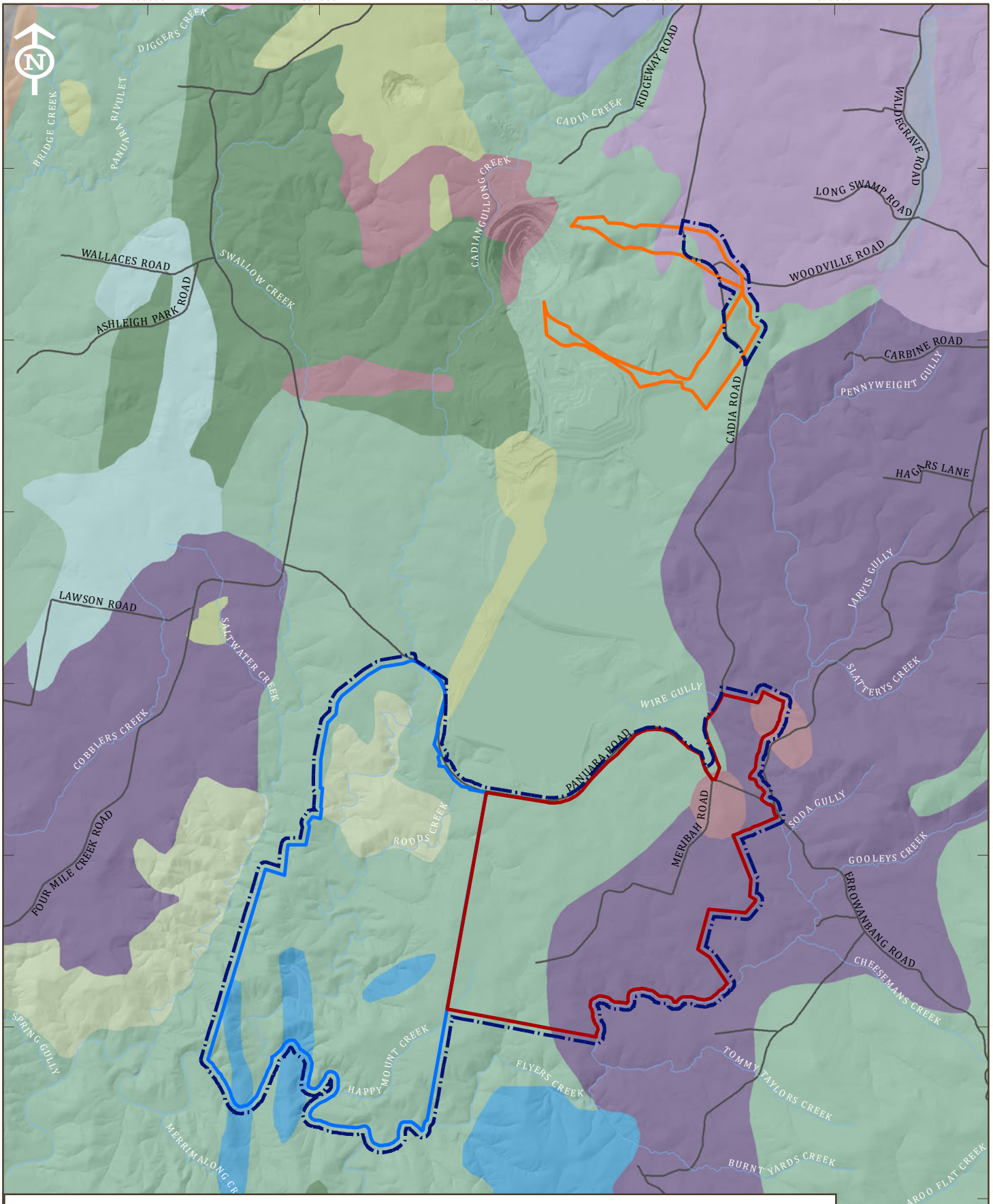
0 0.5 1 2 Kilometers

Scale 1:75000 at A4

Slope Analysis

FIGURE 5

E:\RST002_MineSoils\MS051_Cadia\MS051_013_Slope.mxd 2/11/2021 10:33:36 PM



Legend

- Project Application Area
- Proposal TSF
- Proposal Water Storage
- Proposal Subsidence

Soil Landscapes (Central Eastern NSW v2.1)

- Black Rock
- Borenore-Lyndhurst
- Brinsley
- Canobolas
- Catombal
- Lees Mountain
- Macquarie
- Panuara
- Pinnacle
- Quarry
- Razorback
- Spring Hill
- Stoke-Burnt Yards
- Towac
- Turonfels
- Vittoria-Blayney

GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

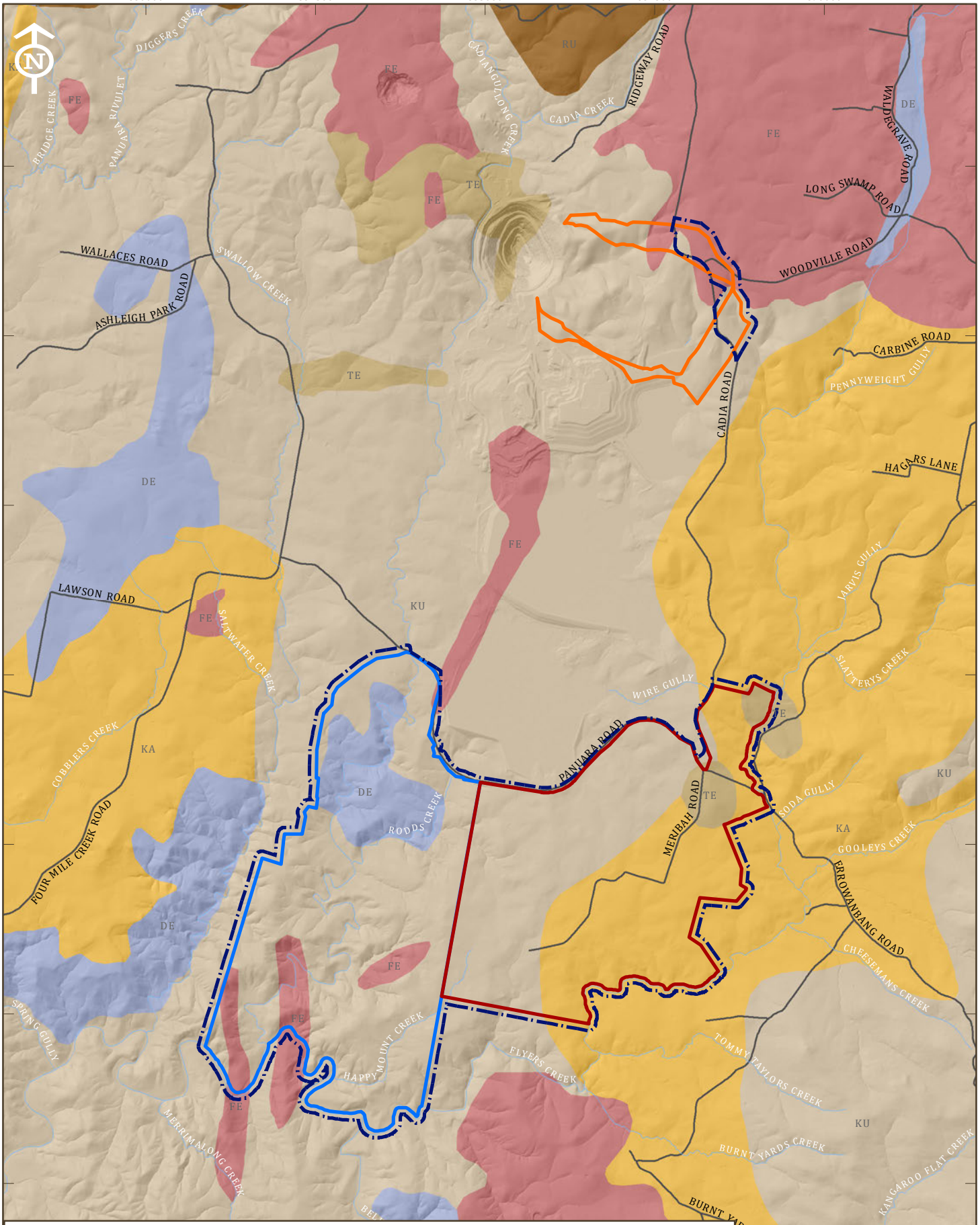
0 0.5 1 2 Kilometers

Scale 1:75000 at A4

Soil Landscapes

FIGURE 6

E:\RST002_MineSoils\MS051_Cadia\MS051_014_SoilLandscapes.mxd 2/11/2021 10:32:32 PM



Legend

- Project Application Area
- Proposed TSF
- Proposed Water Storage
- Proposed Subsidence

Dominant Australian Soil Classification (ASC) - Order

- Dermosols (DE)
- Ferrosols (FE)
- Kandosols (KA)
- Kurosols (KU)
- Rudosols (RU)
- Tenosols (TE)

GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

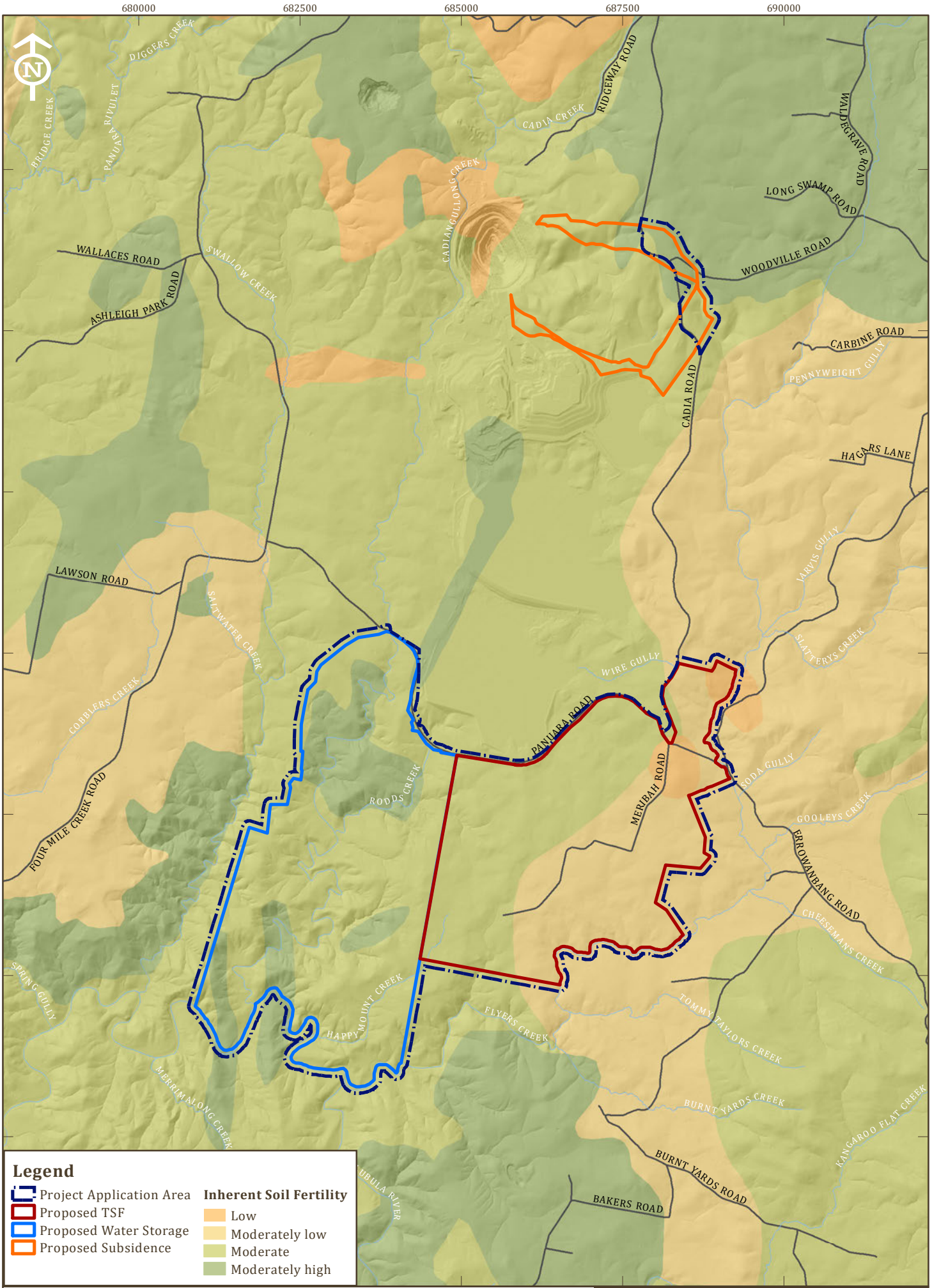
0 0.5 1 2 Kilometers

Scale 1:75000 at A4

Australian Soil Classification

FIGURE 7

E:\RST002_MineSoils\MS051_Cadia\MS051_015_ASC_SoilTypes.mxd 2/11/2021 10:33:25 PM



