DLALC MAROOTA SANDS PROJECT

Rehabilitation Strategy

Prepared for:

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Design Collaborative (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.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.30035-R01-v0.2	8 June 2021	Rod Masters	Murray Fraser	
630.30035-R01-v0.1	22 September 2020	Rod Masters	Murray Fraser	

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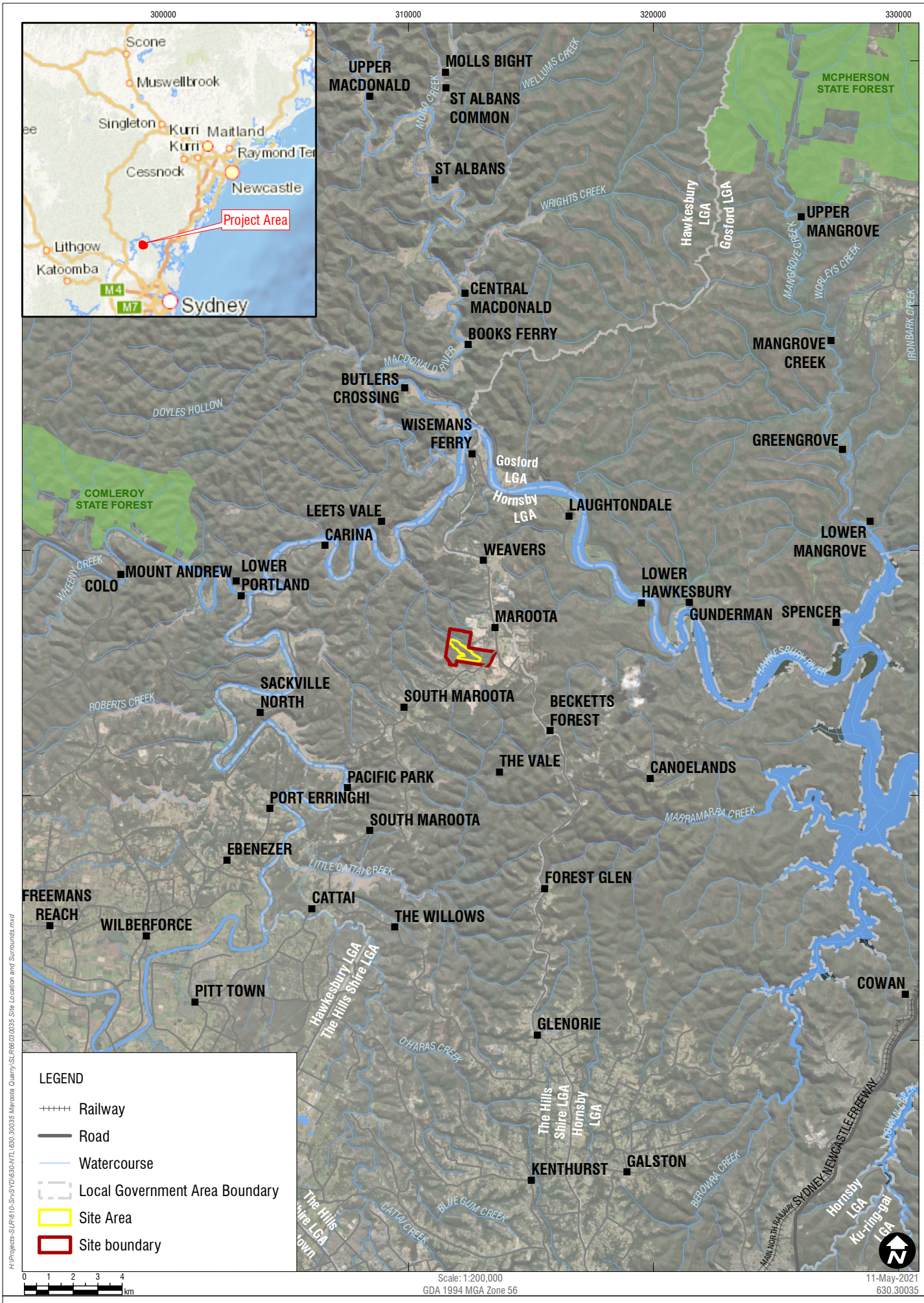
1 Introduction

Design Collaborative has been commissioned by Deerubbin Local Aboriginal Land Council (DLALC) to prepare an Environmental Impact Statement (EIS) for a proposed State Significant friable sandstone extractive industry located at Wisemans Ferry Road, Maroota (the "Maroota Sands Project"). The site location and surrounding area is shown in **Figure 1**. SLR Consulting (SLR) was engaged by Design Collaborative to complete a Rehabilitation Strategy for the site. The Study Area is illustrated in **Figure 2**.

The Maroota Sands Project (the Project) is a proposed state significant sand quarry within a 180.7 ha parcel of land located within the township of Maroota, NSW. The Project is anticipated to approximately 49 ha of the subject site for the extraction, processing and delivery of up to 500,0000 tonnes of sand per annum. The Site's eastern boundary is located just south of Wisemans Ferry Road and Old North Road intersection. The site extends approximately 2km east from Wisemans Ferry Road and approximately 600m to 1500m in a roughly north-south direction.



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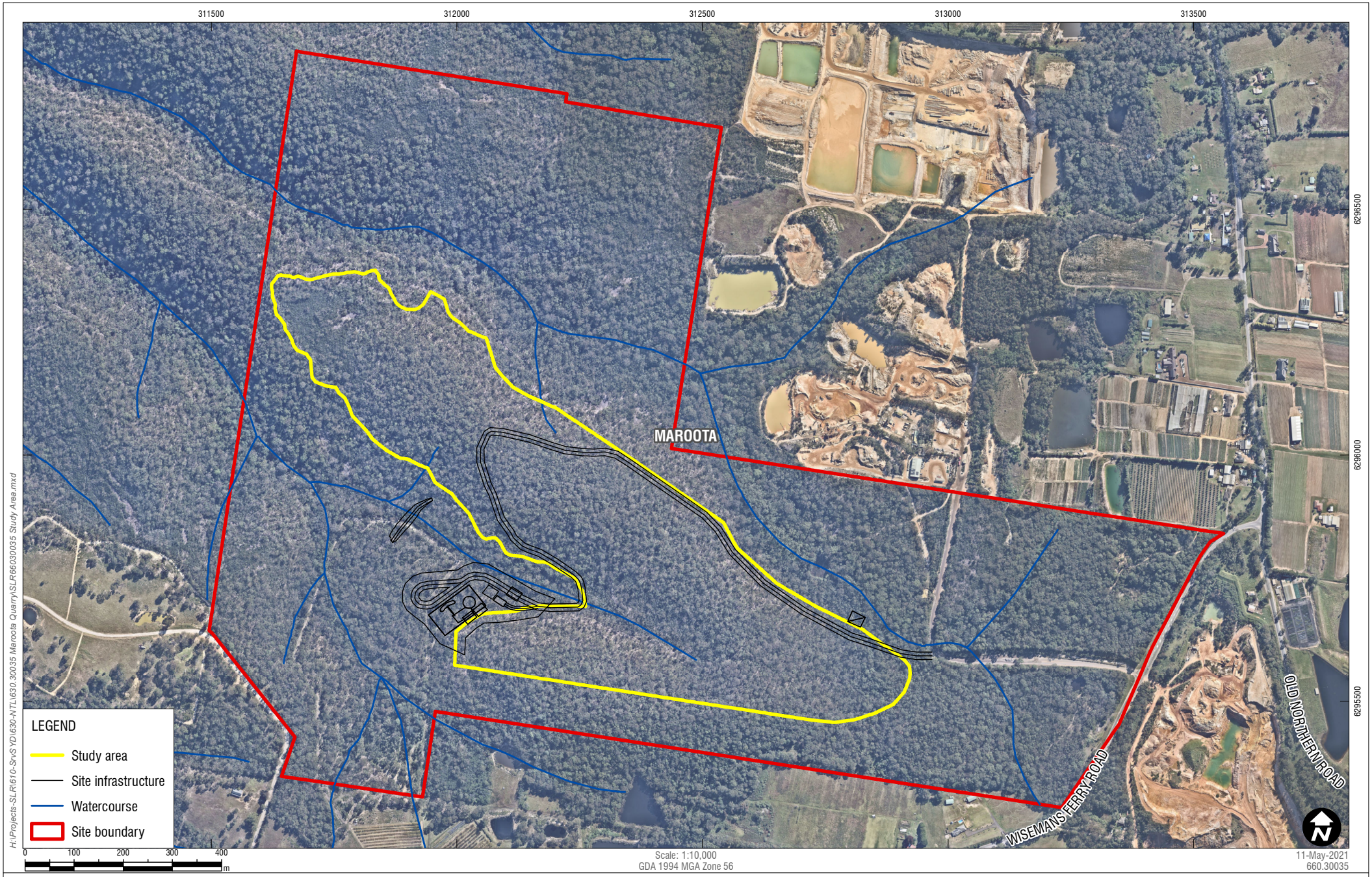
Regional Locality

FIGURE 1



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Study Area

FIGURE 2

2 Project Description

The summary of the key characteristics of the proposed Maroota Sands Project is provided in **Table 1**.

Table 1 Key Characteristics of the Proposed Maroota Sands Project

Key Element	Detail
Proposed Land Use	Extractive Industry
Extraction Method	Overburden, Stripping and Raw Feed Extraction
Resource	Hawkesbury and Maroota Sandstone, shale and clay
Processing Method	Processed into washed sand of various diameters including for use in concrete and road base, and other resource-based products as appropriate.
Quarry Life	28 years
Groundwater Buffer	2m above the wet-weather groundwater levels
Disturbance Area	• 43.7ha extraction area • 2.8ha site infrastructure Area • 0.1ha access haul road • 0.2ha Surface water Dam Total 47ha
Annual Production	500,000 tonnes of saleable product per annum
Total Resource Recovered	• 15.200 million tonnes of sandstone • 160 tonnes of shale • 360 tonnes of overburden • 13.680 million tonnes of saleable product
Management of Waste	Tailings will be press dried and incorporated with the overburden to from the final landforms. Other waste will be segregated and removed by a licensed contractor.
General Infrastructure	• Relocatable sand processing plant • Weighbridge • Administration office and carpark • Site drainage water storage dam • Water tank integrated within the production plant • Storage bins for dried tailings • Internal haul roads • Sales Haul Road • Electrical power supply • Potable water supply • Enviro-cycle sewage system • Machinery workshop and diesel storage tanks • Site fencing • Surface water dam & groundwater bore

3 Regulatory Overview

3.1 Secretary's Environmental Assessment Requirements (SEARs)

On 18th February 2020 the Department of Planning, Industry and Environment (DPIE) issued the Secretary's Environmental Assessment Requirements (SEAR) SSD-10410 for the project.

The relevant SEAR for rehabilitation requires a Rehabilitation Strategy to be prepared for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including:

- rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria;
- nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and
- the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.

3.2 Hills Development Control Plan

The *Hills Development Control Plan* (Hills DCP) contains provisions relating to the rehabilitation of extractive industries sites (see table below). The Hills DCP rehabilitation requirements contained in Chapter 10 (Part B Section 1 – Rural, Part 2: Extractive Industries) are outlined in **Table 2**.

Given that the Maroota Sands Projects is classified as State Significant Development, there is no requirement to meet these provisions, however the Rehabilitation Strategy will be prepared in accordance with the requirements.

Table 2 Hills DCP Rehabilitation Requirements for Extractive Industries

Rehabilitation - Design and Materials	• Extraction sites are to be rehabilitated to a usable and stable final landform. • The rehabilitation of extraction sites is to integrate with the shape, form, contour, vegetation, soil composition, drainage and land use characteristics of the surrounding terrain. • The final use of land for agricultural purposes will only be considered where it can be demonstrated that the original land use was agricultural or where the adjoining land use is for agriculture. Otherwise, all sites are to be rehabilitated to bushland. • Extraction areas should be progressively rehabilitated to integrate with the shape, form, contour, colour, land use, drainage characteristics, landscape quality and diversity of the pre-existing surrounding terrain, under the direction of a qualified person. Rehabilitation should commence prior to proceeding onto the next extraction area. • Stockpiles of clean topsoil & overburden should be appropriately formed and shaped to ensure the viability of the soil and seed source of the site/area for later re- spreading or backfilling. • Extracted areas should be backfilled only with earth and rock materials sourced as a result of extraction. No solid waste or putrescible materials are to be disposed of within the site without the prior approval of Council and other State Government agencies

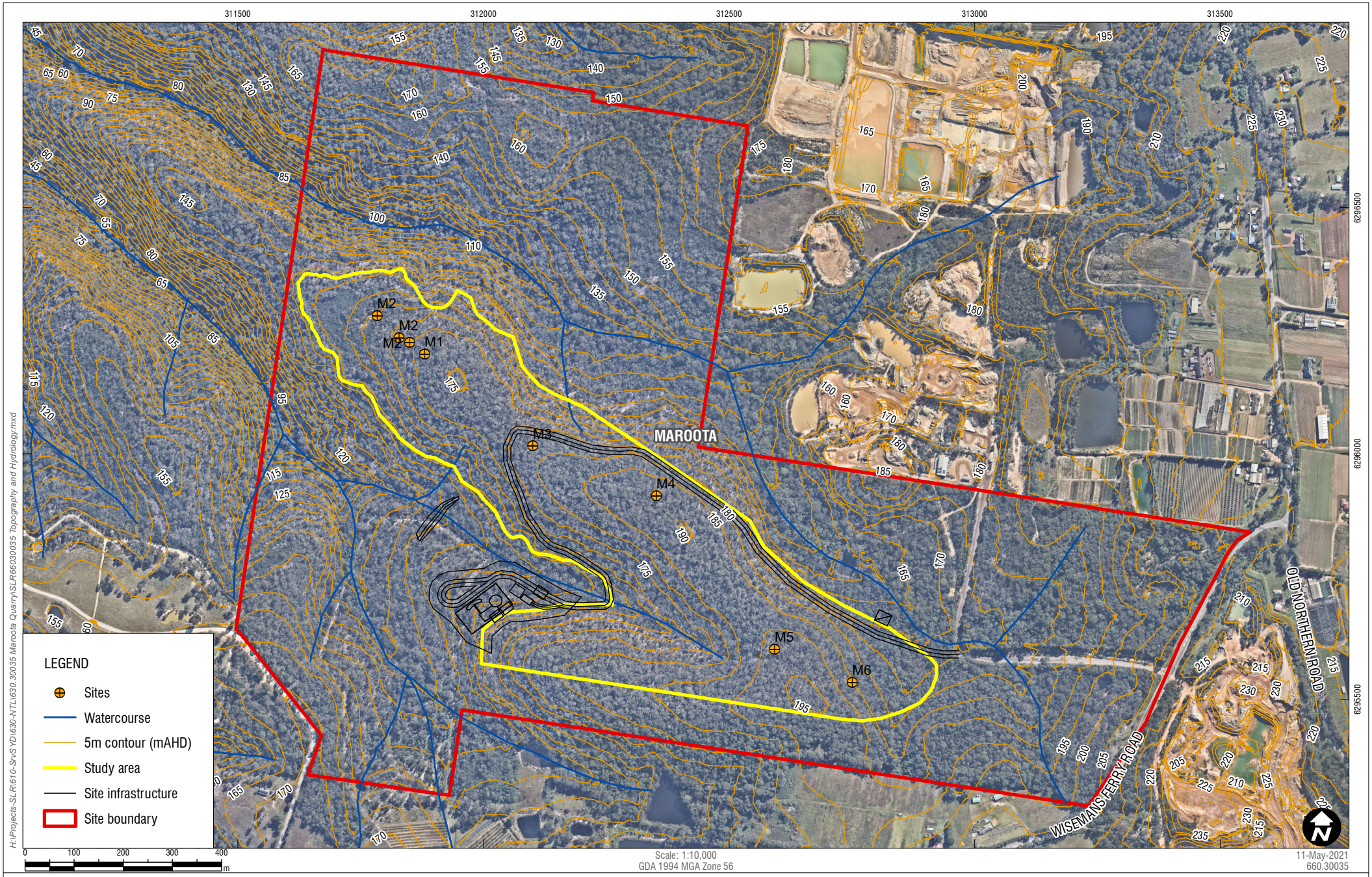
Rehabilitation – Planting and Maintenance	• Rehabilitation should incorporate, where appropriate, endemic native plants, grass covers and species.
	• Disturbed areas should be appropriately maintained until rehabilitation is well established.
	• Permanent ground cover should be established on areas disturbed for more than 30 days and is to be maintained by regular watering and additional applications of seed and fertiliser.
	• Proponents should regularly maintain rehabilitated areas having regard to the following criteria:
	  ◦ Replanting exposed areas & replacing dead plants within six months
	  ◦ Repairing erosion problems
	  ◦ Pest and weed control
	  ◦ Fertiliser applications where appropriate
	  ◦ Regular watering
	  ◦ Application of lime or gypsum to control pH and
	  ◦ improve soil structure, where appropriate

4 Site Description

4.1 Topography and Hydrology

The project site is covered by ridges and low-lying valleys. The proposed extraction area on the property is sited generally on the outcropping sandstone ridge system extending north-westwards from near the frontage to Wisemans Ferry Road. Drainage from the site is via unnamed tributaries of Douglass Creek which flows initially to the northwest and then north into the Nepean River upstream of the site (Graham Lee & Associates Pty Ltd, 2017) (**Figure 3**). The slope analysis (**Figure 4**) further highlights the low-lying flats, in green.

Groundwater levels have been taken from the EMM (2020) (EMM Consultants, 2020). The regional groundwater levels have been interpreted from data loggers installed in March 2017 and retrieved in March 2020. Extracted groundwater hydrographs and data logger locations indicated that water levels range from 5 to 35 metres below ground level.



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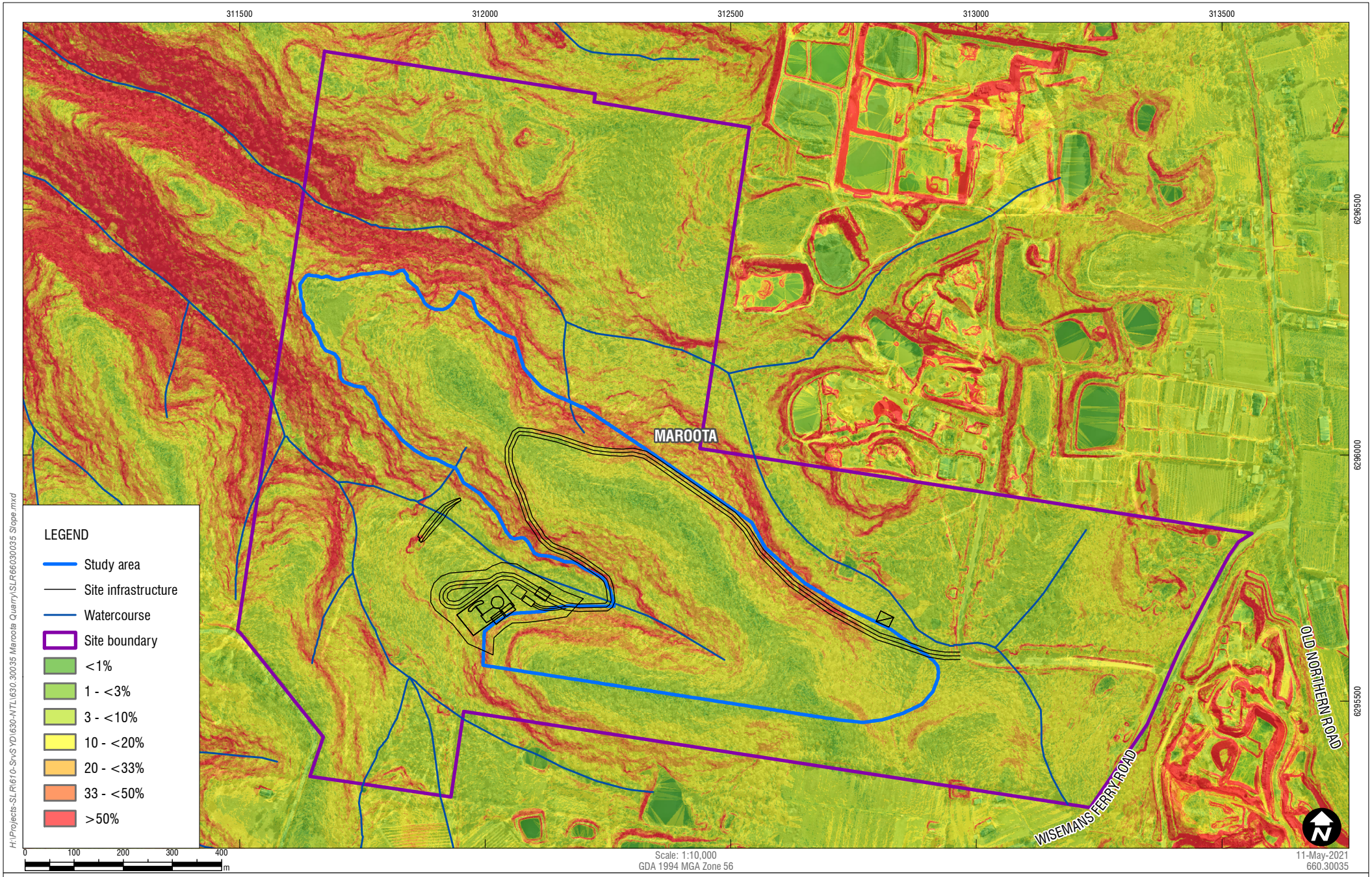
Topography and Hydrology

FIGURE 3



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Slope Analysis

FIGURE 4

4.2 Geology

Due to the resource interest within the Maroota area as a sand resource, several studies into the regional geology have been performed. Categorised by Hopkins and Ross (Hopkins & Ross, 1996), there are three main geological units:

- Maroota Sand;
- Alluvial Sand on Hawkesbury Sandstone; and
- Underlying Hawkesbury Sandstone.

Review of the Department of Land and Water Conservation Maroota Groundwater Study (Department of Land and Water Conservation, 2001) categorises the Maroota area into 3 major lithological units (in order from youngest to oldest), outlined in **Table 3** below.

Table 3 Stratigraphic Units

Age	Unit	Lithology
Tertiary	Unnamed	Basalt
	Maroota Sand	Sand, gravel, clayey sand and clay
Triassic	Ashfield Shale	Shale and laminate
	Hawkesbury Sandstone	Quartzose sandstone and shale lenses

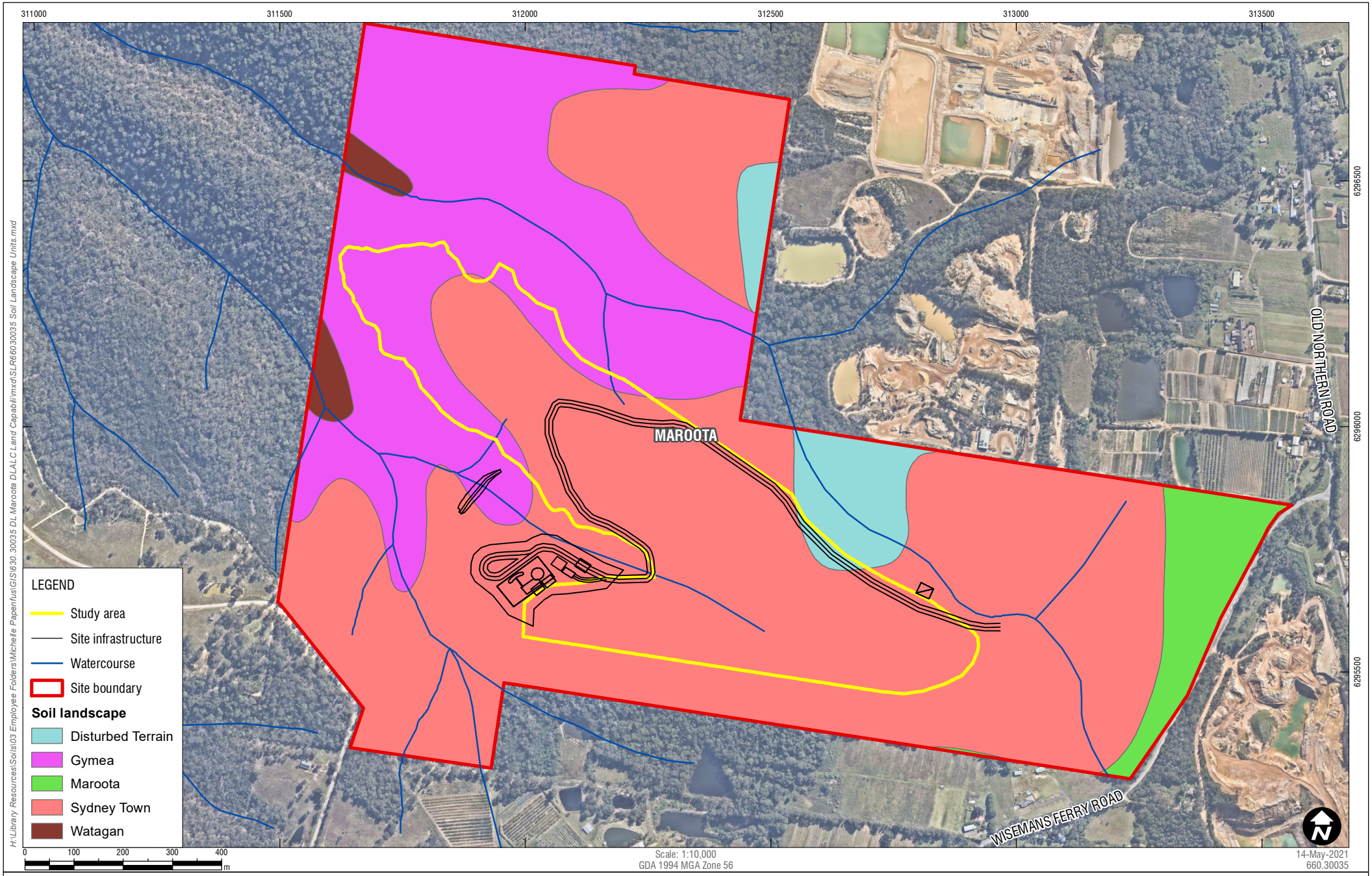
4.3 Soils

The Soil Landscape Units within the Study Area have been mapped by the former NSW Department of Land and Water Conservation, incorporating the NSW Soil Conservation Service (now part of NSW Department of Primary Industries (DPI)), on the *Soil Landscapes of the St Albans 1:100 000 Sheet* (McInnes, 1997) shown in **Figure 5**.

Five Soil Landscape Units occur in the Study Area and are summarised in **Table 4.**

Table 4 Soil Landscape Units

Name	Ha	% of Study Area
Maroota	7	4
Sydney Town	112	63
Gymea	49	28
Disturbed Terrain	8	4
Watagan	2	1
Total	**178**	**100**



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Source: Nearmap (March 2020)

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Soil Landscape Units

FIGURE 5

SLR (2020) conducted a soil survey as an integral component of a Land Capability Assessment (LCA) to accompany the EIS for the Project. One Soil Unit was identified during the soil survey, a Grey-Brown Kurosol with a subdominant soil type comprising a Yellow Kandosol. Representative soil profile descriptions and associated key soil test results are provided in **Tables 5** to **8**.

Table 5 Dystrophic Brown Kurosol (Site 1)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Brown (7.5YR 4/2) sandy loam, weak crumb structure <10 mm peds with weak consistence and a rough fabric. Nil mottling, 10% gravel content 5-10 mm, nil segregations, abundant fine roots. Well drained with a clear and even boundary. Sampled 0.0 – 0.10
	B21 0.20 – 0.60	Yellowish-brown (10YR 5/8) sandy clay loam, moderately structured 10-20 mm blocky peds with moderate consistence and a rough fabric. Nil mottling, 20% cobble content 40-60 mm, nil segregations, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.30 – 0.40
	B22 0.60 – 0.80	Yellowish-brown (10YR 5/8) light-medium clay, moderately structured 15-30 mm blocky peds with strong consistence and a rough fabric. 20% distinct grey mottles, 10% gravel content 5-10 mm, nil segregations, coarse roots common. Moderately drained with a clear and even boundary. Sampled 0.60 – 0.70
	BC +0.80	Weathered sandstone. Not sampled

* Field Munsell Colour used due to high percentage of mottling.

Table 6 Chemical Parameters: Dystrophic Brown Kurosol (Site 1)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.3	Strongly Acidic	2.8	Non-Sodic	0.3	Non-Saline	0.5	Low
B21	5.4	Strongly Acidic	2.8	Non-Sodic	0.2	Non-Saline	0.1	Low
B22	4.7	Very Strongly Acidic	1.3	Non-Sodic	0.3	Non-Saline	0.3	Low

Table 7 Profile: Mesotrophic Yellow Kandosol (Site 6)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Greyish-brown (10YR5/2) sandy loam, weak crumb structured 5-10 mm peds with weak consistence and a rough fabric. Nil mottling, nil stone content, nil segregations, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	B2 0.20 – 0.40	Light yellowish-brown (2.5Y 6/4) clay loam, moderately structured 10-30 mm blocky peds with moderate consistence and a rough fabric. Nil mottles, nil gravel content, nil segregations, coarse roots common. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	BC +0.40	Weathered sandstone. Not sampled

Table 8 Chemical Parameters: Mesotrophic Yellow Kandosol (Site 6)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.4	Strongly Acidic	1.4	Non-Sodic	0.2	Non-Saline	0.2	Low
B2	5.8	Moderately Acidic	4.4	Non-Sodic	0.1	Non-Saline	0.1	Low

Recommended topsoil stripping depths range from 0.1 to 0.6 m according to texture (sandy loam to clay loam). Whilst the soils salinity and sodicity levels are low, moderate to high acidity will require the addition of lime to increase pH during rehabilitation works.

4.4 Land Capability

Land within the Study Area has been classified into LSC Classes 5 and 6. Classes 5 and 6 comprised approximately 26 ha and 22 ha of land within the Study Area respectively, as shown in **Table 9** and **Figure 6**. The limitations associated with each LSC Class are discussed below.