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

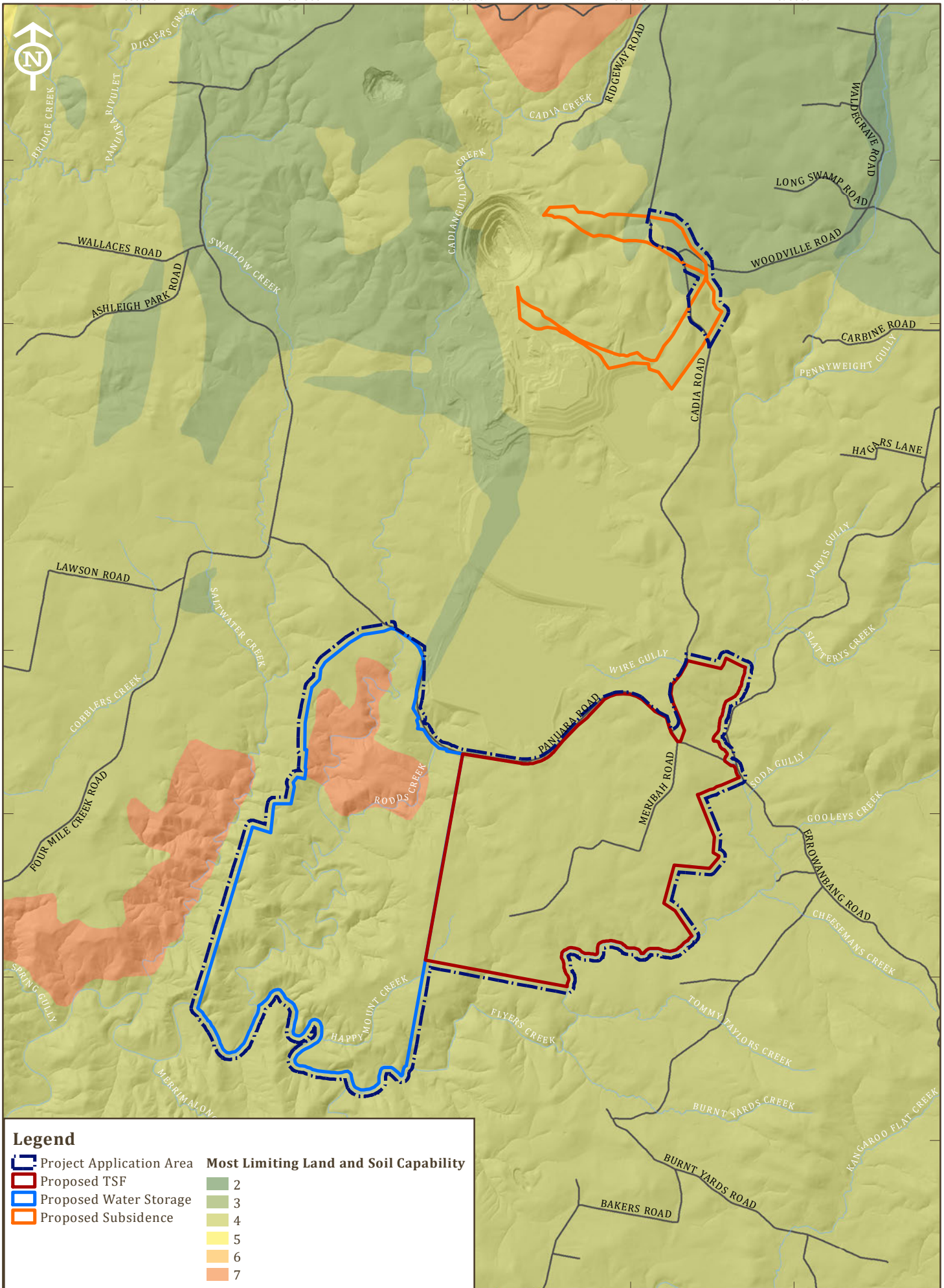
0 0.5 1 2 Kilometers

Scale 1:75000 at A4

Inherent Soil Fertility

FIGURE 8

E:\RST002_MineSoils\MS051_Cadia\MS051_016_InherentFertility.mxd 2/11/2021 10:34:23 PM



MINESOILS
LAND & REHABILITATION SPECIALISTS

Land and Soil Capability

FIGURE 9

E:\RST002_MineSoils\MS051_Cadia\MS051_017_LSC.mxd 2/11/2021 10:36:17 PM

3 THE BSAL ASSESSMENT PROCESS

BSAL is land with a rare combination of natural resources highly suitable for agriculture. These lands intrinsically have the best quality landforms, soil and water resources which are naturally capable of sustaining high levels of productivity and require minimal management practices to maintain this high quality.

The criteria used to measure BSAL under the original *Strategic Regional Land Use Plan* (SRLUP) (DP&I, 2012) were based on three regional scale parameters:

1. Soil Fertility – based on the regional scale *Draft Inherent General Fertility of NSW* (DP&I, 2012),
2. Land and Soil Capability – based on the regional scale *Land and Soil Capability Mapping of NSW* (OEH, 2012), and
3. Access to reliable water supply.

The application of the Strategic Agricultural Land mapping is to 'trigger' the Gateway Process for new project development applications.

The *State Environmental Planning Policy (Resources and Energy) 2021* (Resources SEPP) requires certain types of developments (i.e. mining or petroleum developments) to verify whether the proposed development is on BSAL. The Interim Protocol assists proponents and landholders to understand what is required to identify the existence of BSAL and outlines the technical requirements for the on-site identification and mapping of BSAL.

4 METHODOLOGY

The methodology reported in the following section has been undertaken based on the Interim Protocol (OEH and DPI-OAS&FS, 2013).

Step 1: Identify the project area which will be assessed for BSAL

"The assessment area should include the entire project area and include at least a 100 m buffer to take into account minor changes in design, surrounding disturbance and minor expansion. If BSAL is part of a larger contiguous mass of BSAL then the boundary of this area must also be identified".

The PAA is 3,513 ha, inclusive of a 100m buffer surrounding the potential disturbance areas to account for minor changes in design in accordance with the Interim Protocol, as shown in **Figure 2**.

Step 2: Confirm access to a reliable water supply

"BSAL lands must have access to a "reliable water supply".

Representative rainfall data for the area has been obtained from the closest Commonwealth Bureau of Meteorology (BoM) weather stations to the Activity Area; the Orange Airport Automatic Weather Station (AWS) (063303) and Orange Agricultural Institute (063254). Mean annual rainfall is approximately 881.9 millimetres (mm) at the Orange Airport AWS and approximately 906.5 mm at the Orange Agricultural Institute. This rainfall is above the criteria threshold of 350 mm per year, and therefore the site has access to a reliable water supply.

Step 3: Choose the appropriate approach to map the soils information

Access to the project area will define the level of investigation that the proponent can undertake. If the proponent has access to the land then the BSAL verification requirements for on-site soils assessment as described in sections 6 and 9 of the Interim Protocol should be met. If the proponent does not have access then the proponent should develop a model of soils distribution guided by sections 6 and 9 based on landscape characteristics using the information below.

…

It is important to note that for either approach, if any criteria indicate that the site is not BSAL, then no further assessment is necessary. The flow chart in Figure 2 is designed to assess the simplest criteria first, to avoid more costly assessments if the site can be easily discounted as BSAL.

The Proponent has access to the site for the purposes of site verification of BSAL.

Step 4: Risk assessment

The proponent should undertake a risk assessment as this will influence the density of soil sampling required as explained in Section 9.6.1. The proposed activity on parts or all of the project area may be of low risk to agriculture and so may only require a sampling density of 1:100 000. Alternatively, other areas may be at higher risk of impact and so should have a sampling density of 1:25 000.

To identify the potential for the Project to impact on agricultural resources and the appropriate level of soil survey required, an evaluation of risk to agricultural resources and enterprises was undertaken. This risk assessment is taken from the *Guideline for Agricultural Impact Statements at the Exploration Stage* (DTIRIS, 2012) and is based on the probability of occurrence and the consequence of the impact, as described in the *Land Use Conflict Risk Assessment Guide* (NSW DPI 2011). Depending on the risk, inspection densities can range from 1 site per 25-400 ha for low risk to 1 site per 5-25 ha for high risk (Gallant *et al*.2008) (Refer **Table 1**, **Table 2** and **Table 3**).

Table 1: Agricultural Impacts Risk Ranking Matrix

Consequence		Probability				
		A Almost Certain	B Likely	C Possible	D Unlikely	E Rare
1	Severe and/or permanent damage. Irreversible impacts.	A1	B1	C1	D1	E1
2	Significant and /or long-term damage. Long term management implications. Impacts difficult or impractical to reverse.	A2	B2	C2	D2	E2
3	Moderate damage and/or medium-term impact to agricultural resources or industries. Some ongoing management implications which may be expensive to implement. Minor damage or impacts over the long term.	A3	B3	C3	D3	E3
4	Minor damage and/or short-term impact to agricultural resources or industries. Can be managed as part of routine operations.	A4	B4	C4	D4	E4
5	Very minor damage and minor impact to agricultural resources or industries. Can be effectively managed as part of normal operations.	A5	B5	C5	D5	E5

Low Risk

Medium Risk

High Risk

Source: Interim Protocol Appendix 3 Risk Assessment (OEH 2013)

Table 2: Agricultural Impact Risk Ranking – Probability Descriptors

Level	Descriptor	Description
A	Almost certain	Common or repeating occurrence
B	Likely	Known to occur or it has happened
C	Possible	Could occur or I've heard of it happening
D	Unlikely	Could occur in some circumstances but not likely to occur
E	Rare	Practically impossible or I've never heard of it happening

Source: Interim Protocol Appendix 3 Risk Assessment (OEH 2013)

Table 3: Agricultural Impact Risk Ranking – Consequence Descriptors

Consequence	Description	Example of Implications
Level: 1 Severe	Severe and/or permanent damage to agricultural resources, or industries Irreversible Severe impact on the community	Long term (eg. 20 years) damage to soil or water resources Long term impacts (eg. 20 years) on a cluster of agricultural industries or Important agricultural lands
Level: 2 Major	Significant and/or long-term impact to agricultural resources, or industries Long-term management implications Serious detrimental impact on the community	Water or soil impacted, possibly in the long term (eg. 20 years) Long term (eg. 20 years) displacement / serious impacts on agricultural industries
Level: 3 Moderate	Moderate and/or medium-term impact to agricultural resources, or industries Some ongoing management implications Minor damage or impacts but over the long term.	Water or soil known to be affected, probably in the short – medium term (eg. 1-5 years) Management could include significant change of management needed to agricultural enterprises to continue.
Level: 4 Minor	Minor damage and/or short-term impact to agricultural resources, or industries Can be effectively managed as part of normal operations	Theoretically could affect the agricultural resource or industry in short term, but no impacts demonstrated Minor erosion, compaction or water quality impacts that can be mitigated. For example, dust and noise impacts in a 12-month period on extensive grazing enterprises.
Level: 5 Negligible	Very minor damage or impact to agricultural resources, or industries Can be effectively managed as part of normal operations	No measurable or identifiable impact on the agricultural resource or industry

Source: Interim Protocol Appendix 3 Risk Assessment (OEH 2013)

The proposed projects within the PAA are considered:

a. Consequence: Level 2 – Significant and/or long-term impact to agricultural resources, or industries. Long-term management implications. Serious detrimental impact on the community.

b. Probability: A – Almost Certain. Common or repeating occurrence.