Table 9 Land and Soil Capability Areas

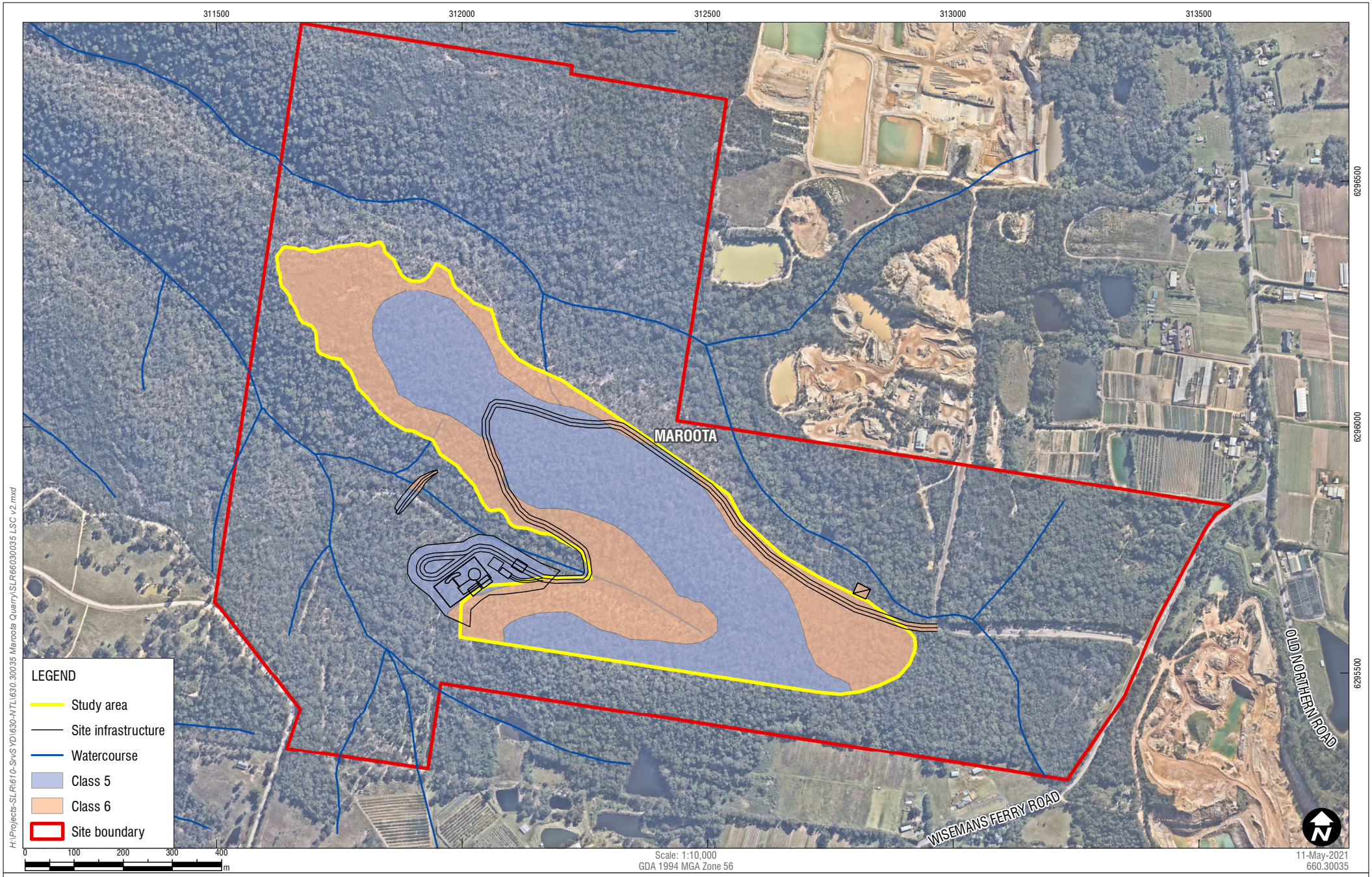
Disturbance Area	Total area (Ha)	LSC 5	LSC 6
Extraction area	43.7	22.7	21.0
Site infrastructure areas	2.8	2.7	0.2
Access haul road	0.1	0.0	0.1
Surface water dam	0.2	0.1	0.1
Total	**46.9**	**25.5**	**21.4**
Percentage of total area	**100%**	**54%**	**46%**

LSC Class 5 Land

Class 5 land is represented by a Grey-Brown Kurosol on areas of less than 20% slope. This classification indicates a moderate to low land capability, with severe limitations to high impact land management uses such as cropping. This land is generally more suitable for grazing with some limitations, or very occasional cultivation for pasture establishment. The limiting factor for LSC Class 5 within the Study Area is slope with soil acidification. It covers the major portion of the Study Area (54%).

LSC Class 6 Land

Class 6 land is represented by a Grey-Brown Kurosol (with a sub-dominant soil type Yellow Kandosol) on areas of greater than 20% slope. This classification indicates Low capability land with very high limitations for high-impact land uses. The land is considered capable for a limited set of low-impact land uses such as grazing, forestry, nature conservation and some horticulture. Careful management of limitations is required to prevent severe land and environmental degradation. The limiting factors for LSC Class 6 land within the Study Area are shallow soils and rockiness. LSC Class 6 land comprises 46% of the Study Area.



Source: Nearmap (March 2020)

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Land and Soil Capability

FIGURE 6

4.5 Land Use

The proposed quarry is located entirely within native bushland and will not directly or indirectly impact land currently used for agricultural production. There are existing sand quarries located directly to the south, east and north of the proposed quarry. There are orchards and other small-scale horticulture to the south of the proposed quarry which are separated by a minimum 100 metre buffer of native bushland.

4.6 Vegetation

Ecological (2020) conducted a flora survey of the project area as a component of the Biodiversity Development Assessment and concluded that the site compromises very good condition remnant vegetation. Four Plant Community Types (PCTs), comprising seven vegetation zones, were identified within the development site and development footprint. A summary of the areas of each zone within the development footprint is provided in **Table 10**.

Table 10 Land and Soil Capability Areas

Vegetation Zone	PCT Name	Condition
1	Red Bloodwood – Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Open understorey
2	Red Bloodwood – Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion.	Dense mid-storey
3	Red Bloodwood – scribbly gum healthy woodland on sandstone plateaux of the Sydney Basin Bioregion.	Heathy understorey
4	Red Bloodwood – scribbly gum healthy woodland on sandstone plateaux of the Sydney Basin Bioregion.	Open understorey
5	Yellow Bloodwood – Narrow leaved Apple healthy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion.	Open understorey
6	Yellow Bloodwood – Narrow leaved Apple healthy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion.	Health understorey
7	Smooth barked Apple – Red Bloodwood – Sydney peppermint healthy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion.	Good

5 Landform Design and Construction

RPM Advisory Services (RPM) were engaged by DLALC to prepare an Extraction and Rehabilitation Plan (ERP) for the Maroota Sands Project. Staged landform plans from the RPM ERP showing areas of construction and rehabilitation for Years 1, 5, 10, 15 and 20 are provided in **Appendix A**.

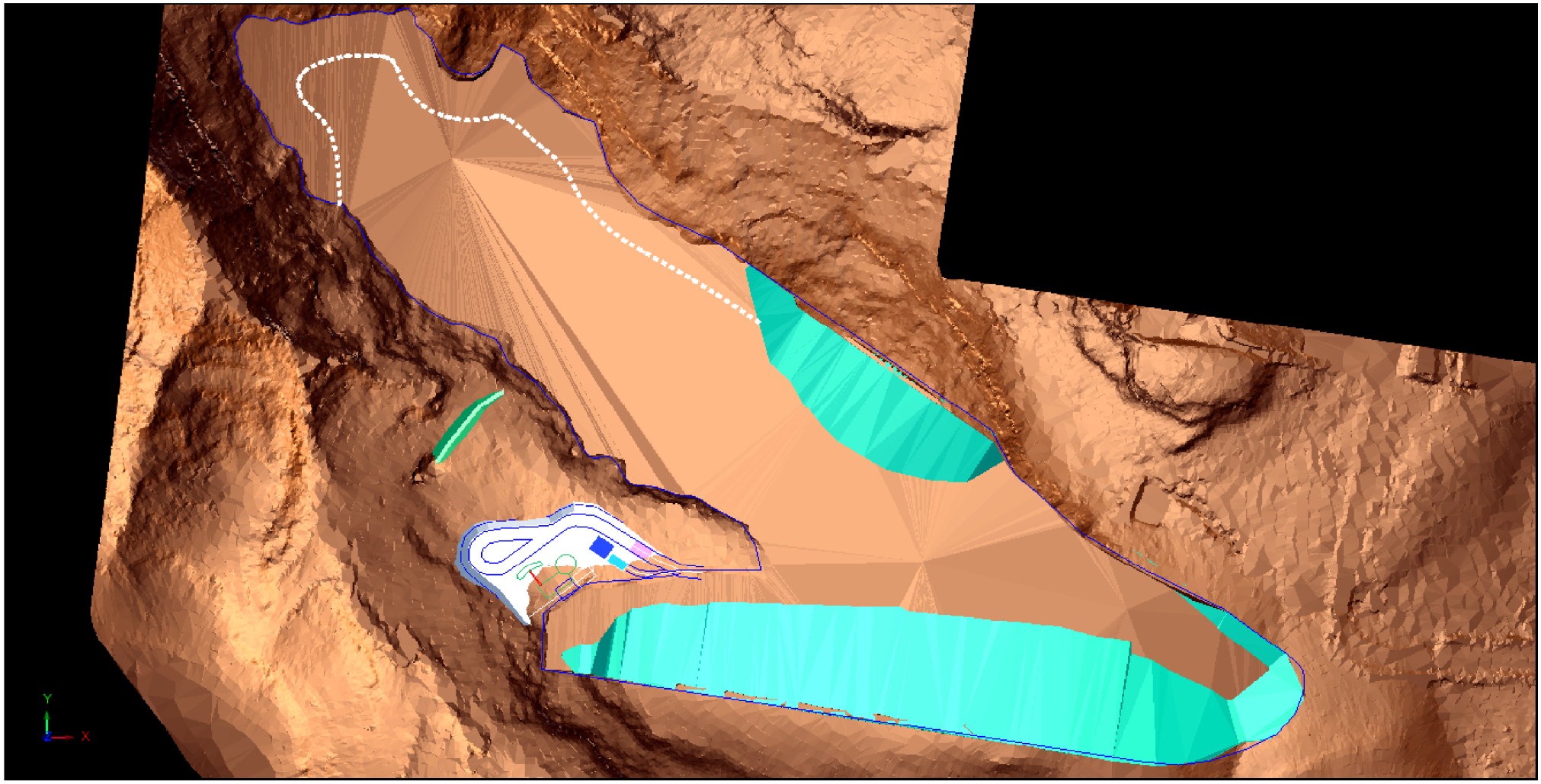
Rehabilitated landforms will be constructed progressively using a combination of overburden, shale, pressed tailings and mulched vegetation. RPM has estimated that the volume of excavated overburden and pressed tailings approximately balances the quantity of material required to construct rehabilitated landforms throughout the life of the sand operation.

The drainage concept for the final landform (refer **Figure 7**) seeks to minimise changes to existing catchment boundaries and avoid the need to discharge concentrated flow from the north-western portion of the landform into terrain that doesn't currently receive any material flows. The concept splits the pit floor into three catchments described below:

- **Eastern Catchment**: During operations this catchment will drain to the west into the water management dam. Rehabilitation will commence immediately after completion of extraction. Once rehabilitation is completed, the drain will be redirect clean water runoff into the watercourse to the north, as it currently occurs.
- **Middle Catchment**: This catchment will drain into the watercourse to the west for both operations and upon completion of the final landform.
- **Western Catchment**: The pit floor will be regraded to a subtle convex landform which will allow runoff to drain mostly as unconcentrated flow to the north and south, as currently occurs. During operations, small temporary sediment dams will be installed to manage runoff from the pit floor.

Rehabilitated slopes will be constructed at a slope gradient of 1:5 (V:H) or 11.3°. Cross sections and long section, prepared by RPM, are also included in **Appendix A**. The cross section of the northern highwall to the southern highwall indicates a maximum slope length of 125 m. Surface water management works will include cut off drains above the fill and contour banks mid-slope followed by revegetation works for erosion and sediment control.

All works will be constructed in accordance with *Managing Urban Stormwater – Soils and Construction, Volume 1, 4th edition* (Landcom, 2004), *Volume 2E Mines and Quarries* (DECC, 2008a) (refer **Section 7.2**).



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Source: Extraction and Rehabilitation Plan for Maroota Sand Project (RPM Global, 2021)

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Conceptual Drainage Design (RPM, 2021)

FIGURE 7

6 Rehabilitation Objectives and Completion Criteria

6.1 Proposed Final Land Use

The proposed final land use will be a combination of native bushland and improved pasture for a post-mining grazing enterprise. A native bushland corridor, approximately 50m wide, will be incorporated around the reshaped landform's perimeter to assist in the integration of the impacts of the tree removal from the project's viewpoints and from the west.

The majority of future revegetation will be conducted using improved pasture species that will primarily be responsible for stabilising the site. All selected species are suitable for sustaining a grazing enterprise. The perimeter of the landform will be revegetated using endemic bushland species (refer **Section 7.2.5.1**).

6.2 Rehabilitation Objectives

Rehabilitation objectives for the Maroota Sands Project are provided in **Table 11**.

Table 11 Rehabilitation Objectives

Feature	Objective
All areas affected by the Landfill	Safe Hydraulically and geotechnically stable Non-polluting Fit for the intended post-construction land use(s)
Areas proposed for native ecosystem re-establishment	Establish self-sustaining ecosystems comprising flora species selected to re-establish and complement local and regional biodiversity
Other areas affected by the Landfill	Restore ecosystem function, including maintaining or establishing self-sustaining ecosystems comprised of local native plant species for the intended post rehabilitation land use(s).
Surface infrastructure	Decommissioned and removed, unless further approval is obtained for their retention and post-Landfill use.
Final landform	Consistent with surrounding topography to minimise visual impacts Incorporate relief patterns and design principles consistent with natural drainage
Rehabilitation materials	Soil and vegetable materials from areas disturbed (including topsoils, substrates and seeds) are recovered, managed and used as rehabilitation resources
Water quality	Water retained on site is fit for the intended post-Landfill use. Water management is consistent with any regional catchment management strategy and the site-specific in-stream water quality objectives
Community	No additional risk to public safety than prior to grant of the consent Minimise adverse socio-economic effects associated with completion of works

6.3 Rehabilitation Phases

The ultimate rehabilitation objective for the Maroota Sands Project is to create a safe, stable and sustainable landform and allow the achievement of the agreed final land use. This will be achieved by demonstrating completion of a series of conceptual phases of rehabilitation which are described in **Table 12.**

Table 12 Rehabilitation Phases

Phase	Description	Responsibility and Comment
1	**Active** – Activities undertaken during (or prior to) construction and operations to enhance rehabilitation such as salvaging and managing soil resources, salvaging habitat resources.	DLALC will be responsible for all activities undertaken during the active (construction) phase of the project relevant to its scope of works.
2	**Decommissioning** – removing infrastructure, hardstands, plant, equipment, buildings and other structures and all contaminated and hazardous materials.	DLALC will be responsible for the decommissioning of all infrastructure and the remediation / removal of any contamination and hazardous materials at construction sites.
3	**Landform Establishment** – the process of forming the final landform. This phase includes all earthworks required to construct the final landform into the desired surface profile. It includes the construction of surface water management/drainage structures and preparing a substrate with the desire physical and chemical characteristics.	DLALC will construct the final landform and all required surface water and drainage infrastructure in accordance with agreed design specifications.
4	**Growth Medium Development** - establishing and enhancing the physical structure, chemical properties and biological properties of a soil stratum suitable for the desire vegetation community. This includes placing and spreading soil and applying ameliorants.	DLALC will reinstate topsoil or suitable alternatives at the specified depth appropriate to the final land use.
5	**Land Use Establishment** – this phase includes the process of establishing the final land use following the construction of the final landform. For vegetated areas this will consist of seeding, planting and transplanting plant species. It incorporates management actions such as weed and feral pest control to achieve species establishment and growth to juvenile communities, and habitat augmentation.	DLALC will be responsible for the revegetation of all rehabilitation areas.
6	**Ecosystem and Land Use Development** - applying management techniques to develop towards a desired and sustainable post construction land use outcome. Incorporates features including species reproduction, nutrient recycling and community structure.	DLALC will be responsible for ongoing maintenance, management and monitoring of rehabilitated areas following take over. This will involve weed and pest management activities, rehabilitation monitoring towards the final completion criteria, minor erosion repair and infill planting.
7	**Rehabilitation Completion** - completion criteria for rehabilitation are met and the land is determined to be suitable for the intended final land use.	DLALC will maintain and manage rehabilitated areas until it is deemed that the final completion criteria have been met.

6.4 Completion Criteria

Completion criteria are objective target levels or values assigned to a variety of indicators (i.e. slope, species diversity, groundcover etc.), which can be measured against to demonstrate progress and the ultimate success of rehabilitation. As such, they provide a defined end point at which time rehabilitation can be deemed successful.

Detailed completion criteria, performance measures and associated indicators will be developed in accordance with the relevant project approvals. These criteria will be developed for each phase of the rehabilitation so that the rehabilitation success can be quantitatively tracked throughout the life of the project.

The performance measures and associated indicators will be designed to provide an appropriate benchmark or guide against which to assess the management of project lands and the resulting improvements.

Indicative completion criteria and responsibilities are presented in **Table 13**.

Table 13 Indicative Completion Criteria

Objective	Performance Indicator	Completion Criteria
Phase 1 - Active		
Minimise risk of injury to people and animals	Risk assessment completed and actioned	Appropriate security measures implemented (where required) prior to commencing works.
Minimise the impact of vegetation clearance activities on flora and fauna	Preclearance records	Appropriate measures have been implemented (where required) to minimise the impact on flora and fauna
Erosion will be controlled	Site records and reports	Erosion and sediment control structures have been installed prior to disturbance.
Topsoils will be appropriately stripped and managed	Topsoil inventory	Topsoil has been stripped and stockpiled in accordance with requirements.
Phase 2 - Decommissioning		
Infrastructure is removed to ensure the site is safe and free of hazardous materials	Site records and reports	All surface infrastructure that is not required for the final land use demolished and removed from the site.
	Demolition records	All demolition work carried out in accordance with *AS2601-2001: The Demolition of Structures* or its latest version.
Disconnection of Services	Site records and reports	All services, including power, water, data and telephone, that are not required for final land use have been safely isolated, disconnected and terminated.
Contaminated areas are identified and remediated, removed or otherwise managed	Certificates of testing, disposal and/or validation testing	Contaminated soils presenting constraints to final land use have been identified and remediated or removed from the areas to be rehabilitated or appropriately managed (in accordance with legislation).
Phase 3 – Landform Establishment		
Landform is safe, stable and non-polluting	Visual inspection / assessment records	Landform survey verifies constructed landform safe and stable and is generally in accordance with the approved landform design.
	Visual inspection / assessment records	Rehabilitated slopes are free draining with appropriate drainage in place so that water will not undermine the structure in the long term.
	Rehabilitation records	Final landform drainage structures including drains, banks, drop structures and dams constructed in accordance with Blue Book requirements (where required).
Phase 4 – Growth Medium Development		
Areas of recent rehabilitation are top-dressed with a suitable growing media where required	Rehabilitation records	Topsoil or suitable alternative is spread uniformly at the specified depth appropriate to the final land use.
Growth media characterised and ameliorated for final land use as required	Rehabilitation records	Soil ameliorants (eg. gypsum, mulch, biosolids, composts) are applied where necessary at the recommended rate per hectare based on soil analysis.
Phase 5 – Land Use Establishment		

Objective	Performance Indicator	Completion Criteria
Ground cover comparable to reference vegetation communities.	Revegetation records	Rehabilitation at the agreed density to provide sufficient ground coverage once established.
Community structure/species composition	Revegetation records	A mixture of species generally commensurate with the surrounding area in accordance with specifications.
Erosion does not present a safety hazard or compromise the post construction land capability.	Rehabilitation monitoring records	No active erosion features (greater than 500 mm depth) that compromise land capability or the final post construction land use.
Weeds and feral animals do not present a risk to rehabilitation	Weed presence in rehabilitation monitoring and site inspection records	No significant weed infestations, and noxious or other weeds do not comprise a significant proportion of the species in any stratum resulting in a risk to rehabilitation area establishment
	Revegetation records	Revegetation conducted with appropriate vegetation protection implemented.
Phase 6 – Land Use Development		
Rehabilitation areas are healthy, sustainable and comparable with surrounding vegetation community	Rehabilitation monitoring – vegetation health	Ground cover (vegetation, leaf litter, mulch) is at least 70% and healthy (health assessed to be similar to analogue sites).
	Rehabilitation monitoring – regeneration.	Second generation seedlings are present or likely to be, based on monitoring of comparable older rehabilitation sites and trends in recent rehabilitation.
Erosion does not present a safety hazard or compromise the landform.	Rehabilitation monitoring records	No significant and active erosion that compromises the landform or proposed final land use.
Weeds and feral animals do not present a risk to rehabilitation	Weed presence in rehabilitation monitoring and site inspection records	No significant weed infestations, and noxious or other weeds do not comprise a significant proportion of the species in any stratum resulting in a risk to rehabilitation area establishment
	Land management and rehabilitation monitoring records	Pest animal presence does not pose a risk to the sustainability of rehabilitation areas.
Phase 7 – Rehabilitation Completion		
Rehabilitation areas are capable of supporting and maintaining the designated final land use	Departmental / landowner signoff	All relevant completion criteria for the land proposed for handover are acknowledged to be met by relevant Government Departments.

6.5 Stakeholder Engagement (Consultation)

Final land use objectives and completion criteria will be determined in consultation with appropriate regulatory authorities and stakeholders. Ongoing consultation will continue to be undertaken in accordance with the Stakeholder Engagement Strategy.

7 Rehabilitation Implementation

7.1 Progressive Rehabilitation Schedule

A progressive rehabilitation schedule will be developed and will outline the disturbance and rehabilitated areas throughout each year of the project and indicate timelines for the progression of rehabilitation towards take over.

Areas disturbed as part of the project will be temporarily stabilised and vegetated within a short time period of construction works to minimise dust generation, soil erosion and weed incursion until the area can be permanently rehabilitated. These works will include:

- Stabilisation of slopes and preparation of sites for revegetation including placement of organic matter, if required;
- Mitigation of sediment runoff from rock emplacement areas, soil/mulch stockpiles and construction works including use of sediment traps;
- Hydroseeding of slopes to assist stabilisation, if required; and
- Erosion and sediment control structures will remain in place and be maintained until the new vegetation is established and provides sufficient ground cover.

7.2 Rehabilitation Phases and Methodologies

7.2.1 Phase 1 – Active

7.2.1.1 Site Preparation and Establishment

Key activities which will be considered in this regard are as follows:

- eliminate access to and disturbance of the adjoining watercourse by construction plant;
- establishing stockpiles and construction material compounds in locations where they will not impact on the adjoining watercourses;
- Install appropriate erosion and sediment control devices prior to any surface disturbance to minimise erosion potential. Erosion and sediment control devices will be designed and installed in accordance with the specifications contained in *Managing Urban Stormwater – Soils and Construction, Volume 1, 4th edition* (Landcom, 2004), *Volume 2E Mines and Quarries* (DECC, 2008a); and
- collecting and stockpiling organic matter including topsoil, woodchip and organic matter for use in rehabilitation.

7.2.1.2 Topsoil Stripping

Stripping and stockpiling of topsoil and mulching vegetation will allow the reconstruction of the natural soil profile and will be a key rehabilitation management measure.

The following management and mitigation strategies are recommended to reduce the potential for soil degradation:

- Strip soil to a depth of 100 to 600mm, subject to further field investigations;

- Soil should preferably be stripped in a slightly moist condition. Material should not be stripped in either an excessively dry or wet condition;
- Wherever practicable, stripped material should be placed directly onto areas to be rehabilitated and spread immediately (if construction sequences and weather conditions permit) to avoid the requirement for stockpiling (for example during utilities installation);
- The surface of topsoil stockpiles should be left in as coarsely structured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming;
- Topsoil should be stockpiled to a maximum height of 2.5m;
- Topsoil stockpiles should be located away from drainage channels and the adjoining watercourse and arranged to minimise damage to native vegetation; and
- Where long-term stockpiling is planned (i.e. greater than 12 months), seed and fertilise stockpiles as soon as possible. An annual cover crop species that produce sterile florets or seeds should be sown (or hydroseeded). The sterile pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil.

7.2.2 Phase 2 - Decommissioning

At the end of the active phase of the project, all non-permanent infrastructure and associated facilities will be decommissioned and removed. In general, decommissioning and demolition activities will involve the following key activities:

- Disconnecting and terminating construction services including power and water;
- Removal of all accommodation facilities;
- Removal of all construction infrastructure;
- Removal of road surface gravel from any access roads not to be retained;
- Identifying and removing (or remediating in situ) all hazardous and contaminated materials;
- Demolishing and removing all fixed plant and buildings from the site;
- Removing all mobile equipment from the site;
- Removal of all construction fencing; and
- Breaking up and removing any concrete footings, pads and pavements.

7.2.3 Phase 3 - Landform Establishment

Landform establishment incorporates shaping the final landform to a safe, stable and non-polluting landform that is appropriate for the desired final land use and consistent with the surrounding landscape. During the landform establishment phase, activities will include slope stabilisation and the construction of permanent water management and erosion and sediment controls.

As outlined in **Sections 5** and **6**, the design of all slope batters will consider long-term stabilisation with minimal maintenance requirements.

Permanent erosion and sediment controls will be designed and installed in accordance with the specifications contained in *Managing Urban Stormwater – Soils and Construction, Volume 1, 4th edition* (Landcom, 2004), *Volume 2E Mines and Quarries* (DECC, 2008a).

7.2.4 Phase 4 - Growth Medium Development

Growth Medium Development incorporates the processes involved to achieve a growing medium which is capable of supporting a sustainable vegetation community. It includes consideration of the chemical, physical and biological properties of the media.

7.2.4.1 Topsoil Respreading

Sampling and analysis of topsoil and subsoil resources, whether stockpiled or in-situ, will be undertaken prior to respreading. This will assist in ensuring that soil quality is consistent with proposed land use objectives. Understanding soil characteristics will also assist in estimating required rates of fertiliser or ameliorants and may also assist in blending specific soil types to achieve enhanced outcomes. Lime addition after topsoil spreading will be necessary to neutralise acidic topsoil present on site.

Prior to re-spreading stockpiled topsoil, an assessment of weed infestation on stockpiles will be undertaken to determine if stockpiles require herbicide application and / or "scalping" of weed species prior to topsoil spreading.

Topsoil will be spread, treated with fertiliser and seeded in an integrated operation. This strategy will allow mitigation of the potential for topsoil loss to wind and water erosion. Appropriate earthmoving equipment must be used to avoid the compaction of the growth media.

Where insufficient topsoil is available, topsoil will be used with organic compost and additional mulch should be used to add organic matter to rehabilitation areas.

Thorough seedbed preparation will be undertaken to ensure optimum establishment and growth of vegetation. Topsoiled areas will be contour ripped, where practicable, to create a "key" between the topsoil and the subsoil. All topsoiled areas will, as far as practical, maintain surface roughness to reduce run-off, increase infiltration and support seed establishment.

7.2.5 Phase 5 - Land Use Establishment

The Land Use Establishment phase constitutes activities associated with establishing the desired post disturbance vegetation including seeding and land management activities such as weed control. Conceptual land use establishment strategies are summarised below.

7.2.5.1 Revegetation

Revegetation must be undertaken in the correct season to optimise plant growth in fail weather conditions. Revegetation will generally be undertaken from mid-October to mid-April. Revegetation will, as far as practicable, be scheduled to occur promptly following the completion of growth medium development activities. Where rehabilitated areas become available out of season, a temporary cover crop will generally be sown to stabilize the site until the primary vegetation cover can be established. The construction and rehabilitation schedule will be developed with consideration to the required timing of revegetation.

Species selection for areas to be rehabilitated will be undertaken using improved pasture species. Revegetation techniques will include broadcast seeding and hydroseeding, if required. An indicative revegetation specification is provided in **Table 14**.

Table 14 Indicative Revegetation Specification (Improved Pastures)

Seed Type	Spring Sowing (kg/ha)	Autumn Sowing (kg/ha)
Japanese Millett	20	
Oats		20
Perennial Ryegrass	6	6
Cocksfoot	8	8
Phalaris	6	6
White Clover*	2	2
Red Clover *	4	2
Sub Clover *	4	6
Fertiliser		
Starter 15	200	200
Mo Super	100	100

**legume species to be inoculated and lime pelleted*

As outlined in **Section 6.1**, a perimeter area of native bushland will be established. An indicative native species revegetation specification, consisting of species that are endemic to the area and occur within the four identified PCTs for the site, is provided in **Table 15**.

Table 15 Indicative Revegetation Specification (Native Vegetation)

Stratum	Scientific Name	Common Name
Canopy	*Eucalyptus punctata*	Grey Gum
	Eucalyptus crebra	Narrow-leaved Ironbark
	Eucalyptus fibrosa	Broad-leaved Ironbark
	Eucalyptus tereticornis	Forest Red Gum
	Eucalyptus. resinifera	Red Mahogany
	Angophora bakeri	Narrow-leaved Apple
	Angophora costata	Sydney Red Gum
	Syncarpia glomulifera	Turpentine
	Corymbia gummifera	Red Bloodwood
	Corymbia eximia	Yellow Bloodwood
Mid Storey	*Allocasuarina littoralis*	Black She-oak
	Syncarpia glomulifera	Turpentine
	Eucalyptus squamosa	Scaly Bark
	Eucalyptus sparsifolia	Narrow-leaved Stringy Bark
	Persoonia linearis	Narrow-leaved Geebung
Ground Layer	*Aristida vagans*	Three-awned Spear Grass
	Austrostipa pubescens	Spear Grass
	Cheilanthes sieberi	Poison Rock Fern
	Dichondra repens	Kidney Weed
	Echinopogon ovatus	Forest Hedgehog Grass
	Entolasia marginata	Bordered Panic
	Entolasia stricta	Wiry Panic

Stratum	Scientific Name	Common Name
	Lepidosperma laterale	Saw Sedge
	Microlaena stipoides	Weeping Grass
	Lomandra multiflora	Lomandra
	Oxalis perennans	Wood-sorrel
	Pratia purpurascens	White Root
	Solanum prinophyllum	Forest Nightshade
	Themeda australis	Kangaroo Grass

7.2.5.2 Vegetation Protection

Feral and pest animals can have significant detrimental impacts on emerging vegetation in rehabilitated areas and reduce the likelihood of revegetation success due to damage to juvenile vegetation from grazing, spreading weed seeds and erosion.

Feral animals will be controlled to minimise the impact on emerging and established vegetation.

7.2.5.3 Weed Control

A program for the control of weeds on the site will be developed and implemented. Early control of weeds will minimise competition and maximise early growth and survival of desired rehabilitation species. This can be achieved by physical removal or by chemical control where appropriate. Weed management will be a component of rehabilitation and management activities and will comprise:

- Regular inspections of the site (particularly rehabilitated areas) to identify potential weed infestations; and
- Identifying, removing and/or spraying weed populations, where appropriate.

The spread of declared noxious weeds will be prevented by using the measures above. Weed control, if required, will be undertaken in a manner that will minimise soil disturbance. Herbicides will be used in accordance with regulatory requirements. Records will be maintained of identified weed infestations and control programs will be implemented according to best management practices for the weed species of concern.

7.2.6 Phase 6 - Land Use Development

Activities associated with the ecosystem sustainability phase of rehabilitation are generally ongoing maintenance and land management activities and rehabilitation monitoring. Maintenance at rehabilitated areas required to be undertaken by DLALC will include, but not be limited to:

- Weeds and pest animal control;
- Managing bushfire risks;
- Minor earthworks to remediate any significant erosion features, including contour banks and diversion channels;
- Additional seeding, if required; and
- Maintaining erosion and sediment controls.

Rehabilitation monitoring will be required to be undertaken by DLALC until it can be demonstrated that rehabilitation areas have met all conditions for Rehabilitation Completion. Rehabilitation monitoring is discussed in **Section 10**.

8 Rehabilitation Quality Assurance Process

A Rehabilitation Quality Assurance Process (RQAP) will be developed and will include details of inspections, monitoring and record keeping which will be required to ensure that:

- Rehabilitation is being implemented in accordance with the nominated methodologies; and
- Identified risks to rehabilitation are being adequately addressed at each phase of rehabilitation.

The RQAP will also include an inspection protocol to ensure that each phase of decommissioning and rehabilitation has been completed. Conceptually, the RQAP will include:

- Phase 1 - Active
    - Documentation of pre-clearance surveys;
    - Maintenance of a topsoil inventory to document stripped, stockpiled and re-spread resources;
    - Regular inspections of temporary and permanent erosion and sediment controls;
    - Regular inspections to identify potential weed infestations; and
    - Documentation of all weed management and eradication programs and follow-up inspections.
- Phase 2 - Decommissioning
    - Inspections and demolition reports to confirm all infrastructure has been removed; and
    - Validation testing to ensure any contamination has been appropriately remediated and/or removed.
- Phase 3 – Landform Establishment
    - Survey and preparation of as constructed drawings of final constructed slopes, landforms and water drainage structures.
- Phase 4 – Growth Medium Establishment
    - Site records of re-spread topsoil, ameliorants, fertiliser etc; and
    - Soil testing results to confirm appropriate soil geochemical parameters for plant establishment.
- Phase 5 – Land Use Establishment
    - Documentation of reseeding or planting activities undertaken including:
        - date of planting;
        - weather conditions;
        - seeding rate (kg/ha); and
        - fertiliser rate (kg/ha).
    - Regular site inspections of rehabilitated areas to allow early identification of any emerging threats to rehabilitation.

9 Rehabilitation Monitoring Process

A dedicated monitoring system is critical to assessing the effectiveness of implementation of the rehabilitation measures as well as to identify the need for corrective action as soon as required.