The risk matrix result is A2 which is considered a high risk to agricultural activities. This area is therefore to have an inspection density of 1:25,000 which requires a minimum observation site every 25 ha within the PAA. For the purpose of this survey, the 100m buffer area is also considered to require an inspection density of 1:25,000.

Site assessment of slope gradients was undertaken using a digital elevation model, which show gradients greater than 10% (as shown in **Figure 5**). This area of 1,891 ha was discounted from BSAL field assessment and verified Non-BSAL based on a desktop review. Contiguous areas of <20 ha within broader areas of slopes >10% cover a total area of 239 ha and were additionally discounted and verified as Non-BSAL. The remainder of the PAA consisting of area of 1,386 ha was subject to further BSAL assessment. This is known as the BSAL Assessment area. Therefore, the number of inspection sites required is a minimum of 56 sites to verify BSAL or Non-BSAL based on the soil types identified.

Step 4: Soils and landscape verification criteria

Ten site verification criteria have been identified, with the easy to measure criteria assessed first. Soil samples were collected and assessed in the field and laboratory. Analytical tests undertaken are listed in **Table 4** below. The ten site verification parameters are: slope; rock outcrop; surface rock fragments; gilgai; soil fertility (based on soil type); effective rooting depth to a physical barrier; soil drainage; soil pH; salinity; and effective rooting depth to a chemical barrier. For soil to be classified as BSAL at each representative site, it must meet all the criteria outlined in the flow chart shown in **Figure 10**. If any criteria are not met, the site is not BSAL and there is no need to continue the assessment. The specific requirements for each parameter to be assessed is outlined in the Interim Protocol.

Site field assessment of slope gradients was undertaken using a hand-held clinometer to confirm the digital elevation model results.

Other exclusion parameters were assessed in the field, including rock outcrops, surface rock and the presence of gilgai. These were considered exclusion sites and no further parameters were recorded.

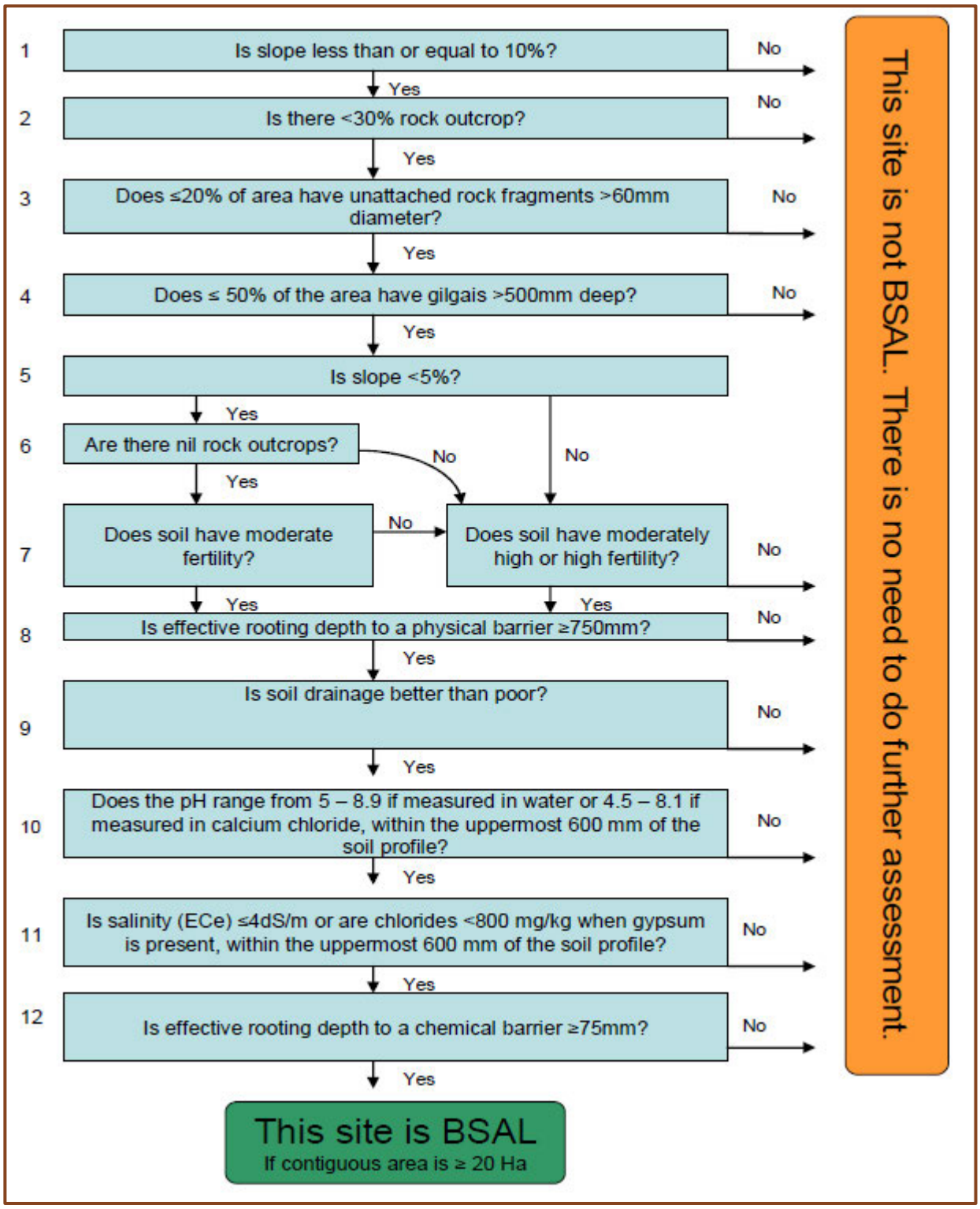
Existing regional soil and land information was considered to provide a background understanding of the area and has been mapped for the properties where access was prohibited.

The 1,386 ha area subject to field assessment is known as the BSAL assessment area and is shown on **Figure 11**. A field assessment was undertaken by Minesoils (Clayton Richards CPSS - Director & Principal Soil Scientist) between March and July 2021, with a total of 93 sites inspected, as shown on **Figure 12**. 90 sites were subjected to detailed test pits, with samples collected at 68 sites for laboratory analysis to confirm soil type and BSAL status. The remaining three sites were included as 'check' sites. (Note: sites labelled 'C' were from the initial fieldwork assessment of the proposed SSTSF domain, and sites labelled 'D' were from the follow up sitework that covered the proposed subsidence domain and the proposed water storage domain).

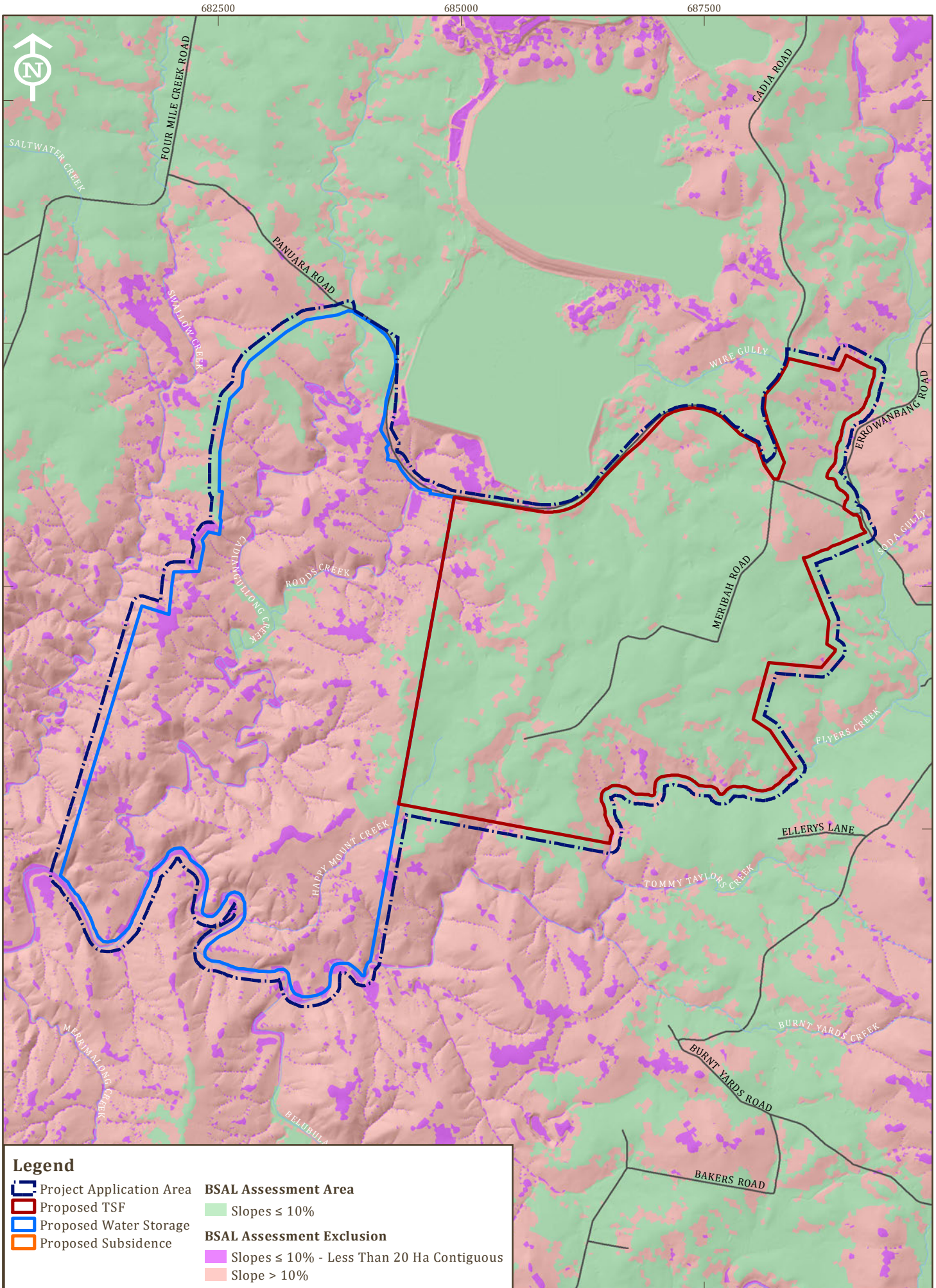
Table 4: Soil Sample Laboratory Analysis

Lab Analysis	
pH (1:5 water & CaCl)	Rayment & Lyons 2011-4A1
Electrical Conductivity (EC) and Chloride	Rayment & Lyons 2011-3A1
Cation Exchange Capacity (CEC) & ESP and Ca:Mg Ratio	Rayment & Lyons 2011-15J1
Particle Size Analysis (PSA) (Selected samples only)	ISSS Hydrometer plus 0.2 and 2.0 mm Sieving (CSIRO 'Yellow Book')

Figure 10: Schematic diagram of BSAL site verification criteria



Source: Interim Protocol (OEH 2013)



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

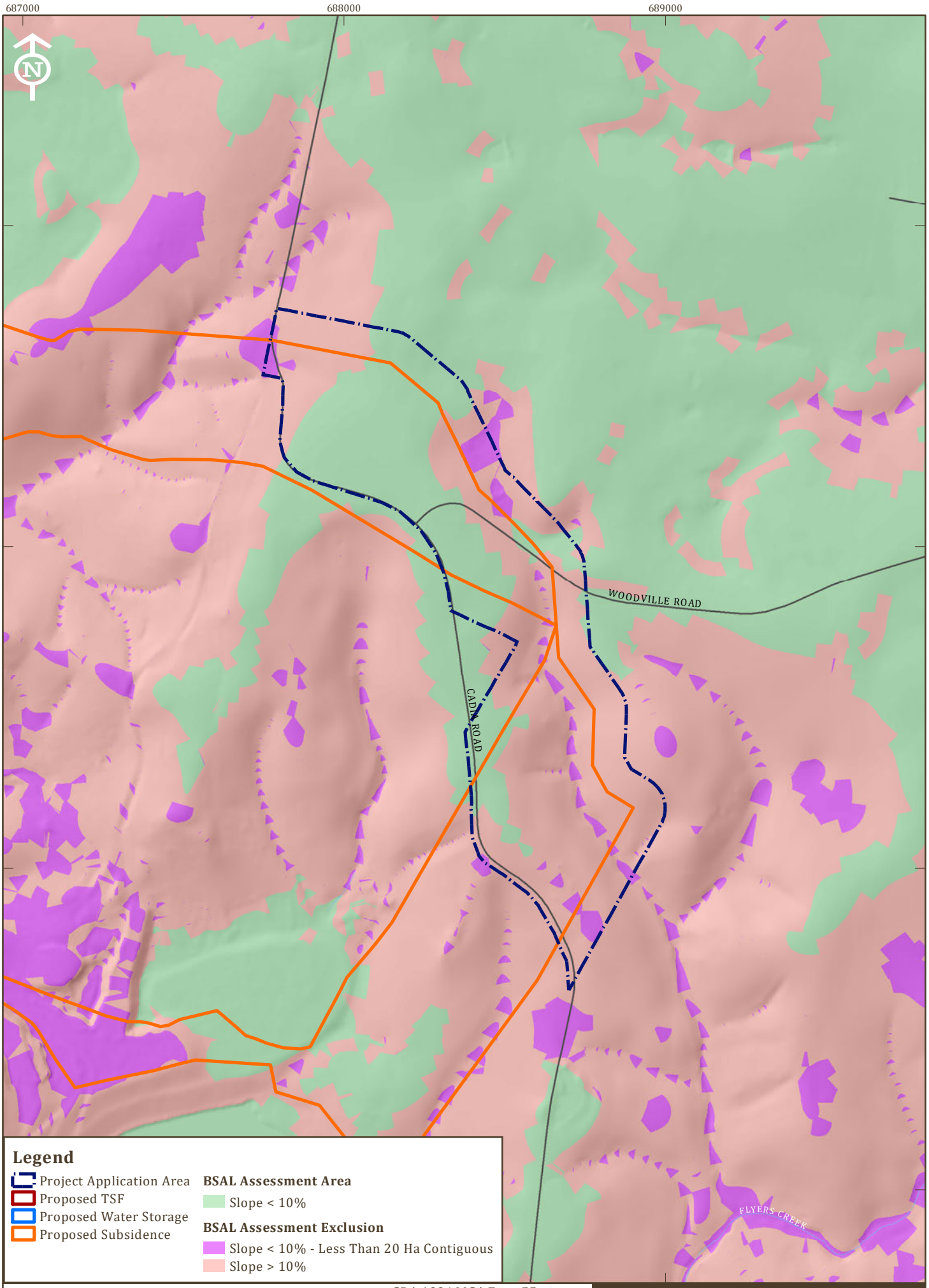
0 250 500 1,000 Meters

Scale 1:50000 at A4

BSAL Assessment Area

FIGURE 11A

E:\RST002_MineSoils\MS051_Cadia\MS051_018_BSALAssessmentA.mxd 2/11/2021 10:42:19 PM



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

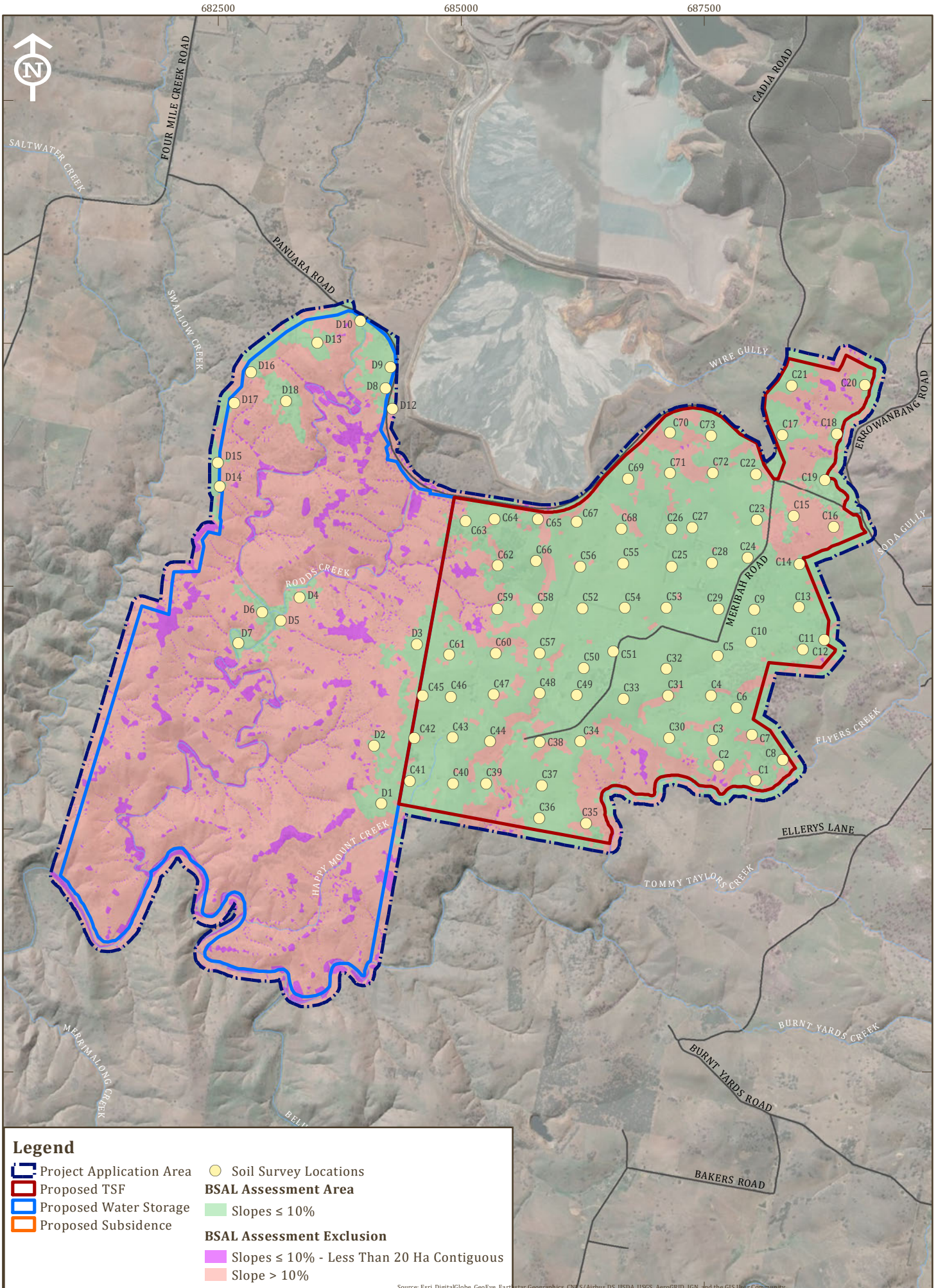
0 50 100 200 Meters

Scale 1:15000 at A4

BSAL Assessment Area

FIGURE 11B

E:\RST002_MineSoils\MS051_Cadia\MS051_019_BSALAssessmentB.mxd 2/11/2021 10:49:29 PM



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

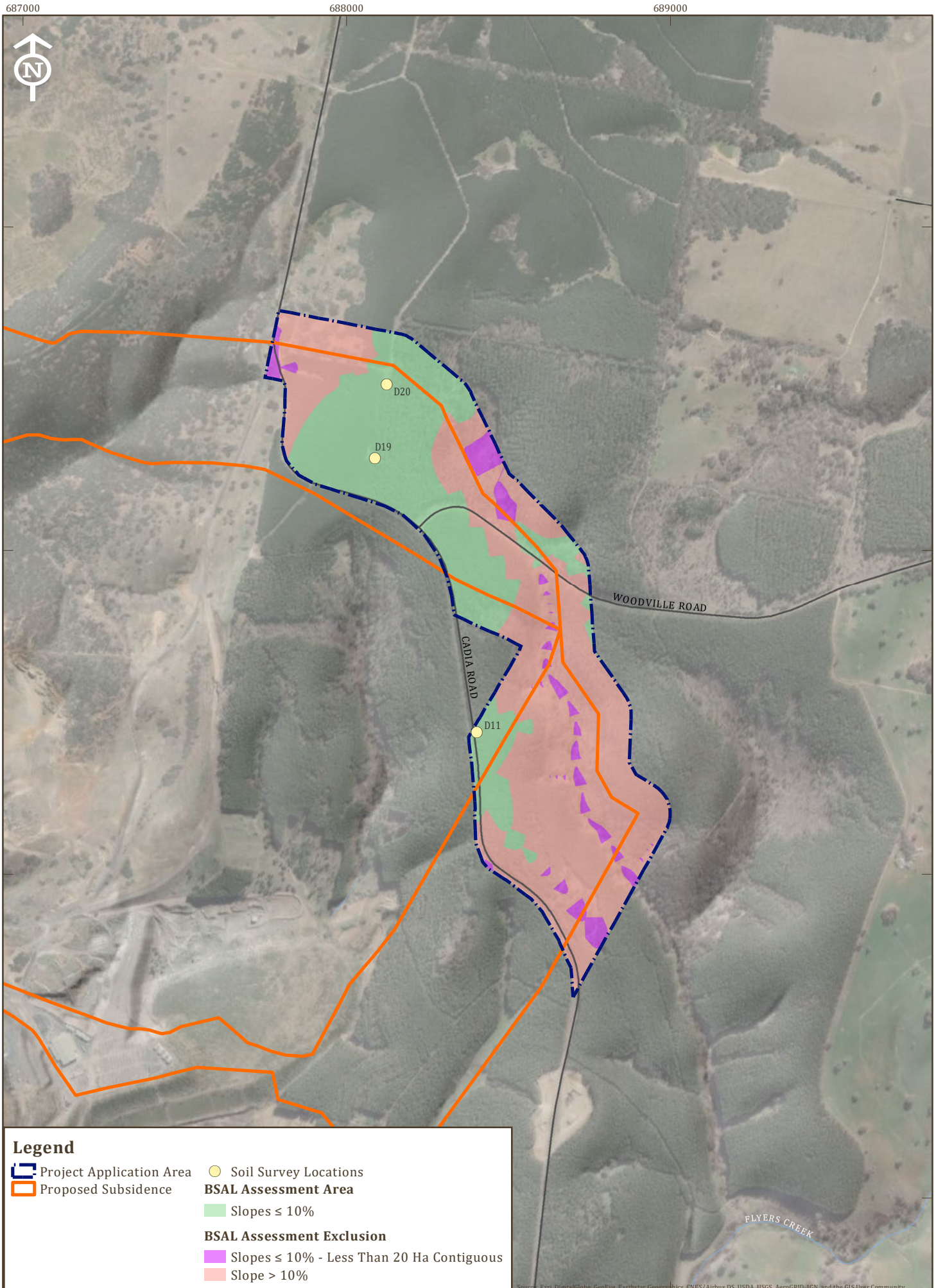
0 250 500 1,000 Meters

Scale 1:50000 at A4

Soil Survey Locations

FIGURE 12A

E:\RST002_MineSoils\MS051_Cadia\MS051_020_SiteLocationsA.mxd 2/11/2021 10:52:48 PM



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

Meters
0 50 100 200
Scale 1:15000 at A4

Soil Survey Locations

FIGURE 12B

E:\RST002_MineSoils\MS051_Cadia\MS051_021_SiteLocationsB.mxd 2/11/2021 11:28:22 PM

5 RESULTS

5.1 BSAL VERIFICATION

The BSAL site verification assessment resulted in 52 sites satisfying the BSAL criteria. A further 41 sites failed to satisfy the requirements for BSAL (refer **Figure 13**). Therefore, BSAL is confirmed to be present within the PAA.