A rehabilitation monitoring program will be prepared to track the progress of rehabilitated areas towards completion. The program will incorporate the most appropriate indicators and methods that:

- Provide a measure of completion criteria to be assessed in accordance with the defined rehabilitation objectives;
- Are reproducible;
- Utilise scientific recognised techniques; and
- Are cost-effective.

Monitoring will be conducted by independent, suitably skilled and qualified persons. Monitoring results, any required maintenance activities and any refinements of rehabilitation techniques will be reported as required by approval conditions.

The monitoring program will be continued until it can be demonstrated that rehabilitation has satisfied the closure criteria. Information from this monitoring program will also be used to refine closure criteria as required.

10 Intervention and Adaptive Management

10.1 Threats to Rehabilitation

Where rehabilitation performance is not trending to the nominated completion criteria this may indicate that there is a threat to long term rehabilitation success. Threats to rehabilitation may include events such as periods of drought, bushfire events, or pressures from weeds and feral animals.

Table 16 provides indicative key threats to rehabilitation for the project. Where the RQAP or monitoring indicates that there is a significant threat to rehabilitation, adaptive management will be undertaken in accordance with a Rehabilitation Trigger Action Response Plan (TARP). A Conceptual TARP described in **Section 11.2**.

Table 16 Indicative Key Threats to Rehabilitation

Threat	Caused by
Erosion and Sediment Control	• Rainfall events. • Lack of appropriate vegetation cover. • Failure of water management structures.
Soil Type(s) and Suitability	• Inadequate topsoil available. • Poor topsoil quality. • Weed infested topsoil. • Poor recovery of topsoil from currently rehabilitated areas.
Flora	• Not considering requirements in rehabilitation planning. • Not collecting and propagating sufficient native seed stock. • Failure to manage weeds. • Pest species / grazing pressures (kangaroos, goats, etc.).
Geotechnical	• Geotechnical slope failure.
Contaminated Land	• Spills, leaks etc.
Bushfire	• Location within the site • Regional fire. • Lightning strike.

10.2 Trigger Action Response Plan

A TARP for rehabilitation will be developed to identify required management actions in the event of impacts to rehabilitation, or where rehabilitation outcomes are not achieved in an acceptable timeframe.

A Conceptual TARP is provided as **Table 17**. It will be reviewed and revised as site specific threats to rehabilitation are identified.

Table 17 Conceptual Trigger Action Response Plan

Aspect / Category	Key Element	Element Number	Trigger / Response	First Level Trigger	Second Level Trigger
Landform stability	Erosion control	1	Trigger	Minor erosion present	Major erosion present which is compromising landform stability.
			Response	An inspection of the site will be undertaken by a suitably trained person. Investigate opportunities to install (or augment existing) water management infrastructure to address erosion. Remediate as appropriate.	Engage a consultant to assist with the management of erosion and sedimentation at the site and provide recommendations to appropriately remediate the erosion. Remediate as soon as practicable.
Growth media	Topsoil quantity	2	Trigger	Topsoil balance indicates a deficiency in topsoil available for rehabilitation.	Deficiency significant and alternate not available such that it will delay rehabilitation progression and the likelihood of rehabilitation success is low.
			Response	Investigate options and alternatives to be able to meet future topsoil requirements.	Source and budget for purchasing topsoil for use in rehabilitation, Investigate use of alternatives such as OGM.
	Topsoil quality	3	Trigger	Properties of soil are inconsistent with analogue sites but are capable of sustaining selected vegetation species.	Properties of soil are inconsistent with analogue sites and the area is not able to sustain selected vegetation species.
			Response	Investigate application of additional soil, and/or use of appropriate soil ameliorants or management options to address soil quality if deemed necessary.	Consultant to be engaged to assist with recommendations to appropriately remediate soil quality and depth. Remediate as soon as practicable.
Vegetation	Ground cover	4	Trigger	Bare patches are > 15% and < 30 % (excluding rocks and logs).	Bare patches are > 30% (excluding rocks and logs).
			Response	Investigate likely causes of unsatisfactory germination rates. Reseed areas with unsatisfactory cover. Review seeding procedures including seasonal mixes, timing and seed rate per hectare.	Undertake analytical soil testing and evaluation, where appropriate implement recommendations for amelioration. Implement appropriate management actions including revising rehabilitation procedures if required.
	Vegetation Health	5	Trigger	Vegetation health index not in the range of analogue sites.	Long term declining trend in vegetation health index.
			Response	Investigate likely causes of vegetation sickness and / or mortality rates. Reseed or replant areas with high sickness or mortality rates. Review seeding and / or planting procedures.	Engage a suitably qualified specialist to investigate causes for vegetation sickness and mortality. Implement appropriate management actions including revising rehabilitation procedures if required.

Aspect / Category	Key Element	Element Number	Trigger / Response	First Level Trigger	Second Level Trigger
	Species Composition	6	Trigger	Species composition is not consistent with the sewn seed mix and or, analogue sites.	Ongoing decline in species composition away from analogue site composition.
			Response	Investigate the likely causes of unsatisfactory germination and or, growth rates. Reseed areas with unsatisfactory cover. Review seeding procedures including seasonal mixes, timing and seed rate per hectare.	Undertake analytical soil testing and evaluation. Where appropriate implement recommendations for amelioration. Implement appropriate management actions including revising rehabilitation procedures if required.
	Weeds	7	Trigger	Monitoring indicates the density of weeds in rehabilitation areas exceeds analogue sites.	Monitoring indicates substantial weed infestations.
			Response	Undertake weed management to remove / spray introduced weed species. Treatment of infestations as appropriate to the species.	Undertake weed management to remove introduced weed species. Investigate management measures to reduce weeds including additional soil amelioration, establishment and retention of cover crops until weed presence is at acceptable levels. Implement recommendations as appropriate.
	Pest animals	8	Trigger	Pest animal species are causing damage to rehabilitation.	Continued damage to rehabilitation from pests after tree guards and fencing has been installed.
			Response	Consult with relevant government agencies to recommend and implement appropriate pest animal control campaign.	Liaise with government agencies and consider appropriate options.

11 References

ANZMEC (2000) Strategic Framework for Mine Closure. Australian and New Zealand Energy Minerals Council and Minerals Council of Australia.

DECC (2008a) *Managing Urban Stormwater – Soils and Construction, Volume 2E Mines and Quarries.*

Department of Land and Water Conservation (2001) *Maroota Groundwater Study, Technical Status Report.*

Ecological (2021) *Maroota Sands Biodiversity Development Assessment Report.*

EMM Consultants (2020) *Groundwater Constraints Assessment - Maroota Friable Sandstone Extraction Project.*

Graham Lee & Associates Pty Ltd (2017) *Investigation of Sand & Sandstone Resources Maroota.*

Hopkins, B. and Ross, J. (1996) *Maroota Groundwater Study, Stage 1 (CS96.027)*, Department of Land and Water Conservation.

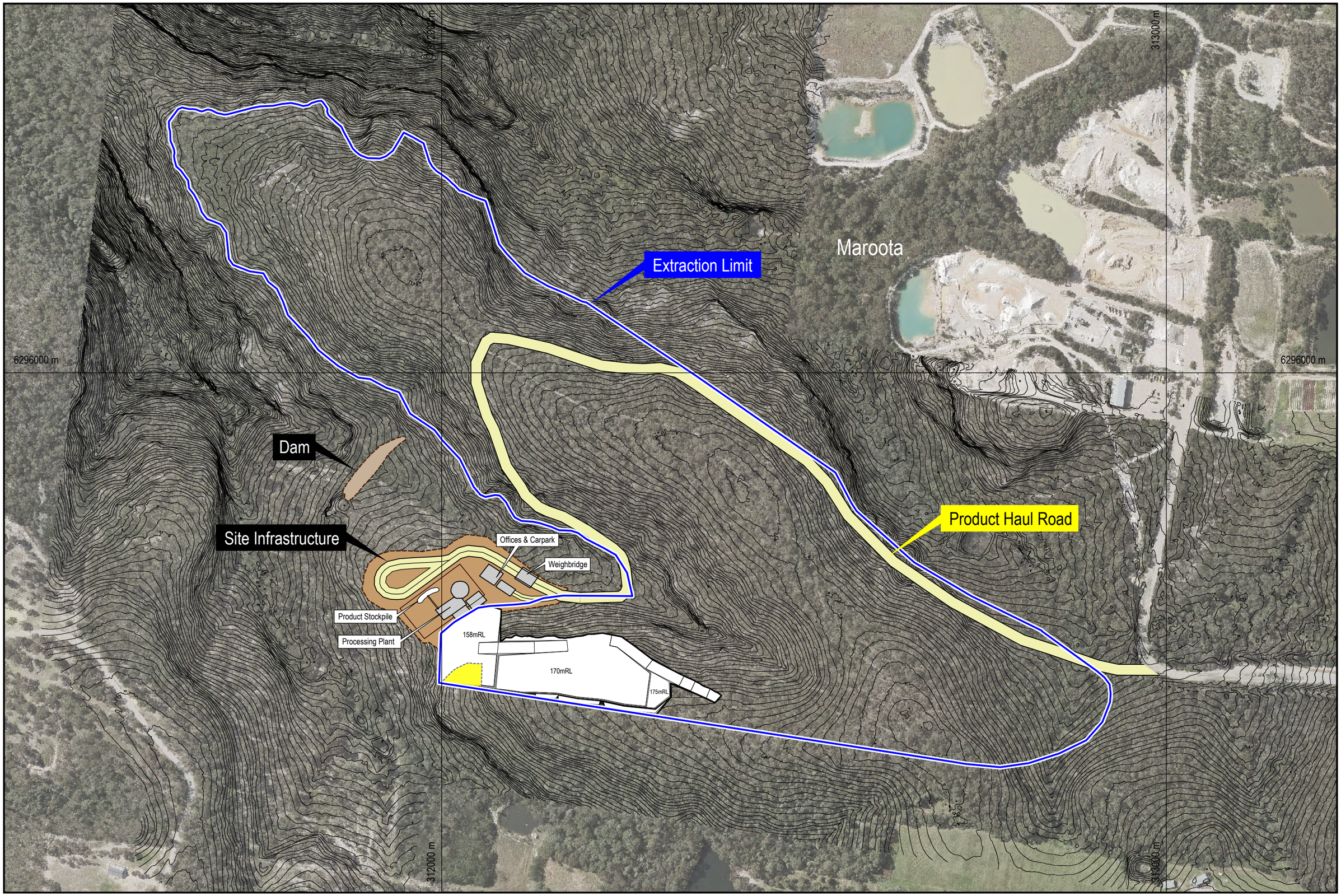
Landcom (2004) *Managing Urban Stormwater – Soils and Construction, Volume 1, 4th edition.*

RPM Global (2021) *Extraction and Rehabilitation Plan for Maroota Sand Project.*

SLR (2021) DLALC Maroota Sands Project - Land Capability Assessment.