Verified BSAL occurs over an area of 825 ha within the PAA, with distribution shown of **Figure 14**. The remaining 2,691 ha of the PAA is verified Non-BSAL.

Table 5 details the BSAL verification assessment process and summaries limiting factors for all eliminated sites.

5.2 SOIL MAPPING UNITS

Two soil mapping units were identified within the BSAL field assessment area of the PAA. The distribution of these soil mapping units is illustrated on **Figure 15**.

The soil mapping units consisted of the following:

- Soil Mapping Unit 1: Chromosols; and
- Soil Mapping Unit 2: Dermosols.

An overview of each of the soil mapping units is presented below.

Soil Mapping Unit 1: Chromosols

There is a broad association between this soil mapping unit and verified BSAL. This mapping unit is the most spatially extensive within the BSAL field assessment area of the PAA, covering an area of 736 ha.

Representative dominant soil types include a range of texture contrast soils with B horizons that are not strongly acid or sodic and often with vertic properties: These are Vertic Eutrophic Brown Chromosols (C2, C3, C4, C6, C21, C22, C29, C40, C49, C68, C73, D1), Vertic Eutrophic Red Chromosols (C7, C26, C31, C54, C59, C61, C63, C64, D17), Vertic Eutrophic Black Chromosols (C42, C62, C66, D18), and Haplic Eutrophic Red Chromosols (C24, D8, D9, D12, D19, D20).

Representative sub-dominant soil types include a range of texture contrast soils (Chromosols) with minor occurrence of sodic subsoils (Sodosols). Additionally, some sub dominant soil types lacking a texture contrast occur within this mapping unit (Dermosols): These area Bleached Eutrophic Brown Chromosols (C36, C37) Mottled Eutrophic Brown Chromosol (C11), Manganic Subnatric Black Sodosol (C19), Bleached-Mottled Eutrophic Brown Chromosol (C20) Manganic Eutrophic Brown Chromosol (C25) Mottled Eutrophic Red Chromosol (C39), Eutrophic Subnatric Brown Sodosol (C28) Bleached-Sodic Eutrophic Brown Chromosol (41), Manganic Subnatric Grey Sodosol (C43) Vertic Eutrophic Yellow Chromosol (C52), Vertic Mesotrophic Brown Chromosol (C53), Haplic Eutrophic Brown Chromosol (C60), Vertic Eutrophic Brown Dermosol (C50), Manganic Mottled-Subnatric Grey Sodosol (C51) and Haplic Eutrophic Red Dermosol (C12).

The primary limitations associated with this mapping unit where the BSAL criteria has not been met include slope, pH, drainage, and moderately low fertility.

The BSAL elimination of these sites is outlined in **Table 6** and details profile descriptions are included in **Appendix 2**.

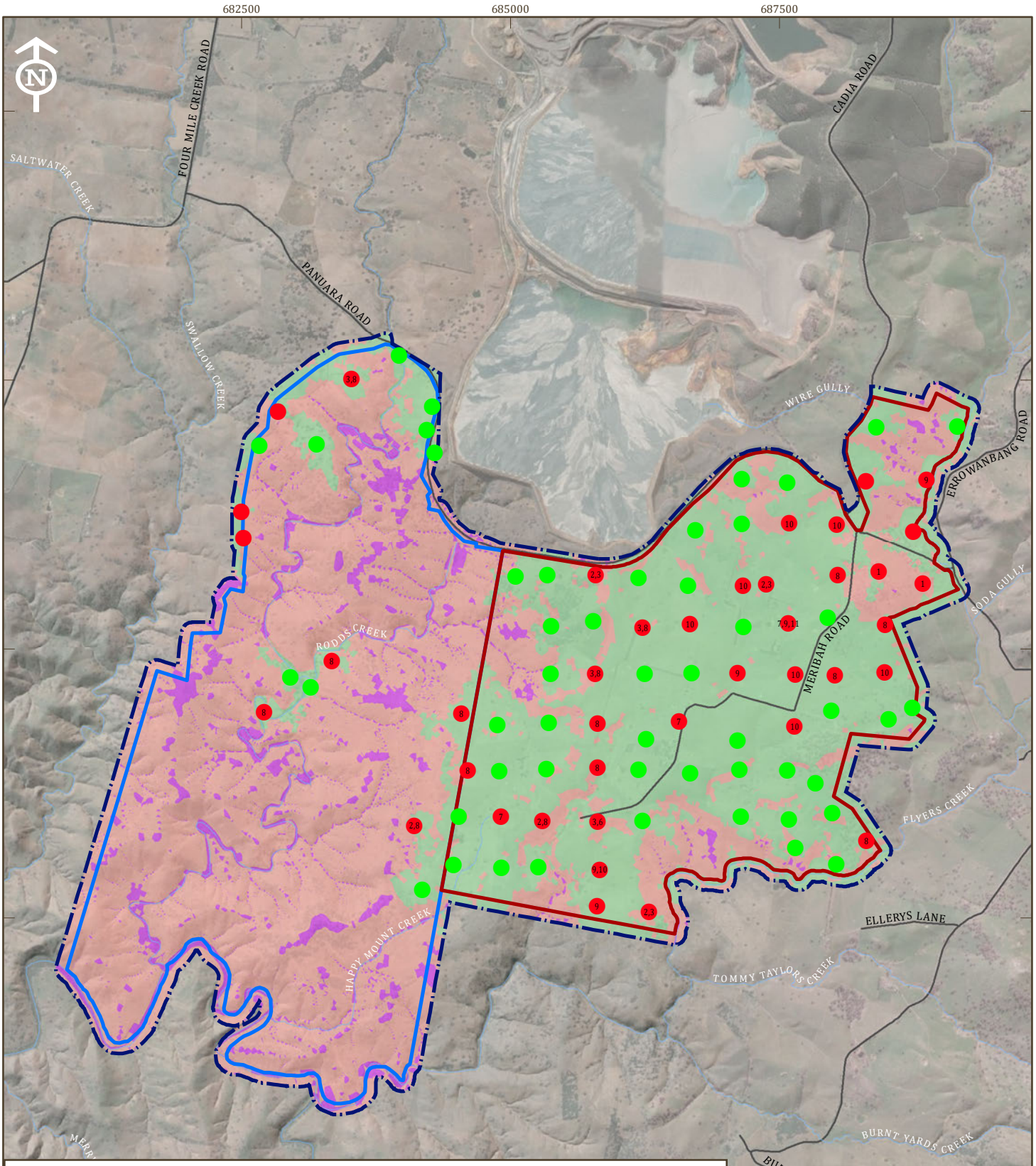
Soil Mapping Unit 2: Dermosols

There is a broad association between this soil mapping unit and verified Non-BSAL. This mapping unit is the least spatially extensive across the BSAL field assessment area of the PAA and covers an area of 651 ha. Representative dominant soil types include a range of clay textured soils with moderate to strong pedality and lacking a texture contrast: These are Haplic Eutrophic Brown Dermosols (C1, C5, C10), Haplic Eutrophic Red Dermosols (C32, C33, C46, C47, D10, D11) and Vertic Eutrophic Red Dermosols (C70, C71, C72),

Representative sub-dominant soil types include a range of soils with weak to moderate pedality and lacking a texture contrast: These are Manganic Eutrophic Red Dermosol (C13, C34, C55), Haplic Eutrophic Black Kandosol (D5, D6), Vertic Eutrophic Black Dermosol (C18), Mottled Eutrophic Black Dermosol (C69), Haplic Epipedal Black Vertosol (C30). In addition, a series of Brown Vertosols were identified during the field assessment but were not further classified due to BSAL constraints superseding the requirement for laboratory analysis of samples (C8, C17, C48, C56, C57, C58).

The primary BSAL limitation associated with this unit are depth to a physical barrier, rockiness, and rock outcrops.

The BSAL constraints of all representative and non-representative sites is outlined in **Table 6**. Detailed profile descriptions of representative sites are included in **Appendix 2**.



Legend

- Project Application Area
- Proposed TSF
- Proposed Water Storage
- Proposed Subsidence

BSAL Assessment Area

- Slopes ≤ 10%

BSAL Assessment Exclusion

- Slopes ≤ 10% - Less Than 20 Ha Contiguous
- Slope > 10%

BSAL Assessment

- BSAL
- Non-BSAL

BSAL Limitations

1. Slope >10%
2. >30% Rock Outcrop
3. Rock Fragments
6. Rock Outcrop
7. Moderately Low Fertility
8. Shallow Soil Depth
9. Poor Drainage
10. pH <5.0
11. Salinity <4dS/m

GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

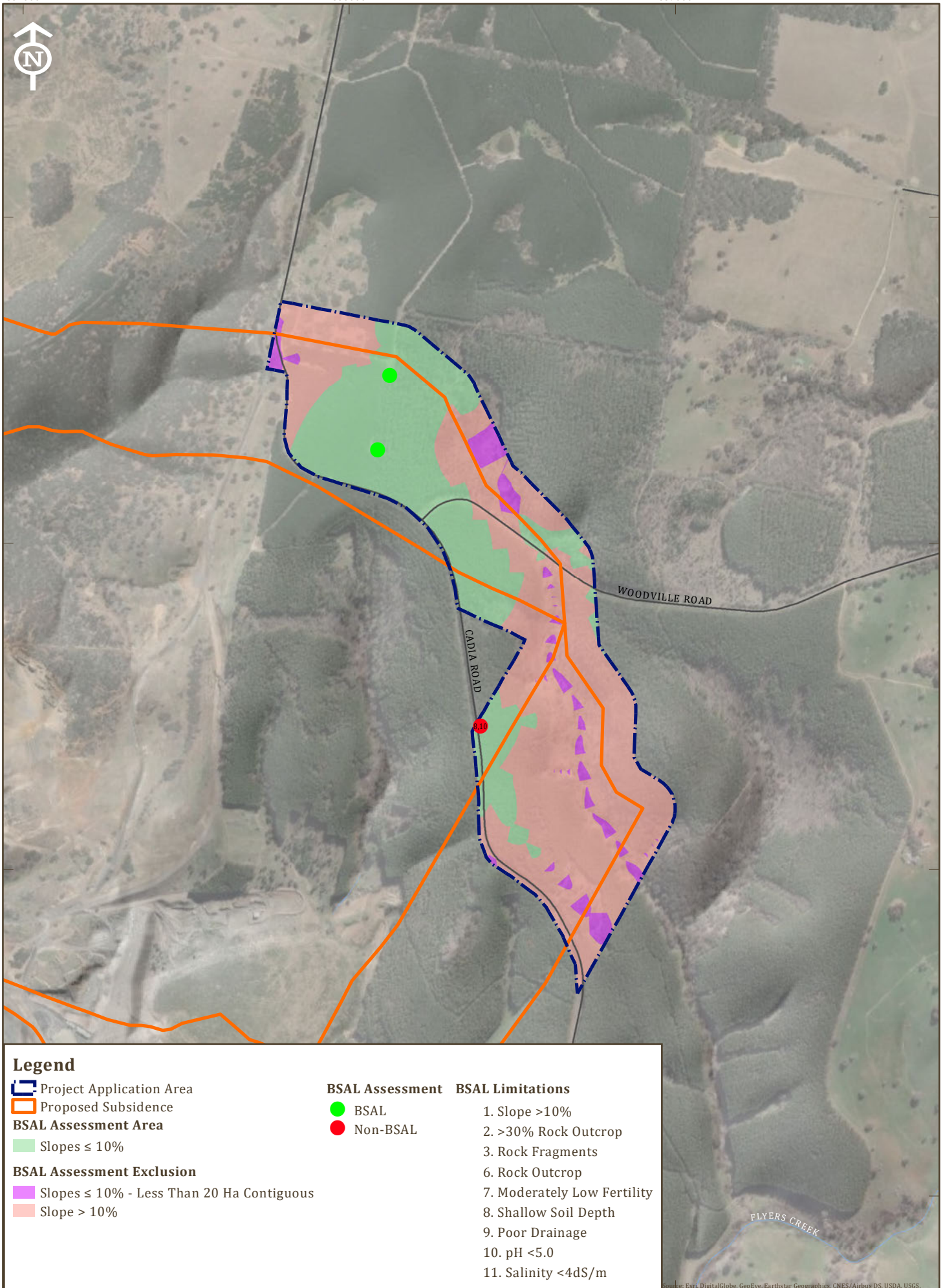
0 250 500 1,000 Meters

Scale 1:50000 at A4

BSAL Assessment

FIGURE 13A

E:\RST002_MineSoils\MS051_Cadia\MS051_022_BSAL_A.mxd 2/11/2021 11:29:33 PM



Legend

Project Application Area
Proposed Subsidence

BSAL Assessment Area

Slopes ≤ 10%

BSAL Assessment Exclusion

Slopes ≤ 10% - Less Than 20 Ha Contiguous
Slope > 10%

BSAL Assessment

BSAL
Non-BSAL

BSAL Limitations

1. Slope >10%
2. >30% Rock Outcrop
3. Rock Fragments
6. Rock Outcrop
7. Moderately Low Fertility
8. Shallow Soil Depth
9. Poor Drainage
10. pH <5.0
11. Salinity <4dS/m

GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

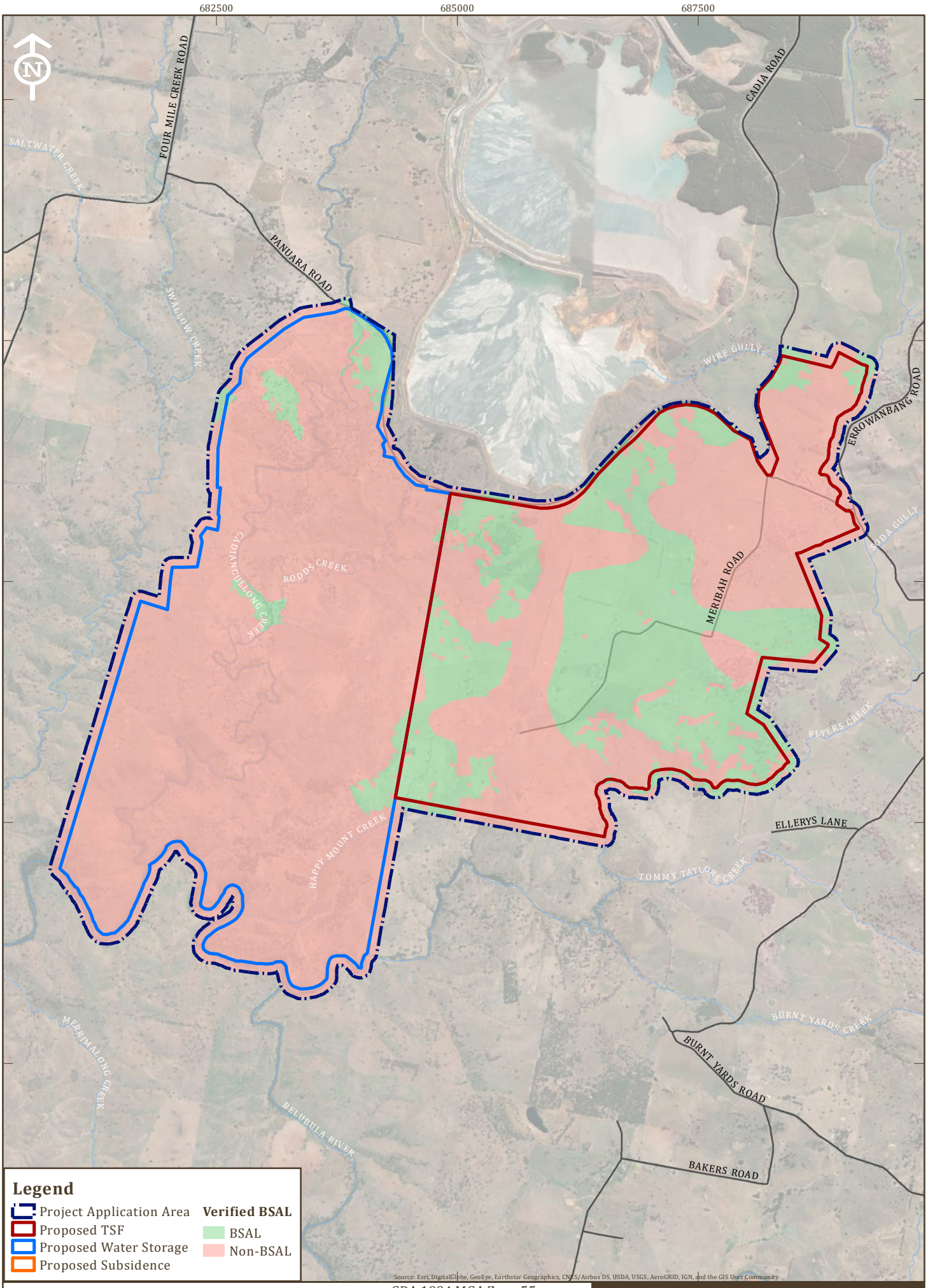
0 50 100 200 Meters

Scale 1:15000 at A4

BSAL Assessment

FIGURE 13B

E:\RST002_MineSoils\MS051_Cadia\MS051_023_BSAL_B.mxd 2/11/2021 11:30:10 PM



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

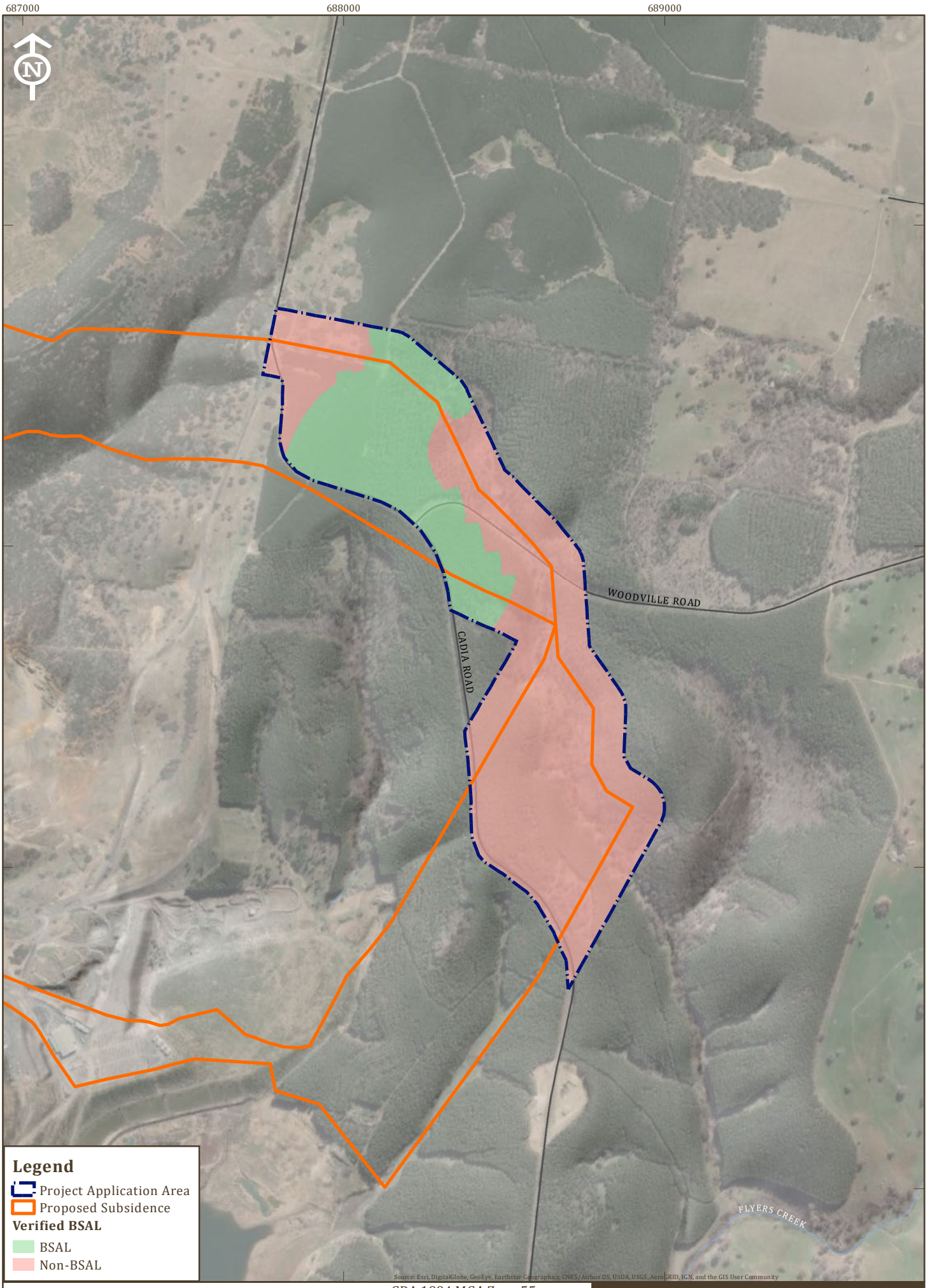
0 250 500 1,000 Meters

Scale 1:50000 at A4

Verified BSAL

FIGURE 14A

E:\RST002_MineSoils\MS051_Cadia\MS051_024_VerifiedBSAL_A.mxd 2/11/2021 11:32:42 PM



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

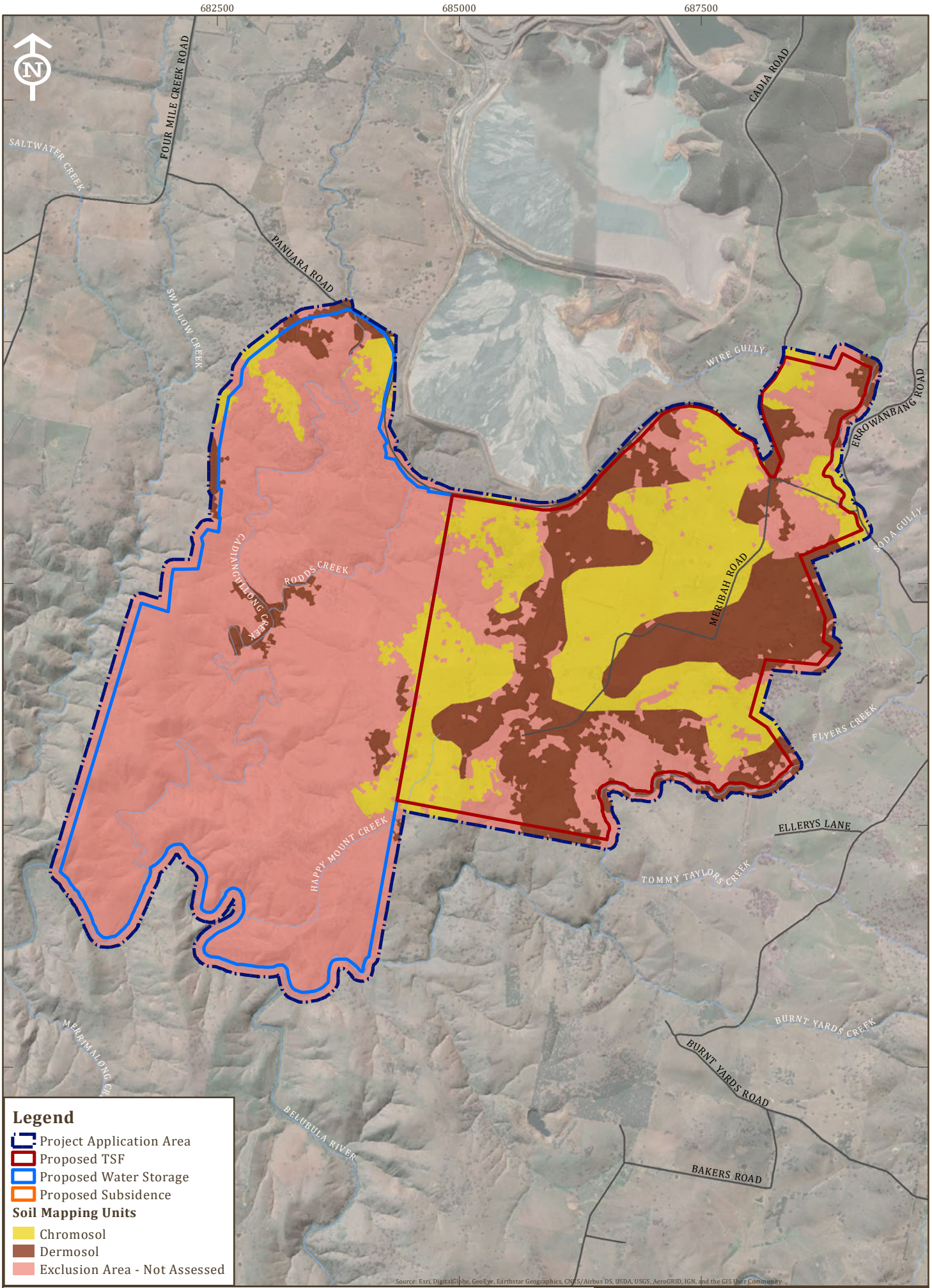
0 50 100 200 Meters

Scale 1:15000 at A4

Verified BSAL

FIGURE 14B

E:\RST002_MineSoils\MS051_Cadia\MS051_025_VerifiedBSAL_B.mxd 2/11/2021 11:33:48 PM



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

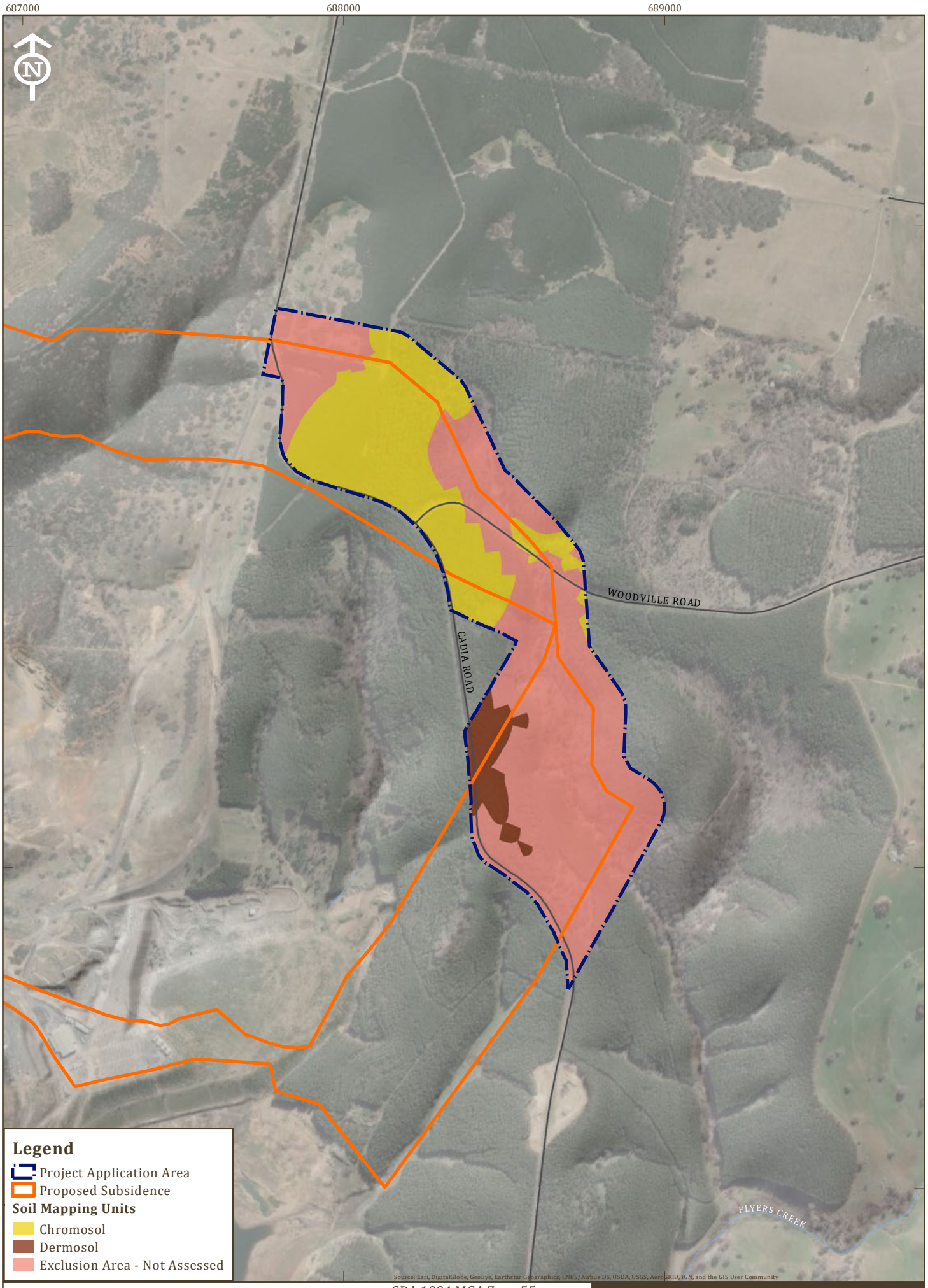
0 250 500 1,000 Meters

Scale 1:50000 at A4

Soil Mapping Units

FIGURE 15A

E:\RST002_MineSoils\MS051_Cadia\MS051_026_SoilUnits_A.mxd 2/11/2021 11:33:20 PM



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

Meters
0 50 100 200
Scale 1:15000 at A4

Soil Mapping Units

FIGURE 15B

E:\RST002_MineSoils\MS051_Cadia\MS051_027_SoilUnits_B.mxd 2/11/2021 11:34:15 PM

Table 5: Site BSAL Verification Summary

Site #	Inspection Site Type	Mapping Unit		Soil Profile - Australian Soil Classification (ASC)	ASC Family Criteria	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate Fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9?	11. Is salinity (ECe) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Soil Profile BSAL Verification	Limiting Factors
		#	Name																	
C1	Detailed	2	Dermosols	Haplic Eutrophic Brown Dermosol	BFLMW	✓	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C2	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BEMOW	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C3	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BFMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C4	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BELOW	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C5	Detailed	2	Dermosols	Haplic Eutrophic Brown Dermosol	BELOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✓	✓	Non-BSAL	10. pH <5.0
C6	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BFMOW	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C7	Detailed	1	Chromosols	Vertic Eutrophic Red Chromosol	BEMOW	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C8	Detailed	2	Dermosols	Red Vertosol	-	✓	✓	✓	✓	✓	✓	-	-	✘	✓	-	-	-	Non-BSAL	8. Shallow Soil Depth
C9	Detailed	2	Dermosols	Brown Dermosol	-	✓	✓	✓	✓	✓	✓	-	-	✘	✓	-	-	-	Non-BSAL	8. Shallow Soil Depth
C10	Detailed	2	Dermosols	Haplic Eutrophic Brown Dermosol	BELOV	✓	✓	✓	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	BSAL	-
C11	Detailed	1	Chromosols	Mottled Eutrophic Brown Chromosol	BHLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C12	Detailed	1	Chromosols	Haplic Eutrophic Red Dermosol	BELOW	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C13	Detailed	2	Dermosols	Manganic Eutrophic Red Dermosol	BEMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✓	✓	Non-BSAL	10. pH <5.0
C14	Detailed	2	Dermosols	Brown Dermosol	-	✓	✓	✓	✓	✓	✓	-	-	✘	✓	-	-	-	Non-BSAL	8. Shallow Soil Depth
C15	Check	1	Chromosols	-	-	✘	✓	✓	✓	✘	✓	-	-	✓	✓	-	-	-	Non-BSAL	1. Slope >10%
C16	Detailed	1	Chromosols	Brown Chromosol	-	✘	✓	✓	✓	✘	✓	-	-	-	-	-	-	-	Non-BSAL	1. Slope >10%
C17	Detailed	2	Dermosols	Brown Vertosol	-	✓	✘	✘	✓	✓	✘	-	-	✘	✓	-	-	-	Non-BSAL	2. >30% Rock Outcrop 3. Rock Fragments 8. Shallow Soil Depth

Site #	Inspection Site Type	Mapping Unit		Soil Profile - Australian Soil Classification (ASC)	ASC Family Criteria	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate Fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9?	11. Is salinity (ECe) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Soil Profile BSAL Verification	Limiting Factors
		#	Name																	
C18	Detailed	2	Dermosols	Vertic Eutrophic Black Dermosol	BFMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✓	✓	✓	Non-BSAL	9. Poor Drainage
C19	Detailed	1	Chromosols	Manganic Subnatric Black Sodosol	BELOW	✓	✓	✓	✓	✓	✓	✘	✘	✓	✘	✓	✘	✘	Non-BSAL	7. Moderately Low Fertility 9. Poor Drainage 11. Salinity <4dS/m
C20	Detailed	1	Chromosols	Bleached-Mottled Eutrophic Brown Chromosol	BFKOW	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C21	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BFLOW	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C22	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BELOW	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✘	✓	✓	Non-BSAL	10. pH <5.0
C23	Detailed	2	Dermosols	Brown Dermosol	-	✓	✓	✓	✓	✓	✓	-	-	✘	✓	-	-	-	Non-BSAL	8. Shallow Soil Depth
C24	Detailed	1	Chromosols	Haplic Eutrophic Red Chromosol	BEMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C25	Detailed	1	Chromosols	Manganic Eutrophic Brown Chromosol	BFOOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C26	Detailed	1	Chromosols	Vertic Eutrophic Red Chromosol	BFLOV	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✓	✓	Non-BSAL	10. pH <5.0
C27	Check	1	Chromosols	-	-	✓	✘	✘	✓	✓	✘	-	-	✓	✓	-	-	-	Non-BSAL	2. >30% Rock Outcrop 3. Rock Fragments
C28	Detailed	1	Chromosols	Eutrophic Subnatric Brown Sodosol	BFLOW	✓	✓	✓	✓	✓	✓	✘	✘	✓	✘	✓	✓	✓	Non-BSAL	7. Moderately Low Fertility 9. Poor Drainage
C29	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BEMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✓	✓	Non-BSAL	10. pH <5.0
C30	Detailed	2	Dermosols	Haplic Epipedal Black Vertosol	ESSW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C31	Detailed	1	Chromosols	Vertic Eutrophic Red Chromosol	BFMOW	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C32	Detailed	2	Dermosols	Haplic Eutrophic Red Dermosol	BELOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C33	Detailed	2	Dermosols	Haplic Eutrophic Red Dermosol	BELOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C34	Detailed	2	Dermosols	Manganic Eutrophic Brown Dermosol	BFLOW	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C35	Detailed	2	Dermosols	Brown Vertosol	-	✓	✘	✘	✓	✘	✘	-	-	✓	✓	-	-	-	Non-BSAL	2. >30% Rock Outcrop 3. Rock Fragments