APPENDIX A

Staged Landform Plans



LEGEND

Landform Construction

N

0 250m

DO NOT SCALE THIS DRAWING - USE FIGURED DIMENSIONS ONLY. VERIFY ALL DIMENSIONS ON SITE

CLIENT

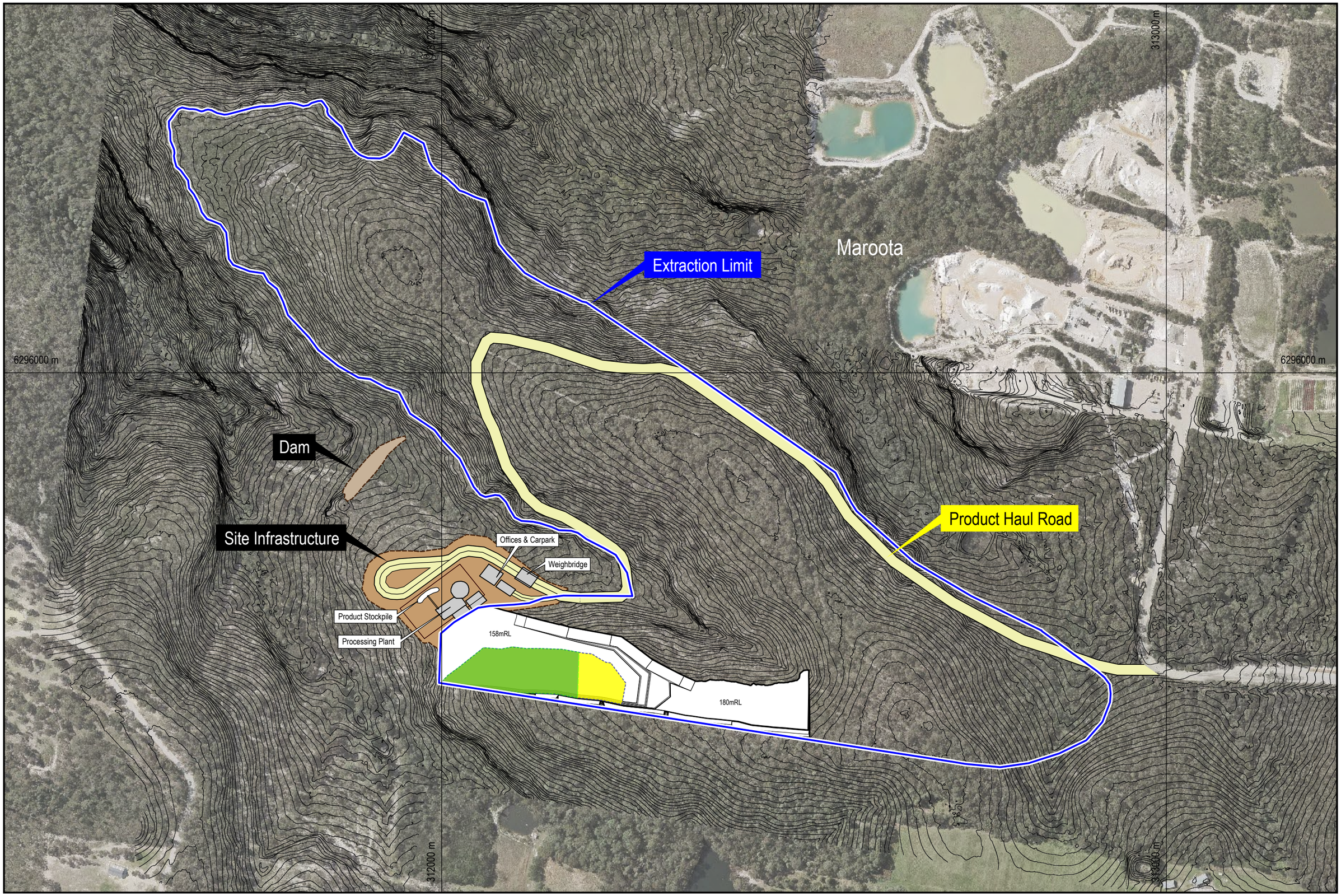
PROJECT

NAME
MAROOTA SAND PROJECT EXTRACTION PLAN

DRAWING
MAROOTA STAGE DESIGN - YEAR 1

FIGURE No.	PROJECT No.	Date
3-4	ADV-AU-00081	April 2021

RPMGLOBAL



LEGEND

Landform Construction

Rehabilitated Area

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PROJECT

NAME
MAROOTA SAND PROJECT EXTRACTION PLAN

DRAWING
MAROOTA STAGE DESIGN - YEAR 2

FIGURE No.	PROJECT No.	Date
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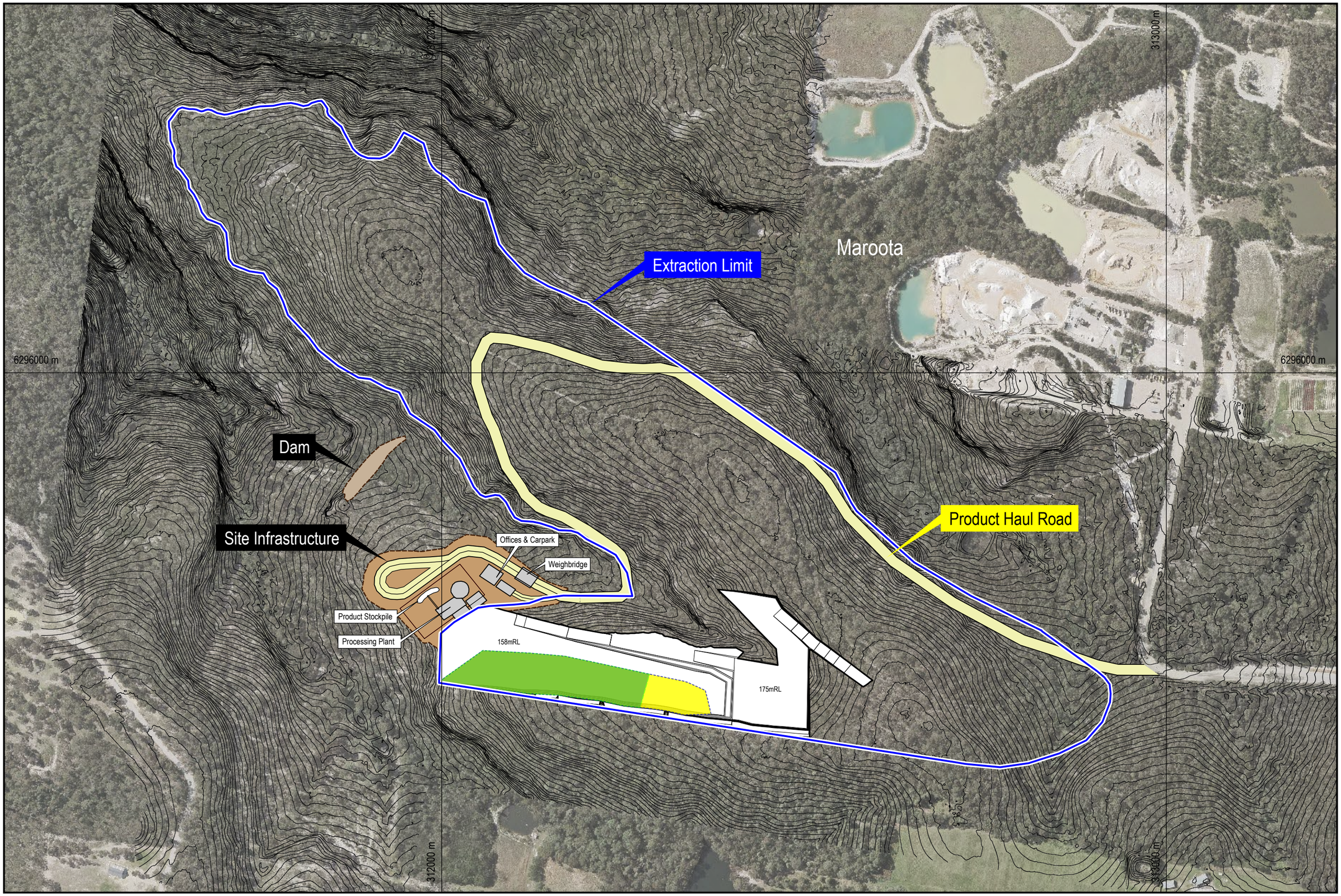

LEGEND

Landform Construction

Rehabilitated Area

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PROJECT

NAME
MAROOTA SAND PROJECT EXTRACTION PLAN

DRAWING
MAROOTA STAGE DESIGN - YEAR 3

FIGURE No.	PROJECT No.	Date
3-6	ADV-AU-00081	April 2021

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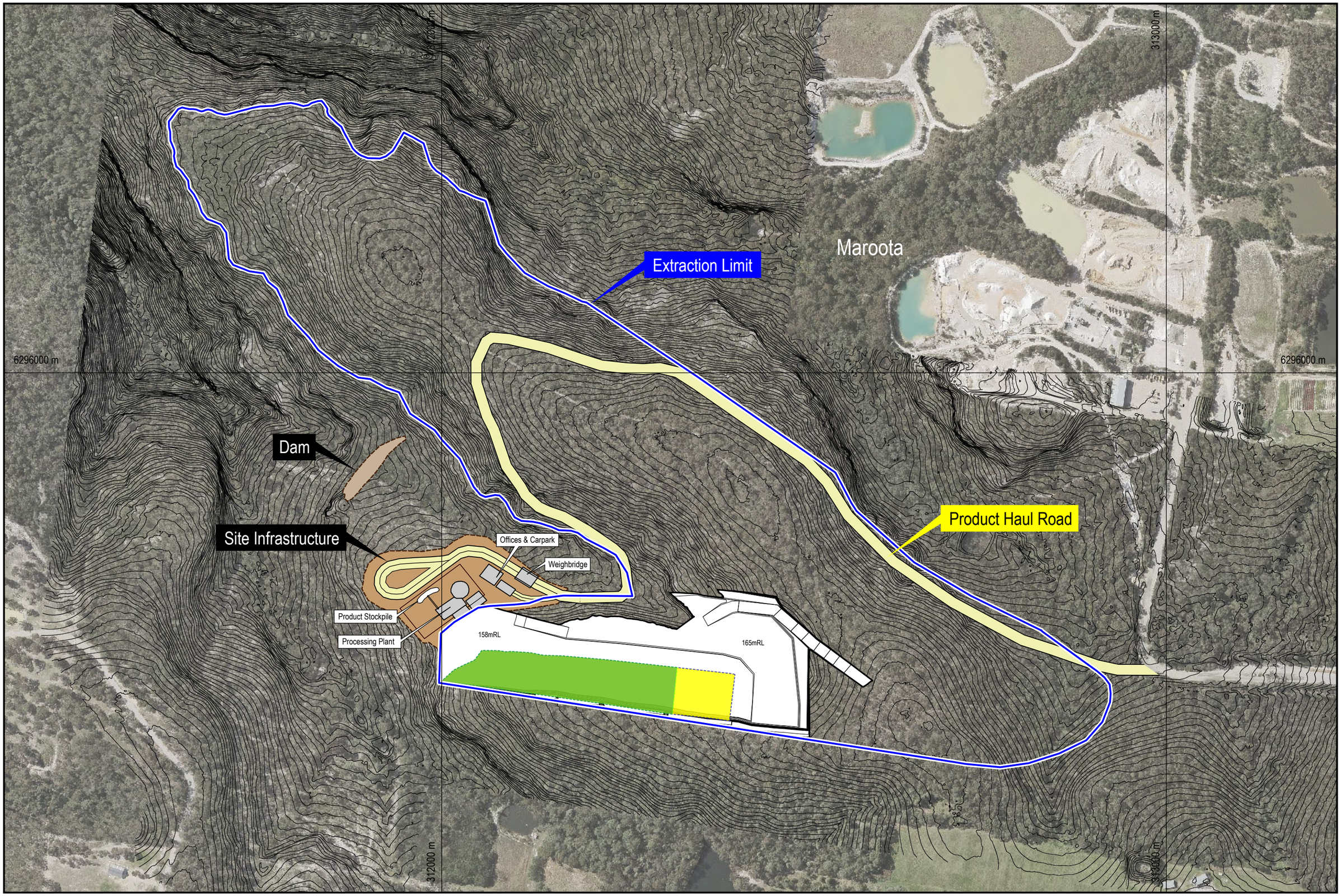

LEGEND

Landform Construction

Rehabilitated Area

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PROJECT

NAME
MAROOTA SAND PROJECT EXTRACTION PLAN

DRAWING
MAROOTA STAGE DESIGN - YEAR 4

FIGURE No.	PROJECT No.	Date
3-7	ADV-AU-00081	April 2021

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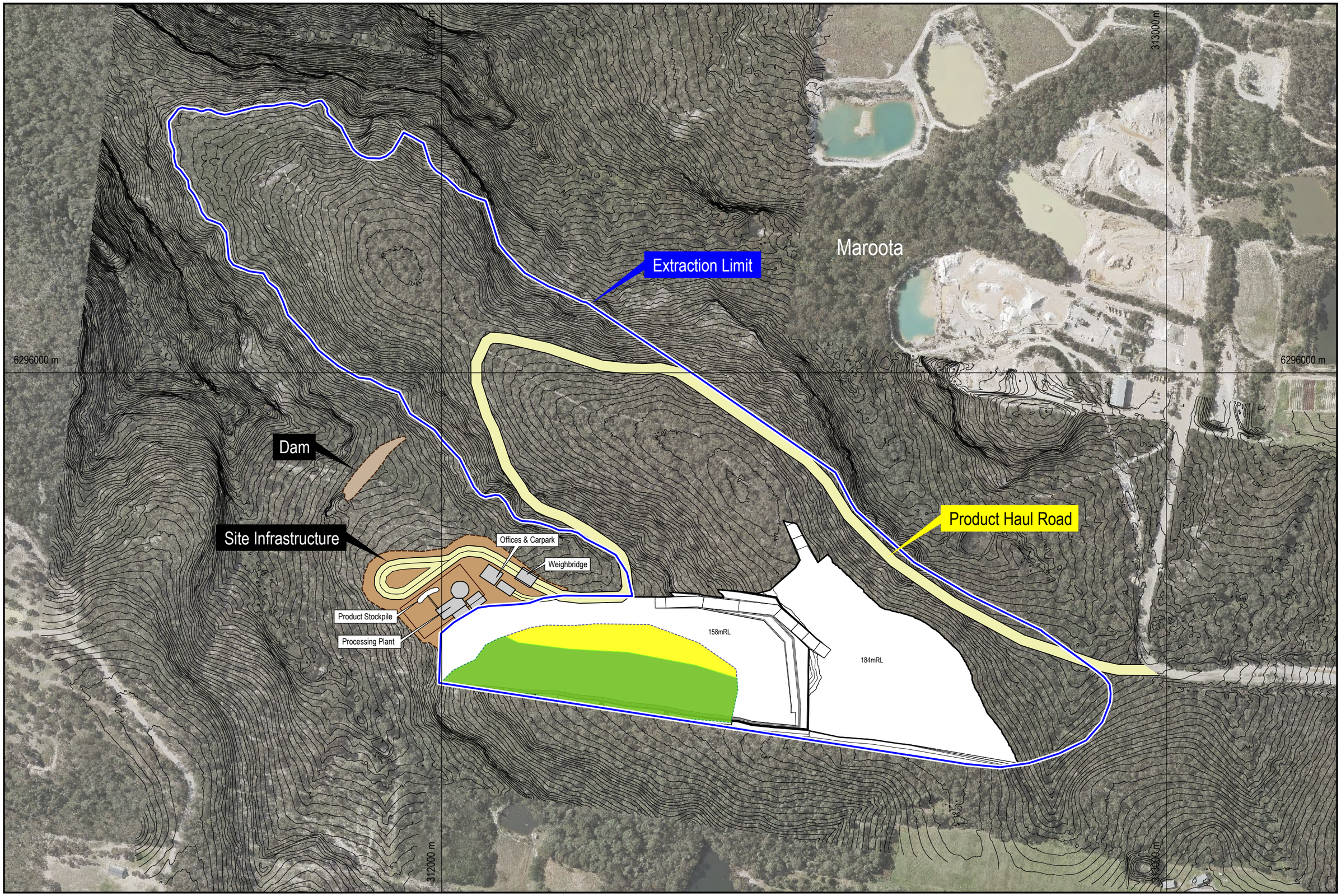