Site #	Inspection Site Type	Mapping Unit		Soil Profile - Australian Soil Classification (ASC)	ASC Family Criteria	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate Fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9?	11. Is salinity (ECe) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Soil Profile BSAL Verification	Limiting Factors
		#	Name																	
C36	Detailed	1	Chromosols	Bleached Eutrophic Brown Chromosol	BGLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	Non-BSAL	9. Poor Drainage
C37	Detailed	1	Chromosols	Bleached Eutrophic Brown Chromosol	BFKOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	Non-BSAL	9. Poor Drainage 10. pH <5.0
C38	Detailed	2	Dermosols	-	-	✓	✓	✗	✓	✓	✗	-	-	✓	✓	-	-	-	Non-BSAL	3. Rock Fragments 6. Rock Outcrop
C39	Detailed	1	Chromosols	Mottled Eutrophic Red Chromosol	CEMOW	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C40	Detailed	1	Chromosols	Vertic Eutrophic Black Chromosol	BFOOW	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C41	Detailed	1	Chromosols	Bleached-Sodic Eutrophic Brown Chromosol	BFLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C42	Detailed	1	Chromosols	Vertic Eutrophic Black Chromosol	BFLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C43	Detailed	1	Chromosols	Manganic Subnatric Grey Sodosol	BGKOW	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	Non-BSAL	7. Moderately Low Fertility
C44	Detailed	2	Dermosols	Red Dermosol	-	✓	✗	✓	✓	✓	✗	-	-	✗	✓	-	-	-	Non-BSAL	2. >30% Rock Outcrop 8. Shallow Soil Depth
C45	Detailed	1	Chromosols	Epipedal Brown Vertosol	-	✓	✓	✓	✓	✗	✓	-	-	✗	✓	-	-	-	Non-BSAL	8. Shallow Soil Depth
C46	Detailed	1	Chromosols	Haplic Eutrophic Red Dermosol	BELOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C47	Detailed	1	Chromosols	Haplic Eutrophic Red Dermosol	BFMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C48	Detailed	2	Dermosols	Epipedal Brown Vertosol	-	✓	✓	✓	✓	✗	✓	-	-	✗	✓	-	-	-	Non-BSAL	8. Shallow Soil Depth
C49	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BFLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C50	Detailed	1	Chromosols	Vertic Eutrophic Brown Dermosol	BFMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C51	Detailed	1	Chromosols	Manganic Mottled-Subnatric Grey Sodosol	BFKOW	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	Non-BSAL	7. Moderately Low Fertility
C52	Detailed	1	Chromosols	Vertic Eutrophic Yellow Chromosol	BFMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C53	Detailed	1	Chromosols	Vertic Mesotrophic Brown Chromosol	BFLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	Non-BSAL	9. Poor Drainage

Site #	Inspection Site Type	Mapping Unit		Soil Profile - Australian Soil Classification (ASC)	ASC Family Criteria	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate Fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9?	11. Is salinity (ECe) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Soil Profile BSAL Verification	Limiting Factors
		#	Name																	
C54	Detailed	1	Chromosols	Vertic Eutrophic Red Chromosol	BELOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C55	Detailed	2	Dermosols	Manganic Eutrophic Red Dermosol	BGOOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	Non-BSAL	10. pH <5.0
C56	Detailed	2	Dermosols	Epipedal Brown Vertosol	-	✓	✓	✗	✓	✓	✓	-	-	✗	✓	-	-	-	Non-BSAL	3. Rock Fragments 8. Shallow Soil Depth
C57	Detailed	2	Dermosols	Epipedal Brown Vertosol	-	✓	✓	✓	✓	✗	✓	-	-	✗	✓	-	-	-	Non-BSAL	8. Shallow Soil Depth
C58	Detailed	2	Dermosols	Epipedal Brown Vertosol	-	✓	✓	✗	✓	✗	✓	-	-	✗	✓	-	-	-	Non-BSAL	3. Rock Fragments 8. Shallow Soil Depth
C59	Detailed	1	Chromosols	Vertic Eutrophic Red Chromosol	BFLOW	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C60	Detailed	1	Chromosols	Haplic Eutrophic Brown Chromosol	BFLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C61	Detailed	1	Chromosols	Vertic Eutrophic Red Chromosol	BFMOW	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C62	Detailed	1	Chromosols	Vertic Eutrophic Black Chromosol	BFMOW	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C63	Detailed	1	Chromosols	Vertic Eutrophic Red Chromosol	BEMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C64	Detailed	1	Chromosols	Vertic Eutrophic Red Chromosol	BFMOW	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C65	Detailed	2	Dermosols	Epipedal Brown Vertosol	-	✓	✗	✗	✓	✓	✗	-	-	✓	✓	-	-	-	Non-BSAL	2. >30% Rock Outcrop 3. Rock Fragments
C66	Detailed	1	Chromosols	Vertic Eutrophic Black Chromosol	BFLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C67	Detailed	1	Chromosols	Manganic Eutrophic Red Dermosol	BELOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C68	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BFLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C69	Detailed	2	Dermosols	Mottled Eutrophic Black Dermosol	BFLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C70	Detailed	2	Dermosols	Vertic Eutrophic Red Dermosol	BFLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
C71	Detailed	2	Dermosols	Vertic Eutrophic Red Dermosol	BFMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-

Site #	Inspection Site Type	Mapping Unit		Soil Profile - Australian Soil Classification (ASC)	ASC Family Criteria	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate Fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9?	11. Is salinity (ECe) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Soil Profile BSAL Verification	Limiting Factors
		#	Name																	
C72	Detailed	2	Dermosols	Vertic Eutrophic Red Dermosol	BFKMW	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✗	✓	✓	Non-BSAL	10. pH <5.0
C73	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BFMOW	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
D1	Detailed	1	Chromosols	Vertic Eutrophic Brown Chromosol	BFLOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
D2	Detailed	2	Dermosols	Brown Dermosol	-	✓	✗	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	Non-BSAL	2. >30% Rock Outcrop 8. Shallow Soil Depth
D3	Detailed	2	Dermosols	Brown Dermosol	-	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	Non-BSAL	8. Shallow Soil Depth
D4	Detailed	2	Dermosols	Brown Dermosol	-	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	Non-BSAL	8. Shallow Soil Depth
D5	Detailed	2	Dermosols	Haplic Eutrophic Black Kandosol	BFLLW	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	BSAL	-
D6	Detailed	2	Dermosols	Haplic Eutrophic Black Kandosol	BFLLW	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	BSAL	-
D7	Detailed	2	Dermosols	Leptic Rudosol	-	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	Non-BSAL	8. Shallow Soil Depth
D8	Detailed	1	Chromosols	Haplic Eutrophic Red Chromosol	BEMOW	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
D9	Detailed	1	Chromosols	Haplic Eutrophic Red Chromosol	BEMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
D10	Detailed	2	Dermosols	Haplic Eutrophic Red Dermosol	BELMW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
D11	Detailed	2	Dermosols	Haplic Eutrophic Red Dermosol	BELOV	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✗	✓	✗	Non-BSAL	8. Shallow Soil Depth 10. pH <5.0
D12	Detailed	1	Chromosols	Haplic Eutrophic Red Chromosol	BEMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
D13	Detailed	2	Dermosols	Brown Dermosol	-	✓	✓	✗	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	Non-BSAL	3. Rock Fragments 8. Shallow Soil Depth
D14	Detailed	2	Dermosols	Brown Dermosol	-	✓	✓	✗	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	Non-BSAL	3. Rock Fragments 8. Shallow Soil Depth
D15	Detailed	2	Dermosols	Brown Dermosol	-	✓	✓	✗	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	Non-BSAL	3. Rock Fragments 8. Shallow Soil Depth
D16	Check	1	Chromosols	-	-	✓	✗	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	Non-BSAL	2. >30% Rock Outcrop 8. Shallow Soil Depth

Site #	Inspection Site Type	Mapping Unit		Soil Profile - Australian Soil Classification (ASC)	ASC Family Criteria	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate Fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9?	11. Is salinity (ECe) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Soil Profile BSAL Verification	Limiting Factors
		#	Name																	
D17	Detailed	1	Chromosols	Vertic Eutrophic Red Chromosol	BFLOV	✓	✓	✓	✓	✖	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
D18	Detailed	1	Chromosols	Vertic Eutrophic Black Chromosol	BEMOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
D19	Detailed	1	Chromosols	Haplic Eutrophic Red Chromosol	BEKOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-
D20	Detailed	1	Chromosols	Haplic Eutrophic Red Chromosol	CELOW	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	BSAL	-

6 CONCLUSION

The Cadia Continued Operations Project BSAL Site Verification Assessment was undertaken March – July 2021 by Minesoils' Clayton Richards (CPSS 2). The PAA was defined as the Project site as well as the required 100m buffer but excluding areas under a current mining lease, which totalled 3,516 ha. A total of 2,130 ha was discounted during desktop analysis by slope >10% and <20 ha contiguous area and/or areas surrounded by slopes >10%. These exclusions left 1,386 ha to be assessed.

A total of 93 sites were assessed in accordance with the Interim Protocol to obtain suitable representative soil profiles to determine soil type and characteristics. A total of 52 sites satisfied the BSAL criteria. Therefore, verified BSAL is confirmed to be present over approximately 825 ha or 23% of the PAA. The remaining 2,691 ha or 77% of the PAA is verified Non-BSAL.

The supporting documents including the e-dirt BSAL online soil data, laboratory analysis and mapping metadata have been provided to DPIE as part of the SVC Application. The soil laboratory analysis results are attached in **Appendix 3**.

7 REFERENCES

Bureau of Meteorology (2021) Climate Data Online Orange Airport AWS (063303) and Orange Agricultural Institute (063254) Website: http://www.bom.gov.au/climate/data Date Accessed: October 2021.

Charman P.E.V and Murphy B.W. (Eds) (2007) Soils - Their Properties and Management - A Soil Conservation Handbook for New South Wales: second edition (New South Wales Printing Office, Sydney).

CSIRO (2006). *Australian Soil Fertility Manual Third Edition.*

DP&I (2012) Upper Hunter Strategic Regional Land Use Plan.

Department of Planning, Industry and Environment (2020) *Soil Landscapes of Central and Eastern NSW* - v2.1, NSW Office of Environment and Heritage, Sydney.

Isbell, R.F. (2016) Australian Soil Classification. CSIRO Publishing, Australia.

Kovac M., Murphy B.W. and Lawrie J.A., 2010, *Soil Landscapes of the Bathurst 1:250,000 Sheet* map, edition 2, Department of Environment, Climate Change and Water NSW, Sydney.

Murphy BW, Eldridge DJ, Chapman GA, McKane DJ (2007) Soils of New South Wales. In 'Soils their properties and management (3rd edn).' (Eds PEV Charman, BW Murphy). (Oxford University Press: Melbourne).

NCST (2008) Guidelines for surveying Soil and Land Resources. (CSIRO Publishing, Australia).

NCST (2009) Australian Soil and Land Survey Field Handbook, 3rd edition (CSIRO Publishing, Australia).

OEH and DPI-OAS&FS (2013) Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land.

OEH (2012) The land and soil capability assessment scheme: second approximation – A general rural land evaluation system for NSW.