LEGEND

Landform Construction

Rehabilitated Area

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CLIENT

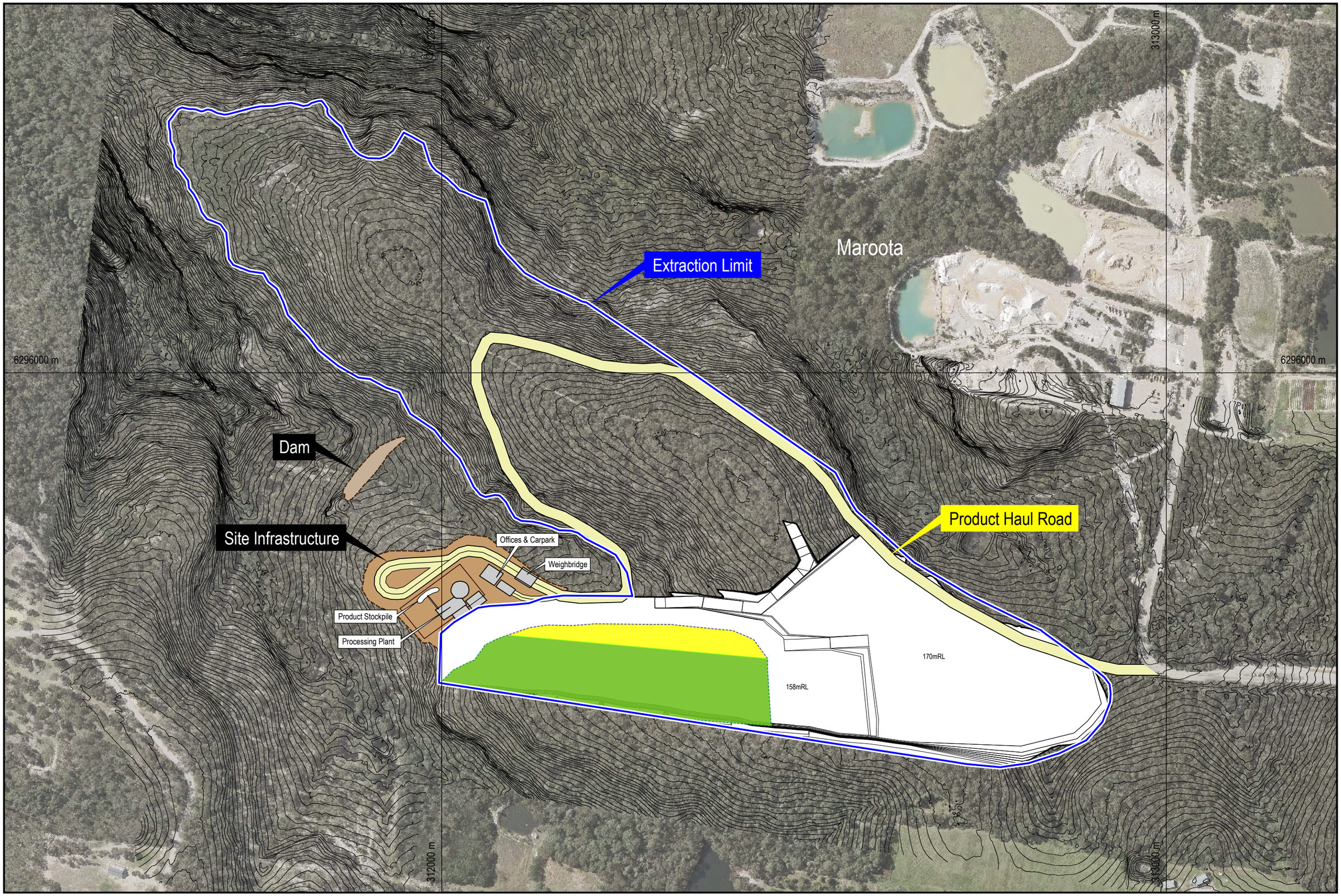
PROJECT

NAME
MAROOTA SAND PROJECT EXTRACTION PLAN

DRAWING
MAROOTA STAGE DESIGN - YEAR 5

FIGURE No.	PROJECT No.	Date
3-8	ADV-AU-00081	April 2021

RPMGLOBAL



LEGEND

Landform Construction

Rehabilitated Area

N

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CLIENT

PROJECT

NAME
MAROOTA SAND PROJECT EXTRACTION PLAN

DRAWING
MAROOTA STAGE DESIGN - YEAR 10

FIGURE No.	PROJECT No.	Date
3-9	ADV-AU-00081	April 2021

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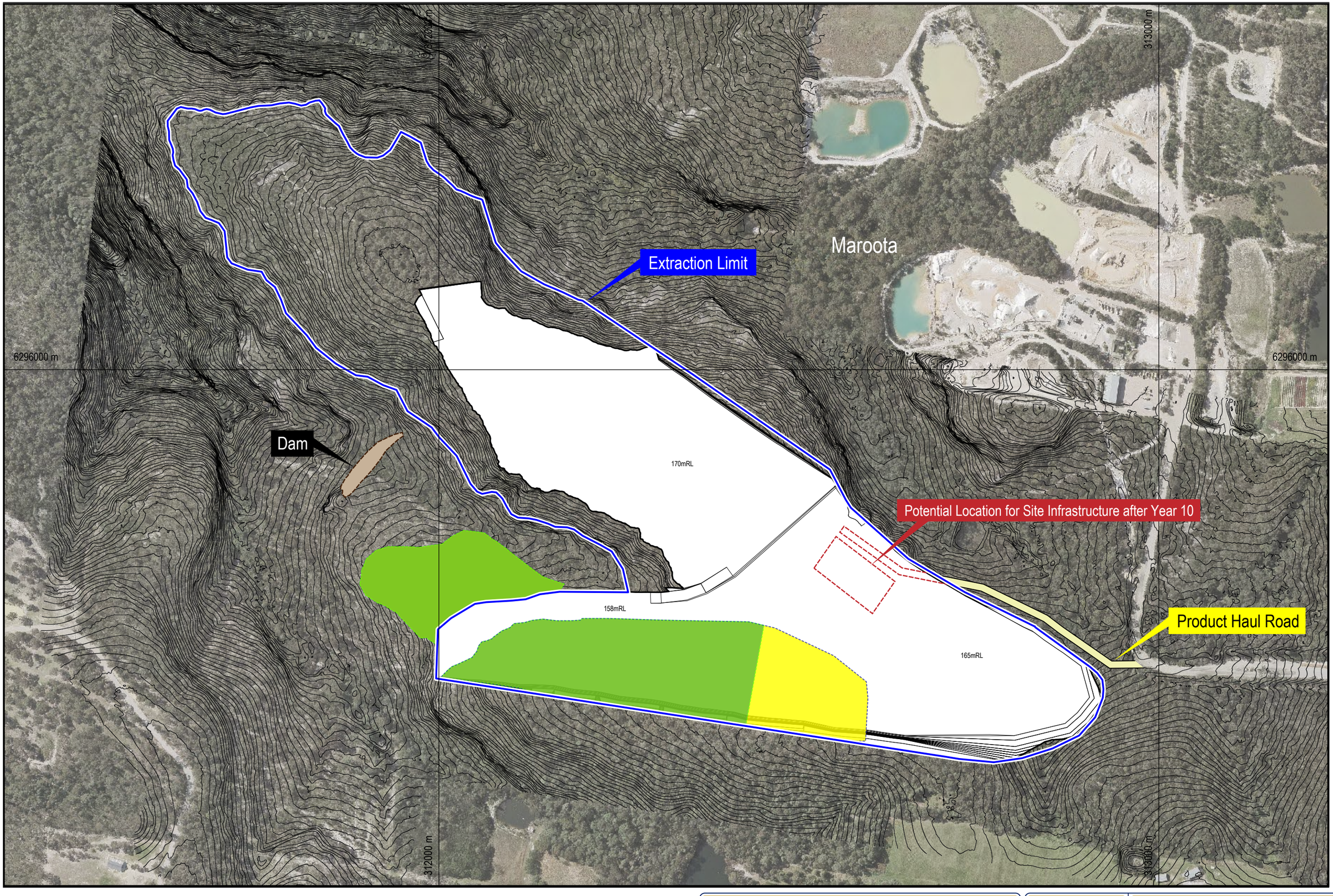

LEGEND

Landform Construction

Rehabilitated Area

N

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CLIENT

PROJECT

NAME
MAROOTA SAND PROJECT EXTRACTION PLAN

DRAWING
MAROOTA STAGE DESIGN - YEAR 15

FIGURE No.	PROJECT No.	Date
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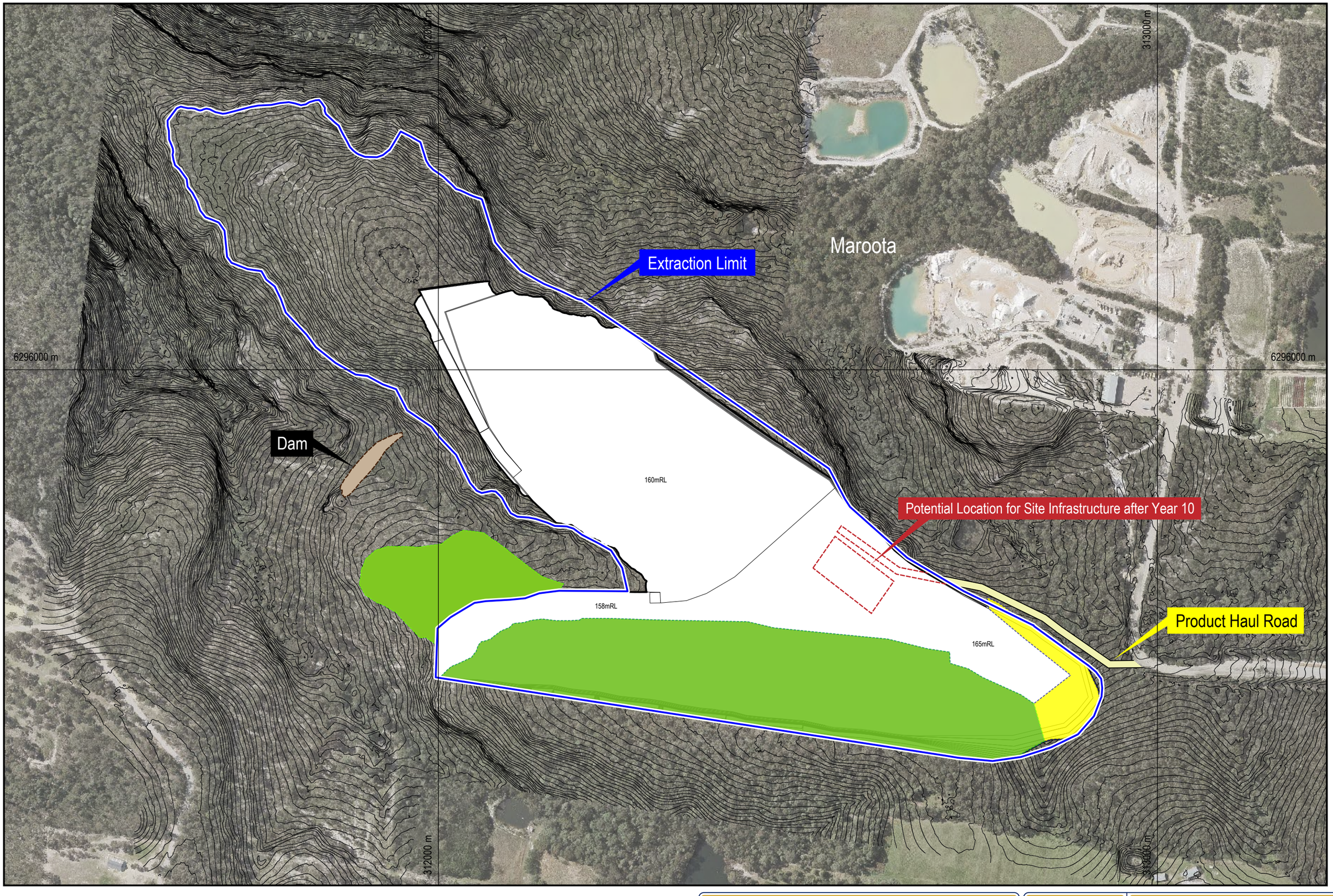

LEGEND

- Landform Construction
- Rehabilitated Area

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CLIENT

PROJECT

NAME
MAROOTA SAND PROJECT EXTRACTION PLAN

DRAWING
MAROOTA STAGE DESIGN - YEAR 20

FIGURE No.	PROJECT No.	Date
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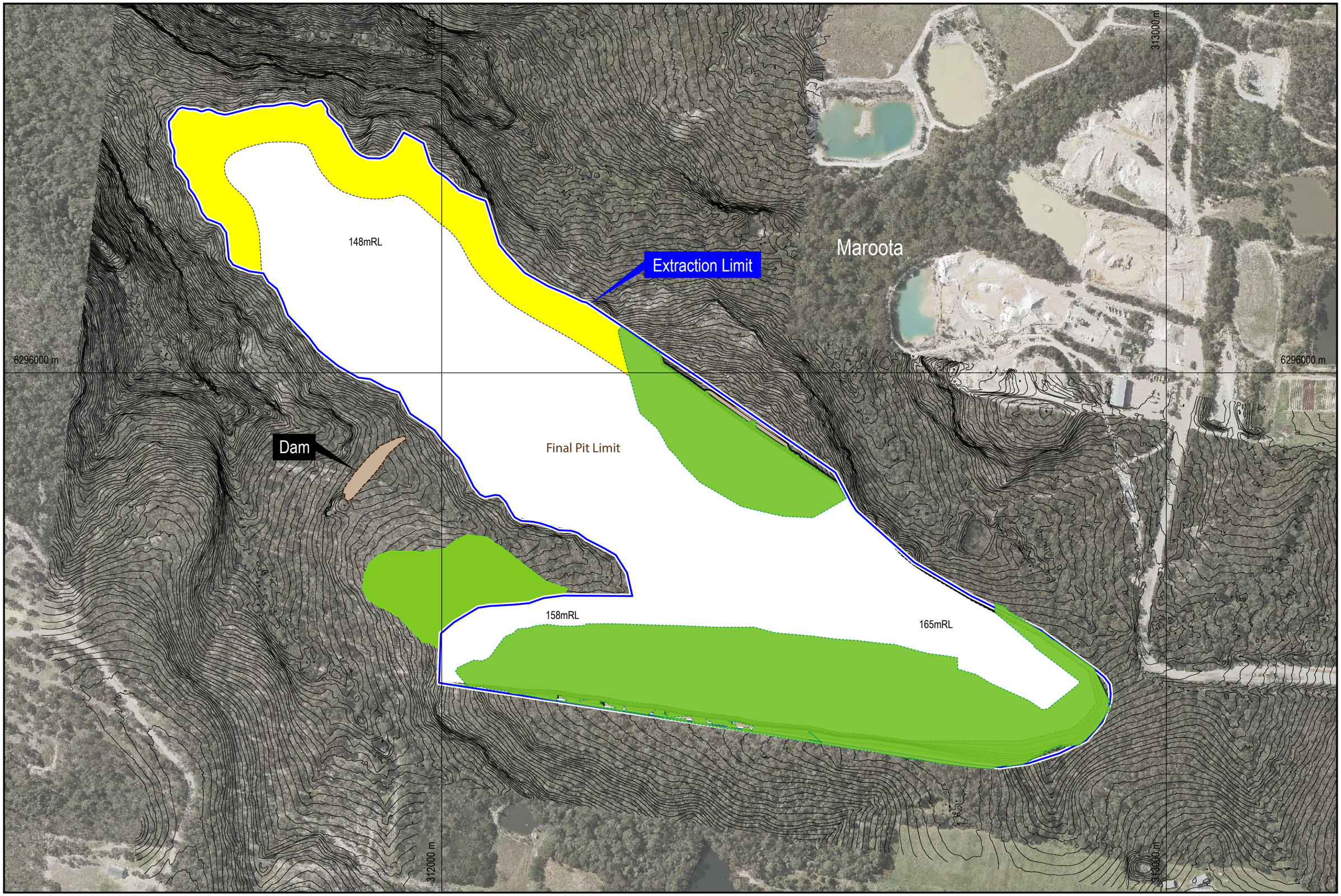

LEGEND

- Rehabilitation Bushland
- Rehabilitated Area

N

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CLIENT

PROJECT

NAME
MAROOTA SAND PROJECT EXTRACTION PLAN

DRAWING
MAROOTA STAGE DESIGN - FINAL

FIGURE No.	PROJECT No.	Date
3-12	ADV-AU-00081	April 2021

RPMGLOBAL

Figure A-1 Year 1 Landform Cross-section

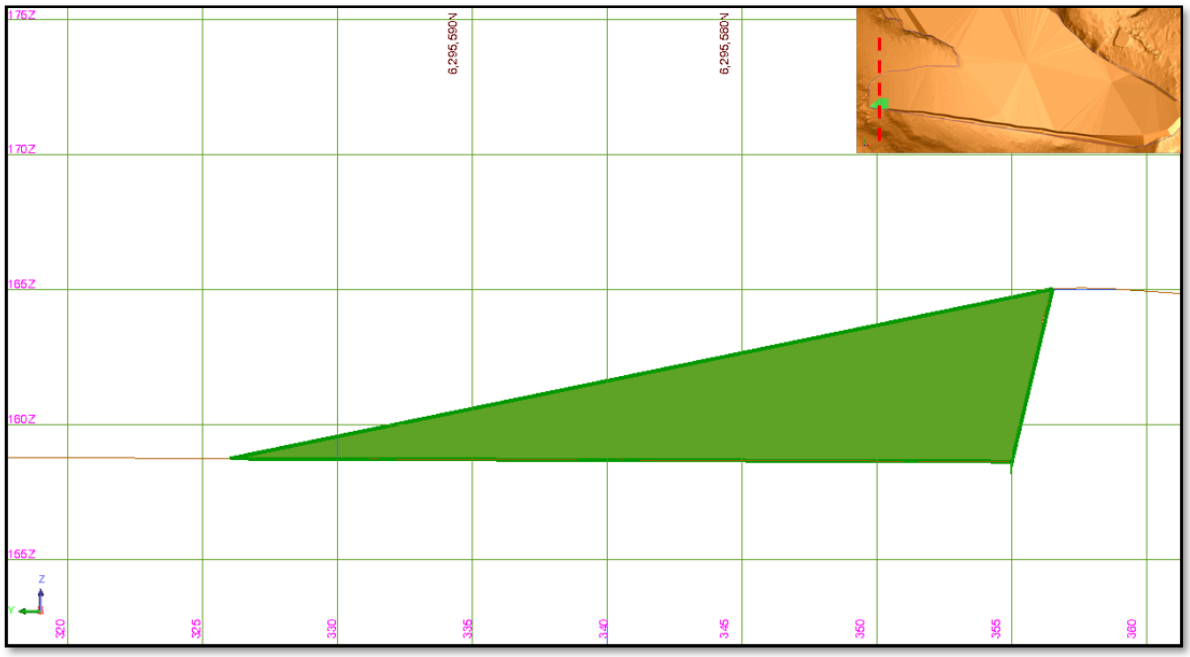


Figure A-2 Year 2 Landform Cross-section

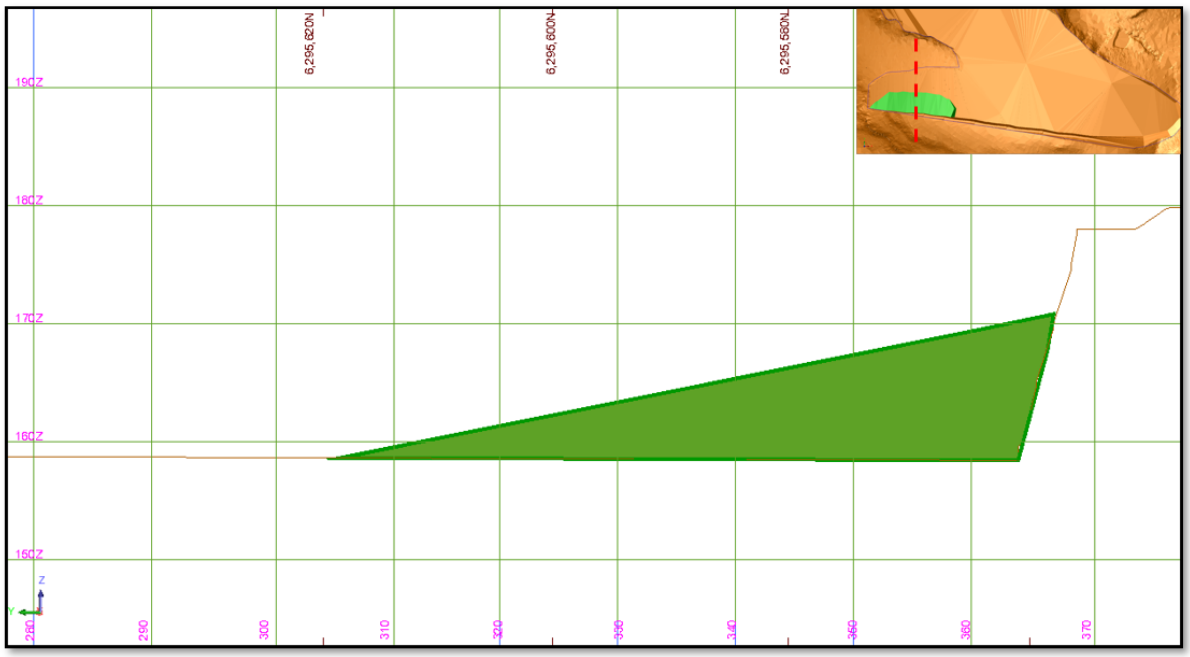


Figure A-3 Year 3 Landform Cross-section

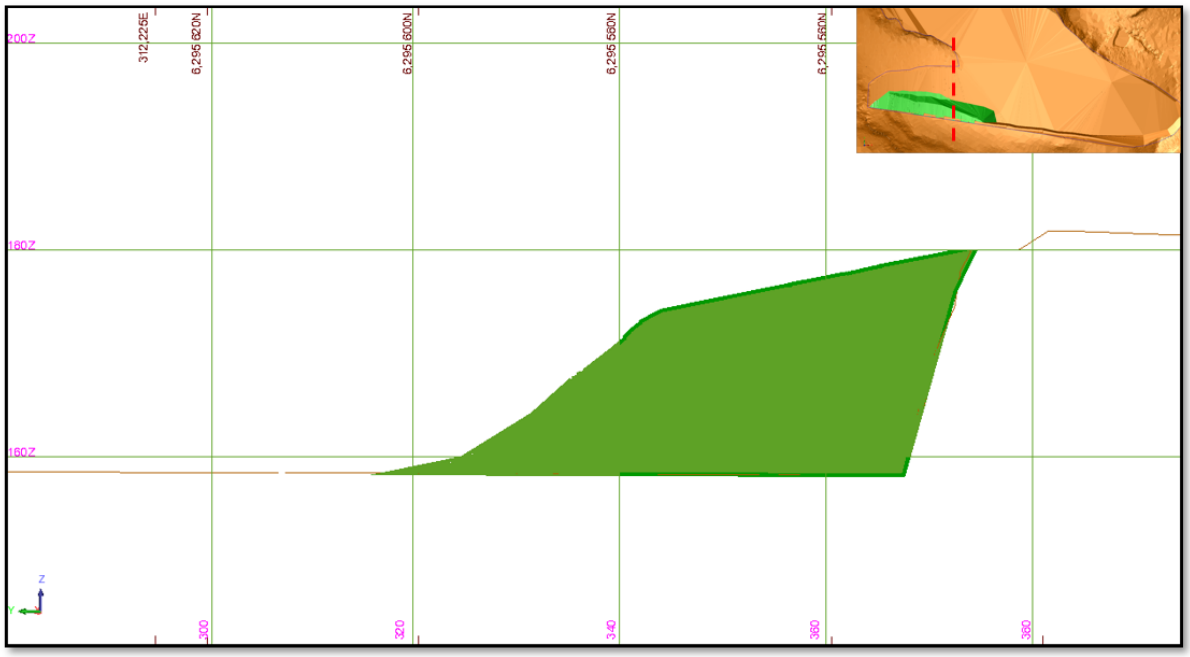


Figure A-4 Year 4 Landform Cross-section

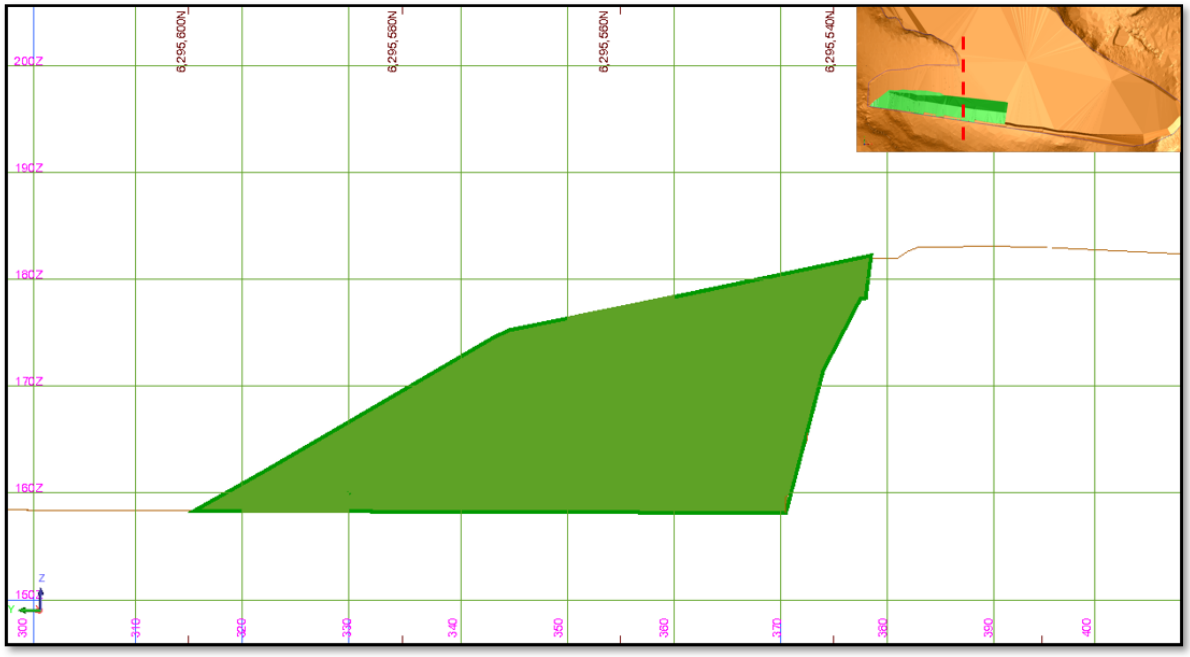


Figure A-5 Year 5 Landform Cross-section

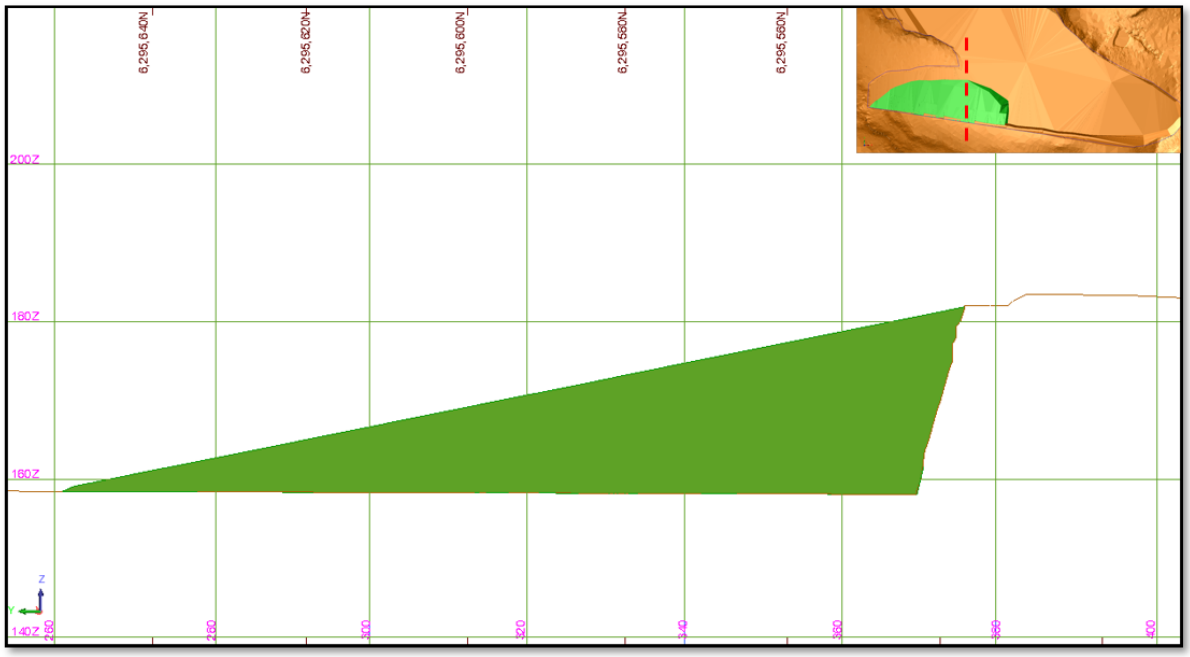


Figure A-6 Year 10 Landform Cross-section

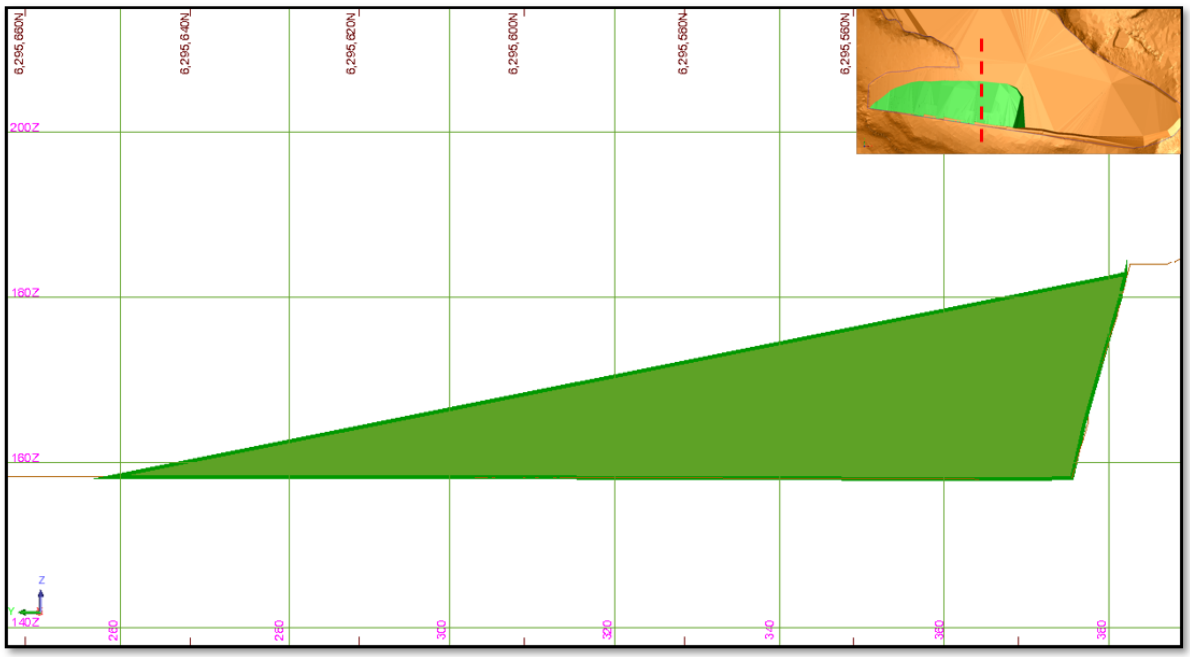


Figure A-7 Year 15 Landform Cross-section

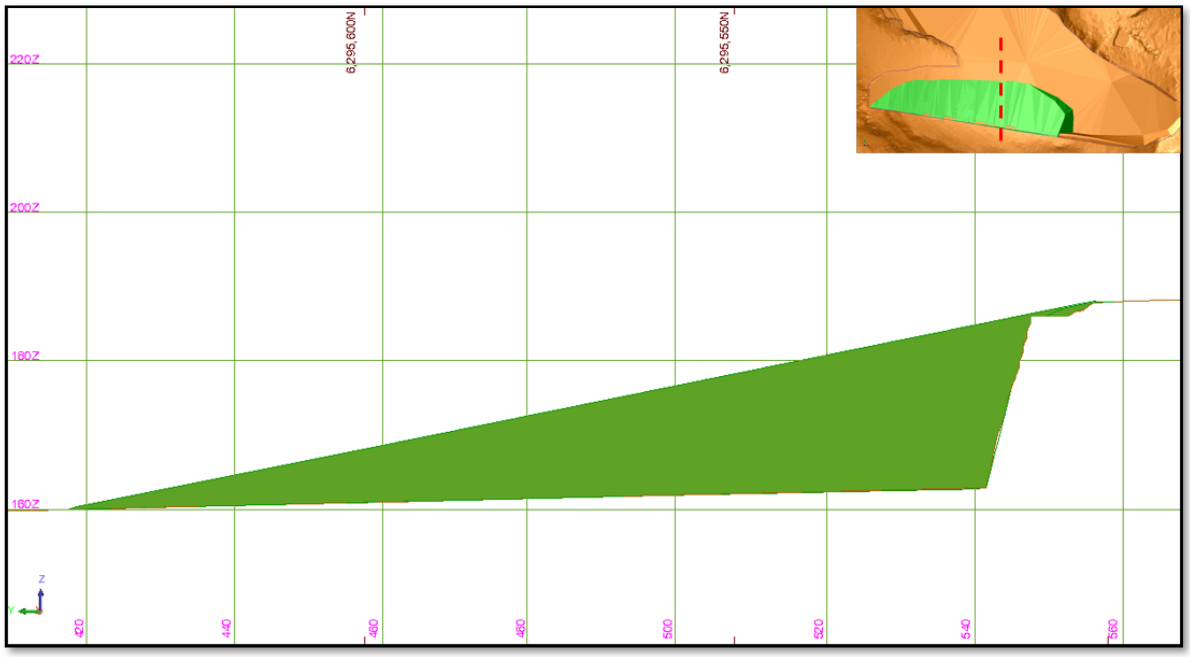
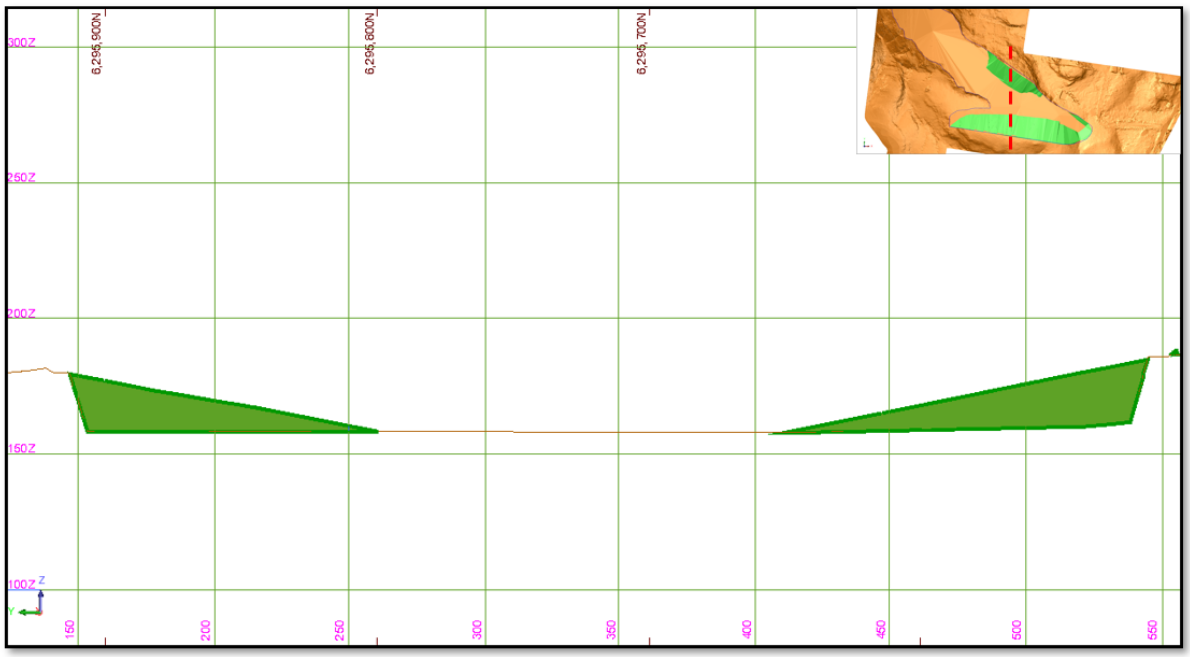


Figure A-8 Final Landform Cross-section (Year 28)



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